10TH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES

24-26 APRIL, 2026
Istanbul – Türkiye

ABSTRACT BOOK

Publish date: 18.04.2026

THE TENTH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES (CMES-2026), ISTANBUL/TÜRKİYE, APRIL 24-26, 2026

The **Tenth International Conference on Computational Mathematics and Engineering Sciences (CMES-2026)** will be held in Beykent University from **24- to 26 April 2026 in İstanbul, Türkiye.** The symposium to be held this year is also significant as it is being organised in honour of Prof. Dr Etibar Penahlı's 70th birthday. It provides an ideal academic platform for researchers and professionals to discuss recent developments in both theoretical, applied mathematics and engineering sciences. This event also aims to initiate interactions among researchers in the field of computational mathematics and their applications in science and engineering, to present recent developments in these areas, and to share the computational experiences of our invited speakers and participants.

The Organizing Committee

Committee Chairs

Hasan Bulut, Fırat University, Türkiye
Zakia Hammouch, Ecole Normale Superierue de Meknes, Moulay Ismail University, Morocco
Ercan Çelik, Kyrgyz-Turkish Manas University, Kyrgyzstan
Haci Mehmet Baskonus, Harran University, Türkiye

MESSAGE FROM THE GENERAL CHAIRS

Dear Conference Attendees,

We are honored to welcome you to the **Tenth International Conference on Computational Mathematics and Engineering Sciences (CMES-2026)** at Beykent University from 24 to 26 April 2026 in Istanbul City, Türkiye.

CMES, founded in 2016 at Faculty of Science and Techniques Errachidia Moulay Ismail University Morocco is an annual intarnational conference, which was very successful in the past years by providing opportunities to the participants in sharing their knowledge and informations and promoting excellent networking among different international universities. This year, the conference includes 200 extended abstracts, several submissions were received in response to the call for papers, selected by the Program Committee. The program features keynote talks by distinguished speakers such as:

Nikolay A. Kudryashov from National Research Nuclear University MEPhI, Russia; **Aly R. Seadawy** from Taibah University, Saudi Arabia; **Yeliz Karaca** from University of Massachusetts Chan Medical School, USA, **Javid Ali** from Department of Mathematics , Aligarh Muslim University, Aligarh, India; **Adil Jhangeer** from VSB-Technical University of Ostrava, Czech Republic; **Varga Kalantarov** from Koç University, Türkiye, **Yusif Gasimov** from Azerbaijan University, Azerbaijan. The conference also comprises contributed sessions, posters sessions and various research highlights.

We would like to thank the Program Committee members and external reviewers for volunteering their time to review and discuss submitted abstracts. We would like to extend special thanks to the Honorary, Scientific and Organizing Committees for their efforts in making CMES-2026 a successful event. We would like to thank all the authors for presenting their research studies during our conference. We hope that you will find CMES-2026 interesting and intellectually stimulating, and that you will enjoy meeting and interacting with researchers around the world.

.

***Hasan Bulut*,**

Firat University, Elazig, Türkiye.

Zakia Hammouch,

ENS Meknes, Moulay Ismail University Morocco

Thu Dau Mot University, Binh Duong Province, Vietnam

China Medical University Hospital Taichung 40402, Taiwan.

TOPICS

Control Theory,
Game Theory,
Applied Mathematics,
Financial Mathematics,
Artificial Intelligence,
Education Sciences,
Engineering Sciences,
Computer Science,
Information Technology,
Geometry and Its Applications,
Analysis and Its Applications,
Statistics and Its Applications,
Algebra and Its Applications,
Topology and Its Application,
Chaos and Dynamical Systems,
Cryptography and its Applications,
Fractional Calculus and Applications,
Economics and Econometric Studies,
Electrical and Electronic Engineering,
Defense industry and applications,
Mathematical Biology,
Computational Epidemiology,
Mathematical Chemistry,
Mathematics Education and Its Applications,
Numerical Methods and Scientific Programming,
Linearand Nonlinear programming and Dynamics,
Modeling of Bio-systems for Optimization and Control,
Ordinary, Partial, Stochastic and Delay Differential Equations,
Computational Fluids mechanics. Heat and Mass Transfers,
Earth Sciences,
Applied Sciences

COMMITTEE CHAIRS

Prof.Dr.Hasan Bulut, Firat University, Elazığ, Türkiye
Prof.Dr.Zakia Hammouch, ENS Meknes, Moulay Ismail University, Morocco
Prof. Dr. Ercan Çelik, Kyrgyz-Turkish Manas University, Kyrgyzstan
Prof.Dr.Haci Mehmet Baskonus, Harran University, Türkiye
Prof. Dr. Tolga Aktürk, Ordu University, Türkiye

COMMITTEE CO-CHAIRS

Prof.Dr. Carlo Cattani, Tuscia University, Viterbo, Italy
Prof.Dr. Mohammed Ouazzani Jamil, University Privee of Fez, Morocco
Prof. Dr. Hassan Qjidaa, Sidi Mohammed Ben Abdellah University, Fes Morocco
Prof. Dr. El Mehdi El Khattabi, Moulay Ismail University Morocco

HONORARY COMMITTEE

SCIENTIFIC COMMITTEE

Ahmet Yıldız (İnönü University, Malatya, Türkiye)
Akbar Barati Chiyaneh (Yüzüncüyıl University, Bitlis, Van)
Alen Osançlıol (İstanbul Beykent University, İstanbul – Türkiye)
Ali Akgül (Siirt University, Türkiye)
Ali Çakmak (Bitlis Eren University, Bitlis, Türkiye)
Ali İhsan Mut (Dicle University, Türkiye)
Ali Karcı (İnönü University, Malatya)
Ali Rostami (University of Tabriz, Tabriz, Iran)
Ali Yousef (Kuwait College Of Science And Technology, Kuwait)
Alireza Khalili Golmankhaneh (IAU Urmia Branch, Iran)
Alla Belousova (Don State Technical University, Russian Federation)
Alev Dülger (Dicle University, Türkiye)
Alper Ekinci (Bandırma 17 Eylul University, Türkiye)
Alper Osman Öğrenmiş (Fırat University, Elazığ, Türkiye)
Alper Polat (Munzur University, Türkiye)
Aly Ramadan Seadawy (Taibah University, Saudi Arabia)
Anargül Urdaletova (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Aneta Barakoska (Faculty of Philosophy, University St. Cyril, Macedonia)
Anna Sandulyak (Université de Moscow, Russia)
Arife Atay (Dicle University, Türkiye)
Armando Ciancio (University of Messina, Italy)
Arzu Akbulut (Bursa Uludağ University, Türkiye)
Arzu Denk Oguz (Atılım University, Türkiye)
Asan Ömüraliyev (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Atif A. Namazov (Azerbaijan Technical University, Baku, Azerbaijan)
Avıt Asanov (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Ayhan Şerbetçi (Ankara University, Ankara)
Aynur Keskin Kaymakçı (Selcuk University, Konya)
Ayşe Dilek Maden (Selçuk University, Konya)
Ayşe Metin Karakaş (Bitlis Eren University, Bitlis, Türkiye)
Ayşegül Çetinkaya (Ahi Evran University, Türkiye)
Azat Akmatbekova (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Badr Abou E Majd (Mohammed V University in Rabat, Morocco)
Bashar A. Al-Talip (University of Mosul, Iraq)
Bayram Çekim (Gazi University, Türkiye)
Bayram Şahin (Ege University, İzmir, Türkiye)
Behçet Öznacar (Near East University, Cyprus)
Berivan Polat (Munzur University, Türkiye)
Beytullah Yağız (Yüzüncü Yıl University, Türkiye)
Bilal Alatas (Fırat University, Türkiye)
Bilal Şenol (İnönü University, Malatya)
Bilgehan Polatoğlu (Atatürk University, Türkiye)
Burcu Gürbüz (Johannes Gutenberg-University Mainz, Germany)
Burçin Doğan (Malatya Turgut Özal University, Türkiye)
Burhan Tiryakioğlu (Marmara University, Türkiye)
Bülent Tavlı (Tobb Economics And Technology University, Türkiye)
Cameron Browne (University of Louisiana at Lafayette, USA)
Carla M.A. Pinto (ISEP, Porto, Portugal)
Carlo Cattani (Tuscia University, Viterbo, Italy)

Cemil İnan (Mardin Artuklu University, Türkiye)
Ceren Kına (Malatya Turgut Özal University, Türkiye)
Cesim Temel (Yüzüncüyıl University, Türkiye)
Chérif Ziti (Moulay Ismail University, Morocco)
Christos Volos (Aristotle University, Greece)
Çağrı Karaman (Atatürk University, Erzurum, Türkiye)
Çiğdem İnan (Mersin University, Türkiye)
Damla Yılmaz (Erzurum Technical University, Türkiye)
Danyal Soybaş (Erciyes University, Türkiye)
Davut Hanbay (İnönü University, Malatya)
Derya Arslan (Bitlis Eren University, Türkiye)
Derya Avci (Balikesir University, Türkiye)
Dilek Okuyucu (Erzurum Technical University, Türkiye)
Dumitru Baleanu (Cankaya University, Türkiye)
Dursun Irk (Eskişehir Osmangazi University, Eskişehir)
Dyyak Ivan (Ivan Franko National University, Lviv, Ukraine)
Ebru Bozkurt (Ataturk University, Türkiye)
Ecem Acar (Harran University, Şanlıurfa, Türkiye)
El Abbassi Ahmed (FSTE, Moulay Ismail University, Morocco)
El Ayyadi Rachid (FST, Sidi Mohammed Benabdellah University, Morocco)
El Hassan Ben Ahmed (Ens Meknes, Moulay Ismail University, Morocco)
El Houcine Lafhim (Sidi Mohamed Ben Abdellah University, Morocco)
El Khomssi Mohamed (Sidi Mohamed Ben Abdellah University, Morocco)
El Mehdi El Khattabi (Ens Meknes, Moulay Ismail University, Morocco)
Ella Abilayeva (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Elman Hazar (Igdır University, Türkiye)
Elmira Abdıldayeva (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Emel Biçer (Bingöl University, Türkiye)
Emrah Yılmaz (Fırat University, Elazığ)
Engin Özkan (Erzincan Binali Yıldırım University, Erzincan)
Ennahnahi Noureddine (Sidi Mohamed Ben Abdellah University, Morocco)
Erdal Baş (Fırat University, Elazığ, Türkiye)
Erdal Ekici (Çanakkale Onsekiz Mart University, Çanakkale)
Erdal Ulualan (Kutahya University, Türkiye)
Erdal Ünlüyol (Ordu University, Türkiye)
Erhan Deniz (Kafkas University, Türkiye)
Erhan Güler (Bartın University, Türkiye)
Erhan Pişkin (Dicle University, Diyarbakır, Türkiye)
Erhan Set (Ordu University, Türkiye)
Erol Yaşar (Mersin University, Türkiye)
Esin Ilhan (Kırşehir Ahi Evran University, Türkiye)
Esra Karataş Akgül (Siirt University, Türkiye)
Eva Kaslik (University of Timisoara, Romania)
Evrim Toklu (Agrı İbrahim Cecen University, Türkiye)
Ezgi Kaya (Iğdır University, Türkiye)
Fahd Jarad (Cankaya University, Türkiye)
Fahrettin Muhtarov (Bakü State University, Azerbaijan)
Fatma Ayaz (Gazi University, Türkiye)
Fatma Berna Benli (Erciyes University, Türkiye)

Fatma Bulut (Bitlis Eren University, Bitlis, Türkiye)
Fatma Erdoğan (Firat University, Elazığ)
Fatma Sağsöz (Atatürk University, Türkiye)
Fatma Taşdelen Yeşildal (Ankara University, Türkiye)
Fethi Bin Muhammad Belgacem (Paaet, Shaamyia, Kuwait)
Fethiye Müge Sakar (Dicle University, Türkiye)
Feyza Esra Erdoğan (Ege University, İzmir, Türkiye)
Fikret Aliyev (Bakü State University, Azerbaijan)
Filiz Taşcan (Eskişehir Osmangazi University, Eskişehir)
Firat Evirgen (Balikesir University, Türkiye)
Francesco Villecco (University Salerno, Italy)
Fulya Şahin (Ege University, İzmir, Türkiye)
Gazmend Nafezi (University of Prishtina, Kosovo)
Gonca Onargan (Final International University, Girne, Cyprus)
Gözde Özyurt (İstanbul Beykent University, İstanbul – Türkiye)
Gökhan Gökdere (Fırat University, Elazığ)
Gülşat Muhametjanov (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Gürhan İçöz (Gazi University, Türkiye)
Güven Kaya (Bingöl University, Türkiye)
Hacer Sengul (Harran University, Sanlı urfa, Türkiye)
Hamit Akyüz (Gazi University, Ankara, Türkiye)
Hasan Can Kısakürek (İstanbul University, İstanbul, Türkiye)
Hasan Doğan (Karamanoğlu Mehmetbey University, Karaman)
Hasan Taş (Fırat University, Elazığ, Türkiye)
Hasan Yusuf (The University of Nigeria, Nsukka)
Hatice Taş (Bitlis Eren University, Bitlis, Türkiye)
Hazım Sürer (Ataturk University, Erzurum, Türkiye)
Hussain Benazza (ENSAM, Moulay Ismail University Morocco)
Hüseyin Kaya (İnönü University, Malatya, Türkiye)
Hüseyin Yılmaz (Ankara University, Ankara)
Huzaifa Umar (Near East University)
Ilyas Öztürk (Dicle University, Diyarbakır, Türkiye)
İbrahim Arslan (Fırat University, Türkiye)
İbrahim Korkmaz (Kırıkkale University, Türkiye)
İbrahim Okan Öztürk (Dicle University, Diyarbakır)
İsmail Yılmaz (Çanakkale Onsekiz Mart University, Türkiye)
İsmail Hakkı Keskin (Fırat University, Elazığ)
Ismail Küçük (Eskişehir Osmangazi University, Eskişehir)
Iván Reyes (Universidad Autónoma de Querétaro, México)
Jakub Tichy (Czech University of Life Sciences, Czech Republic)
Jean-Côme Toutain (University of Poitiers, France)
Jeta Alo (İstanbul Beykent University, İstanbul – Türkiye)
João Barbosa (University of Lisbon, Portugal)
João Luís (IST, University of Lisbon, Portugal)
John K. B. (University of York, UK)
Josep A. R. (University of Barcelona, Spain)
Joseph Asongu (University of Juba, Sudan)
Juan E. López (University of Chile, Chile)
Jürgen Noack (Brandenburg University of Technology, Germany)

Júlia Kovács (Technical University of Budapest, Hungary)
Kadir S. (University of Uludag, Türkiye)
Kalıskan Matanova (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Kamran E. (University of Tehran, Iran)
Kamran Yavuz (Ankara University, Ankara, Türkiye)
Kamil Kose (Gazi University, Türkiye)
Karim Jebli (University of Monastir, Tunisia)
Keith A. (University of Oxford, UK)
Kenan Kavasoğlu (Çankırı Karatekin University, Türkiye)
Khaled M. (King Fahd University of Petroleum and Minerals, Saudi Arabia)
Khoa T. (Vietnam National University)
Kohei T. (Kyoto University, Japan)
Kostas G. (University of Thessaloniki, Greece)
Krzysztof K. (Silesian University, Poland)
László Sz. (University of Szeged, Hungary)
Louay Al-Kharouf (University of Bahrain, Bahrain)
Mazllum Kamberi (University of Prishtina, Kosovo)
Maher Shoukry (Cairo University, Egypt)
Nazgül Adanbayeva (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Meerim Imaş Kızı (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Mehmet Yavuz (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Mohamed S. S. (Al-Mansoura University, Egypt)
Mohamed Tarek Hamza (Mansoura University, Egypt)
Mubariz Alvi (University of Sindh, Pakistan)
Muhammet Kamali (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Murat Karakaş (Bitlis Eren University, Bitlis, Türkiye)
Mustafa Arslan (Gazi University, Türkiye)
Mustafa Tunc (Erzurum Technical University, Türkiye)
Nezih Gülkır (Akdeniz University, Türkiye)
Nihan Turan (İstanbul Beykent University, İstanbul – Türkiye)
Nima Mostafavi (Isfahan University of Technology, Iran)
Nural Özkaya (Dicle University, Diyarbakır, Türkiye)
Ouberka Hanane (ENS, Moulay Ismail University Morocco)
Oğuz Karabacak (İstanbul University, İstanbul, Türkiye)
Ömer Gökhan Kaya (Sakarya University, Türkiye)
Ömer Yılmaz (İnönü University, Malatya, Türkiye)
Özlem Defterli (Çankaya University, Türkiye)
Ouarghi Khalid (ENS, Moulay Ismail University Morocco)
Peyil Esengul Kızı (Kyrgyz-Turkish Manas University, Kyrgyzstan)
Rafik Ben Fadhel (University of Carthage, Tunisia)
Ramazan Alper (İnönü University, Malatya, Türkiye)
Rattan Kumar Sahu (IIT Bhubaneswar, India)
Samir Ben Lakhdar (University of Carthage, Tunisia)
Salisu Ibrahim (Tishk International University)
Selma R. (University of Graz, Austria)
Sergiy R. (Ukrainian Academy of Science, Ukraine)
Sinan Deniz (Yüzüncü Yıl University, Türkiye)
Sipahi, D (Bilkent University, Türkiye)
Skouri Rachid (EST, Moulay Ismail University Morocco)

ORGANIZING COMMITTEE

Prof. Dr. Mahir Hasansoy , İstanbul Beykent University, Türkiye
Prof. Dr. Erhan Pişkin, Dicle University, Türkiye
Prof. Dr. Murat Şat, Erzincan Binali Yıldırım Üniversity, Türkiye
Prof. Dr. Tuba Gülşen, Fırat University, Elazığ, Türkiye
Prof. Dr. Araz Aliev Azerbaijan State Oil and Industry University, Baku, Azerbaijan
Assoc. Prof. Dr. Mücahit Akbıyık, İstanbul Beykent University, Türkiye
Assoc. Prof. Dr. Dilek Demirkuş, İstanbul Beykent University, Türkiye
Assoc. Prof. Dr. Tuğba Şenlik Çerdik, İstanbul Beykent University, Türkiye
Assoc. Prof. Dr. Siham Zain, Moulay Ismail University Morocco
Assoc. Prof. Dr. Abdelmjid Bouazizi, Moulay Ismail University Morocco
Assoc. Prof. Almas Temirbekov (Al-Farabi Kazakh National University)
Assoc. Prof. Ali Yaqubov (Azerbaijan National Aviation Academy)
Assoc. Prof. Dr. Gülnur Yel, Final International University, Girne, Cyprus
Assoc. Prof. Dr. Muhammed Yiğider, Erzurum Technic University, Türkiye
Assoc. Prof. Dr. Zulqıurnain Sabır (Depatment of mathematıcs, Lebanese Amerıcan Unıversıty, Beirut, Lebanon)
Assoc. Prof. Dr. Sertaç Göktaş, Mersin University, Türkiye
Assoc. Prof. Dr. Ulviye Demirbilek, Mersin University, Türkiye
Asst. Prof. Dr. Funda Türk, Bartın University, Türkiye
Asst. Prof. Dr. Yasemin Demirel, İstanbul Topkapı Üniversitesi, Türkiye
Asst. Prof. Dr. Nazife Orhan Şimşek, Beykent University, Türkiye
Asst. Prof. Dr. Ayşe Nur Akkılıç, Beykent University, Türkiye
Demet Akdağ, Beykent University, Türkiye

LOCAL COMMITTEE

Özlem Orhan (Bandırma Onyedi Eylül Ün, Balıkesir)
Mehmet Karay (Final Int. University, Girne, Cyprus)
Münevver Tuz (Fırat University, Elazığ, Türkiye)
Ebru Cavlak Aslan (Fırat University, Elazığ, Türkiye)
Bahar Acay (Fırat University, Türkiye)
Ahu Ercan (Fırat University, Elazığ, Türkiye)
Berat Karaagac (Adıyaman University, Türkiye)
Ezgi Kaya (Igdır University, Igdır, Türkiye)
Onur Saldır (Van Yüzüncü Yıl University, Van, Türkiye)
Zelal Temel (Van Yüzüncü Yıl University, Van, Türkiye)
İbrahim Enam İnan (Fırat University, Elazığ, Türkiye)
Meltem Öğrenmiş (Fırat University, Elazığ, Türkiye)
Hajar Farhan Ismael (University of Zakho, Iraq)
Karmina K. Ali (University of Zakho, Iraq)
Sibel Şehriban Ataş (Fırat University, Elazığ, Türkiye)
Aysenur Akkılıç (Fırat University, Elazığ, Türkiye)
Aslı Alkan (Fırat University, Elazığ, Türkiye)
Beyhan Kemaloğlu (Fırat University, Elazığ, Türkiye)
Mucahit Saydam (Fırat University, Elazığ, Türkiye)
Çağrı Yılmazer (Fırat University, Elazığ, Türkiye)
Merve Zeynep Gecmen (Ağrı Ibrahim Çeçen University, Ağrı, Türkiye)
Necati Erdoğan (Van Yüzüncü Yıl Üniversity,Van, Türkiye)
Arif Özkul (Fırat University, Elazığ, Türkiye)
Mehtep Güneri (Fırat University, Elazığ, Türkiye)
Melik Şenyuva (Fırat University, Elazığ, Türkiye)
Süleyman Sarıkaya (Fırat University, Elazığ, Türkiye)
Şeyma Firdevs Korkmaz (Fırat University, Elazığ, Türkiye)
Tuğçem Partal (Recep Tayyip Erdoğan University, Türkiye)
Ali Sercan Karakaş (İnönü University, Türkiye)
Taylan Demir (Ankara Üniversity, Türkiye)

LANGUAGE EDITORIAL COMMITTEE

Suheyla Demirkol Orak (Firat University, Elazıg, Türkiye)

International Communications Consultant

Rengin AK, Kirklareli University, Kırklareli, Türkiye
Hikmet Kemaloğlu, Fırat University, Elazığ, Türkiye
İlkay Açıkgöz Erkaya, Ahi evran University, Türkiye
M. Evren Aydın, Fırat University, Elazığ, Türkiye

PROCEEDINGS

Full version of submitted papers will be published in Special Volumes of reputed journals. Procedure, Guidelines and Checklist for the preparation and submission of papers to the Proceedings of CMES-2026 can be found in the journals websites. The journals in which selected and peer-reviewed full papers of CMES-2026 will be published are as follows:

1. **BOOK OF ABSTRACTS [Free of charge]**

If Authors submit ABSTRACT TEXTS, then, after getting referees evaluations for these abstracts, they will be published in ABSTRACT PROCEEDING BOOK of CMES-2025. For FULL TEXT PAPERS, Authors have to submit their FULL TEXT PAPERS online via submission system of CMES-2025. These FULL TEXT PAPERS will be published in FULL TEXT PROCEEDING BOOK of CMES-2025 after getting at least two positive reports.

2. **CONFERENCE PROCEEDINGS [Free of charge]**

At the beginning, if Authors submit FULL TEXT PAPERS, then, after getting at least two positive referee reports, FULL TEXT PAPERS will be published in FULL TEXT PROCEEDING BOOK of CMES-2025 with ISBN:77733 number. Therefore, Abstracts of these FULL TEXT PAPERS will **NOT** be published in ABSTRACT PROCEEDING BOOK of CMES-2025.

3. FRACTAL AND FRACTIONAL JOURNAL [SCI-E],
Selected papers from CMES-2025 will be published in a special issue dedicated to the Conference entitled "**Feature Papers for Mathematical Physics Section".**
https://www.mdpi.com/journal/fractalfract/special_issues/1TAP5BBZ45
This journal is indexed by SCI-E.

4. PROCEEDINGS OF THE INSTITUTE OF MATHEMATICS AND MECHANICS [E-SCI]
Selected papers from CMES-2025 will be published by https://proc.imm.az/special/

This journal is indexed by E-SCI.

5.TURKISH JOURNAL OF SCIENCE, [FREE]
Participants of CMES 2025 can submit their good quality papers to Turkish Journal of Science. After the peer review process, the papers will be published at TJOS. The authors must write "CMES 2025" as comments to the editor.
(Editor in Chief: Dr. Ahmet Ocak AKDEMİR) For on-line submission: https://dergipark.org.tr/tr/pub/tjos

6.TURKISH JOURNAL OF INEQUALITIES, [FREE]
"Participants of CMES 2025 can submit their good quality papers to Turkish Journal of Inequalities. Selected papers will be published at TJI after the peer review process. The participants can send their papers to erhanset@tjinequality.com. The authors must write "CMES 2025" as the subject.
(Editor in Chief: Prof. Dr. Erhan SET)
http://tjinequality.com/

7. MATHEMATICS IN NATURAL SCIENCE (MNS)
Authors can submit their full text paper directly to the journal by using the following link
https://www.isr-publications.com/mns

8. MATHEMATICS IN ENGINEERING, SCIENCE AND AEROSPACE (MESA), [FREE, SCOPUS]
"Selected papers will be published after peer review in the Journal of Mathematics in Engineering, Science and Aerospace (MESA)"
(Editor in Chief: Prof. Seenith Sivasundaram)
http://nonlinearstudies.com/index.php/mesa

9. APPLIED MATHEMATICS AND NONLINEAR SCIENCES, [SCOPUS]
Participants of CMES 2025 can submit their high quality full text papers to Applied Mathematics and Nonlinear Sciences by selecting CMES-2025 under the Select Article Type Menu.
https://www.editorialmanager.com/amns/default.aspx

10. MATHEMATICAL MODELLING AND NUMERICAL SIMULATION WITH APPLICATIONS (MMNSA), [TR DİZİN]
The Special Issue on "Advanced Methods of Modelling and Numerical Computation in Science and Engineering". Authors can submit their full text paper directly to the journal by using the information provided in the following link
https://mmnsa.org/index.php/mmnsa/special_issues/SI-CMES2023

11. SYMMETRY [SCI-E] ;
SPECIAL ISSUE "ADVANCES IN MATRIX

TRANSFORMATIONS, OPERATORS AND SYMMETRY"
Authors can submit their full text paper directly to the journal by using the following link
https://www.mdpi.com/journal/symmetry/special_issues/Advances_Matrix_Transformations_Operators_Symmetry

12. YUZUNCU YIL UNIVERSITY JOURNAL OF THE INSTITUTE OF NATURAL AND APPLIED SCIENCES (TR-Dizin)
Authors can submit their full text paper directly to the journal by using the following link
https://dergipark.org.tr/tr/pub/yyufbed

13. PEDAGOGICAL PERSPECTIVE (PEDPER)
Pedagogical Perspective **(PedPer)** is an international, double blind reviwing, non-profit, professional scientific journal. PedPer is a journal that accepts manuscripts related to pedagogy and education.
http://pedagogicalperspective.com/

14. COMPUTATIONAL METHODS FOR DIFFERENTIAL EQUATIONS (CMDE)
This is to announce that according to the authentication letter numbered 3/18/64395 dated 22 June 2016 issued by the Iranian Ministry of Science, Research and Technology, the Computational Methods for Differential Equations (CMDE) is ranked as “Scientific Research” Journal. Moreover, the CMDE is indexed by the well-known databases such as Web of Science, Scopus, Clarivate Analytics products and services- ESCI, ISC (Islamic World Science Citation Center), Zentralblatt, Doaj, etc. Before the review process, all papers are checked by iThenticate for plagiarism, and similarities of up to 25% are considered acceptable, taking into account author names but not including references.
https://cmde.tabrizu.ac.ir/

PROF. DR. ETIBAR PENAHLI

Professor Etibar Panakhov, born in 1955 in the Kalinin region of Armenia, is a renowned mathematician and an internationally recognized authority in the field of spectral theory of differential operators.

He graduated with honors from the Physics and Mathematics Boarding School in Baku in 1971 and from the Faculty of Mechanics and Mathematics of Azerbaijan State University in 1976. During his final year, he completed and defended his diploma thesis at Moscow State University. He continued his postgraduate studies at Moscow State University (1976–1980) and, in 1981, successfully defended his PhD thesis under the supervision of the prominent mathematician Professor B.M. Levitan. Since 2017, E. Panakhov, has been a Doctor of Science in Mathematics and a year later, he received a diploma as a professor of Azerbaijan.

Professor Panakhov's research has made significant contributions to the theory of direct and inverse spectral problems for differential operators. His work focuses on the spectral analysis of regular and singular Sturm–Liouville, Dirac, diffusion, and integro-differential operators, as well as inverse problems in potential theory. In recognition of the importance of his contributions, the Soviet Academy of Sciences included his work among the most significant scientific achievements of 1991.

He is the author of more than 200 scientific publications and has played a vital role in the development of the next generation of mathematicians. Under his supervision, 25 master's theses have been completed and 15 doctoral degrees awarded, with six of his students advancing to professorships.

From 1996 to 2019, Professor Panakhov served as Professor at Firat University in Elazig, Turkey, where he held key leadership roles, including Head of the Mathematics and Actuarial Departments, member of the University Senate, and advisor to the Rector on international relations with Turkic-speaking countries.

A committed leader in the global mathematical community, Professor Panakhov is a founding organizer of the Turkic World Mathematicians Society (TWMS) and served as its Vice President for over two decades, representing both Turkey and Azerbaijan. He has also been a principal organizer of multiple international TWMS congresses.

His international academic engagement includes visiting professorships in India, France, Iran, Hong Kong, Kazakhstan, and other countries, reflecting the global impact of his work.

Professor Panakhov currently serves as Co-Editor-in-Chief of the TWMS Journal of Pure and Applied Mathematics and continues to contribute actively to its advancement. He has also led the "Inverse Problems and Image Definition" Department at the Scientific Research Institute of Applied Mathematics under Baku State University and is a member of the Expert Council on Mathematics of the Higher Attestation Commission under the President of the Republic of Azerbaijan.

PLENARY & INVITED TALKS

TALK IN HONOR OF PROF. DR. ETIBAR PENAHLI

PROF.DR. VARGA KALANTAROV[1]
[1]Department of Mathematics, Koc University, Istanbul, Türkiye
vkalantarov@ku.edu.tr

TALK IN HONOR OF PROF. DR. ETIBAR PENAHLI

PROF.DR. MIKHAIL BRODSKY[1]
[1]President at Lincoln University, Lincoln, United Kingdom
president@lincolnuca.edu

TALK IN HONOR OF PROF. DR. ETIBAR PENAHLI

PROF. DR. YUSIF GASIMOV[1]
[1] Vice-rector; Azerbaijan University, Azerbaijan

vkalantarov@ku.edu.tr

FROM THE PAINLEVÉ TEST TO SOLUTIONS OF THE KURAMOTO–SIVASHINSKY EQUATION WITH NONLINEAR CONVECTION

PROF. DR. NIKOLAY A. KUDRYASHOV[1]

[1]Department of Applied Mathematics, National Research

Nuclear,University MEPHI, 31 Kashirskoe Shosse, 115409 Moscow,

Russian Federation,

nakudryashov@mephi.ru

ABSTRACT

This report is devoted to the study a generalization of the Kuramoto-Sivashinsky equation in the form [1]

$$u_t + u_{xx} + \sigma u_{xxx} + u_{xxxx} + \beta u u_x + \chi (u^2)_{xx} = 0.$$

This equation is used to model processes in combustion physics, plasma physics, hydrodynamics, and other fields. Since the Cauchy problem for this equation cannot be solved by the inverse scattering transform, a traveling wave reduction is employed to seek solutions. It is shown that the equation generally fails the Painlevé test. However, we find parameter of equation values, the necessary condition for the existence of a general solution is satisfied [2]. Using the results of the Painlev\'e analysis, first integrals for the nonlinear ODEs are derived. The general solutions for two specific cases, each involving four arbitrary constants, are presented in terms of the Weierstrass elliptic function and the transcendental solutions of the first Painlevé equation. Furthermore, exact solutions with one and two arbitrary constants are obtained using the simplest equation method.

REFERENCES

1. Aspe H. and Depassier M. C. (1990) Evolution equation of survace wavesin a convecting fluid, Physical Revieew A 22, 19008,4135–4142.
2. Kudryashov, N.A., (2025) Painleve test, first integrals and analytical solutionsof the Korteweg de Vries Burgers equation with a nonlinear source, Chaos, Solitons and Fractals, 201, doi = 10.1016/j.chaos.2025.117380.G.M.

RECENT DEVELOPMENTS ON ANALYTICAL AND COMPUTATIONAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS IN PHYSICS AND ENGINEERING

PROF. DR. ALY R. SEADAWY[1]
aabdelalim@taibahu.edu.sa

1Mathematics Department, Faculty of Science, Taibah University,

Al-Madinah Al-Munawarah 41411, Saudi Arabia

ABSTRACT

Partial differential equations have become a useful tool for describing the natural phenomena of science and engineering. Nonlinear evolution equations (NLEEs) arise in many branches of science such as mathematics, physics, mechanics, engineering, and material science. The NLEEs are widely used to describe physical phenomena in various scientific and engineering fields, such as fluid mechanics, plasma physics, optical fibres, biology, solid-state physics, etc. Exact solutions of NLEEs play an important role in the proper understanding of the mechanism of many physical phenomena and processes in various areas of natural science. They can help to analyze the stability of these solutions and the movement role of the wave by making graphs of the exact solutions. The potential topics The main topics will be as follows:

- Methods of Mathematical Physics.
- Partial differential equations.
- Fractional partial differential equations.
- Stability analysis of dynamical system.
- Nonlinear water waves.
- Soliton solutions.
- Related topics about the partial differential equations.
- Computational fluid dynamics.
- Advanced theory of the fractal and fractional calculus.
- Methods for solving the fractal and fractional PDEs in physics and Engineering.
- Application of the fractal and fractional calculus in physics and Engineering.
- Fractal variational principle.
- Computational fluid dynamics

MATHEMATICAL NEURON–NEURAL-NETWORKS DYNAMICS WITH CONTINUOUS- AND DISCRETE-TIME MODELS IN NEUROSCIENCE, BIOLOGY AND PRECISION MEDICINE: COMPLEX FEATURE ENGINEERING AND DATA COMPLEXITY

PROF. DR. YELİZ KARACA[1]

[1]Department of Mathematics and Department of Neuroscience, University

of Massachusetts (UMass) Chan Medical School, Worcester, MA, USA

yeliz.karaca@ieee.org

ABSTRACT

The extraction of the association between the complex systems' components could be regarded as a challenge due to their nonlinear characteristics; thus, focusing deterministically on only one single aspect of a situation may impede the understanding of the whole system or attaining a unitary whole. Data and refining of a raw dataset emerge as one important property of feature engineering through which the features for each label are built and the data used for the feature are filtered. There could be instances when missing values may include incorrect, incomplete and non-existent information, which reduce the accuracy and performance of machine learning algorithms. For the purpose of compensating this situation, complex feature engineering, which is a process of selecting, generating or modifying features such as sets of input variables or data to facilitate machine learning models learn patterns more effectively, provides complementary solutions in unstable environments with emergent structural and behavioral patterns, where emergence refers to shifts in the whole systems behavior. The features emphasize the quintessential example of the way simplicity generates complexity in conjunction with the inquiries regarding how it is possible that patterns can emerge from randomness. Further in mathematical aspects, mathematical modeling (i.e. wavelets, fractional calculus, fractals, artificial intelligence (AI), deep learning, ensemble methods, entropy, and so on) integrated with advanced technologies has been extensively utilized to characterize complex patterns existent in different areas such as medicine, neuroscience, biology, epidemiology, signal processing, image processing, computer informatics, data science, applied sciences, engineering and other related fields. Furthermore, discrete time and continuous time are two alternative frameworks within which variables that evolve over time are modeled in mathematical dynamics. Discrete time views values of variables as occurring at distinct, separate points in time, or equivalently as being unchanged throughout each non-zero region of time or time period. This implies that time is regarded as a discrete variable. Hence, a non-time variable jumps from one value to another as time moves from one time period to the next. To put it differently, discrete signal or discrete-time signal is a time series that consists of a sequence of quantities. While system

behavior is expressed by difference equations, discrete signals are common in computational simulations and data-based modeling processes. Continuous time, on the other hand, regards variables as having a
2
particular value only for an infinitesimally short amount of time. Between any two points in time, there are an infinite number of other point, and therein, the time variable could range over the entire real number line, or depending on the context, over some subset of it such as the non-negative reals. Thus, in continuous time modeling, the system behavior is generally denoted through differential equations, and in nature, they represent most of the physical processes like fluids, mechanical systems, epidemiology, and so forth. Overall, generally discrete models signify computational and complexity power, whereas continuous models signify theoretical accuracy. For these reasons, these two approaches complement each other in modern sciences. Hidden Markov Model (HMM), as a stochastic process where implicit or latent stochastic processes can be inferred indirectly through a sequence of observed states, is proven to be an applicable mathematical model concerning uncertain phenomena toward the description and computation of complex dynamical behaviors, thereby enabling the mathematical formulation of neural dynamics across spatial and temporal scales. HMM and multifractal methods within the framework of predictive quantization complexity models have been demonstrated to provide for the differential prognosis and differentiation of the subgroups with respect to multiple sclerosis (MS) which is an autoimmune degenerative disease with time and space related dissemination, leading to neuronal apoptosis, coupled with some subtle features that could be overlooked in clinical or medical practices. Overall, it is highly essential to quantify the nonlinear brain dynamics and its anatomical structure to be able to grasp the subtle features; yet, characterization across different interacting spatio-temporal scales is involved due to the brain's operation on multiple timescales, which may pose a formidable challenge. In view of these aspects and considerations as well as based on work and research conducted, the current lecture specifically aims to facilitate multifaceted decision-making processes, optimized outcome prediction, addressing the complexity of diseases and identification of the right pre-determined features through the proper selection of the variables with respect to the related discipline based on the pertinent criteria so that the mathematical model can be established appropriately. Such factors also emphasize the interdisciplinary regimes including the medical, clinical and computer-based aspects based on mathematical modeling considering their distinctive contributions that need to be carried out appropriately in a well-poised balance and knowledge-based scheme. These can ensure the identification of the external factors triggering the diseases along with the past history thereof, which can bring about timely and accurate prediction, diagnostics, course of the disease, follow-up, efficient management while being able to maintain the life quality of the patients with optimal outcomes including life-quality, (self-)control and survival, as health primarily is at stake.

Keywords: Complex feature engineering and data complexity, Computational and mathematical biology-medicine, Mathematical modeling, Discrete-time models, Continuous-time models, Mathematical neurology; Mathematical neuron-neural-networks dynamics modeling; AI, Ensemble predictive algorithmic systems; Deep learning, Mobile cloud computing; Computational complexity; Diffusion MRI signal processing; Accurate neuron geometry models, Bloch Torrey PDE, Stochastic processes and analyses, Pre-determined features; Uncertainty quantification; Precision medicine; Multifractal and singularity analysis; Fractional calculus operators; Discrete Hidden Markov model.

REFERENCES

1. Karaca, Y., & Moonis, M. (2026). Mathematical Neuron-Neural-Networks Dynamics Modeling and Brain Complexity of Multicriteria Fractal-Based Ensemble Predictive Algorithmic Systems. Journal of Computational and Applied Mathematics, 117319.
2. Karaca, Y. (2023). Fractional calculus operators–Bloch–Torrey partial differential equation–artificial neural networks–computational complexity modeling of the micro–macrostructural brain tissues with diffusion MRI signal processing and neuronal multi-

components. Fractals, 31(10), 2340204.

3. Karaca, Y., Baleanu, D., & Karabudak, R. (2022). Hidden Markov model and multifractal method-based predictive quantization complexity models vis-á-vis the differential prognosis and differentiation of multiple sclerosis' subgroups. Knowledge-Based Systems, 246, 108694.

4. Karaca, Y. (2022). Theory of complexity, origin and complex systems. In Multi-Chaos, Fractal and Multi-fractional Artificial Intelligence of Different Complex Systems (pp. 9-20). Academic Press.

5. Karaca, Y., Moonis, M., Zhang, Y. D., & Gezgez, C. (2019). Mobile cloud computing based stroke healthcare system. International Journal of Information Management, 45, 250-261.

6. Karaca, Y., Moonis, M., & Baleanu, D. (2020). Fractal and multifractional-based predictive optimization model for stroke subtypes' classification. Chaos, Solitons & Fractals, 136, 109820.

A NOVEL APPROACH FOR CHARACTERIZING NONLINEAR DYNAMICAL SYSTEM BEHAVIOR THROUGH SELF-ORGANIZING MAPS AND CLUSTERING ANALYSIS

PROF. DR. ADIL JHANGEER[1]

[1]VSB-Technical University of Ostrava, Czech Republic

adil.jhangeer@vsb.cz

Abstract

Understanding the behavior of complex nonlinear dynamical systems remains a significant challenge because of the high dimensionality and intricate interactions among system parameters. These complexities often mask the underlying dynamical patterns, making it difficult to predict and control system responses under varying conditions.

In this study, we propose a novel framework based on Self-Organizing Maps (SOMs) combined with clustering techniques to systematically characterize system behavior arising from parameter variations. The proposed approach groups dynamical responses that exhibit similar patterns and enables the identification of latent structures within the parameter space.

To further interpret the resulting clusters, we perform a detailed dynamical analysis of each group. As a case study, the methodology is applied to the FitzHugh–Nagumo model, demonstrating its effectiveness in revealing distinct behavioral regimes. The obtained results identify meaningful latent patterns and classify the parameter space into 12 major behavioral groups, reflecting the heterogeneous nature of the system dynamics.

Overall, this approach provides an effective tool for understanding how parameter variations influence system behavior and offers valuable insights for the prediction and control of complex nonlinear systems.

CONTROLLABILITY OF GENERALIZED HILFER FRACTIONAL DYNAMICAL SYSTEMS WITH DELAYS

PROF. DR. JAVID ALI[1]

[1]Department of Mathematics, Aligarh Muslim University, Aligarh, India

javid.mm@amu.ac.in

Abstract

In this talk, we discuss the controllability of dynamical systems with (k,φ)-Hilfer fractional derivative with infinite delay and delay in control function. The necessary and sufficient condition obtained for the controllability requirement for linear systems, which are characterized by the Mittag–Leffler (M–L) functions, while the fixed point approach is used to arrive at adequate controllability criteria for nonlinear systems. The novel feature of this study is to inquire into the controllability notion by using (k, φ)-Hilfer fractional derivative, the most generalized variant of the Hilfer derivative. The advantage of this type of fractional derivative is that it recovers the majority of earlier studies on fractional differential equations (FDEs). Finally, few numerical examples are provided to illustrate our main results.

Keywords: Fractional dynamical systems, Controllability, Gramian matrix, Fixed point theorem, measure of non-compactness.

TYPE	AUTHORS	TITLES	PAGE	TOPICS
Oral	**Yusif Gasimov, Abdeljalil Nachaoui, Aynura Aliyeva**	A NUMERICAL METHOD TO THE SOLUTION OF THE INVERSE CAUCHY PROBLEM FOT THE PAULI EQUATION	1	Applied Mathematics
Oral	**Latifa Agamalieva, Ban Jamal Khalid Alsindi, Hasan Bulut**	SOLITON SOLUTIONS OF THE LONGITUDINAL WAVE EQUATION IN A MAGNETO-ELECTRO-ELASTIC CIRCULAR ROD VIA KUDRYASHOV EXPANSION METHOD	2	Applied Mathematics
Oral	**Hikmet Kemaloğlu, Baran Bahtiyar**	NEURAL NETWORK PROCESS FOR MODEL OF INFECTIOUS DISEASE TRANSMISSION SYSTEM	5	Mathematical Biology
Oral	**Hikmet Kemaloğlu, Asaad Bakar**	AN ARTIFICIAL DEEP NEURAL NETWORK APPROACH FOR MATHEMATICAL MODEL	6	Mathematical Biology
Oral	**Esin İlhan**	AN EXTRACTION OF A NOVEL SOLITON SOLUTIONS OF THE NONLINEAR MATHEMATICAL MODEL	7	Applied Mathematics
Oral	**Esin İlhan**	ANALYTICAL STRUCTURES AND CONSERVATION LAWS OF THE (2+1)-DIMENSIONAL CUBIC KLEIN-GORDON EQUATION	8	Applied Mathematics
Oral	**Arif Ozkul, Oznur Engi, Hasan Bulut**	THE EXTENDED RATIONAL SINE-COSINE AND SINH-COSH METHODS APPLIED TO THE NONLINEAR COMPLEX SYSTEMS	9	Applied Mathematics
Online	**Zozan Oktan, Cemil Tunç**	ASYMPTOTIC STABILITY ANALYSIS FOR SECOND-ORDER NONLINEAR STOCHASTIC INTEGRO–DELAY DIFFERENTIAL EQUATIONS	12	Stochastic and Delay Differential Equations
Online	**Zozan Oktan, Cemil Tunç**	STABILITY AND BOUNDEDNESS ANALYSIS OF THIRD-ORDER NONLINEAR STOCHASTIC DIFFERENTIAL EQUATIONS WITH DELAY	13	Stochastic and Delay Differential Equations
Oral	**Ban Jamal Khalid Alsindi, Arif Özkul, Hasan Bulut**	SOLITARY WAVE SOLUTIONS AND MODULATION INSTABILITY OF THE SCHRODINGER EQUATION WITH MIXED DERIVATIVE AND AMPLITUDE DEPENDENT TERM	14	Fractional Calculus and Applications
Oral	**Tukur Abdulkadir Sulaiman,Hanife Kalka, Mehtap Guneri, Hasan Bulut**	NEW WAVE STRUCTURES OF A NONLINEAR PHYSICAL MODEL	15	Applied Mathematics
Oral	**Sannaky Ibtissam,El Berraı Imane, Adnaouı Khalid**	STOCHASTIC INSIGHTS INTO CYSTIC ECHINOCOCCOSIS CONTROL TO BREAK THE TRANSMISSION CYCLE	16	Applied Mathematics
Online	**Melike Karta, Nimet Tanır**	NUMERICAL SOLUTION OF THE GENERALIZED EQUAL WIDTH WAVE (GEW) EQUATION USING THE CRANK-NICOLSON FINITE DIFFERENCE SCHEME WITH OPERATOR SPLITTING TECHNIQUE	17	Applied Mathematics
Online	**Melike Karta, Kadriye Nazlıaydın**	NUMERICAL SOLUTION OF THE 1-DIMENSIONAL BENJAMIN-BONA-MAHONY-BURGERS EQUATION USING A DISCRETE APPROXIMATION METHOD WITH OPERATOR SPLITTING TECHNIQUE	18	Applied Mathematics
Oral	**Coşkun Yakar, Dilara Karslıoğlu**	STRICT MITTAG-LEFFLER STABILITY OF FRACTIONAL UNPERTURBED SYSTEMS WITH INITIAL TIME DIFFERENCE	19	Applied Mathematics
Online	**Gülnihal Demir, Pelin Özkartepe**	GROWTH AND DERIVATIVE ESTIMATES OF ALGEBRAIC POLYNOMIALS IN THE COMPLEX PLANE	21	Analysis and Its Applications
Oral	**"Şeyma Firdevs Hızal, Mehtap Güneri, Hasan Bulut"**	"NOVEL SOLITONS OF THE BISWAS - MILOVIC EQUATION WİTH KERR LAW NONLINEARITY"	22	Applied Mathematics
Oral	**Diana M. Audi**	INSTRUCTOR-TRAINED AI TUTOR FOR MATHEMATICS EDUCATION: DESIGN AND EVALUATION OF A CUSTOM GPT	23	Mathematics Education and Its Applications
Oral	**Etibar Penahlı, Ahu Ercan**	"FRACTIONAL EULER METHOD FOR SOLVING FRACTIONAL DIFFERENTIAL EQUATIONS"	24	Applied Mathematics

Oral	Betül Özbay Elibüyük	DYNAMICS OF ADVECTION-DIFFUSION-REACTION PROCESSES: A Z^{+}-NUMBER VALUED APPROACH WITH ABC GRANULAR FRACTIONAL CALCULUS	25	Fractional Calculus and Applications
Oral	Ahlam elkhettab,Imane elberrai	MODEL OF KIDNEY FUNCTION DECLINE UNDER THE INFLUENCE OF DIABETES AND HYPERTENSION	27	Applied Mathematics
Oral	Dorsaf Kouas	ON THE S-SPECTRUM AND LOCAL S-SPECTRUM OF QUATERNIONIC RIGHT LINEAR OPERATORS	28	Analysis and Its Applications
Oral	Sana Bouzidi	CHARACTERIZATION OF SOME ESSENTIAL SPECTRA OF THE SUM OF TWO BLOCKS OPERATOR MATRICES INVOLVING THE RELATIVELY FREDHOLM PERTURBATIONS	29	Analysis and Its Applications
Oral	Surajo Sulaiman, Aliyu Suleiman	GENERALIZED ENTRY FORMULA FOR COMPUTING A MULTIVARIATE POLYNOMIAL RESULTANT	33	Geometry and Its Applications
Oral	Huzaifa Umar, Maryam Isa Abdulkadir ,Maryam Rabiu Aliyu, Abubakar Adamu	ENHANCEMENT OF MALARIAL PARASITE IMAGE RESTORATION USING FISTA AND INERTIAL TSENG MATHEMATICAL ALGORITHMS	35	Applied Sciences
Oral	Farouk Sa'ad	OPTIMAL CONTROL AND MATHEMATICAL MODELING OF EBOLA VIRUS TRANSMISSION IN BAT-HUMAN INTERACTIONS	36	Mathematical Biology
Oral	Ado Balili	DYNAMICAL BEHAVIOUR AND NEW EXACT TRAVELLING WAVE SOLUTIONS FOR THE (2+1) DIMENSIONAL FRACTIONAL STOCHASTIC DAVEY-STEWARTSON SYSTEM VIA TWO ROBUST TECHNIQUES	37	Applied Mathematics
Online	Muhittin Evren Aydın, Harith Adnan Arab Al-Azzawi	EXISTENCE OF RADIAL SOLUTIONS FOR CURVATURE-TYPE EQUATIONS	38	Applied Mathematics
Online	Şeyma Firdevs Hızal , Nur Seza Altınışık	MATHEMATICAL MODELING AND NUMERICAL ANALYSIS OF SALMONELLOSIS TRANSMISSION BETWEEN ANIMAL AND HUMAN POPULATIONS	39	Mathematical Biology
Oral	Hasan Bulut, Yaren Kılıç, Şeyma Firdevs Hızal	APPLICATIONS OF THE (M+1/G′) METHOD TO SOME NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS	40	Applied Mathematics
Oral	Coşkun Yakar, Dilara Karslıoğlu	STRICT MITTAG-LEFFLER STABILITY OF FRACTIONAL UNPERTURBED SYSTEMS WITH INITIAL TIME DIFFERENCE	41	Applied Mathematics
Oral	Faton Merovci	STATISTICAL PROPERTIES AND APPLCATIONS OF A NEW TWO-PARAMETER INVERSE RAYLEIGH DISTRIBUTION	42	Statistics and Its Applications
Online	Mahir Ceylan Erdoğan	A NOVEL METHOD TO SOLVE THE SOME CONFORMABLE FRACTIONAL NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS	44	Applied Mathematics
Online	Sehnaz Yıldırım, Erdal Bas	"MATHEMATICAL PHARMACOKINETIC PROCESSES WITH LOCAL DERIVATIVE"	45	Applied Mathematics
Online	Sumeyye Turan, Erdal Bas	M-SERIES DERIVATIVE MATHEMATICAL MODELING FOR ADVANCED BUILDING ENERGY OPTIMIZATION	46	Applied Mathematics
Online	Hasan Cakicioglu, Muslum Ozisik, Aydin Secer	CUBIC-QUINTIC FORM OF SELF-PHASE MODULATION FOR THE (2+1)- PERTURBED BISWAS-MILOVIC EQUATION WITH OPTICAL DROMIONS	47	Applied Mathematics
Online	Elif Tufan Gov, Muslum Ozisik, Aydin Secer	OPTICAL DROMIONS WITH THE (2+1)-DIMENSIONAL STOCHASTIC PERTURBED GENERALIZED NONLINEAR SCHRODINGER EQUATION HAVING THE KERR LAW OF SELF-MODULATION	48	Applied Mathematics

Oral	**Muhammad Abubakar Isah, Ibrahim Isah, Ahmad Muhammad, Salim Jibrin Danbatta**	EMERGENCE OF LOGARITHMIC NONLINEAR WAVES IN A LIOUVILLE MODEL: AN EXACT ANALYTICAL STUDY	49	Applied Mathematics
Oral	**Şeyma Firdevs Hızal, Özlem Defterli, Hasan Bulut**	AN OVERVIEW OF RECENT MATHEMATICAL MODELS TO PREDICT EPIDEMICS	51	Mathematical Biology
Oral	**Ayşe Metin Karakaş, Fatma Bulut, Bahadır Yüzbaşı**	THE CAUCHY MODIFIED GARIMA DISTRIBUTION: PROPERTIES, INFERENCE, AND EMPIRICAL APPLICATIONS	52	Applied Mathematics
Oral	**Sadullah Bulut, Muhammed Yiğider**	AI-SUPPORTED MODIFIED EXP-EXPANSION FUNCTION METHOD FOR NONLINEAR DYNAMICAL SYSTEMS	53	Fractional Calculus and Applications
Oral	**İlknur Kızıl, Ulviye Demirbilek, Hadi Rezazadeh**	WAVE SOLUTIONS, ENERGY ANALYSIS, AND PHYSICAL CHARACTERIZATION OF A NONLINEAR EVOLUTION EQUATION	54	Applied Mathematics
Oral	**"Ulviye Demirbilek,Hasan Bulut,Ercan Çelik, İlknur Kızıl"**	SOLITON WAVE STRUCTURES OF (2+1) DIMENSIONAL NONLINEAR EVOLUTION EQUATION	55	Applied Mathematics
Online	**Aslıhan Demir, Ayşe Metin Karakaş, Sinan Çalık**	THE NOVEL LOMAX-GARIMA DISTRIBUTION: PROPERTIES AND APPLICATIONS	56	Statistics and Its Applications
Online	**Damla Dağ, İlhame Amirali**	ON STABILITY INEQUALITIES AND NUMERICAL SOLUTIONS OF THIRD-ORDER NEUTRAL INTEGRO-DIFFERENTIAL EQUATIONS	57	Applied Mathematics
Oral	**Hasan Bulut, Şeyma Firdevs Hızal, Gülnur Yel**	TYPE-SOLITONS PROPAGATION FOR NONLINEAR SYSTEMS OF MATHEMATICAL MODEL	58	Applied Mathematics
Online	**Selçuk Han Aydın , Shokoufeh Ghezeljeh**	FUNDAMENTAL SOLUTION METHOD AND APPLICATION TO THE 3-D MHD EQUATIONS	59	Applied Mathematics
Online	**Yusuf Erbek,Bilal Şeker, İsmail Can Şeker**	BRIGHTNESS ENHANCEMENT OF LOW-LIGHT IMAGES USING POLYNOMIAL-BASED	60	Analysis and Its Applications
Online	**Ali Sercan Karakaş**	A RESEARCH STUDY ON THE NUMERICAL SOLUTION OF THE BURGERS EQUATION BY GALERKIN METHOD BASED ON HERMITE B-SPLINE FUNCTIONS	62	Applied Mathematics
Online	**Numan Yalçın**	"A PRELIMINARY STUDY ON THE ANAGEOMETRIC LAPLACE TRANSFORM"	63	Applied Mathematics
Oral	**Zelal Aslan, Ulviye Demirbilek, Arzu Akbulut**	"CONSERVATION LAWS AND EXACT SOLUTIONS OF A NONLINEAR PARTIAL DIFFERENTIAL EQUATION"	64	Applied Mathematics
Online	**Numan Yalcin, Mutlu Dedeturk**	"A STUDY ON THE ANAGEOMETRIC DERIVATIVE AND ITS FUNDAMENTAL PROPERTIES"	65	Applied Mathematics
Online	**Ayşe Demirhan, Erhan Pişkin**	"NONEXISTENCE OF GLOBAL SOLUTIONS FOR THE SINGULAR PARABOLIC-TYPE EQUATION"	66	Applied Mathematics
Online	**Bahattin Erkmen,Bilal Şeker, İsmail Can Şeker**	COMPARISON OF IMAGE ENHANCEMENT PERFORMANCES OF DIFFERENT POLYNOMIAL-BASED APPROACHES	67	Analysis and Its Applications
Oral	**Güldar Efe, Erhan Pişkin**	"EXISTENCE OF SOLUTIONS FOR A HIGHER-ORDER WAVE EQUATION WITH DELAY TERM"	68	Applied Mathematics
Oral	**Alan Kılıç**	GLOBAL EXISTENCE AND BLOW UP OF SOLUTIONS FOR A HYPERBOLIC-TYPE EQUATION	69	Applied Mathematics

Online	**Mücahit Yüzgül, Bilal Şeker, İsmail Can Şeker**	ENHANCEMENT OF IMAGE CONTRAST USING POLYNOMIAL-BASED NUMERICAL METHODS	70	Analysis and Its Applications
Oral	**Muhteşem Demir, Erhan Pişkin**	THEORETICAL AND NUMERICAL RESULTS OF SOLUTIONS FOR THE PARABOLIC TYPE EQUATION	71	Applied Mathematics
Oral	**Erhan Pişkin, Nebi Yılmaz**	THEORETICAL AND NUMERICAL ANALYSIS OF NONLINEAR HIGHER-ORDER WAVE EQUATIONS	72	Applied Mathematics
Oral	**Nursemin Kaş, Tolga Aktürk**	ANALYTICAL INVESTIGATION OF NONLINEAR WAVE STRUCTURES VIA A MODIFIED EXPONENTIAL METHOD	73	Applied Mathematics
Online	**Nada Alsaaıd, Ulviye Demirbilek, Arzu Akbulut**	LIE SYMMETRY ANALYSIS, CONSERVATION LAWS AND EXACT SOLUTIONS OF A NONLINEAR EVOLUTION EQUATION	74	Applied Mathematics
Oral	**Melik Senyuva, Ban Jamal Khalid Alsindi, Hasan Bulut**	WAVE PROPAGATION OF THE (2+1)-DIMENSIONAL NON- LINEAR SCHRODINGER EQUATION	76	Applied Mathematics
Online	**Hazal Yüksekkaya**	THE PLATE PARTIAL DIFFERENTIALEQUATION:EXISTENCE ANDDECAY	78	Applied Mathematics
Online	**Nermin Ulas, Alper Osman Ogrenmis**	"MULTIPLICATIVE LOKSODROME CURVES ON HELICOIDAL SURFACES"	79	Geometry and Its Applications
Oral	**N. M. Temirbekov, Z. I. Seitmuratova, G. B. Zhussipova**	"COMPARATIVE ANALYSIS OF INTERPOLATION METHODS AND MACHINE LEARNING ALGORITHMS FOR GEOCHEMICAL ANOMALIES OF ORE OBJECTS"	80	Applied Mathematics
Online	**Etibar Panakhov, Aytan Bakhshizada**	"ASYMPTOTIC FORMULA FOR EIGENVALUES OF CANONICAL FORM OF THE DIRAC OPERATOR"	81	Applied Mathematics
Online	**Hüseyin Şen**	OSCILLATION OF SOLUTIONS OF DIFFERENCE EQUATIONS WITH CONTINOUS ARGUMENTS	83	Applied Mathematics
Oral	**Aynur Şahin**	ON A FASTER ITERATIVE METHOD FOR FIXED POINT PROBLEMS IN BANACH SPACES AND ITS APPLICATIONS	85	Analysis and Its Applications
Online	**Murat Arı**	A NUMERICAL APPROACH FOR A COUPLED NONLINEAR WAVE SYSTEM USING A MESHLESS COLLOCATION FRAMEWORK	86	Numerical Methodsand Scientific Programming
Oral	**Sevda Ö. Çalıkuşu, Davood Ahmadian, Fevzi Erdoğan, Nihal İnce, Vildan Aslan**	MODELING INVESTOR PHYSIOLOGY WITH STOCHASTIC DYNAMICS: FROM EMOTIONAL PARAMETERS TO BEHAVIORAL CLUSTERS	87	Stochastic and Delay Differential Equations
Online	**Ayşe Fidan, Erhan Pişkin**	QUALITATIVE ANALYSIS OF SOLUTIONS FOR A WEIGHTED HYPERBOLIC-TYPE EQUATION	88	Applied Mathematics
Online	**Ajay Kumar**	FRACTIONAL MODIFIED CAMASSA–HOLM AND DEGASPERIS–PROCESI EQUATIONS: DYNAMIC BEHAVIOR AND NONLINEAR WAVE STRUCTURES	90	Applied Mathematics
Oral	**Nigar Yıldırım Aksoy, Nurşah Çelik**	ON SOLUTION OF A NEUMANN PROBLEM FOR A SCHRODINGER-TYPE EQUATION	91	Applied Mathematics
Online	**Rıfat Oku, Fevzi Erdoğan**	"HYBRID FUZZY REGRESSION MODELS: A COMPARATIVE STUDY"	92	Statistics and Its Applications
Online	**Mustafa Hicret Yaman**	EDMD OF EARTHQUAKE ACTIVITY IN TURKIYE	95	Applied Mathematics
Online	**Aytekin Enver, Fatma Ayaz**	FRACTIONAL REACTION–DIFFUSION MODELING OF COLORECTAL CANCER THERAPY	96	Fractional Calculus and Applications
Online	**Ezgisu Uzel, Alper Osman Ogrenmis**	SPIRAL CURVES AND GENERALIZATIONS IN THE MULTIPLICATIVE PLANE	97	Geometry and Its Applications

Online	**Ahmad Muhammad, Muhammad Abubakar Isah, Salim Jibrin Danbatta, Sulaiman Sulaiman Ahmad**	REVEALING DISSIPATION AS CAUSAL MEMORY STORAGE IN LINEAR AND NONLINEAR SYSTEMS: QSER APPLICATION	98	Applied Sciences
Online	**Ahmad Muhammad, Muhammad Abubakar Isah, Salim Jibrin Danbatta, Sulaiman Sulaiman Ahmad**	QSER: A PHYSICS-GUIDED DECOMPOSITION FRAMEWORK FOR PHYSICAL SYSTEMS	99	Applied Sciences
Online	**Sinan Aslan**	"SOME INTEGRAL INEQUALITIES DERIVED FROM EXPONENTIALLY QUASI-CONVEX PARTIAL DERIVATIVES ON THE CO-ORDINATES"	101	Analysis and Its Applications
Oral	**Araz R. Aliev, Rustam Eyniyev**	IMPROVING THE INTELLIGENCE OF NON-PLAYER CHARACTER IN GAMES USING MACHINE LEARNING AND DEEP LEARNING METHODS FOR TEXT-BASED DEPRESSION DETECTION	102	Applied Sciences
Oral	**Emine Üyücü, Ummahan Aca**	SOFT INT-MODULES OVER A SOFT INT-RING	103	Algebra and Its Applications
Online	**Fatih Temizsu**	ON GENERALIZED P-DECREASING SEQUENCES IN LATTICE NORMED SPACES VIA LACUNARY DENSITY	104	Analysis and Its Applications
Online	**Seçkin Yalçın, Murat Candan**	"FIBONACCI WEIGHTED DIFFERENCE SEQUENCE SPACE"	105	Analysis and Its Applications
Online	**Ismail Onder, Muslum Ozisik, Aydin Secer**	ON OPTICAL SOLITONS AND QUALITATIVE ANALYSIS OF THE THIRD ORDER PERTURBED NONLINEAR SCHRODINGER EQUATION HAVING THE KERR LAW IN THE ABSENCE OF GROUP VELOCITY DISPERSION	106	Applied Mathematics
Online	**Hüseyin Ekinci, Gulshat Muhametjanova**	THE EFFECT OF GEOGEBRA SOFTWARE ON MATHEMATICS ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN KYRGYZSTAN	107	Mathematics Education and Its Applications
Oral	**Merve Zeynep Kaya, Ercan Çelik, Mesut Karabacak**	PHYSICS-INFORMED GRAPH NEURAL NETWORKS FOR SOLVING HEAT EQUATION PDES ON SCATTERED MESHES	108	Applied Mathematics
Oral	**Gülşen Orucova Büyüköz**	"BINARY NEWTON-RAPHSON BASED OPTIMIZER WITH S-SHAPED AND V-SHAPED TRANSFER FUNCTIONS FOR 0-1 KNAPSACK PROBLEM"	109	Applied Mathematics
Online	**Gözde Özyurt**	"A STUDY ON NECTARINE MATRICES VIA SPLIT-COMPLEX REPRESENTATION"	110	Algebra and Its Applications
Online	**Nooriza Mirzabekova, Ercan Çelik**	APPROXIMATE SOLUTIONS OF LINEAR INTEGRO-DIFFERENTIAL EQUATIONS USING BESSEL POLYNOMIALS	111	Applied Mathematics
Online	**Sadaghat Shahmorad, Ercan Çelik**	BLOCK GAUSSIAN ELIMINATION WITH QR FACTORIZATION IN PLACE OF DIAGONAL BLOCK INVERSION	112	Applied Mathematics
Online	**Elif Deniz Öztürk, Ercan Çelik, S.Şule Şener Kılıç**	KUDRYASHOV EXPANSION METHOD APPLIED TO FISHER MATHETICAL MODEL	113	Applied Mathematics
Online	**Tuğba Yavuz**	"NOTES ON SOME CLASSES OF MEROMERPHIC CLOSE-TO-CONVEX FUNCTIONS "	114	Analysis and Its Applications
Online	**Ebru Cavlak Aslan, Özlem Pirinççi**	SEMI ANALYTICAL SOLUTIONS OF TWO FORMS OF THE GKDV EQUATION	115	Applied Mathematics
Online	**Fatih Rıza Çelik**	"APPROXIMATION BY FIBONACCI BASED KING TYPE SZÁSZ OPERATORS"	117	Analysis and Its Applications

Online	Okan Genç, Ömer Oruç	"EN EFFICIENT NUMERICAL METHOD FOR SECOND ORDER SINGULARLY PERTURBED DIFFERENTIAL EQUATIONS"	118	Numerical Methodsand Scientific Programming
Online	Bahar Acay Öztürk	MATHEMATICAL MODELING OF EARTHQUAKE EFFECTS ON MULTISTOREY BUILDINGS USING THE PROPORTIONAL DERIVATIVE APPROACH	119	Applied Mathematics
Online	Eman Bakır Ahmad Ajm, Fatma Tokmak Fen, Mehmet Onur Fen	"ANTIPERODICITY IN QUASILINEAR IMPULSIVE SYSTEMS"	120	Ordinary
Online	Süleyman Sarikaya, Yavuz Altin	LACUNARY STATISTICAL CONVERGENCE OF ORDER ’ IN CONE METRIC SPACES	121	Analysis and Its Applications
Online	Lale Cona, Deniz Şimşek	A HYBRID ITERATION APPROACH FOR SPLIT EQUILIBRIUM AND FIXED POINT PROBLEMS	122	Analysis and Its Applications
Oral	Özge Hamzaoğlu, Arzu Akbulut	EXACT SOLUTIONS OF THE EXTENDED KAIRAT II-X EQUATION	123	Applied Mathematics
Online	Lale Cona, Jackson Kalule	ABOUT SOLVING GENERALIZED VARIATIONAL INEQUALITY, FIXED POINT AND EQUILIBRIUM PROBLEMS	124	Analysis and Its Applications
Oral	Dmitrii Zhelobnev, Nisa Çelik	EXACT ANALYTICAL WAVE SOLUTIONS FOR THE COMBINED KAIRAT-II-X EQUATION VIA THE MODIFIED SARDAR SUB-EQUATION METHOD	125	Applied Mathematics
Online	Ugur Bayrakçı, Seyma Tülüce Demiray, Tayyip Onat	ON THE SOLUTIONS OF UNIDIRECTIONAL WAVE MODEL	126	Applied Mathematics
Oral	Talha Arslan	THE FAMILY OF ’ MONOTONE DISTRIBUTIONS: DIFFERENT ESTIMATION METHODS AND APPLICATIONS	127	Statistics and Its Applications
Oral	Talha Arslan	A SKEW-UNIT-NORMAL DISTRIBUTION AND ITS APPLICATIONS	128	Statistics and Its Applications
Oral	Seyma Tülüce Demiray, Ugur Bayrakçı, Ahmet Hakan Doğan	THE SOLUTIONS OF UNIDIRECTIONAL WAVE MODEL VIA IBSEFM	129	Applied Mathematics
Oral	Mehmet Ali Taşkıran, Tuğçem Partal	HYBRID AI-BASED MATHEMATICAL MODELING OF BREAST CANCER DYNAMICS	130	Applied Mathematics
Online	İrem Çakmak, Tuba Gulsen, Etibar S. Panakhov	A NUMERICAL STUDY OF RUNGE–KUTTA METHODS WITHIN THE FRAMEWORK OF GEOMETRIC MULTIPLICATIVE CALCULUS	131	Analysis and Its Applications
Online	Ayşe Deniz Birkan, Tuba Gulsen, Etibar S. Panakhov	MODELING MEMORY EFFECTS IN WATER DISTRIBUTION NETWORKS VIA FRACTIONAL CALCULUS	132	Analysis and Its Applications
Oral	Zuhal Kucukarslan Yuzbası	GEOMETRIC DYNAMICS OF SPIN CHAINS	133	Geometry and Its Applications
Oral	Gülsüm Şanal	FRACTIONAL LYAPUNOV STABILITY ANALYSIS AND STATISTICAL INFERENCE OF A FRACTIONAL STABILITY INDEX (FSI) FOR TIME-DYNAMIC RISK TRAJECTORIES	134	Applied Mathematics
Online	Ramazan Aykat, Faruk Düşünceli	NUMERICAL SOLUTION OF THE KORTEWEG-DE VRIES EQUATION USING CHEBYSHEV POLYNOMIAL-BASED ARTIFICIAL NEURAL NETWORKS	135	Applied Mathematics
Online	Pınar Kurulur, Faruk Düşünceli	"SOLVING LANE-EMDEN EQUATION THROUGH THE ELZAKI TRANSFORM METHOD"	136	Applied Mathematics
Online	Beytullah Yağız, Sinan Deniz, Yener Altun	A HYBRID METAHEURISTIC APPROACH FOR HYPERPARAMETER OPTIMIZATION OF MACHINE LEARNING MODELS	137	Applied Sciences

Online	Sinan Deniz, Beytullah Yağız, Yener Altun	INVESTIGATION OF DERIVATIVE-BASED AND DERIVATIVE-FREE OPTIMIZATION APPROACHES IN NONLINEAR PARAMETER ESTIMATION	138	Applied Sciences
Online	Sabri Gündüz, Faruk Düşünceli	NUMERICAL SOLUTION OF THE TELEGRAPH EQUATION USING ARTIFICIAL NEURAL NETWORKS	139	Applied Mathematics
Online	Gülden Altay Suroğlu, Ayşe Buğatekin, Yaşar Tatar, Esra Ölçücü	A MULTIPLICATIVE MODEL FOR TIMEDEPENDENT RESIDUAL LIMB VOLUME CHANGES USING FRUSTUM-BASED LAYER GEOMETRY	140	Geometry and Its Applications
Online	Gülden Altay Suroğlu, Şeyma Firdevs Hızal, Münevver Yıldırım Yılmaz, Hasan Bulut	"A CONFORMABLE FRENET FRAMEWORK FOR REGULARIZED FRACTAL FAULT CURVES"	141	Geometry and Its Applications
Online	Oktay Mukhtarov, Merve Yücel, Kadriye Aydemir	SOLUTION OF HELMHOLTZ EQUATION BY THE α-P DTM	142	Applied Mathematics
Online	Alper Döyen	A HYBRID FUZZY AHP-PROMETHEE II APPROACH FOR EVALUATING CUSTOMER SERVICE REPRESENTATIVES IN THE BANKING SECTOR	143	Applied Mathematics
Online	Emre Bayrak, Murat Işık, Engin Kocaman, Mustafa Safa Yılmaz, Bahattin Koç	EFFECT OF MILLING PARAMETERS ON SURFACE ROUGHNESS, HARDNESS, TENSILE STRENGTH AND MICROSTRUCTURE IN INCONEL 718 ALLOY PRODUCED BY ADDITIVE MANUFACTURING METHOD	144	Applied Mathematics
Online	Yasemin Turğut	MULTI SOLITON SOLUTIONS OF SAWADA KOTERA EQUATION	145	Applied Mathematics
Online	Ayşe Elhaman	TRAVELLING-WAVE SOLUTIONS OF HIROTA EQUATION	146	Applied Mathematics
Oral	Ebru Altunbağ	MULTI-TASK TRANSFORMER ARCHITECTURE FOR MULTI-ASSET FINANCIAL RISK AND RETURN FORECASTING: CONDITIONAL EFFICACY, NEGATIVE TRANSFER, AND EXPLAINABILITY ANALYSIS	147	Applied Mathematics
Online	Velat Karakeçi	MULTI SOLITON SOLUTIONS OF COMPLEX MKDV EQUATION	148	Applied Mathematics
Oral	Esra Pekönür, Sevilay Erdoğan Tutam, Mutlu Akar	SARDAR METHOD FOR SOLITON SOLUTIONS IN ANTI-CUBIC NONLINEAR MODEL	149	Applied Mathematics
Oral	Sevilay Erdoğan Tutam, Esra Pekönür, Mutlu Akar	EXACT SOLUTIONS OF FRACTIONAL BISWAS–MILOVIC EQUATION USING KUDRYASHOV METHODS	150	Applied Mathematics
Online	Fırat Korkmaz, Hatice Aslan	ON THE ADAPTATION OF SUMMABILITY METHODS TO SERIES WITH NONLINEAR FOURIER BASIS	151	Analysis and Its Applications
Online	Dilara Yapışkan, Cristiana J. Silva	DYNAMICAL ANALYSIS OF BRUCELLOSIS TRANSMISSION UNDER MULTIPLE TIME DELAYS	152	Mathematical Biology
Oral	Şükran Yalçın	SYMMETRY METHODS FOR ORDINARY DIFFERENTIAL EQUATION	153	Applied Mathematics
Online	Erkan Sancar, Erhan Pişkin	"NONEXISTENCE OF GLOBAL SOLUTIONS FOR THE WAVE EQUATION WITH FRACTIONAL TERM "	154	Applied Mathematics
Oral	Mst. Munny Khatun, M. Ali Akbar, Onur Alp İlhan	ANALYSIS OF THE OPTICAL SOLITON SOLUTIONS TO THE FRACTIONAL CUBIC-QUARTIC NONLINEAR SCHRODINGER EQUATION WITH PARABOLIC-LAW	156	Applied Mathematics
Oral	Duygu Dönmez Demir, Asuman Açık, Ali Konuralp	THE PELL-LUCAS COLLOCATION METHOD FOR HIGH-ORDER LINEAR DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS	158	Applied Mathematics

Online	**Yuusf Fatihu Hamza**	GAUSS-SEIDEL PROGRESSIVE ITERATIVE APPROXIMATION FOR CATMULL-CLARK SURFACES INTERPOLATION	160	Applied Mathematics
Online	**Asan Omuraliev, Ella Abylaeva**	"ASYMPTOTIC ANALYSIS OF THE CAUCHY PROBLEM FOR A SINGULARLY PERTURBED LINEAR SCALAR INTEGRO-DIFFERENTIAL EQUATION"	161	Applied Mathematics
Online	**Marcelo V. Flamarion**	SOLITON GAS IN NON-INTEGRABLE SYSTEMS	162	Applied Mathematics
Online	**Hatice Taskesen, Zehra Cabir**	LOCAL EXISTENCE FOR SOLUTIONS OF A DAMPED WAVE EQUATION OF VARIABLE COEFFICIENT	163	Applied Mathematics
Poster	**Gazmend Nafezi, Eros Halili, Mazllum Kamberi**	MONTE CARLO–BASED NUMERICAL VERIFICATION OF CLINICAL ELECTRON BEAM DOSIMETRY USING FLUKA	164	Numerical Methodsand Scientific Programming
Online	**Asif Pashayev**	GLOBAL EXISTENCE OF SOLUTIONS TO THE MIXED PROBLEM FOR A SYSTEM OF NONLINEAR PSEUDO-HYPERBOLIC EQUATIONS	165	Applied Mathematics
Online	**Rashad Mastaliyev, Khayala Alasgerova, Asif Pashayev**	ON THE OPTIMALITY OF SINGULAR CONTROLS IN AN OPTIMAL CONTROL PROBLEM DESCRIBED BY A SYSTEM OF STOCHASTIC NONLINEAR INTEGRO-DIFFERENTIAL EQUATIONS	166	Applied Mathematics
Oral	**Fahrettin Yakuphanoglu**	BEYOND THE INTEGER-ORDER REALITY: FRACTAL TIME-DYNAMICS OF SEMICONDUCTORS ENCODED VIA FYTRONIX HARDWARE-IN-THELOOP (HIL) MODELING	167	Applied Sciences
Oral	**Fahrettin Yakuphanoglu**	RECURSIVE SINGULARITY MAPPING: A DIVERGENT NUMERICAL PARADIGM FOR SYNCHRONOUS SIGNAL EVOLUTION IN SUBDECAMETRIC DEFENCE ELECTRONICS	168	Applied Sciences
Oral	**Fahrettin Yakuphanoglu**	NONLINEAR STOCHASTIC MAPPING AND ATTRACTOR STABILIZATION IN FYTRONIX NANOSTRUCTURED SOLAR SIMULATION SYSTEMS	169	Applied Sciences
Oral	**Aysegul Dere**	THE MEMORY OF MATTER: A FRACTIONAL ONTOGENY OF BIO-ORGANIC SENSING INTERFACES	170	Applied Sciences
Oral	**Aysegul Dere**	BEYOND LINEAR APPROXIMATION: MULTIPHYSICS NUMERICAL ARCHITECTURES FOR CAPTURING NON-EQUILIBRIUM OPTOELECTRONIC FLUX IN DISORDERED THINFILM TRANSISTORS	171	Applied Sciences
Poster	**Aysegul Dere**	SCULPTING THEVOID: THE TOPOLOGICAL NARRATIVE AND FRACTAL SOVEREIGNTY OF VACUUM-GROWN ATOMIC LANDSCAPES	172	Applied Sciences
Online	**Büşra Ceylan Kuzu, Yunus Güral**	SPARSE MODEL INFERENCE IN HIGH-DIMENSIONAL DATA: CORRELATION-SENSITIVE ADAPTIVE LASSO METHOD AND PERFORMANCE ANALYSIS	173	Statistics and Its Applications
Online	**Nurhan Dündar**	"THE PROPERTIES OF SOLUTIONS TO THE WEAKLY DISSIPATIVE MODIFIED CAMASSAHOLM EQUATION"	174	Applied Mathematics
Online	**Ebru Cavlak Aslan, Emine Şimşek**	EXACT SOLUTIONS OF A NONLINEAR COUPLED SYSTEM VIA EXTENDED HYPERBOLIC FUNCTION METHOD	175	Applied Mathematics
Online	**Soukaina Zayat, Dumitru Baleanu**	" DESIGNING ADVANCED NEURAL NETWORK ALGORITHMS FOR BIOLOGICAL MODELS "	176	Mathematical Biology
Online	**Özlem Akgümüş**	EXPLORING COMPLEX BEHAVIORS IN A REFUGE-BASED DISCRETE PREDATOR–PREY MODEL	177	Mathematical Biology
Oral	**Yasemin Demirel**	OPTIMIZING SEQUENTIAL DATA PROJECTIONS VIA NONPARAMETRIC ERROR CORRECTION: A COMPOSITE MODELING APPROACH	178	Artificial Intelligence

Online	**Yerra Shankar Rao, Kishan Kumar, Mehmet Yavuz, Binayak Dihudi**	FRACTIONAL-ORDER MODELING OF MALWARE SPREAD USING THE HOMOTOPY PERTURBATION METHOD	179	"Fractional Calculus and Applications"
Online	**Derya Arslan**	A SECOND-ORDER ACCURATE NUMERICAL SCHEME FOR SINGULARLY PERTURBED BOUNDARY LAYER PROBLEMS WITH ERROR ANALYSIS	180	Applied Mathematics
Online	**Beyza Billur İskender Eroğlu, Derya Avcı**	BOUNDARY CONTROL OF HEAT CONDUCTION UNDER THE FADING MEMORY EFFECT	181	Applied Mathematics
Online	**Aylin Yetim , Derya Avcı**	A NOVEL MODEL FOR THE DYNAMIC INTERACTION OF ADDICTION, UNEMPLOYMENT, AND CRIME	182	Applied Mathematics
Online	**Dumitru Baleanu**	ON MODIFIED FRACTIONAL OPERATOR WITH MITTAG-LEFFLER KERNEL	183	Applied Mathematics
Oral	**Binar Elmahmud, Durmuş Yarımpabuç, Özlem Öcal**	COMPARISON OF NUMERICAL SOLUTION METHODS IN TUMOR-IMMUNE INTERACTIONS	184	Applied Mathematics
Online	**Zehra Özdemir, Canan Yanilmaz, Emrah Yilmaz**	GOTTMAN-MURRAY PROBLEM ON BIGEOMETRIC MULTIPLICATIVE CALCULUS	185	Analysis and Its Applications
Online	**M. Sivabalan, A. Ashwin, Mehmet Yavuz, T. Nandha Gopal, T. Megala**	NONLINEAR DYNAMICS OF A PREDATOR-PREY MODEL WITH FEAR REFUGE MECHANISM AND PREY HARVESTING	186	Applied Mathematics
Oral	**Hakan Faik Er, Halit Orhan**	RELATIONSHIP BETWEEN UNIVALENT FUNCTIONS AND FRACTAL GEOMETRY	187	Geometry and Its Applications
Online	**Cihan Öksüz, Etibar Penahlı, Münevver Tuz**	Comparative Analysis of Exponential, Logistic, and Gompertz Tumor Growth Models and Mathematical Evaluation of the Treatment Effect	188	Applied Mathematics
Online	**Asan Omuraliev, Peyil Esengul kyzy**	ASYMPTOTIC ANALYSIS OF SINGULARLY PERTURBED VOLTERRA-TYPE INTEGRAL EQUATIONS	189	Applied Mathematics

A NUMERICAL METHOD TO THE SOLUTION OF THE INVERSE CAUCHY PROBLEM FOT THE PAULI EQUATION

Yusif Gasimov[1,2,3], Abdeljalil Nachaoui[4], Aynura Aliyeva[5]

[1]Azerbaijan University, Baku, Azerbaijan
[2]Institute of Physical Problems, Baku State University, Baku, Azerbaijan
[3]Institute of Mathematics, Baku, Azerbaijan
[4]Laboratoire de Mathématiques Jean Leray, Nantes Université, Nantes, France
[5]Sumgayit State University, Sumgayit, Azerbaijan

yusif.gasimov@au.edu.az, abdeljalil.nachaoui@univ-nantes.fr, aynura.aliyeva@sdu.edu.az

Abstract

This paper investigates the inverse Cauchy problem for the two-dimensional Pauli equation, which models the dynamics of a spin quantum particle in an external magnetic field. The problem involves reconstructing the unknown boundary condition on an inaccessible portion of the boundary from overdetermined data measured on the accessible part. By exploiting the diagonal structure of the Pauli operator and assuming a homogeneous magnetic field, the system decouples into two independent scalar equations. The problem is formulated on the unit square with homogeneous Dirichlet conditions on three sides and an unknown Robin-type condition on the remaining side. Using separation of variables, the solution is expressed as a Fourier series expansion involving the unknown boundary trace. Differentiation with respect to y and evaluation at the accessible boundary yields a Fredholm integral equation of the first kind for ϕ, with the measured data appearing on the right-hand side. The kernel involves an infinite series that decays rapidly, allowing truncation after a few terms. To stabilize the inversion, Lavrentiev regularization is applied, converting the ill-posed first-kind equation into a well-posed second-kind Fredholm equation with regularization parameter. The regularized equation is discretized using a Haar wavelet collocation method. Explicit analytical formulas are derived for all matrix entries, ensuring computational efficiency and accuracy. Numerical experiments demonstrate the method's performance for both single-mode and multi-mode solutions.

The explicit matrix entries derived from the Haar wavelet discretization avoid numerical quadrature, making the method computationally efficient and suitable for practical implementation.

Keywords: Inverse Cauchy problem; Pauli equation; Fredholm integral equation; Haar wavelet; Lavrentiev regularization; collocation method.

REFERENCES

1. C. Cattani and Y. Gasimov, The Schrödinger-Pauli equation in a finite square domain, *Mediterr. J. Math.*, 21(92), 2024.
2. A. Nachaoui, S. M. Rashid, and G. W. Sadiq, A mesh free wavelet method to solve the Cauchy problem for the Helmholtz equation, *Springer Proceedings in Mathematics & Statistics*, 428:77-98, 2023.

SOLITON SOLUTIONS OF THE LONGITUDINAL WAVE EQUATION IN A MAGNETO-ELECTRO-ELASTIC CIRCULAR ROD VIA KUDRYASHOV EXPANSION METHOD

Latifa Agamalieva[1,2], Ban Jamal Khalid Alsindi[3], Hasan Bulut[4]

[1]Azerbaijan University, Baku, Azerbaijan
[2]Institute for Physical Problems, Baku State University, Baku, Azerbaijan
[3]Duhok University, College of Basic Education, Duhok, Iraq
[4]Firat University, Department of Mathematics, Elazig, Turkiye

latifa.agamalieva@azuniv.edu.az, ban.alsindi@uoduhok.edu.iq, hbulut@firat.edu.tr

Abstract

In this paper, we investigate novel computational soliton solutions for the M-truncated longitudinal wave equation in a magneto-electro-elastic (MEE) circular rod. The governing equation models wave propagation in nonlinear systems and incorporates the M-truncated derivative, which preserves classical properties of fractional derivatives. By applying the Kudryashov expansion method (KEM) in conjunction with a traveling wave transformation, the nonlinear partial differential equation is reduced to an ordinary differential equation. The balancing principle yields the solution structure, and the auxiliary equation is employed to construct soliton solutions. New families of soliton solutions are successfully extracted and expressed in terms of topological, rational, exponential, trigonometric, and hyperbolic function structures. The obtained solutions exhibit diverse dynamic wave behaviors, including bright and dark solitons, depending on the choice of material and geometric parameters. The physical characteristics of these solutions are illustrated through three-dimensional and density profiles by selecting suitable parameter values. This study enhances the understanding of nonlinear wave phenomena in magneto-electro-elastic materials and demonstrates the efficiency of the Kudryashov expansion method for solving fractional nonlinear models arising in mathematical physics and engineering applications.

Keywords: M-truncated derivative; longitudinal wave equation; magneto-electro-elastic rod; Kudryashov expansion method; soliton solutions

REFERENCES

1. H.M. Baskonus, H. Bulut and A. Atangana, On the complex and hyperbolic structures of longitudinal wave equation in a magneto-electro-elastic circular rod, Smart Materials and Structures, Vol:25, No:3, 035022, 2016.
2. C.X. Xue, E. Pan and X.Y. Zhang, Solitary Waves in a Magneto-Electro-Elastic Circular Rod, Smart Materials and Structures, Vol:20, No:10, 035022, 2011.
3. J.V.D.C. Sousa and E.C. de Oliveira, A New Truncated M-Fractional Derivative Type Unifying Some Fractional Derivative Types with Classical Properties, International Journal of Analysis and Applications, Vol:16, No:1, 83-96, 2018.

Static and dynamic experimental measurements of Co thin films magnetocrystalline anisotropy constants

Ahmed Kharmouche

Laboratory of Surfaces and Interfaces Studies of Solid Materials (LESIMS), Department of Physics, Faculty of Technology, SETIF1 University Ferhat ABBAS, 19000, SETIF, ALGERIA

kharmouche_ahmed@univ-setif.dz & *kharmouche_ahmed@yahoo.fr*

We utilized thermal evaporation, beneath a pressure of 10^{-7}mbar, to synthesize thin films of cobalt on monocrystalline silicon substrates. The initial flux of atoms reaches the substrates under normal and oblique incidences. The layer thickness ranges from 20 to 400 nm. To explore the static magnetic properties, the hysteresis loops are achieved by means of Vibrating Sample Magnetometer (VSM) and Alternating Gradient Field Magnetometer (AGFM) tools and the zero-field magnetic structure has been investigated by Magnetic Force Microscopy (MFM), using a Veeco 3100 apparatus. To explore the dynamic magnetic properties, and particularly the magnetic anisotropy in Co/Si films, we utilized Brillouin Light Scattering (BLS) experiments, with a (2x3)–pass tandem Fabry-Perot interferometer, and Ferromagnetic Resonance (FMR) technique. These tools inferred that all the films are under stress and exhibit a hexagonal close packed (hcp) structure, with the <0001> texture. The easy magnetization axis is found to be in the plane of the film whatever is the thickness layer. Coercivity decreases as the thickness layer increases, following a t^{-n} Néel law, suggestive of Bloch domain motion. MFM images expose precise stripe patterns, chiefly for the thickest films. BLS measurements allowed to establish a satisfactory agreement between the experimental and the computed spectra. Uniaxial magnetocrystalline anisotropy constants K_u are computed using BLS as well as FMR tools. For the Co films produced under perpendicular incidence, the measured values of K_u are as high as 7 Merg.cm^{-3} and for the films produced obliquely, the uniaxial magnetocrystalline anisotropy constants jump to 13 Merg.cm^{-3}.

Keywords: XRD; VSM; BLS; FMR

REFERENCES

1. A Kharmouche, S-M Chérif, A Bourzami, A Layadi and G Schmerber, Structural and magnetic properties of evaporated Co/Si(100) and Co/glass thin Films, *J. Phys. D: Appl. Phys.* **37**, 2583–2587 (2004). http://dx.doi.org/10.1088/0022-3727/37/18/014

2. A. Kharmouche, Anisotropy Factors of Co-Based Thin Films Computed from FMR and AGFM Studies. *J Supercond Nov Magn* **30**, 3295–3299 (2017). https://doi.org/10.1007/s10948-016-3803-9

3. Kharmouche, A. An experimental study of the static magnetic properties of Co thin films. Eur. Phys. J. B **97**, 87 (2024). https://doi.org/10.1140/epjb/s10051-024-00729-w

Impact of Growth and Thermal Annealing in Oxygen and Nitrogen Atmospheres on the Properties of Terbium Oxide Thin Films for Advanced Semiconductor Applications

Abubakar A. Sifawa

Department of Physics, Sokoto State University, Sokoto 852101, SSU, Sokoto, Nigeria

aasifawa13@gmail.com,

Abstract

This study investigates the impact of post-deposition annealing in oxygen (O_2) and nitrogen (N_2) environments on the structural and surface properties of RF-sputtered Tb_4O_7 thin films on silicon (Si). Samples were annealed at 500 °C and compared with an unannealed (standard) sample. GIXRD results show that annealing enhances crystallinity and grain growth while retaining the cubic Tb_4O_7 phase, with crystallite sizes increasing from 10.97 nm (standard) to 17.26 nm (O_2-annealed) and 25.86 nm (N_2-annealed). FESEM images confirm substantial grain growth, especially in the N_2-annealed film, which displays the largest and most uniform grains with a smooth, void-free surface. AFM measurements further support this trend, showing RMS roughness decreasing from 1.91 nm (standard) to 1.58 nm (N_2) and 0.98 nm (O_2). EDX analysis verifies the presence of Tb, O, and Si, with the N_2-annealed film having the highest oxygen concentration (22.87 at%), while the O_2-annealed film shows a lower value (15.79 at%) due to oxygen diffusion toward the interface. Overall, N_2 annealing yields the most uniform, defect-free Tb_4O_7 films, making it the most promising route for high-quality Si-based semiconductor applications.

Keywords: GIXRD pattern; post-deposition annealing; surface properties.

REFERENCES

1. Abed, S. M., Mohammad, S. M., Hassan, Z., Shahrier, M. R., Abubakar A. S, Improvement of UV photodetector performance through coating Si nanowires with Au nanoparticle-decorated ZnO thin film. *AIP Conference Proceedings*, Vol: 3310, No: 1, 070004, 2025.
2. Bai, X. M., Voter, A. F., Hoagland, R. G., Nastasi, M., & Uberuaga, B. P, Efficient annealing of radiation damage near grain boundaries via interstitial emission. *Science*, Vol: 327, No: 5973, 1631–1634, 2010.

Neural network process for model of infectious disease transmission system

Hikmet Kemaloğlu, Baran Bahtiyar

[1] Department of Mathematics, University of Firat, Elazig, Turkey

hkoyunbakan@gmail.com, brnbhtyr2121@gmail.com

Abstract

In this study, by considering an infectious disease model given below, we discuss the role of both personal and medical measures in preventing or reducing the spread of the infectious disease. The population has been divided into those exposed, infected, vaccinated, contracting the infection, and recovering from the disease. It can be confirmed that some individuals in the exposed group do not contract the virus by certain personal strategies. Health policies can also be developed and predictions can be made regarding the potential spread of the disease by using of data from the infected section. The presence of each component in the model discussed highlights the importance of medical and personal measures in controlling the spread of infectious diseases. When we do not consider some parts of the population, such as those vaccinated, we can not examine the effect of the vaccine on disease spread. We present the results by using artifical neural network method. The total population N is divided into seven epidemiological subgroups such as susceptible (S), exposed (E), infected (I), quarantined (Q), recovered (R), dead (D), and vaccinated (V) individuals [1-3].

Keywords: Neural network ; infectious disease; Activation function

REFERENCES

1. Sabir, Z., Sadat, R., Ali, M.R., Said, S.B. and Azhar, M., 2023. A numerical performance of the novel fractional water pollution model through the Levenberg-Marquardt backpropagation method. Arabian Journal of Chemistry, 16(2), p.104493
2. Sabir, Z., Botmart, T., Raja, M.A.Z., Sadat, R., Ali, M.R., Alsulami, A.A. and Alghamdi, A., 2022. Artificial neural network scheme to solve the nonlinear influenza disease model. Biomedical Signal Processing and Control, 75, p.103594.
3. Siettos, C.I. and Russo, L., 2013. Mathematical modeling of infectious disease dynamics. Virulence, 4(4), pp.295-306

An artificial deep neural network approach for mathematical model

Hikmet Kemaloğlu, Asaad Bakar

[1] Department of Mathematics, University of Firat, Elazig, Turkey

hkoyunbakan@gmail.com, asaadkh998@gmail.com

Abstract

In recent years, mathematical studies on modelling waterborne diseases have not only investigated the transmission processes, but also the impact of environmental factors on disease dynamics. Environmental pollution, including air, water and soil pollution, is one of the leading causes of death worldwide. In this study, we consider a nonlinear system of differential equations consisting of four state variables that characterize the dynamics of the proposed model. The numerical solution of this nonlinear system is obtained through an artificial neural network–based computational scheme. Furthermore, the geometric interpretation of the obtained results is provided in order to analyze the qualitative behavior and dynamical structure of the system [1-4].

Keywords: Waterborne Pathogen; Artificial Neural network; Activation function

REFERENCES

1. Auld, H., MacIver, D., Klaassen, J., 2004. Heavy rainfall and waterborne disease outbreaks: theWalkerton example. J. Toxicol. Environ. Health A 67, 1879–1887.
2. Sabir, Z., Sadat, R., Ali, M.R., Said, S.B. and Azhar, M., 2023. A numerical performance of the novel fractional water pollution model through the Levenberg-Marquardt backpropagation method. Arabian Journal of Chemistry, 16(2), p.104493
3. Sabir, Z., Botmart, T., Raja, M.A.Z., Sadat, R., Ali, M.R., Alsulami, A.A. and Alghamdi, A., 2022. Artificial neural network scheme to solve the nonlinear influenza disease model. Biomedical Signal Processing and Control, 75, p.103594.
4. Sabir,Z., Nazzal, A. Srour, A., Koyunbakan,H., Bhatti,S., 2025 A machine learning radial basis deep neural network procedure for the solutions of the nonlinear breast cancer model, Int. J. Model. Simul. Sci. Comput. 2550035.

AN EXTRACTION OF A NOVEL SOLITON SOLUTIONS OF THE NONLINEAR MATHEMATICAL MODEL

Esin Ilhan[1]

[1]Faculty of Engineering and Architecture, Kirsehir Ahi Evran University, Kirsehir, Turkey

eilhan@ahievran.edu.tr

Abstract

We construct new computational soliton solutions for the Zakharov–Kuznetsov equation (mZKE), which are represented by topological, rational, exponential, trigonometric, and hyperbolic functions on the other hand. For the purpose of deriving various dynamical wave structures of soliton solutions within the framework of evolutionary dynamical structures of solitary wave solutions, the extended rational sinh-Gordon equation approach (ERSGEA) is utilized. This method provides an effective strategy for implementing the strategy. In order to demonstrate a solution, permissible parameter selections are allowed. The physical behavior of these solutions is empirically illustrated in order to improve the understanding of the physical events that are linked with the dynamical models that are used in mathematical physics.

***Keywords*:** Zakharov–Kuznetsov equation, the extended rational sinh-Gordon equation, soliton solutions.

REFERENCES

1. Yu R., Expansion of a compressible non-barotropic fluid in vacuum, Math Methods Appl Sci, Vol:44, No:5, 3521–3526, 2021.
2. Zhang Z., Energy conservation for the weak solutions to the ideal inhomogeneous magnetohydrodynamic equations in a bounded domain, Nonlinear Anal Real, Vol:63, Article 103397, 2022.
3. Sharma V.D., Radha R., Exact solutions of Euler equations of ideal gasdynamics via Lie group analysis, Z Angew Math Phys, Vol:59, No:6, 1029–1038, 2008.
4. Rogers C., Shadwick W.F., Bäcklund Transformations and Their Applications, Academic Press, New York, 1982.
5. Adeyemo O.D., Motsepa T., Khalique C.M., A study of the generalized nonlinear advection diffusion equation arising in engineering sciences, Alexandria Eng J, Vol:61, 185–194, 2022.
6. Zhang L., Khalique C.M., Classification and bifurcation of a class of second-order ODEs and its application to nonlinear PDEs, Discrete Cont Dyn S, Vol:11, 777–790, 2018.
7. Morrison P.J., Meiss J.D., Carey J.R., Scattering of regularized long-waves, Phys D, Vol:11, 324–336, 1984.
8. Kudryashov N.A., Analytical Theory of Nonlinear Differential Equations, Institute of Computer Investigations, Moscow, 2004.
9. Fan E.G., Yuen M., Similarity reductions and new nonlinear exact solutions for the 2D incompressible Euler equations, Phys Lett A, Vol:378, No:7–8, 623–626, 2014.
10. Feireisl E., Gwiazda P., Swierczewska-Gwiazda A., et al., Regularity and energy conservation for the compressible Euler equations, Arch Ration Mech Anal, Vol:223, No:3, 1375–1395, 2017.

ANALYTICAL STRUCTURES AND CONSERVATION LAWS OF THE (2+1)-DIMENSIONAL CUBIC KLEIN-GORDON EQUATION

Esin İlhan [1]

[1]Faculty of Engineering and Architecture, Kirsehir Ahi Evran University, 40500, Kirsehir, Turkey

eilhan@ahievran.edu.tr

Abstract

The (2+1) cubic Klein-Gordon equation is used in a wide range of disciplines, including river floods, tsunami wave propagation, breakwater construction and management, dam-break scenarios, coastal engineering, and many phenomena in physical oceanography. The goal of this study is to establish wave solutions using the extended rational sine-cosine and sinh-cosh techniques (ERSC). The provided approaches enable the construction of a variety of novel solutions with distinct forms. The solutions are closely tied to physical characteristics, with particular wave-form features that appear under certain conditions. Furthermore, the new conservation theorem is applied to systematically deduce conservation laws from Lie-point symmetry. Graphical representations in two- and three-dimensional formats are plotted to demonstrate the propagation of selected exact solutions that include a variety of parameter values.

Keywords: The extended rational sine-cosine and sinh-cosh methods; Analytical solutions; M-truncated derivative, Lie-backlund symmetries; Conservation laws.

REFERENCES

1. K.M. Abdul-Al-Woaduda, Md.J. Islam, D. Kumar, A.R. Khan, Analytical solutions to the (2+1)-dimensional cubic Klein-Gordon equation in the presence of fractional derivatives: A comparative study, Partial Differential Equations in Applied Mathematics, Vol:12, 101001, 2024.
2. K. Khan, M.A. Akbar, Exact solutions of the (2+1)-dimensional cubic Klein–Gordon equation and the (3+1)-dimensional Zakharov-Kuznetsov equation using the modified simple equation method, Journal of the Association of Arab Universities for Basic and Applied Sciences, Vol:15, 74-81, 2014.
3. Hghg G. Wang, K. Fakhar, Lie symmetry analysis, nonlinear self-adjointness and conservation laws to an extended (2+1) dimensional Zakharov-kuznetsov- Burgers equation, Comp. Fluids ,Vol:119, 143-148, 2016.

The extended rational sine-cosine and sinh-cosh methods applied to the nonlinear complex systems

Arif Ozkul[1], Oznur Engin[2], Hasan Bulut[1]

[1]Department of Mathematics, Firat University, Elazig, Turkey

[2]Clean Energy Technologies Institute, Yıldız Technical University, İstanbul, Turkey

arifozkul@gmail.com; oznur@yildiz.edu.tr; hbulut@firat.edu.tr

Abstract

We establish novel computational soliton solutions for the system of nonlinear complex equations. These solutions are represented by periodic, singular periodic, trigonometric, and hyperbolic functions. Within the context of evolutionary dynamical structures of solitary wave solutions, the extended rational sinh-cosh is utilized to derive a variety of dynamical wave structures of soliton solutions. This is done in order to put the effective method into action. When attempting to demonstrate a solution, permissible parameter selections are granted permission. In the field of mathematical physics, the physical behavior of these solutions is empirically illustrated in order to improve the understanding of the physical events that are linked with these dynamical models.

Keywords: nonlinear systems of complex equations, the extended rational sinh-cosh, soliton solutions.

References

[1] D'aprile, T. Semiclassical states for the nonlinear Schrödinger equation with the electromagnetic field. Nonlinear Differential Equations and Applications NoDEA, 13(5), 655-681 (2007)

[2] Jiang, T., Guo, Z., Zhang, D., Vasil'ev, V.I.: A fast algorithm for the Schrodinger equation in quaternionic quantum mechanics. Appl. Math. Lett. 150, 108975 (2024)

[3] Nagasawa, M.: Schr¨odinger Equations and Diffusion Theory. Birkh¨auser (1993)

[4] Abdikian, A., Tamang, J., Saha, A.: Electron-acoustic supernonlinear waves and their multistability in the framework of the nonlinear Schr¨odinger equation. Commun. Theor. Phys. 72(7), 075502 (2020)

[5] B Kopçasız, FNK Sağlam, H Bulut, T Radwan. Exploration of the soliton solutions of the (n+1) dimensional generalized Kadomstev Petviashvili equation using an innovative approach. Scientific Reports 15 (1), 14542

[6] A Alkan, H Bulut, T Aktürk, Ö ENGİN, N Güllüoğlu. Analysis of nonlinear partial differential equation of traveling wave solutions with an effective method. Sigma 43 (2), 487-494

TRANSONIC FLOW INSTABILITY OVER AIRFOILS AT SMALL DEPLOYMENTS OF A SPOILER

Alexander Kuzmin [1]

[1] Department of Fluid Dynamics, St. Petersburg State University, St. Petersburg, Russia

a.kuzmin@spbu.ru,

Abstract

A deployment of the spoiler modifies the wing profile (airfoil) in such a way that its curvature becomes small or negative in a vicinity of the spoiler hinge point. In [1, 2], it was shown that profiles comprising arcs of small curvature provoke formation of local supersonic regions, whose coalescence/rupture occurs abruptly and produces flow instability. This concept was used in a numerical study of the turbulent transonic flow over the NASA SC(2)-0710 airfoil with a deployed spoiler [3]. In particular, at the spoiler deflection angle θ=3°, computations showed a high sensitivity of the lift to small perturbations at negative angles of attack α .

In the present paper, we perform numerical study of transonic flow over the NASA SC(2)-0710 airfoil, focusing on the spoiler deflection angle θ=4.5°. Solutions of the Reynolds-averaged Navier-Stokes equations are obtained with a finite-volume solver on fine computational meshes. The solutions reveal an intricate dependence of the lift coefficient on the angle of attack α and freestream Mach number M_∞. A high sensitivity of the flow to small perturbations in the bands $0.825 \le M_\infty \le 0.875$, $0° \le \alpha \le 0.3°$ is demonstrated. A physical interpretation of the sensitivity is suggested.

Also, we study transonic flow over a NACA 0012 airfoil with the same spoiler and discuss a few distinctions in the behavior of lift coefficient as compared to the one for NASA SC(2)-0710 airfoil.

Results of this study demonstrate the existence of adverse values of θ, M_∞, and α, at which slight gusts or turbulence of atmosphere can cause significant fluctuations in the wing lift and, consequently, severe vibrations of aircraft in cruise flight.

Keywords: Numerical simulation; Transonic flow; Shock wave instability.

REFERENCES

1. Hafez M., Guo W., Some anomalies of the numerical solutions of shock waves, part II: Effect of artificial and real viscosity, Computers and Fluids, Vol: 28, 721–739, 1999.
2. Kuzmin A., Non-unique transonic flows over airfoils, Computers and Fluids, Vol:63, 1–8, 2012.
3. Kuzmin A., Sensitivity analysis of transonic flow past a NASA airfoil/wing with spoiler deployments, Internat. J. of Aeronautical and Space Sciences, Vol:15, No:3, 232–240, 2014.

DESIGNING AN IN-PLANT LOGISTICS SYSTEM TO REDUCE WORK-IN-PROCESS: A MILK-RUN APPLICATION IN A MACHINING LINE

Fatma Kaymaz Karahan[1]

[1] Engineering Management Master's Program with Thesis, Graduate Education Institute, İstanbul Sabahattin Zaim University, İstanbul, Türkiye

524125002@std.izu.edu.tr

Doğan Şengül [2]

[2] Department of Software Engineering, Faculty of Engineering and Natural Sciences, İstanbul Sabahattin Zaim University, İstanbul, Türkiye

dogan.sengul@izu.edu.tr

Abstract

Excessive inventory of Work-In-Process (WIP) in manufacturing systems wastes time, hides production constraints, and increases costs. This paper addresses the logistical problems associated with a machining facility that accumulates large amounts of intermediate stock. To solve this, the study proposes a transition from a traditional "push" based manufacturing system to a "pull" based milk run logistics model. The paper describes the design phase of the logistics system, which includes the determination of optimal quantities for each lot, the design of customized transport carts and pallets, and the choice of equipment used to tow them. Additionally, the methods used to determine the most efficient routes and to synchronize the frequency of deliveries to meet the needs of the production line are presented. Ultimately, by providing a formal structure to design in-plant logistic systems, this research demonstrates the feasibility of reducing waste and optimizing the flow of materials in the manufacturing supply chain prior to full-scale implementation.

Keywords: Process Improvement; In-plant milk-run; In-plant logistics; Work-in-Process (WIP); Machining; Lean.

REFERENCES

1. Kilic, H. S., Durmusoglu, M. B., & Baskak, M.. (2012). Classification and modeling for in-plant milk-run distribution systems. *The International Journal of Advanced Manufacturing Technology*, *62*(9-12), 1135–1146. https://doi.org/10.1007/s00170-011-3875-4.

Asymptotic Stability Analysis for Second-Order Nonlinear Stochastic Integro–Delay Differential Equations

Zozan OKTAN[1]

[1] Department of Mathematics, Van Yuzuncu Yil University, Van, Turkey

zozanoktan34@gmail.com,

Cemil TUNÇ[2]

[2]School of Engineering and Natural Sciences, İstanbul Medipol University, 34810, Istanbul, Turkey

cemiltunc@medipol.edu.tr,

Abstract

This paper studies the stochastic stability and boundedness of solutions to third-order nonlinear stochastic delay differential equations with variable delays using the Lyapunov–Krasovskii functional approach. Two new theorems establishing these qualitative properties are obtained. Furthermore, two examples are provided to illustrate the applicability of the theoretical results. The results presented here extend and generalize several existing contributions in the literature.

Acknowledgment: This work was supported by TÜBİTAK through the 2211-A National PhD Scholarship Program.

Keywords: SIDDE, stability in probability, multiple constant delays, second order, L-KF.

References

[1] Abou-El-Ela, A. M.A. Sadek, A. I., Mahmoud, A. M. and Taie, R.O.A., On the stochastic stability and boundedness of solutions for stochastic delay differential equation of the second order, Chin.J. Math. Art. ID 358936, 8 PP, 2015.

[2] Mao, X., *Stochastic differential equations and applications*. Elsevier, 2007.

[3] Tunç, C., Oktan, Z., Improved new qualitative results on stochastic delay differential equations of second order. *Comput. Methods Differ. Equ.* 12(1),67-76, 2024. https://doi.org/10.22034/cmde.2022.52821.2229

Stability and Boundedness Analysis of Third-Order Nonlinear Stochastic Differential Equations with Delay

Zozan OKTAN[1]

[1] Department of Mathematics, Van Yuzuncu Yil University, Van, Turkey

zozanoktan34@gmail.com,

Cemil TUNÇ[2]

[2] School of Engineering and Natural Sciences, İstanbul Medipol University,34810, İstanbul, Turkey

cemiltunc@medipol.edu.tr,

Abstract

This study investigates the stochastic stability and boundedness of solutions to third-order nonlinear stochastic delay differential equations with variable delays by means of the Lyapunov–Krasovskii functional approach. Two new theorems establishing these qualitative properties are derived. Moreover, two illustrative examples are presented to demonstrate the applicability of the proposed results. The obtained results extend and generalize several related findings available in the literature.

Acknowledgment: This work was supported by TÜBİTAK through the 2211-A National PhD Scholarship Program.

Keywords: SDDE, stability in probability, boundedness in probability, variable delay, third-order, L-KF.

References

[1] Mahmoud, A. M., Bakhit, D. A. M. Study of the stability behaviour and the boundedness of solutions to a certain third-order differential equation with a retarded argument. *Annals of. Applied Mathematics* 35.1 99-110, 2019.

[2] Mao, X., *Stochastic differential equations and applications*. Elsevier, 2007.

[3] Oktan, Z., Tunç, C., Asymptotic stability and uniform boundedness of third-order stochastic delay differential equations. Applied Analysis and Optimization. 9 (2025), no.2, 1-18, 2025.

Solitary wave solutions and modulation instability of the Schrodinger equation with mixed derivative and amplitude dependent term

Ban Jamal Khalid Alsindi[1], Arif Özkul[2], Hasan Bulut[2]

[1]University of Duhok, College of Basic Education, Iraq

[2]Department of Mathematics, Faculty of Science, Firat University, Elazig, Turkey

Abstract

This study examines the resonant nonlinear Schrödinger equation (RNLSE), which represents the fluid modeling and propagation dynamics of optical solitons, and includes both an equation with mixed derivatives and an amplitude-dependent term. To get the solitary-wave solution to the governing equation, we use the generalized projective-Riccati equation approach (GPRE). Kerr law nonlinearity is used to study the given equation. We obtain solutions for combined bright-dark, singular, and periodic solitons. These solitons are guaranteed to exist by the constraint requirements that arise from the solution structure. We examine the governing equation's modulation instability (MI) study. MI is a basic process in nonlinear dispersive media where a wave with a constant amplitude becomes unstable to perturbations of long wavelengths.

Keywords: Solitary wave solutions, Kerr law, generalized projective-Ricatti equation method, modulation instability.

References

[1] P.~G. Drazin and R.~S. Johnson, \emph{Solitons: An Introduction}, Cambridge University Press, 1989.

[2] M.~J. Ablowitz, \emph{Nonlinear Dispersive Waves: Asymptotic Analysis and Solitons}, Cambridge University Press, 2011.

[3] D.~J. Korteweg and G.~de~Vries, ``On the change of form of long waves advancing in a rectangular canal, and on a new type of long stationary waves,'' \emph{Philosophical Magazine}, vol.~39, pp.~422--443, 1895.

[4] Iqbal, M., Seadawy, A. R., Lu, D., \& Zhang, Z. (2024). Multiple optical soliton solutions for wave propagation in nonlinear low-pass electrical transmission lines under analytical approach. Optical and Quantum Electronics, 56(1), 35.

[5] Younas, U., Ismael, H. F., Sulaiman, T. A., \& Yusuf, A. (2024). Dynamics of M-truncated optical solitons in fiber optics governed by fractional dynamical system. Optical and Quantum Electronics, 56(1), 25.

[6] Murad, M. A. S., Ismael, H. F., Sulaiman, T. A., \& Bulut, H. (2024). Analysis of optical solutions of higher-order nonlinear Schrödinger equation by the new Kudryashov and Bernoulli's equation approaches. Optical and Quantum Electronics, 56(1), 76.

New Wave Structures Of A Nonlinear Physical Model

Tukur Abdulkadir Sulaiman[1] **, Hanife Kalka**[1] **, Mehtap Guneri**[1] **, Hasan Bulut**[1]

[1] Department of Mathematics, University of Firat, Elazig, Turkiye

Abstract

This study derives new wave structures for the Zakharov–Kuznetsov equation (mZKE), including rational mixed topological and non-topological solitons as well as mixed singular solitons. By employing the rational extended sinh–Gordon expansion method, various dynamical wave structures of soliton solutions are obtained within the framework of nonlinear evolution equations. Appropriate parameter choices are considered to illustrate the existence of these solutions. Furthermore, the physical behaviors of the obtained solutions are graphically illustrated to enhance the understanding of the underlying physical phenomena in mathematical physics.

Keywords: Zakharov–Kuznetsov equation; soliton solutions; Topological; Non-topological

REFERENCES

1. R. Yu, Expansion of a compressible non-barotropic fluid in vacuum. Math Methods Appl Sci, 44(5) 3521-3526 (2021)
2. Z. Zhang, Energy conservation for the weak solutions to the ideal inhomogeneous magnetohydrodynamic equations in a bounded domain. Nonlinear Anal Real, 63, 103397 (2022)
3. V.D. Sharma, R. Radha, Exact solutions of Euler equations of ideal gasdynamics via Lie group analysis. Z Angew Math Phys, 59(6), 1029-1038 (2008)
4. C. Rogers, W.F. Shadwick, B¨acklund Transformations and Their Applications; Mathematics in Science and Engineering Series; Academic Press: New York, NY, USA, 1982

Stochastic insights into cystic echinococcosis control to break the transmission cycle

SANNAKY Ibtissam[1]

EL BERRAI Imane[1]

ADNAOUI Khalid[1]

[1] Department of Analysis, Modeling and Simulation, Faculty of Sciences Ben M'sick, Casablanca, Morocco

bissamsannaky@gmail.com,

Abstract

Cystic Echinococcosis is a neglected parasitic zoonotic disease that involves a complicated multi-host transmission cycle between accidental, definitive, and intermediate hosts[1]. The global burden of this disease necessitates robust control strategies to mitigate transmission; however, the current prevention methods remain elusive due to a limited understanding of the disease dynamics[2].

In this paper, we present a deterministic model of eight differential equations describing the evolution of CE among humans, dogs, livestock, infected carcasses, and *E.granulosus* parasitic eggs[3], which we develop to a continuous-time Markov chain model, to understand the behavior of the disease among humans, dogs, and livestock, we analyze the two models and we give important properties about the equilibrium and their stability. Then we formulate a five-type Branching process to derive the extinction and outbreak probabilities. Our findings reveal that the main cause of the persistence of the disease depends primarily on the livestock-carcasses-dog cycle, not the direct dog-to-human transmission. Humans are dead-end hosts, and they do not contribute to the transmission cycle of the disease.

Our models show that managing infected carcasses and controlling dog access are key intervention points that can lead to disease extinction, especially for small outbreaks, but for larger ones, combined strategies are needed. This provides clear guidance for control programs.

Keywords: Cystic Echinococcosis, Multitype Branching Process, CTMC model, Control

[1] Cardona et Carmena, A Review of the Global Prevalence, Molecular Epidemiology and Economics of Cystic Echinococcosis in Production Animals, Veterinary Parasitology 192 (2013) 10–32.
[2] Widdicombe, Cystic Echinococcosis Control in South America, PhD thesis.
[3] Sannaky, I., Riouali, M., Ouldkhouia, N., El berrai, I. and Adnaoui, K., Math-ematical modeling of Echinococcosis in humans, dogs and livestock with optimalcontrol strategies. Iran. J. Numer. Anal. Optim., 2025; 15(3): 1075-1115.https://doi.org/10.22067/ijnao.2025.90038.1530

NUMERICAL SOLUTION OF THE GENERALIZED EQUAL WIDTH WAVE (GEW) EQUATION USING THE CRANK-NICOLSON FINITE DIFFERENCE SCHEME WITH OPERATOR SPLITTING TECHNIQUE

Melike Karta[1] **and Nimet Tanır**[1]

[1] Department of Mathematics, Faculty of Science, Ağrı İbrahim Çeçen University, Ağrı, Turkey

mkarta@agri.edu.tr, nimettanir@gmail.com

Abstract

The generalized equal-width wave (GEW) equation is used as an important tool in modeling unidirectional, nonlinear wave motions encountered in many physical fields such as shallow water waves, plasma physics and optics. In this study, the Crank-Nicolson finite difference scheme is used to numerically solve the Generalized Equal Width Wave (GEW) equation through the Rubin-Graves linearization technique using the operator splitting technique. Two test problems—the motion of a single solitary wave and the interaction of two solitary waves—are examined in order to bolster our work. The outcomes are contrasted with other numerical solutions that have been published in the literature. By calculating the numerical conserved laws and L_2 and L_∞ error norms, the accuracy of the suggested method is examined. The method is unconditionally stable, according to a linear stability analysis of the approximation produced by the scheme.

Keywords: GEW equation , Operatör splitting technique, Crank-Nicolson finite difference.

REFERENCES

1. **Evans, D. J., Raslan, K. R**. The accurate numerical solution of the generalized equal width wave equation by using a B-spline method. Mathematics and Computers in Simulation, 70(1), 16–26, (2005).

2. **Karta M.** A numerical algorithm for solitary wave solutions of the GEW equation, Afrika Matematika, 34:90. 2-16, (2023)

3. **Nasir, M. J., Haq, S., Abbas, M., Iqbal, A.** Numerical solutions of generalized equal width equation using sextic B-spline collocation method. Alexandria Engineering Journal, 62, 501–512, (2023).

NUMERİCAL SOLUTİON OF THE 1-DİMENSİONAL BENJAMİN-BONA-MAHONY-BURGERS EQUATİON USİNG A DİSCRETE APPROXİMATİON METHOD WİTH OPERATOR SPLİTTİNG TECHNİQUE

Melike Karta[1] **and Kadriye Nazlıaydın**[1]

[1] Department of Mathematics, Faculty of Science, Ağrı İbrahim Çeçen University, Ağrı, Turkey

mkarta@agri.edu.tr, kadriyenazliaydin@gmail.com

Abstract

In this research, a new method combining the Crank-Nicolson method with operator splitting techniques has been developed for the numerical solution of the BBM-Burgers equation. This problem are divided into two sub-equations, one linear and one nonlinear. Operator splitting, combined with the Crank-Nicolson finite difference method, was applied to these equations. Two test problems with initial and boundary conditions are considered for the numerical solution of the 1-dimensional homogeneous BBM-Burgers equation. To investigate the accuracy and efficiency of the numerical solution, the error norms L_2 and L_∞ and conservation quantities are evaluated through comprehensive analyses. When the results of the proposed approach are compared with other numerical methods in the literature, it is concluded that it will capture wave profiles and structures more accurately, reduce error norms, and improve processing time.

Keywords: BBM-Burgers equation , Operatör splitting technique, Crank-Nicolson finite difference.

REFERENCES

1. **Arora S, Jain R, Kukreja V.K.** Solution of Benjamin-Bona-Mahony-Burgers equation using collocation method with quintic Hermite splines. Applied Numerical Mathematics 154: 1–16, 2020.

2. **Kata,M.** Numerical solution for Benjamin-Bona-Mahony-Burgers equation with Strang time-splitting technique. Turkish Journal of Mathematics 47: 537 – 553, 2023.

3. **Kutluay S, Esen A.** A finite difference solution of the regularized long wave equation. Mathematical Problems in Engineering ,1-14, 2006. DOI: 10.1155/MPE/2006/85743

STRICT MITTAG-LEFFLER STABILITY OF FRACTIONAL UNPERTURBED SYSTEMS WITH INITIAL TIME DIFFERENCE

Coşkun Yakar[1], Dilara Karslıoğlu[2]

[1] Department of Mathematics, University of Gebze Technical, Kocaeli,Turkey

cyakar@gtu.edu.tr, dilarakarslioglu@gmail.com,

Abstract

This paper examines the strict Mittag-Leffler stability of fractional unperturbed systems whose solutions begin at distinct initial times. The analysis is developed within the Caputo fractional derivative setting and relies on a refined variation-of-parameters approach to capture the influence of the initial time difference on stability behavior. Our results show that even minor shifts in the starting instant can significantly alter the asymptotic properties of fractional dynamics. The derived stability criteria strengthen existing Mittag-Leffler–type theories and extend them to a broader class of unperturbed systems incorporating initial time differences. Several examples are included to validate the theoretical findings and to highlight the accuracy and applicability of the proposed framework.

Keywords: Fractional differential systems; Mittag-Leffler stability; Initial time difference; unperturbed systems; Caputo derivative; Lyapunov functional

REFERENCES

1. Li Y, Chen YQ, Podlubny I, Mittag–Leffler stability of fractional order nonlinear dynamic systems, Automatica, 45, 1965-1969, 2009.

*Abstract Submission should be prepared only **1 page**.

Wavelet-Based Nonlinear Dynamic Modeling of Seawater Fraction in Coastal Aquifers

Sani I. Abba[1]

[1] Department of Civil Engineering, Prince Mohammad Bin Fahd University, Al Khobar, 31952, Saudi Arabia

sabba@pmu.edu.sa,

Abstract

Accurate estimation of seawater fraction (fsea) is essential for characterizing seawater intrusion in coastal aquifers, particularly in arid regions. This study proposes a wavelet-based nonlinear dynamic modeling framework to estimate fsea using experimentally measured hydrochemical data. The dataset consists of several groundwater samples with pH, electrical conductivity (EC), Ca^{2+}, Mg^{2+}, HCO_3^-, F^-, NO_3^-, and SO_4^{2-} as input variables and fsea as the output. The proposed framework is applied to a coastal aquifer system in Saudi Arabia, addressing a critical seawater intrusion problem associated with intensive groundwater abstraction in arid coastal environments. Multiple Hammerstein–Wiener nonlinear system identification models with different wavelet-network configurations were developed and evaluated. The models integrate wavelet-based input and output nonlinearities with a dynamic linear block to capture the complex, nonlinear mixing behavior between seawater and freshwater. Model parameters were estimated in the time domain using a Gauss–Newton line search algorithm. Comparative analysis showed consistent predictive performance across model structures, with the best-performing configuration achieving a fit of 75.1%, while alternative configurations yielded comparable fits in the range of 74.6–74.8%. The results demonstrate that wavelet-based nonlinear dynamic modeling provides a robust and computationally efficient approach for seawater fraction estimation, even under limited data conditions. The proposed framework is well suited for seawater intrusion assessment in coastal aquifers and highlights the reliability of wavelet-enhanced Hammerstein–Wiener models for hydrogeochemical system identification.

Keywords: Saudi Arabia, Seawater fraction, Coastal aquifers, Nonlinear dynamic modeling, System identification

Growth and Derivative Estimates of Algebraic Polynomials in the Complex Plane

Gülnihal Demir[1] – Pelin Özkartepe[2]

gulnihalkodaz@hotmail.com

Department of Mathematics, University of Gaziantep, Turkey

Abstract. This paper is devoted to the study of growth and derivative estimates for algebraic polynomials in the complex plane. We establish quantitative upper bounds for polynomial derivatives in terms of the polynomial norm on compact subsets with prescribed geometric properties. Under suitable regularity assumptions on the boundary, Bernstein–Walsh type inequalities are applied to obtain sharp estimates. The obtained results extend and refine several known inequalities and highlight the influence of boundary geometry on the growth behavior of polynomial derivatives.

Main Result. Let $\Omega \subset \mathbb{C}$ be a bounded domain whose boundary contains finitely many singular points of various types, including nonzero exterior angles and exterior zero angles. Assume that the boundary of Ω satisfies the Dini-smoothness condition away from these singular points. Let P_n be an algebraic polynomial of degree at most n and let m be a positive integer. Then, for every $z \in \Omega$ there exists a constant $C > 0$, independent of n and P_n, such that

$$\left| \mathrm{P}_n^m(z) \right| \leq C n^m \|\mathrm{P}_n\|_{\Omega}$$

The constant C depends only on the geometric characteristics of the boundary of Ω and the type of singularities involved.

Keywords: Algebraic polynomials; Bernstein–Walsh inequality; derivative estimates; Dini–smooth domains; complex plane.

REFERENCES

1. Walsh, J. L. (1935). Interpolation and approximation by rational functions in the complex domain (Vol. 20). American Mathematical Soc.

NOVEL SOLITONS OF THE BISWAS - MILOVIC EQUATION WİTH KERR LAW NONLINEARITY

Şeyma Firdevs Hızal [1], **Mehtap Güneri** [1], **Hasan Bulut** [1]

[1]Department of Mathematics, University of Firat, Elazig, Turkey

sfkorkmaz@firat.edu.tr, mehtapguneri941@gmail.com, hbulut@firat.edu.tr

Abstract

In this study, optical soliton solutions of the Biswas–Milovic equation under Kerr law nonlinearity are examined analytically. Exact solutions of the nonlinear evolution equation are obtained by employing the modified F-expansion method, which enables a systematic investigation of nonlinear wave structures. Using this approach, several families of soliton solutions are derived, including bright, dark and periodic soliton forms. In addition, periodic wave solutions are observed to arise under appropriate parameter choices. The results show that the Biswas–Milovic equation supports different dynamical wave behaviors depending on the selected parameters. In this sense, the present work provides a unified analytical treatment of various soliton structures within a single framework and contributes to a clearer theoretical understanding of soliton dynamics in nonlinear optical models. The obtained solutions may serve as a useful basis for future analytical studies of related nonlinear evolution equations.

Keywords: Biswas–Milovic equation; Kerr law nonlinearity; Modified F-expansion method; Optical solitons.

REFERENCES

1. PanWang, Assanto, G., Marchant, T. R., & Minzoni, A. A. Reorientational versus Kerr dark and gray solitary waves using modulation theory. *Physical Review E, 84*, 066602, 2011.
2. PanWang, Biswas, A., Ebadi, G., Triki, H., Yildrim, A., & Yousefzadeh, N. Topological soliton and other exact solutions to KdV–Caudrey–Dodd–Gibbon equation. *Results in Mathematics, 63*, 687–703, 2012.
3. Manafian, J., & Lakestani, M. Optical solitons with Biswas-Milovic equation for Kerr law nonlinearity. *European Physical Journal Plus, 130*, 61, 2015.
4. PanWang, Inc, M., Aliyu, A. I., & Yusuf, A. Traveling wave solutions and conservation laws of some fifth–order nonlinear equations. *European Physical Journal Plus, 132*, 224, 2017.

Instructor-Trained AI Tutor for Mathematics Education: Design and Evaluation of a Custom GPT

Diana M. Audi[1]

[1] Department of Mathematics, American University of Sharjah (AUS), Sharjah, UAE

Daudi@aus.edu ,

Abstract

Recent advances in generative artificial intelligence have sparked growing interest in AI-assisted learning; however, the use of generic AI tools in mathematics education remains problematic due to inconsistent reasoning, limited pedagogical alignment, and frequent mathematical inaccuracies. This paper presents the design and evaluation of a custom instructor-trained AI tutor (Math-GPT) developed specifically to support university-level mathematics learning. Unlike general-purpose AI systems, the proposed Math-GPT is trained exclusively on instructor-curated materials, including lecture notes, handwritten derivations, worked examples, and structured solution templates, ensuring alignment with established mathematics pedagogy. The study adopts a mixed-methods research design, using a Calculus II course as a pilot context to investigate the impact of the Math-GPT on student learning outcomes, engagement, and confidence. Quantitative data include pre- and post-conceptual assessments, quiz and exam performance, and usage analytics, while qualitative data are gathered through student surveys, reflections, and focus groups. Statistical hypothesis testing is employed to evaluate learning gains and identify relationships between AI usage patterns and performance outcomes. Preliminary findings indicate that students using the Math-GPT demonstrate improved conceptual understanding, higher problem-solving accuracy, and increased self-efficacy compared to non-users. Students also report greater clarity in understanding multi-step procedures and reduced frustration when studying independently. The paper further discusses design principles for instructor-aligned AI tutors and outlines a scalable framework for integrating custom AI support into mathematics curricula. These results suggest that discipline-specific, pedagogy-aware AI tutors can play a meaningful role in enhancing mathematics learning when thoughtfully designed and rigorously evaluated.

Keywords: Artificial Intelligence in Education; Mathematics Education; Generative AI;; Intelligent Tutoring Systems; Instructor-Trained AI; Calculus Education; AI-Supported Learning; Pedagogy-Aware AI.

FRACTIONAL EULER METHOD FOR SOLVING FRACTIONAL DIFFERENTIAL EQUATIONS

Etibar Penahlı[1], Ahu Ercan[2]

[1] Department of Mathematics, Baku State University, Baku, Azerbaijan

[2] Department of Mathematics, University of Firat, Elazig, Turkey

epenahov@hotmail.com , ahuduman@firat.edu.tr

Abstract

In this study, a numerical approach for solving fractional differential equations is presented. Approximate solutions are obtained using the fractional Euler method, and the results are compared with available analytical solutions to evaluate the accuracy and efficiency of the proposed scheme. The comparative analysis demonstrates that the fractional Euler method provides reliable and consistent approximations, particularly for different values of the fractional order. The findings confirm the effectiveness of the numerical approach and highlight its potential applicability to a wide class of fractional-order models.

Keywords: Fractional differential equations; Euler method; Approximate solutions.

REFERENCES

1. Diethelm, K., The analysis of fractional differential equations, Springer, 1–247, 2010.
2. Podlubny, I., Fractional differential equations, Academic Press, 1–340, 1999.
3. Tomášek, P., On Euler methods for Caputo fractional differential equations, Archivum Mathematicum, Vol:59, No:3, 287–294, 2023.
4. Khader, M., Using Modified Fractional Euler Formula for Solving the Fractional Smoking Model, European Journal of Pure and Applied Mathematics, Vol:17, No:4, 2676-2691, 2024.

.

Dynamics of Advection-Diffusion-Reaction Processes: A Z^{+}-Number Valued Approach with ABC Granular Fractional Calculus

Betül ÖZBAY ELİBÜYÜK [1]

[1] Department of Mathematics,Kırklareli University, Kırklareli, TÜRKİYE

betul.ozbay@klu.edu.tr,

Abstract

This study focuses on the theoretical construction of Advection-Diffusion-Reaction (ADR) equations using Z^{+}-number valued parameters and Atangana-Baleanu-Caputo (ABC) fractional derivatives. In modeling transport processes, it is often necessary to handle both the memory effects of the medium and the uncertainty of the data. While standard fuzzy sets address the vagueness of parameters, they lack the ability to model the reliability of the information source. To fill this gap, we incorporate Z^{+}-numbers into the ADR model, allowing for a simultaneous evaluation of information restriction and its associated reliability.The mathematical formulation is built on the ABC operator, which, through its non-singular Mittag-Leffler kernel, provides a more flexible framework for non-local dynamics compared to classical derivatives. A key part of our theoretical approach is the use of granular derivatives. This method is employed to prevent the typical problem where the uncertainty interval of a solution grows unnaturally over time. By combining granular computing with Z^{+}-numbers, we establish a consistent way to define the evolution of the ADR process. The paper details the structural properties of this model and discusses how the fractional order and reliability components interact within a granular space. This work provides a formal basis for analyzing mass transport in systems where both the physical parameters and the data sources are uncertain.

Keywords: ABC Fractional Derivative, Z^{+}-numbers, Granular Computing, ADR Equations.

REFERENCES

1. M. Mazandarani, Y. Zhao, Z-differential equations, IEEE Transactions on Fuzzy Systems 28 (2020), 462–473. doi:10.1109/TFUZZ.2019.2908131.
2. H. T. T. Tam, H. V. Long, N. P. Dong, N. T. K. Son, On z-fractional differential equations, International Journal of Computer Mathematics 99 (2022) 2175–2204. doi:10.1080/00207160.

Comparative Performance of Machine Learning Models in African Regions with High and Low COVID-19 Case Prevalence.

Zurki Ibrahim, Department of Biological Sciences, Sule Lamido University, Nigeria.

Email: zurkiibrahim@slu.edu.ng

Abstract

Introduction: The global pandemic caused by COVID-19 has led to an appalling effect on health. This work aims to show the performance of four machine learning based models in COVID-19 cases forecast, machine learning based models because of accurate and nonlinearity estimate abilities were applied, comprising of ANN, ANFIS, SVM as well as conventional MLR models. **Methodology:** The complete confirmed cumulative cases of COVID-19 due to the infection by the novel virus in regions with highest cases of the novel diseases (Southern Africa and West Africa) and regions with lowest cases (Eastern and Northern Africa) were considered in this research, these respective nations have been selected crosswise diverse African provinces to symbolize multiplicity. Additionally, their Statistics of affirmed cases are order of extents disparities, which make available sufficient opportunity to assess the planned simulations for the territories with both low and high amounts of confirmed cases, additionally, a small number of these states has documented the confirmed cases and the rate of mortality moderately longer time than several other nations, which is one more evidence for selecting them. **Results**: Numerous time lags were employed so as to achieve the Markov strong point of the earlier incidences with regards to the present issue. According to Table 9 outcomes for Eastern African states, demonstrate the low predictive efficacy by the applied models in Uganda, the model with maximum performance in the validation stage is adaptive neuro-fuzzy inference system having Mean Absolute Deviation = 0.0181, Mean Square Error = 0.0056, Mean Square Error = 0.0750 and R2 = 0.0650. Regarding the outcomes of Southern Africa illustrated by Table 11 in the stage of validation, it can be observed that the entire models possessed greater prediction efficacy. ANFIS has the paramount modelling proficiency having Mean Absolute Deviation = 0.0195, Mean Square Error = 0.0011, Root Mean Square Error = 0.0331 and R2 = 0.8846. These findings can hand out as an allusion for modeling COVID-19 cases as well as determining hospitalization requirements.

Key words: Machine Learning, COVID-19, Models, Pandemic.

REFERENCES

Abdullahi, J., Elkiran, G., & Nourani, V. (2017). Application of artificial neural network to predict reference evapotranspiration in Famagusta, North Cyprus. In 11th International Scientific Conference on Production Engineering Development and Modernization of Production (pp. 549-554).

Ye, Z.W., Yuan, S., Yuen, K.S., Fung, S.Y., Chan, C.P., & Jin, D.Y. (2020). Zoonotic origins of human coronaviruses. Int J Biol Sci 16:1686–1697

Model of Kidney Function Decline Under the Influence of Diabetes and Hypertension

Ahlam elkhettab [1] ,Imane elberrai

[1] Hassan 2 University, Casablanca, Morocco

ahlam.elkhettab-etu@etu.univh2c.ma,

Abstract

Chronic kidney disease (CKD) is a major public health concern, often driven by underlying conditions such as diabetes and hypertension. This study presents a compartmental model to analyze the progression of kidney function decline under the influence of these risk factors.
The system is modeled using a set of ordinary differential equations (ODEs) describing the evolution of each compartment over time. Simulations demonstrate that without intervention, the proportion of individuals in CKD increases significantly, whereas appropriate treatment and disease management slow progression. This model provides a quantitative framework to assess the impact of risk factors and treatment strategies on kidney function decline, offering valuable insights for public health planning and clinical decision-making.

Keywords: Exponential Chronic Kidney Disease, Compartmental Model, Mathematical Modeling, Disease Progression, Ordinary Differential Equations, Renal Function Decline

REFERENCES

1. Lin YC, Chang YH, Yang SY, Wu KD, Chu TS. Update of pathophysiology and management of diabetic kidney disease. Journal of the Formosan Medical Association. 2018;117(8):662-675.
2. Anderson S, Brenner BM. Pathogenesis of diabetic glomerulopathy: the role of glomerular hyperfiltration. In: Mogensen CE, ed. The Kidney and Hypertension in Diabetes Mellitus. Springer US; 1988:17-30.
3. Hostetter TH. Hyperfiltration and glomerulosclerosis. Seminars in Nephrology. 2003;23(2):194-199.
4. Soldatos G, Cooper ME. Diabetic nephropathy: important pathophysiologic mechanisms. Diabetes Research and Clinical Practice. 2008;82(Suppl 1):S75-S79.
5. Wolffenbuttel BHR, Boulanger CM, Crijns FRL, Huijberts MSP, Poitevin P, et al. Breakers of advanced glycation end products restore large artery properties in experimental diabetes. Proceedings of the National Academy of Sciences. 1998;95(8):4630-4634.

On the S-spectrum and Local S-spectrum of Quaternionic Right Linear Operators

Dorsaf Kouas [1]

[1] Department of Mathematics, University of Sfax, Sfax, Tunisia

dorsaf.kouas@fsegs.usf.tn,

Abstract

In this study, enlightened by the S-spectral and the local S-spectral theory of right linear operators, we investigate and study some results of the S-spectra and local S-spectra of right linear operators matrices. In addition, we give the necessary and sufficient conditions to characterize some S-spectra of the block operator matrix in terms of the S-spectra of its diagonal entries. Finally, we explore how the operator matrix of right quaternionic linear operators has the single-valued extension property (abbreviated SVEP).

Keywords: Quaternionic Hilbert space, matrix operator, local S-spectrum, single valued extension property.

REFERENCES

1. Kouas Dorsaf. On the local S-spectra with Bishop's property of operators matrices in a right quaternionic Hilbert space. *Rend. Circ. Mat. Palermo (2)* 74 (2025), no. 1, Paper No. 69, 14 pp.

Characterization of some essential spectra of the sum of two blocks operator matrices involving the relatively Fredholm perturbations

Sana Bouzidi [1]

[1] Department of Mathematics, University of Sfax, Sfax, Tunisia

sana.bouzidi2017@gmail.com,

Abstract

In this presentation, we deal with the theory of the relatively Fredholm perturbations which allows us to provide a new criteria to characterize some essential spectra of the sum of two 2*2 blocks of operators matrices.

Keywords: Matrix operator, closable operator, relatively Fredholm perturbations, Essential spactra.

REFERENCES

1. Bouzidi Sana. Spectral properties of the sum of two operators matrices via relatively Fredholmness perturbations. *Commun. Korean Math. Soc.* 39 (2024), no. 4, 897--915. MR4816577

Uncertainty-Aware Modeling of 3D Concrete Printing Strength via Neural Stochastic Differential Equations

Sadi I. Haruna[1]*, Abba Bashir[2]*, Yasser E. Ibrahim[1], Sani I. Abba[3]

[1] Engineering Management Department, College of Engineering, Prince Sultan University, Riyadh 11586, Saudi Arabia

[2]Department of Civil Engineering, Federal University Dutsin-Ma, Katsina, Nigeria

[3]Department of Civil Engineering, Prince Mohammad Bin Fahd University, Al Khobar, 31952, Saudi Arabia

*sharuna@psu.edu.sa, babba@fudutsinma.edu.ng

Abstract

The anisotropic properties, curing procedures, and intricate material interactions of 3D printed concrete (3DPC) are the main challenges in applying machine learning algorithms to cutting-edge technologies such as 3DPC to forecast its compressive strength (CS). This study explores machine learning (ML) and deep learning (DL) models for predicting compressive strength (CS) in 3D-printed concrete (3DCP). Four models, LinkNet-50, UNet, Neural SDE, and SVR, were evaluated using experimental data. Feature analysis identified Silica Fume (SF) as the strongest positive CS influencer (correlation: 0.94) and Slag (S) or Hydrated Matrix Content (HMC) as critical negative factors. Neural SDE demonstrated superior reliability with balanced error distributions (-0.2 to 0.4) during training, effectively modeling material uncertainty. SVR exhibited persistent overestimation bias, while LinkNet-50 and UNet showed robust accuracy but minor testing-phase generalization gaps. This work establishes Neural SDE as a transformative tool for stochastic modeling in additive manufacturing

Keywords: 3D concrete printing, compressive strength prediction, Neural SDE, stochastic modeling, machine learning, additive manufacturing.

An EPQ Model for Non-Instantaneous Deteriorating Items with Gradual Supply and Shortage Under Two Phase Production Rate

Mansur Hassan[1] **Mahmud Dalha Mahmud**[1]

[1] Department of Mathematics, Northwest University, Kano, Nigeria

mhassan@yumsuk.edu.ng ,

Abstract

This paper proposes an economic production quantity model for non-instantaneously deteriorating items in which a gradual supply and shortage are considered. The demand during production time is continuous and at a constant rate while it is replenishment is gradual supply. Shortage is allowed and completely backlogged. The purpose is to determine the production cycle time and optimal inventory level in each cycle so that the total variable cost is minimized. The necessary and sufficient conditions are provided to show the existence and uniqueness of the optimal solution while a solution methodology based on differential calculus is adopted. The MATLAB software was also used in plotting graph in order the complexity of the proposed model. Then numerical example, sensitivity analysis and graphical representation are provided to illustrate the application of the proposed model.we obtain some new complex analytical solutions to the nonlinear Kundu-Eckhaus equation which seems in the quantum field theory, weakly nonlinear dispersive water waves and nonlinear optics by using exponential function method.

Keywords: EPQ model, Deteriorating items, Gradual supply.

NONLINEAR ANALYSIS Of ISOTOPIC PLATES WITH STRAIN-BASED FINITE ELEMENT AND COMPLEX BOUNDARY CONDITIONS

Djamal Hamadi[1], Abdulrahman M. Al-Nadhari[2], Ali Zine[3] and Maria Legouirah[4]

[1] LARGHYDE Laboratory, Department of Civil Engineering and Hydraulics, Faculty of Architecture, Urbanism and Civil Engineering and Hydraulics, University of Biskra, BP 145 RP, 07000, Biskra, Algeria

d.hamadi@univ-biskra.dz,

Abstract

The finite elements based on the strain approach have been extensively applied to the linear analysis of plate structures due to its highly efficiency and faster convergence compared to the displacement formulated elements. However; its application to nonlinear analysis remains relatively limited, primarily due to the complexity of non linear behavior assumptions, in addition to the computational difficulties associated with the nonlinear stiffness matrix formulation. In the present paper, the strain-based approach is extended to the geometrically nonlinear analysis of isotropic plates subjected to transverse loading with complex boundary conditions. A quadrilateral Mindlin plate element based on the strain formulation is coupled with a strain-based membrane element. The nonlinear equilibrium equations are solved through the Newton–Raphson iterative procedure. Through the applications performed, the results obtained show excellent agreement with ABAQUS simulations and previously published finite element solutions. This confirms the accuracy and the robustness of the proposed element. Furthermore, the findings emphasize the importance of the strain based approach for the nonlinear analysis of plate structures

Keywords: Strain-based finite element, plate element, Non linear analysis, Complex boundary conditions.

REFERENCES

1. AL-Nadhari, A.M., Hamadi, D. & Legouirah, M. Formulation of an efficient strain-based finite element for large deflection analysis and free vibration of plates. Asian J Civ Eng 26, 3821–3841 (2025). https://doi.org/10.1007/s42107-025-01400-0.
2. AL-Nadhari, A.M., Abderrahmani S., Hamadi, D. & Legouirah, M. Advanced analysis of rectangular plate elements using strain-based Kirchhoff theory for static and free vibration responses under complex boundary conditions. Mechanics of Advanced Materials and Structures, 1-13, 10 December (2025). https://www.tandfonline.com/doi/abs/10.1080/15376494.2025.2595689

GENERALIZED ENTRY FORMULA FOR COMPUTING A MULTIVARIATE POLYNOMIAL RESULTANT

Surajo Sulaiman[1] **and Aliyu Suleiman**[2]

[1] Department of Mathematics, Northwest University, Kano, Nigeria.

[2] Department of Mathematics, Air Force Institute of Technology, Kaduna, Nigeria.

ssulaiman@yumsuk.edu.ng and a.suleiman@afit.edu.ng ,

Abstract

In an elimination theory particularly using a matrix method to compute multivariate resultant. The ultimate goal is to derive or construct technique that have a considerable size. In this paper, the entry for computing $n \times n$ Dixon matrix was found and is free from any extraneous factor. The result of complexity analysis reveal a significant decrease in terms of the degree of the computational complexity. All computer algebra system (CAS) have only functions that can evaluate three bivariate polynomials. Therefore availability of this formula will now provide a chance for a generalize function that will have no restriction to certain class of polynomial. Another advantage of the formula was the computation without intermediate cancellations terms that are redundant.

Keywords: Resultant Matrix, Dixon Matrix, Entry formular and Multivariate polynomial

REFERENCES

1. Chionh, E.W., Concise Parallel Dixon Determinant, Computer Aided Geometric Design, 14(6), pp. 561-570, 1997.
2. Wang, W. & Lian, X. Computations of Multi-resultant with Mechanization. Applied Mathematics and Computation, 170(1), pp. 237- 257, 2005.
3. Qin, X., Wu, D., Tang, L. & Ji, Z., Complexity of Constructing Dixon Resultant Matrix, International Journal of Computer Mathematics, 94(10), pp. 2074-2088, 2017.

Enhancing Stock Price Prediction with Bi-Directional LSTM-Grey Wolf Optimizer (BiLSTM-GWO)

Abdulmajid B. Umar[1], **Fatima Ado Musa**[2]

[1] Faculty of Computing, Northwest University, Kano
[2] School of Science Aminu Kano College of Islamic and Legal Studies, Kano

abumar@yumsuk.edu.ng

Abstract

Financial institutions, traders, and investors depend heavily on stock price predictions, but traditional approaches frequently falter due to the complexity and volatility of the market. In order to increase the accuracy of stock price predictions, the research suggests a hybrid BiLSTM-GWO model that captures long-term dependencies in the dynamic and non-linear character of financial markets while also optimizing model parameters. The main objectives are to develop a hybrid BiLSTM-GWO stock price prediction model, train and test it on historical stock data, and assess its effectiveness with important performance indicators. Through efficient parameter optimization and temporal data analysis, the methodology combines the GWO algorithm with the BiLSTM network to improve the predictive power of the model. It is anticipated that the suggested hybrid technique will increase the model's resilience to changing market conditions and surpass conventional models in terms of forecast accuracy, particularly when it comes to identifying intricate stock market patterns. This framework is expected to provide financial institutions and investors with a more dependable tool for risk management and investment strategy improvement. When ongoing trials are finished, final data will confirm the BiLSTM-GWO model's efficacy. .

Keywords: LSTM, BiLSTM, GWO, Stock price prediction

REFERENCES

1. Akhtar, M. M., Zamani, A. S., Khan, S., Shatat, A. S. A., Dilshad, S., & Samdani, F. (2022). Stock market prediction based on statistical data using machine learning algorithms. Journal of King Saud University - Science, 34(4), 101940. https://doi.org/10.1016/j.jksus.2022.101940

2. Chandar, S. K. (2020). Grey Wolf optimization-Elman neural network model for stock price prediction. Soft Computing, 2. https://doi.org/10.1007/s00500-020-05174-2

Enhancement of Malarial Parasite Image Restoration Using FISTA and Inertial Tseng Mathematical Algorithms

Huzaifa Umar[1]*, Maryam Isa Abdulkadir[2], Maryam Rabiu Aliyu[3], Abubakar Adamu[1,4]

[1]Operational Research Center in Healthcare, Near East University, TRNC Mersin 10, Nicosia 99138, Turkey.

[2]Department of Biotechnology, Cyprus International University, Haspolat-Lefkosa, Mersin 10, Turkey.

[3]Department of Bioengineering, Cyprus International University, Haspolat-Lefkosa, Mersin 10, Turkey

[4]School of Mathematical Sciences, Chongqing Normal University, Chongqing, 401331, People's Republic of China

huzaifa.umar@neu.edu.tr

Abstract

Malaria is a serious infectious disease caused by a peripheral blood parasite of the genus Plasmodium. Conventional microscopy is the standard method for diagnosing the disease, but there are challenges in reproducibility due to the nature of the microscopic images. Considering the remarkable health impact of malaria globally, there is a special need to develop mathematical algorithms to restore blurry images to enhance the diagnosis and software analysis of microscopic slides. This study employed the Inertial Tseng Algorithm (ITA) and the Fast Iterative Shrinkage Thresholding Algorithm (FISTA) to process and enhance malarial parasite images afflicted with known additive noise and blur functions. Furthermore, the performance of these algorithms in the restoration process of test images containing parasitized and un-parasitized blood cell images was revealed using advanced image processing tools. Numerical simulations showed that the ITA method consistently surpassed the FISTA method in restoring the degraded images. Overall, the research underscored the effectiveness of the utilized algorithms and emphasized the significance of integrating mathematical algorithms with newly established mechanisms in the processing and restoration of medical images.

Keywords: Medical blood parasite; Microscopic images; Diagnosis; Image deblurring; Additive

Optimal Control and Mathematical Modeling of Ebola Virus Transmission in Bat-Human Interactions

Farouk Sa'ad[1]

[1] Department of Mathematics, Northwest University, Kano, Nigeria

ftsaad@yumsuk.edu.ng

Abstract

The Ebola virus disease is a highly fatal zoonotic disease with bats considered the natural reservoir host. Understanding the transmission dynamics between bats and humans is crucial for developing effective control strategies. This study proposes a mathematical model to investigate the spread of Ebola through the interaction of these two populations and contaminated environment. A system of nonlinear ordinary differential equations incorporates various epidemiological factors, including disease progression, environmental contamination, and cross-species transmission. The model's properties, such as positivity, boundedness, and stability, are established. Optimal control theory is employed to formulate control strategies representing interventions like culling, vaccination, and quarantine. Pontryagin's Maximum Principle is applied to derive the necessary conditions for optimal control. Numerical simulations are conducted to evaluate the impact of control measures on disease prevalence. The findings provide insights into the interplay between bat and human populations in Ebola virus transmission and inform public health policies for mitigating future outbreaks.

Keywords: Ebola Virus; Bats; Human; Optimal Control; Environmental contamination

REFERENCES

1. Riad, M.H., Adekunle, A.I., Okuonghae, D., Gumel, A.B. and Dzonzi-Undi, H., 2022. A multihost model for assessing the impact of environmental transmission on Ebola virus disease dynamics. Infectious Disease Modelling, 7(1), pp.53–72.

Dynamical Behaviour and New Exact Travelling Wave Solutions for the (2+1) dimensional Fractional Stochastic Davey-Stewartson System via Two Robust Techniques

Ado Balili[1]

[1] Department of Mathematics, Northwest University, Kano, Nigeria

adobalili@gmail.com

Abstract

This paper explores the truncated M fractional stochastic Davey Stewartson system influenced by noise within the framework of Itô calculus. As a two-dimensional integrable system and a higher dimensional extension of the nonlinear Schrödinger equation, this model has applications in plasma physics, nonlinear optics, hydrodynamics, and related areas. To obtain exact optical soliton solutions which include dark, bright, combined, and periodic waveforms. We employ the improved Bernoulli sub equation function method (IBSEFM) and extended Kudryashov method (EKM). These solutions offer valuable insights into various complex physical processes, particularly due to the significance of the Davey–Stewartson equation in modeling turbulence in plasma waves and optical fiber dynamics. Furthermore, we utilize Maple to visualize the results through 3D plots, contour diagrams, 2D plots, and polar coordinate plots, illustrating impact of fractional order and the effects of stochastic noise on the behavior of the solutions. Our findings reveal that the multiplicative Brownian motion helps stabilize the solutions around zero.

Keywords: Travelling wave solution; Davey-Stewartson system; Extended Kudryashov method; Improved Bernoulli sub-equation function method; Stochastic

REFERENCES

1. Abdelaziz, M.A., Moussa, A., Alrahal, D. Exact Solutions for the Nonlinear (2+1)-Dimensional Davey-Stewartson Equation Using the Generalized ($\frac{G'}{G}$)-Expansion Method. *J. Math. Res. Vol: 6*, 91–99, 2014.

2. Tariq, M. M., Riaz, M. B., Kozubek, T., Aziz-ur Rehman, M. Exploring chaos and stability: Dynamic insights into the stochastic Davey-Stewartson system through advanced sensitivity analysis. *Model. Earth Syst. Environ. 11*, 83, 2025.

3. Iqbal, M.S., Inc, M. Optical Soliton solutions for stochastic Davey–Stewartson equation under the effect of noise. *Opt. Quantum Electron. 56*, 1148, 2024.

Existence of Radial Solutions for Curvature-Type Equations

Muhittin Evren Aydın[1], **Harith Adnan Arab Al-Azzawi**[2]

[1]Department of Mathematics, Fırat University, Elazığ, Türkiye

[2]Department of Mathematics, Graduate School of Natural and Applied Sciences, Fırat University, Elazığ, Türkiye

meaydin@firat.edu.tr, harthdnan38@gmail.com

Abstract

In this talk, we study the rotational λ-translators M in Euclidean space, namely those surfaces whose Gaussian curvature K satisfy $K = \langle N, \vec{v} \rangle + \lambda$, where N is the Gauss map of M, $\vec{v}$ is the fixed direction and λ is a real constant. In particular, we re-consider the obtained existence result in [2] when M intersects the rotation axis, orthogonally. In this case, since the resulting ODE is singular, the classical theory does not assure the its existence. Using Fixed Point Theory, we see that the solutions exist.

Keywords: Gauss curvature flow; Fixed Point Theory; Translator.

REFERENCES

1. B. Andrews, Gauss curvature flow: the fate of the rolling stones. Invent. Math. 138 (1999), 151–161.
2. M. E. Aydın, R. López, Invariant λ-translators for the Gauss curvature flow in Euclidean space, arXiv:2508.17321v1 [math.DG], 2025.
3. M. E. Aydın, R. López, Translators of flows by powers of the Gauss curvature. Ann. Mat. Pura Appl. 202 (2023), 235–251.
4. M. E. Aydın, R. López, Rotational K^{α}-translators in Minkowski space. Taiwanese J. Math.27(5) (2023), 953–969.
5. J. Urbas, Complete noncompact self-similar solutions of Gauss curvature flows, I: Positive powers. Math. Ann. 311 (1998), 251–274.

MATHEMATICAL MODELING AND NUMERICAL ANALYSIS OF SALMONELLOSIS TRANSMISSION BETWEEN ANIMAL AND HUMAN POPULATIONS

Şeyma Firdevs HIZAL [1], **Nur Seza ALTINIŞIK** [1]

[1]Department of Mathematics, University of Firat, Elazig, Turkey

sfkorkmaz@firat.edu.tr, nursezaltn@gmail.com

Abstract

In this paper, Salmonellosis is a significant zoonotic infection transmitted from animals to humans, primarily through foodborne pathways. In this study, a two-population SIR epidemic model is developed to investigate the transmission dynamics of Salmonella between animal and human populations. The model incorporates intra-animal transmission, animal-to-human transmission, human-to-human spread, and recovery processes within a unified mathematical framework. The resulting system of nonlinear differential equations is solved numerically in the Mathematica environment using the Euler and fourth-order Runge–Kutta methods. Simulations performed under different parameter scenarios reveal the critical role of transmission rates and hygiene-related factors in shaping disease progression. The proposed model provides a systematic mathematical framework for analyzing cross-population transmission mechanisms of Salmonellosis and contributes to quantitative assessments aimed at improving zoonotic disease control strategies.

Keywords: Salmonellosis; Zoonotic Diseases; SIR Model; Numerical Analysis

REFERENCES

1. Kermack, W. O., & McKendrick, A. G. (1927). A contribution to the mathematical theory of epidemics. Proceedings of the Royal Society of London. Series A, 115(772), 700-721.
2. Hethcote, H. W. (2000). The mathematics of infectious diseases. SIAM Review, 42(4), 599-653.
3. Wu, X., Lu, Y., Zhou, S., Chen, L., & Xu, B. (2016). Impact of climate change on human infectious diseases.
4. E. S. Türker & E. Can "Bilgisayar Uygulamalı Sayısal Analiz Yöntemleri", 2. Baskı.

APPLICATIONS OF THE (M+1/G′) METHOD TO SOME NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS

Hasan Bulut [1], Yaren Kılıç [1], Şeyma Firdevs Hızal [1]

[1] Department of Mathematics, University of Firat, Elazig, Turkey

kilicyaren76@gmail.com , sfkorkmaz@firat.edu.tr , hbulut@firat.edu.tr,

Abstract

Nonlinear partial differential equations play an important role in modeling complex phenomena encountered in physics, engineering, and applied sciences. In this study, the (m+1/G') method was applied to obtain analytical solutions of selected nonlinear partial differential equations. Through an appropriate wavelet transformation, the equations under consideration were reduced to ordinary differential equations, and their solution structures were systematically constructed using the (m+1/G') method. As a result of applying the method, various closed-form solutions in the forms of hyperbolic, trigonometric, and rational functions were obtained. The accuracy and structure of the obtained solutions were verified using the Mathematica program. The program has provided great convenience in the symbolic solution of differential equations and the visualization of results, enabling the step-by-step examination of the consistency and accuracy of solutions in the form of hyperbolic, trigonometric, and rational functions obtained through the method.

Keywords: (m+1/G′) method; Nonlinear partial differential equations; Traveling wave transformation

REFERENCES

1. Dilara Altan Koç, Sümeyye Kılbitmez, Hasan Bulut, The New Complex Travelling Wave Solutions of the Simplified Modified Camassa Holm Equation, Optical and Quantum Electronics, Vol:56, 215, 2024.
2. Dilara Altan Koç, Yusif S. Gasimov, Hasan Bulut, A Study on the Investigation of the Travelling Wave Solutions of the Mathematical Models in Physics via (m+1/G')-Expansion Method, Advanced Mathematical Models and Applications, Vol:9, No:1, 5-13, 2024.
3. Hasan Bulut, Hajar F. Ismael, Exploring New Features fort the Perturbed Chen-Lee-Liu Model via (m+1/G')-Expansion Method, Proceeding of the Institute of Mathematics and Mechanics, Vol:48, No:1, 164-173, 2022.

STRICT MITTAG-LEFFLER STABILITY OF FRACTIONAL UNPERTURBED SYSTEMS WITH INITIAL TIME DIFFERENCE

Coşkun Yakar[1], Dilara Karslıoğlu[2]

[1] Department of Mathematics, University of Gebze Technical, Kocaeli, Turkey

[2] Department of Management Information Systems, University of Fenerbahçe, İstanbul, Turkey

cyakar@gtu.edu.tr, dilara.karslioglu@fbu.edu.tr,

Abstract

This paper examines the strict Mittag-Leffler stability of fractional unperturbed systems whose solutions begin at distinct initial times. The analysis is developed within the Caputo fractional derivative setting and relies on a refined variation-of-parameters approach to capture the influence of the initial time difference on stability behavior. Our results show that even minor shifts in the starting instant can significantly alter the asymptotic properties of fractional dynamics. The derived stability criteria strengthen existing Mittag-Leffler–type theories and extend them to a broader class of unperturbed systems incorporating initial time differences. Several examples are included to validate the theoretical findings and to highlight the accuracy and applicability of the proposed framework.

Keywords: Fractional differential systems; Mittag-Leffler stability; Initial time difference; unperturbed systems; Caputo derivative; Lyapunov functional

REFERENCES

1. Li Y, Chen YQ, Podlubny I, Mittag–Leffler stability of fractional order nonlinear dynamic systems, Automatica, 45, 1965-1969, 2009.

STATISTICAL PROPERTIES AND APPLCATIONS OF A NEW TWO-PARAMETER INVERSE RAYLEIGH DISTRIBUTION

Faton Merovci[1]

[1] Faculty of Mechanical and Computer Engineering, University of Mitrovica "Isa Boletini", Mitrovica, Kosovo

faton.merovci@umib.net

Abstract

In this paper, we propose a flexible two-parameter extension of the Inverse Rayleigh distribution for modeling lifetime data. The main statistical properties of the proposed model are investigated, including its quantile function, moments, mean deviations, entropy measures, stress–strength reliability, and order statistics. Parameter estimation is carried out using maximum likelihood estimation, the method of moments, and least squares estimation. The performance of the proposed estimators is assessed through a Monte Carlo simulation study in terms of bias and mean squared error. Real data applications confirm the practical usefulness and improved flexibility of the proposed model over classical and competing alternatives.

Keywords: Inverse Rayleigh distribution, hazard rate function, maximum likelihood estimation, Monte Carlo simulation, stress–strength reliability.

REFERENCES

1. Idzhar Lakibul, Lakibul G family of distributions: special models, properties and applications, Reliability: Theory & Applications, Vol: 20, No: 84, 617-631, 2025.
2. Faton Merovci, A three-parameter record-based transmuted Rayleigh distribution (order 3): theory and real-data applications, Symmetry, Vol:17(7), No: 1034, 1-31.
3. Muzafer Shala, Faton Merovci, A new three-parameter inverse Rayleigh distribution: simulation and application to real data, Symmetry, Vol: 16(5), 63.1-24, 2025.

CONSENSUS-GATED EXECUTION: A MULTI-AGENT LLM ARCHITECTURE FOR AUTONOMOUS CRYPTOCURRENCY TRADING

Agon Bajgora [1]

[1] Faculty of Mechanical and Computer Engineering, University of Mitrovica "Isa Boletini", Mitrovica, Kosovo

agon.bajgora@umib.net

Abstract

Autonomous cryptocurrency trading agents have gained significant traction following the February 2026 launch of Coinbase's Agentic Wallets, with over 13,000 agents registering within 24 hours. However, existing multi-agent trading systems rely primarily on collaborative consultation (TradingAgents) or sequential self-reflection (TradingGroup), lacking structured adversarial deliberation mechanisms. We propose Consensus-Gated Execution, a novel multi-agent architecture where specialized Bull and Bear agents engage in structured debate rounds, with a meta-evaluator synthesizing arguments to determine trade execution based on consensus strength. Our approach introduces three key innovations: role-specialized adversarial agents, multi-round argument refinement protocols, and evidence-based consensus gating that modulates position sizing based on debate quality. Preliminary theoretical analysis suggests this architecture should improve drawdown management through systematic risk identification while maintaining decision quality through adversarial stress-testing of trading theses. The system integrates with existing execution infrastructure via the MCP protocol, positioning itself as the missing decision-making layer between market data and trade execution.

Keywords: Multi-agent systems, LLM trading, consensus mechanisms, adversarial debate, autonomous agents

REFERENCES

1. Coinbase. (2026, February 11). "Introducing Agentic Wallets: Give Your Agents the Power of Autonomy." Coinbase Developer Platform. Available: coinbase.com

2. Rahwan, I., Cebrian, M., Obradovich, N. et al. Machine behaviour. Nature 568, 477–486 (2019). https://doi.org/10.1038/s41586-019-1138-y

A Novel Method to Solve the Some Conformable Fractional Nonlinear Partial Differential Equations

Mahir Ceylan ERDOĞAN[1,*]

[1,*]**Department of Computer Engineering, Istanbul Health and Technology University, Istanbul, Turkey**

erdoganmahir@gmail.com,

Abstract

This study examines conformable fractional nonlinear partial differential equations. A novel analytical framework, referred to as the conformable Adomian decomposition method, is proposed for solving the considered equations. The developed approach is constructed through the integration of the conformable fractional derivative and the Adomian decomposition technique. The efficiency of the proposed scheme is evaluated through numerical simulations, which confirm the reliability and effectiveness of the method in generating approximate solutions for the investigated fractional models.

Keywords: Conformable fractional derivative; Fractional Nonlinear Partial Differential Equations; Adomian decomposition method.

REFERENCES

1. Avit, Ö., & Anac, H. (2024). Thenovel numerical solutions for conformable fractional Kuramoto-Sivashinsky equations by using Cq-HATM and CHPETM. *Alexandria Engineering Journal*, *92*, 294-309.
2. Prakash, A., Veeresha, P., Prakasha, D. G., & Goyal, M. (2019). A new efficient technique for solving fractional coupled Navier–Stokes equations using q-homotopy analysis transform method. *Pramana*, *93*(1), 6.
3. Alkan, A., Bulut, H., & Aktürk, T. (2025). The novel numerical solutions of conformable fractional Cahn-Hilliard equation in the presence of advection and reaction terms via the novel hybrid method. *Gümüşhane Üniversitesi Fen Bilimleri Dergisi*, *15*(1), 274-285.
4. Podlubny, I. (1999). *Fractional differential equations: An introduction to fractional derivatives, fractional differential equations, to methods of their solution and some of their applications*. Academic Press, New York.

*Abstract Submission should be prepared only **1 page**.

MATHEMATICAL PHARMACOKINETIC PROCESSES WITH LOCAL DERIVATIVE

Sehnaz YILDIRIM[1] **, Erdal BAS**[1]

[1]Department of Mathematics, University of Firat, Elazig, Turkey

sehnazy28@gmail.com, erdalmat@firat.edu.tr

Abstract

In this paper, we address the mathematical differential equation system of the pharmacokinetic model to demonstrate drug distribution via oral administration. The aim of this study is to solve a more general version of the model that includes the M-derivative. We solve the M-derivative pharmacokinetic model using the M-Laplace transform, a powerful tool. A general assessment is made regarding the effects of drug absorption on the body. We analyze the graphs of the obtained results using the MATLAB program.[1-4].

Keywords: M-Derivate, pharmacokinetic model, drug delivery.

REFERENCES

1. Acay, B., Bas, E., & Abdeljawad, T. (2020). Non-local fractional calculus from different viewpoint generated by truncated M-derivatie. Journal of Computational and Applied Mathematics, 366, 112410.
2. Sousa, J. V. D. C., & de Oliveria, E. C. (2017). A new truncated M-fractional derivative type unifying some fractional derivative types with classical properties. arXiv preprint arXiv:1704.08187.
3. Karaoglan, M., Bas, E., & Boulaaras, S. (2026). Advanced fractional modeling of pharmacokinetic processes using mabc and hilfer derivatives. fractals, 2650031.
4. Bhatter, S., Jandig, K., & Purohit, S. D. (2022). Fractionalized mathematical models for drug diffusion. Chaos, Solitons & Fractals, 165, 112810.

M-Series Derivative Mathematical Modeling for Advanced Building Energy Optimization

Sumeyye TURAN[1] **Erdal BAS**[2]

[1-2] Department of Mathematics, University of Firat, Elazig, Turkey

sumeyyeturan2323@gmail.com , erdalmat@firat.edu.tr

Abstract

In this study, we propose an improved model for achieving energy savings and efficiency in building heating and cooling systems using novel local limit-based fractional operators. The model is formulated using both the truncated M-derivative and the truncated M-series fractional derivative. Analytical solutions for these two different mathematical models are obtained using the Laplace transform, and a simulation analysis is performed to observe and compare the behavior of the solution curves. The M-series fractional derivative approach demonstrates that the additional degrees of freedom it introduces to the system allow for a more flexible and realistic modeling of non-renewable energy efficiency [1-3].

Keywords: M –series derivative, Energy Efficiency, Mathematica Models.

REFERENCES

[1] Nagle, R. K., Saff, E. B., & Snider, A. D. (2008). *Fundamentals of Differential Equations* (7th ed.). Pearson Addison-Wesley.

[2] Ilhan, E., & Kıymaz, I. O. (2020). A generalization of the truncated M-fractional derivative and applications to fractional differential equations. *Appl. Math. Nonlinear Sci*, *5*(1), 171-188.

[3] Bas, E., Acay, B., (2019). An Energy-saving model in frame of the local derivative. International Conference On Computational Mathematics And Engineerıng Sciences

Cubic-quintic form of self-phase modulation for the (2+1)-perturbed Biswas-Milovic equation with optical dromions

Hasan Cakicioglu[1], **Muslum Ozisik**[2], **Aydin Secer**[2]

[1]*Graduate School of Science and Engineering, Department of Mathematical Engineering, Yildiz Technical University, Istanbul, Türkiye.*
[2]*Department of Mathematical Engineering, Yildiz Technical University, 34220 Istanbul, Türkiye.*

**Corresponding author e-mail: hasan.cakicioglu@std.yildiz.edu.tr*

Abstract

In this study, we examined (2+1)-dimensional perturbed Biswas–Milovic equation with parabolic law and constructed its optical soliton solutions using the Kudryashov method. We obtained dark and kink solitons and analyzed their behavior for some parameters value. Using 2D and 3D graphs, we illustrated how variations in system parameters directly influence soliton propagation, revealing the link between parameter changes and dynamic responses. We researched modulation instability analysis to track the spatiotemporal evolution of the system and identify the instability thresholds. Our results show that the parabolic law strongly shapes both the dynamic and stability of solitons. By deriving a diverse set of exact analytical solutions and explicitly demonstrating the effect of the parabolic law on soliton behavior, we provided deeper insight into nonlinear wave dynamics. These findings directly inform the design of advanced optical systems and expand potential applications in communication technologies and nonlinear wave theory.

Keywords: (2+1)-Biswas-Milovic equation; Dark and kink solitons; Perturbation; The Kudryashov technique; Modulation instability.

REFERENCES

1. Biswas, D. Milovic, Bright and dark solitons of the generalized nonlinear Schrödinger's equation, Communications in Nonlinear Science and Numerical Simulation, Vol:15, No:6, 1473–1484, 2010.
2. P. Albayrak, Optical solitons of Biswas–Milovic model having spatio-temporal dispersion and parabolic law via a couple of Kudryashov's schemes, Optik, Vol:279, 170761, 2023.
3. Y. Chahlaoui, R. M. A. Shohib, M. E. M. Alngar, Perturbed Biswas-Milovic equation with Kudryashov's law of refractive index: analysis and solutions for nonlinear optical systems, Optical and Quantum Electronics, Vol:56, No:7, 1108, 2024.
4. N. A. Kudryashov, Implicit Solitary Waves for One of the Generalized Nonlinear Schrödinger Equations, Mathematics, Vol:9, No:23, 2021.
5. G. P. Agrawal, Optical solitons, in: Nonlinear Fiber Optics, Ed: Govind P. Agrawal, 127–187, 2019.
6. J. Singh, D. Kumar, D. Baleanu, New aspects of fractional Biswas–Milovic model with Mittag-Leffler law, Mathematical Modelling of Natural Phenomena, Vol:14, No:3, 303, 2019.

Optical dromions with the (2+1)-dimensional stochastic perturbed generalized nonlinear Schrödinger equation having the Kerr law of self-modulation

Elif Tufan Gov[1,*], Muslum Ozisik[2], Aydin Secer[2]

[1]Graduate School of Science and Engineering, Department of Mathematics, Yildiz Technical University, Istanbul, Turkey.

[2]Department of Mathematical Engineering, Yildiz Technical University, 34220 Istanbul, Turkey.

[3]Department of Mathematical Engineering, Yildiz Technical University, 34220 Istanbul, Turkey.

**Corresponding author E-mail: elftfn@gmail.com*

Abstract

In this study, optical dromion solutions of the stochastic perturbed generalized (2+1)-dimensional nonlinear Schrödinger equation with the Kerr law of self-modulation are investigated. While the standard nonlinear Schrödinger equation generally includes the basic Kerr nonlinearity, the (2+1)-dimensional Biswas–Milovic equation under study has a wider range of solutions, including more complex nonlinear interactions, higher-order dispersion effects, and in some cases, perturbations and stochastic terms. The model is capable of generating solutions for optical solitons, optical dromions, breather solutions, and rogue waves, and it is particularly possible to investigate localized optical phenomena in two dimensions, especially in the (2+1)-dimensional aspect. By employing suitable wave transformations together with the new Kudryashov integration scheme, optical dromions solutions of the governing equation are derived. The obtained solutions reveal, the influence of stochastic perturbation parameters and Kerr-type nonlinearity on the amplitude is analyzed in detail. Graphical simulations are presented to support the analytical findings and to illustrate the dynamical behavior of the solutions under varying physical parameters. The results demonstrate that stochastic effects play a significant role for nonlinear optical systems. These findings contribute to a deeper understanding of higher-dimensional nonlinear media and may provide potential insights for applications in optical communication systems, photonic devices, and nonlinear optics.

Keywords: (2+1)-dimensional generalized nonlinear Schrödinger equation; Optical dromions; The new Kudryashov integration scheme; Perturbation; Dark and bright solitons; Noise intensity.

References

[1] Govind P. Agrawal, Nonlinear Fiber Optics, Fifth Edition, 2013, Academic Press, https://doi.org/10.1016/C2011-0-00045-5.

[2] Anjan Biswas, Daniela Milovic, (2010). Bright and dark solitons of the generalized nonlinear Schrödinger's equation, Communications in Nonlinear Science and Numerical Simulation, Volume 15, Issue 6, Pages 1473-1484.

[3] Muslum Ozisik, (2022). Novel (2+1) and (3+1) forms of the Biswas–Milovic equation and optical soliton solutions via two efficient techniques, Optik, Volume 269, 169798.

[4] Nikolay A. Kudryashov, First integrals and general solutions of the Biswas-Milovic equation, Optik, Volume 210, 2020, 164490, ISSN 0030-4026, https://doi.org/10.1016/j.ijleo.2020.164490.

Emergence of Logarithmic Nonlinear Waves in a Liouville Model: An Exact Analytical Study

Muhammad Abubakar Isah*[1], Ibrahim Isah[2], Ahmad Muhammad[3], Salim Jibrin Danbatta[4]

[1]Department of Mathematics, Istanbul Ticaret University, 34445, Istanbul, Turkiye,
[2]Department of Art and Humanities School of General and Remedial Studies, Kano State Polytechnic, Nigeria,
[3]Department of Physics and Materials Sciences, College of Arts and Sciences, Qatar University Doha, 2713, Qatar.
[4]Department of Software Engineering, Faculty of Engineering and Natural Sciences, Uskudar University, Istanbul, Turkiye.

myphysics 09@hotmail.com*[1], ibistatistics@kanopoly.edu.ng[2], a.muhammad@qu.edu.qa[3], salimdambatta@gmail.com[4].

Abstract

In this work, the Painleve property, the traveling wave transformation, and the φ^6-model expansion method are used to construct exact analytical solutions of a Liouville-type nonlinear evolution equation. An extended algebraic framework is used to solve the ordinary differential equation that results from the reduction of the governing partial differential equation using a suitable traveling wave transformation. The logarithmic expressions of the obtained solutions result in a variety of nonlinear wave structure families, such as singular wave profiles, periodic waves, and solitary waves. To demonstrate the dynamical behavior of the model, the impact of physical parameters on the propagation properties of the solutions is examined. The outcomes show that the chosen approach offers a methodical and effective way to obtain exact solutions for nonlinear equations with exponential nonlinearities. These results advance our theoretical knowledge of nonlinear. These findings contribute to the theoretical understanding of nonlinear wave propagation and may be useful in applications related to fluid dynamics, plasma physics, and other areas of applied science where Liouville-type models arise.

Keywords: The Liouville equation; Logarithmic exact solutions; Jacobi elliptic functions; the φ^6-model expansion method.

REFERENCES

1. A. Kupiainen et al., “Advances in the Analytic Construction of Liouville Field Theory,” J. High Energy Phys., vol. 2025, no. 2, pp. 1–40, Feb. 2025.
2. Isah, M. A., & Yokuş, A. (2026). Seismic pulse propagation: Analytical modeling and exact soliton solutions. *Soil Dynamics and Earthquake Engineering*, *203*, 110121.
3. Yokus, A., & Isah, M. A. (2025). Unveiling novel insights: Nonlinear dispersion dynamics of optical solitons through new φ^6-Model expansion in the Klein–Gordon equation. *Chinese Journal of Physics*, *95*, 476-492.

PREDICTING CONSTRUCTION PROJECT DELAYS USING MACHINE LEARNING MODELS

Ali Ulvi KASAPOĞLU[1,2] and Seval ENE YALÇIN[2]

[1] Setyap Construction, Ankara, Türkiye

[2] Bursa Uludağ University, Faculty of Engineering, Department of Industrial Engineering, Bursa, Türkiye

502206007@ogr.uludag.edu.tr ,

sevalene@uludag.edu.tr,

Abstract

Delays in construction projects are a major problem worldwide, often causing higher costs, lower quality, and damage to contractors' reputation. Managing and predicting these delays is challenging because construction projects are complex, involve many different factors, and the data available is often limited or incomplete. Traditional methods for analyzing risk are usually not enough, as they rely on personal judgments and cannot fully show how different factors affect each other over time.

In this study, we examined delay risks using data from real construction projects. Key factors affecting delays, such as project size, duration, resource use, and management practices, were analyzed in detail. Projects were then grouped based on their delay levels. Machine learning techniques were used to create models that can predict the likelihood of delays in new projects. These models were tested to see how reliable and accurate they were, showing that data-driven approaches can help project managers make better decisions and reduce the negative impacts of delays.

Keywords: Artificial Intelligence, Machine Learning, Delay Risk Analysis, Project Planning.

REFERENCES

1. Saleh Alsulamy, Predicting construction delay risks in Saudi Arabian projects: A comparative analysis of CatBoost, XGBoost, and LGBM, Expert Systems with Applications, Vol:268, No:126268, 1–16, 2025.
2. Aynur Kazaz, Serdar Ulubeyli, Nihan Avcioglu Tuncbilekli, Causes of Delays in Construction Projects in Turkey, Journal of Civil Engineering and Management, Vol:18, No:3, 426–435, 2012.
3. Christian Nnaemeka Egwim, Hafiz Alaka, Luqman Olalekan Toriola-Coker, Habeeb Balogun, Funlade Sunmola, Applied artificial intelligence for predicting construction projects delay, Machine Learning with Applications, Vol:6, 100166–100166, 2021.

AN OVERVIEW OF RECENT MATHEMATICAL MODELS TO PREDICT EPIDEMICS

Şeyma Firdevs Hızal[1], Özlem Defterli[2], Hasan Bulut[1,3]

[1]Department of Mathematics, Fırat University, Elazıg, TR23100, Turkey

[2]Department of Mathematics, Cankaya University, Ankara, TR06815, Turkey

[3]Department of Mathematics, Beykent University, İstanbul, TR34500, Turkey

sfkorkmaz@firat.edu.tr, defterli@cankaya.edu.tr, hbulut@firat.edu.tr

Abstract

Mathematical models are essential tools for understanding the transmission dynamics of infectious diseases and predicting the progression of epidemics. In recent years, numerous studies have focused on the development of epidemiological models based on mathematical and data-driven approaches. This study provides a brief overview of commonly used epidemiological modeling frameworks reported in the literature. The reviewed studies primarily involve classical compartmental models such as the SIR and SEIR models and their extensions, which describe disease transmission through systems of differential equations representing transitions between epidemiological compartments. In addition, recent research increasingly integrates computational techniques and data-based forecasting methods to improve prediction accuracy. Despite these advances, challenges related to parameter uncertainty, data limitations, and the incorporation of behavioral factors remain significant issues in epidemic modeling. This study summarizes the main mathematical approaches used in epidemiological modeling and prediction. Further directions will be discussed.

Keywords: Compartmental epidemic models; Infectious disease dynamics; Differential equations

REFERENCES

1. Valeriano Iranzo, Saul Perez-Gonzalez, Epidemiological Models and COVID-19: A Comparative View, HPLS, No:43, 104, 2021.
2. Fatemeh Mirsaeedi, Mohammad Sheikhalishahi, Mehrdad Mohammadi, Dmitry Ivanov, Epidemiological Models to Predict Infection Epidemic: A Literature Review, Handbook of Ripple Effects in the Supply Chain, No:276, 249-330, 2025.
3. Fatemeh Mirsaeedi, Mohammad Sheikhalishahi, Mehrdad Mohammadi, Amir Pirayesh, Dmitry Ivanov, Compartmental Models in Epidemiology: Bridging the Gap with Operations Research for Enhanced Epidemic Control, Annals of Operations Research, No:357, 1021-1078, 2026.

THE CAUCHY MODIFIED GARIMA DISTRIBUTION: PROPERTIES, INFERENCE, AND EMPIRICAL APPLICATIONS

Ayşe Metin KARAKAŞ [1] **, Fatma BULUT** [2] *** and Bahadır YÜZBAŞI** [3]

[1] Department of Statistics, University of Bitlis Eren, Bitlis, Turkey.

[2] Department of Mathematics, University of Bitlis Eren, Bitlis, Turkey.

[3] Department of Econometrics, University of İnönü, Malatya, Turkey.

akarakas@beu.edu.tr, fbulut@beu.edu.tr, bahadir.yuzbasi@inonu.edu.tr

Abstract

This study introduces a novel two-parameter lifetime distribution, called the Cauchy Modified Garima (CMG) model, constructed by applying a Cauchy-type generator to the Modified Garima baseline distribution. Owing to its parsimonious yet flexible structure, the proposed model can capture a variety of density shapes, including decreasing and unimodal forms, and it provides enhanced tail flexibility through the Cauchy parameter. Key distributional properties are investigated, including the survival and hazard rate functions, quantile function, entropy-based measures, and order statistics with residual life functions. Parameter inference is conducted using both likelihood-based estimation and Bayesian MCMC procedures, and the finite-sample performance of the resulting estimators is assessed via Monte Carlo simulations. The practical relevance of the proposed CMG distribution is illustrated through two real data applications and benchmarked against several competing lifetime models, including classical Garima-type and standard reliability distributions. Overall, the comparative analyses indicate that the CMG model provides accurate estimation and competitive fit, highlighting its effectiveness for heterogeneous lifetime and reliability data with potentially heavy-tailed behavior.

Keywords: Cauchy-generated distribution; Modified Garima distribution; quantile function; hazard rate; maximum likelihood estimation; Bayesian inference; reliability analysis.

REFERENCES

1. A.K. Chaudhary, L.B.S. Telee, V. Kumar**,** Cauchy modified generalized exponential distribution:Estimation and applications*,* International Journal of Statistics and Applied Mathematics, Vol: 9, No: 2, 56–65, 2024.
2. Ayşe Metin Karakaş, Fatma Bulut, S. Şahin Bal**,** A novel Gompertz-type distribution with applications to radiological dose and pharmacokinetic data*,* Mathematics**,** Vol: 14, No: 4, 702, 2026.
3. Ayşe Metin Karakaş, Fatma Bulut, The new Gompertz distribution model and applications*, Symmetry,* Vol: 17, No: 6, 843, 2025.
4. Ayşe Metin Karakaş, Fatma Bulut, The half-logistic generalized power Lindley distribution: Theory and applications*,* Symmetry, Vol: 17, No: 11, 1936, 2025.

AI-SUPPORTED MODIFIED EXP-EXPANSION FUNCTION METHOD FOR NONLINEAR DYNAMICAL SYSTEMS

Sadullah Bulut[1] Muhammed YİĞİDER[2]

[1-2]Department of Mathematics, University of Erzurum Technical, Erzurum, Turkey
sadullah.bulut@erzurum.edu.tr, myigider@erzurum.edu.tr

Abstract

This study presents a method for solving nonlinear partial differential equations using an artificial intelligence-assisted modified exp-expansion function. First, the nonlinear equation is transformed into an ordinary differential equation by applying an appropriate traveling wave transformation. The analytical solution is then expressed as a finite series expansion made up of exponential functions within the modified exp-expansion framework. Unlike traditional analytical methods, the degree of the expansion and the unknown coefficients in the series are determined automatically with an artificial intelligence-based search strategy. This removes the need for manual trial procedures often used in standard expansion techniques. The proposed framework systematically investigates the possible solution space and finds parameter combinations that meet the governing equation. As a result, the analytical structure of the solutions is maintained, and the computational complexity is greatly reduced. Additionally, incorporating artificial intelligence into the modified exp-expansion method enhances the flexibility of the classical approach and allows for the generation of a wider range of exact solutions for nonlinear dynamical systems and various applied mathematical models.

Keywords: AI-supported analytical method, Modified Exp-Expansion Function Method, Nonlinear wave solutions.

REFERENCES

1. Ming, L., Muhammad, J., Yaro, D., Tipu, G. H., & Younas, U. (2025). Investigation of the exact solutions via sub-equation neural network method to the nonlinear systems in fluid and nuclear physics. AIP Advances, 15(7).
2. Bulut, S., & Yigider, M. (2025). Deep learning approaches for β− conformable fractional differential equations: A PINN, NRPINN-s, and NRPINN-un based solutions. AIMS Mathematics, 10(6), 13721-13740.

Wave Solutions, Energy Analysis, and Physical Characterization of a Nonlinear Evolution Equation

İlknur Kızıl [1] **Ulviye Demirbilek**[1] **Hadi Rezazadeh** [2]

[1] Department of Mathematics, Faculty of Science, Mersin University, Mersin, Turkey.

[2] Faculty of Engineering Modern Technologies, Amol University of Special Modern Technologies, Amol, Iran

ilknurkizil12025@gmail.com, udemirbilek@mersin.edu.tr, h.rezazadeh@ausmt.ac.ir

Abstract

In this study, the nonlinear evolution equation addressed is used to model various physical phenomena, primarily in fluid mechanics and wave dynamics, as well as in biophysical processes, nonlinear optical systems, and plasma physics [1,3]. Two advanced analytical methods have been used to obtain exact solutions of the equation. These methods have created many soliton solutions and different wave solutions for the model. In addition to the analytical techniques employed, a periodic solution has been obtained using the energy equation. This demonstrates that the dynamics of the system are stable, the solution is consistent with the physical principle of energy conservation, and the solutions are applicable to real physical systems. Finally, detailed analyses of the physical behaviors of some solutions have been conducted using 3D, 2D, and contour plots. The techniques applied and the solutions achieved offer a strong resource for various physical and engineering challenges, making a significant contribution to research in these fields.

Keywords: Nonlinear Dynamics; Exact solutions; Soliton Solutions;

REFERENCES

1. Mahmood, S. S., Murad, M. A. S., Rezazadeh, H., Demirbilek, U., & Salahshour, S. (2026). Optical propagation in Kudryashov's model with arbitrary refractive index and nonlocal nonlinearities. *Physica B: Condensed Matter*, 418439.
2. Demirbilek, U., Tedjani, A. H., & Seadawy, A. R. (2025). Analytical solutions of the combined Kairat-II-X equation: a dynamical perspective on bifurcation, chaos, energy, and sensitivity. *AIMS Math*, *10*(6), 13664-13691.
3. Kızıl, İ., Demirbilek, U., & Çelik, E. (2026). Investigation of New Analytical and Numerical Solutions of the Extended (2+ 1) Dimensional Boussinesq Equation Using Fractional Derivative Approaches. *Journal of Computational Physics*, 114654.

Soliton Wave Structures of (2+1) Dimensional Nonlinear Evolution Equation

Ulviye Demirbilek[1] **Hasan Bulut**[2] **Ercan Çelik**[3] **İlknur Kızıl**[1]

[1] Department of Mathematics, Faculty of Science, Mersin University, Mersin, Turkey.

[2] Department of Mathematics, University of Firat, Elazig, Turkey.

[3] Department of Mathematics, Ataturk University, Erzurum, Turkey

hbulut@firat.edu.tr, udemirbilek@mersin.edu.tr, ercan.celik@manas.edu.kg,
ilknurkizil12025@gmail.com.

Abstract

In this study, a (2+1)-dimensional nonlinear evolution equation, which is effective in problems related to soliton waves, will be addressed, involving phenomena with mathematical physics and complex dynamics such as biophysics and ecology models, nonlinear fluid dynamics, plasma physics, geophysics, and acoustic applications [1,3]. An advanced analytical method has been used to obtain exact solutions of the equation, and a variety of wave solutions with dark, bright, periodic, combo, and lump soliton structures have been derived. Some of these solutions have been visualized through 3D, 2D, and contour plots, and their physical structures have been thoroughly examined. Comprehensive analyses have been conducted on the dynamic properties, structural diversity, and physical meanings of the solutions. The visualization of these solutions shows how such equations behave in different physical environments.

Keywords: Evolution Equation; Wave Solutions; Solitons.

REFERENCES

1. Bulut, H., Demirbilek, U., & Çelik, E. (2025). Dynamical Soliton Solutions of (2+ 1)-Dimensional Paraxial Wave and (4+ 1)-Dimensional Fokas Wave Equations With Truncated M-Fractional Derivative Using an Efficient Technique. *Journal of Mathematics*, *2025*(1), 6659392.
2. Demirbilek, U., Tedjani, A. H., & Seadawy, A. R. (2025). Analytical solutions of the combined Kairat-II-X equation: a dynamical perspective on bifurcation, chaos, energy, and sensitivity. *AIMS Math*, *10*(6), 13664-13691.
3. Kızıl, İ., Demirbilek, U., & Çelik, E. (2026). Investigation of New Analytical and Numerical Solutions of the Extended (2+ 1) Dimensional Boussinesq Equation Using Fractional Derivative Approaches. *Journal of Computational Physics*, 114654.

The Novel Lomax-Garima Distribution: Properties and Applications

Aslıhan Demir[1] Ayşe Metin Karakaş[2] Sinan Çalık[3]

[1,3]Department of Statistics, University of Firat, Elazig, Turkey

[2]Department of Statistics, University of Bitlis Eren, Bitlis, Turkey

[1]a.bilici128@gmail.com [2]aysekarakas5767@gmail.com [3]scalik@firat.edu.tr

Abstract

In this study, the Novel Lomax-Garima (NL-G) distribution, a novel continuous probability distribution combining the flexibility of the Lomax distribution with the modeling capacity of the Garima distribution, is introduced. The statistical properties of the distribution are comprehensively examined; the validity of the probability density function (PDF), cumulative distribution function (CDF), hazard function, quantile function (via the Lambert-W function), and series expansion representation are derived. Furthermore, closed-form expressions for the moments of the distribution are obtained. The Least Squares (LS), Weighted Least Squares (WLS), and Maximum Likelihood (ML) methods are used to estimate the parameters of the proposed distribution. The efficiency of the estimation methods is evaluated according to bias and mean square error (MSE) criteria through a comprehensive simulation study conducted for different sample sizes. The findings reveal the consistency and efficiency of the estimators, particularly the ML estimators, with increasing sample size.

Keywords: Lomax Distribution, Garima Distribution, Quantile Function, Lambert-W Function, Maximum Likelihood Estimation, Simulation.

REFERENCES

1. Astorga, J. M., & Iriarte, Y. A. (2025). The Lambert-Topp-Leone distribution: An alternative for modeling proportion and lifetime data. *Frontiers in Applied Mathematics and Statistics*, *11*, 1527833.

2. Collett, D. (2023). *Modelling survival data in medical research* (4th ed.). Chapman and Hall/CRC.

3. Cordeiro, G. M., & de Castro, M. (2011). A new family of generalized distributions. *Journal of Statistical Computation and Simulation*, *81*(7), 883-898.

4. Gemay, A. M., Karakaya, K., Bakr, M., Balogun, O. S., Atchade, M. N., & Hussam, E. (2023). Power Lambert uniform distribution: Statistical properties, actuarial measures, regression analysis, and applications. *AIP Advances*, *13*(9), 095319.

5. Eugene, N., Lee, C., & Famoye, F. (2002). Beta-normal distribution and its applications. *Communications in Statistics - Theory and Methods*, *31*(4), 497-512.

ON STABILITY INEQUALITIES AND NUMERICAL SOLUTIONS OF THIRD-ORDER NEUTRAL INTEGRO-DIFFERENTIAL EQUATIONS

Damla Dağ [1] **and İlhame Amirali** [1]

[1] Department of Mathematics, Düzce University, Düzce, Turkey

damlaadaag2630@gmail.com

ailhame@gmail.com

Abstract

In this study, stability inequalities and numerical solutions for third-order neutral integro-differential equations are investigated. New stability inequalities are derived to establish the stability of the solutions. Moreover, a numerical method is used to approximate the solutions of the considered problem. The obtained results contribute to the theoretical analysis and numerical solutions of third-order neutral integro-differential equations.

Keywords: Neutral integro-differential equations; Stability inequalities; Numerical solutions.

REFERENCES

1. S. Abdollahramezani, A. Chizari, A. E. Dorche, M. V. Jamali, J. A. Salehi, Dielectric metasurfaces solve differential and integro-differential equations, Optics Letters, Vol:42, No:7, 1197–1200, 2017.

2. I. Amirali, B. Fedakar, G. M. Amiraliyev, Second-order numerical method for a neutral Volterra integro differential equation, Journal of Computational and Applied Mathematics, Vol:453, No:1, 116160, 2025.

3. H. M. Christov, Nonlinear neutral integro-differential equations in economic modeling, International Journal of Economic Theory, Vol:3, No:4, 283–298, 2007.

4. E. Hesameddini, M. Shahbazi, Solving multipoint problems with linear Volterra-Fredholm integro-differential equations of the neutral type using Bernstein polynomials method, Applied Numerical Mathematics, Vol:136, No:1, 122–138, 2019.

5. J. Medlock, M. Kot, Spreading disease: integro-differential equations old and new, Mathematical Biosciences, Vol:184, No:2, 201–222, 2003.

Type-Solitons Propagation for nonlinear systems of mathematical model

Hasan Bulut[1,2], Şeyma Firdevs HIZAL[1], Gülnur Yel[3]

[1]Faculty of Science Department of Mathematics, Firat University Elazig, Türkiye

[2]Istanbul Beykent University, Faculty of Arts-Sciences, Department of Mathematics, Buyukcekmece / Istanbul, Türkiye

[3]Faculty of Engineering, Final International University, Girne, Mersin 10, Türkiye

Abstract

The purpose of this study is to obtain soliton solutions for a mathematical model that is nonlinear. The extraction of various kinds of solutions is accomplished by the utilization of an effective sine-Gordon equation (SGEM) approach. The three-dimensional, two-dimensional, and contour plots have been utilized in order to illustrate the physical characteristics of the solutions that have been produced.

Keywords: soliton solutions, nonlinear systems of equations, sine-Gordon equation

References

[1] G. B. Whitham. Linear and Nonlinear Waves, JohnWhiley, New york, 1974.

[2]Agrawal GP. Nonlinear fiber optics. New York, Academic Press, 1995.

[3]Hesegawa A, Kodama Y. Solitons in optical communication. Oxford, Oxford University Press,1995.

[4]A. Biswas, S. Konar, Introduction to Non-Kerr Law Optical Solitons, CRC Press Boca Raton, FL, USA (2006).

[5]J. Fujioka, E. Cortes, R. Perez-Pascual, R.F. Rodriguez, A. Espinosa, B.A. Malomed, Chaotic solitons in the quadratic-cubic nonlinear Schrodinger equation under nonlinearity management, Chaos 21, 63-70 (2011).

[6]R. Pal, S. Loomba, C.N. Kumar, Chirped self-similar waves for quadratic-cubic nonlinear Schrodinger equation, Annals of Physics, https://doi.org/10.1016/j.aop.2017.10.007 (2017).

Fundamental Solution Method and Application to the 3-D MHD Equations

Selçuk Han AYDIN [1] **, Shokoufeh GHEZELJEH** [1]

[1] Department of Mathematics, Karadeniz Technical University, Trabzon, Türkiye

shaydin@ktu.edu.tr, Shokofeh.ghezeljeh@gmail.com,

Abstract

In this study, we consider the the method of fundamental solution both on 2D and 3D cases by considering fundamental solutions of Laplace, convection-diffusion and modified Helmholtz equations. We tested the proposed numerical procedure for different type problems and obtain solutions are compared in terms of L2 norms using the exact solutions of the corresponding partial differential equations. Then, the considered schemes are applied to the numerical solution of the MHD flow equations by transforming the coupled partial differential equations to the both decoupled convection-diffusion and modified Helmholtz equation forms. The comparision of the two different numerical formulations are performed using the known exact solution of the MHD equation in 2-D case over square domain. Finally, the formulations are extended for the solution of the 3-D MHD equations. Obtained solutions are displayed in terms of tables and figures for different problem parameters.

Keywords: Fundamental Solution Method, MHD Equations, 3-D Application

REFERENCES

1. L Dragos, Magnetofluid Dynamics, Abacus Pres, 1975.
2. J A Shercliff J, Fluid Mech, Vol:1, No: 6 , 644–666, 1956.
3. L Shuainan, L Po-Wei, F Chia-Ming, G Yan, Localized method of fundamental solutions for two and three-dimensional transient convection-diffusion-reaction equations, Engineering Analysis with Boundary Elements, Vol:124, 237–244, 2021.
4. S H Aydin, M C Erdogan, Stabilization in 3-D FEM and solution of the MHD equations, Mathematical Methods in the Applied Sciences, Vol:46, No:12, 13395-13410, 2023.

BRİGHTNESS ENHANCEMENT OF LOW-LİGHT IMAGES USİNG POLYNOMİAL-BASED

[1]Yusuf Erbek,[2]Bilal Şeker, [3]İsmail Can Şeker

[1]Institute of Graduate Studies, Department of Mathematics, Batman University, Batman, Turkey

[2]Department of Mathematics, Batman University, Batman, Turkey

[3]Turkish Technology, Ankara, Turkey

nebulatarsus@gmail.com, bilal.seker@batman.edu.tr, i.seker@thy.com,

Abstract

Improving low-light images is a well-known challenge, especially when trying to increase brightness without ruining colors or adding structural noise. While deep learning models handle this reasonably well, they usually work as opaque "black boxes" and need heavy computational resources. In this paper, we take a completely different route using Geometric Function Theory. Instead of relying on massive training data, we construct our approach around bi-univalent functions defined on the open unit disk, structured under Sakaguchi subordination and driven by Hermite polynomials. This setup lets us explicitly calculate the upper bounds for the initial Taylor coefficients (a_2 and a_3). We tested our method on the standard LOL dataset and evaluated the results using the SSIM metric. Overall, our mathematical model proves to be a practical, transparent alternative to data-heavy algorithms for image enhancement.

Keywords: Analytic Functions, Low-Light Image Enhancement, SSIM, Convolution.

REFERENCES

1. Chen Wei, Wenjing Wang, Wenhan Yang, Jiaying Liu, Deep Retinex Decomposition for Low-Light Enhancement, arXiv preprint arXiv:1808.04560.
2. Zhou Wang; A.C. Bovik; H.R. Sheikh; E.P. Simoncelli, Image Quality Assessment: From Error Visibility to Structural Similarity. IEEE Trans. Image Process. 13(4), 600–612 (2004).
3. K. Sivagami Sundari, B. Srutha Keerthi, Enhancing the quality of low-light images via the coefficient bounds derived for a subclass of Sakaguchi-type function,EURASIP Journal on Image and Video Processing, 2025(4), 2025.

COMPUTATIONAL FLUID DYNAMICS SIMULATIONS FOR TURBINE BLADE COOLING USING JET IMPINGEMENT

Sefa YILMAZ[1], **Sertaç ÇADIRCI**[2]

[1,2] Istanbul Techincal University, Departmant of Mechanical Engineering

[1]yilmazsefa1@itu.edu.tr, [2]cadircis@itu.edu.tr

Abstract

This study presents a comprehensive numerical investigation of internal heat-transfer characteristics in a generic turbine blade passage cooled by jet impingement under high crossflow conditions. A three-dimensional CFD model was developed using the appropriate Reynolds-averaged Navier–Stokes (RANS) turbulence model to resolve jet–crossflow interaction, flow separation, and heat-transfer augmentation mechanisms. The numerical methodology is in accordance with the experimental and numerical studies available in the literature [1,2]. Parametric simulations were conducted for multiple impingement hole arrangements, jet-to-jet pitch (P) and jet-to-surface spacing (H) at various jet Reynolds numbers (Re_D) under a certain high crossflow intensity to evaluate their influence on area-averaged Nusselt number (Nu) distributions. The investigated parameter space covers Re_D values from 10000 to 40000, with H/D ranging from 1.4 to 5.3 and P/D from 2 to 8 where D denotes jet diameter. Based on the numerical results, an empirical correlation for the Nusselt number was developed as a function of Re_D, H/D and P/D. The results indicate that the jet Reynolds number is the dominant factor governing heat-transfer enhancement, while H/D and P/D exert secondary but comparable influences due to jet diffusion and reduced jet-to-jet interaction.

Keywords: Internal Cooling, CFD, Heat Transfer, Jet Impingement, Crossflow.

REFERENCES

1. M. Forster and B. Weigand, "Experimental and numerical investigation of jet impingement cooling onto a concave leading edge of a generic gas turbine blade," *International Journal of Thermal Sciences*, vol. 164, Art. no. 106862, 2021

2. R. E. Chupp, D. E. Helms, P. W. McFadden, and T. R. Brown, "Evaluation of internal heat-transfer coefficients for impingement-cooled turbine airfoils," *AIAA Journal of Aircraft*, vol. 6, no. 3, pp. 203–208, 1969.

A research study on the numerical solution of the Burgers equation by Galerkin Method based on Hermite B-spline functions

Dr. Ali Sercan KARAKAŞ[1]

[1] Department of Mathematics, University of Inonu, Malatya, Turkey

ORCİD ID: 0000-0001-8622-1127

alisercankarakas@gmail.com,

Abstract

Scientists who seek to understand, interpret, and explain the natural phenomena with curiosity have modeled these situations and transferred them into the abstract world of mathematics. They have also studied them under various solution methods and presented some of their findings as research studies. The main objective of this study is to present a numerical investigation of the Burgers equation using Hermite B-spline basis functions, which have become popular in recent years and are increasingly used, under certain boundary and initial conditions, with the help of cubic-degree Galerkin finite elements methods. To the best of the authors' knowledge, no study using the Galerkin method with Hermite basis functions has been found in the literature. This indicates the originality of the research. The equation under consideration will first be subjected to a Crank-Nicolson type discretization. Subsequently, after the nonlinear terms in the governing equation are linearized using appropriate linearization methods, a fully discretized structure will be obtained using Hermite basis functions in the spatial direction. Thus, the initial equation will be transformed into a problem of finding an algebraic equation system that can be solved in time and position, and a quadratic matrix system will be obtained using the boundary conditions given with the governing equation, and the corresponding code will be written using the MATLAB programming language, which is a symbolic programming language. Using the matrix system obtained and the pseudo code written, the reliability and accuracy of the numerical method applied under three different test problems will be investigated. If the analytical solutions exist for the test problems addressed in the results section, the error norms will be calculated. If no analytical solution exists, the conservation constants known as mass, energy, and momentum will be calculated and compared with other numerical solution methods in the literature to measure the novelty of the applied method and the accuracy of its results. The results will be presented in tables and graphs in the study. Upon examination of the results, it has been found that good results are obtained, that the method is applicable in many engineering applications, and that its application to partial differential equations of different types and under different boundary conditions is recommended.

Keywords: Galerkin finite Element Method, Burgers, Hermite Basis function.

A PRELIMINARY STUDY ON THE ANAGEOMETRIC LAPLACE TRANSFORM

Numan Yalcin [1]

[1] Department of Electronics and Automation, Vocational School of Gumushane, Gumushane University, Gumushane, Turkey

numan@gumushane.edu.tr

Abstract

This study presents a preliminary framework for the anageometric Laplace transform within non-Newtonian calculus. The transform is defined based on the anageometric integral, and its fundamental properties, including linearity and basic operational rules, are established. A simple example is provided to illustrate its basic computational behavior. The results suggest that the proposed transform can serve as an alternative analytical tool in non-classical settings. Further developments and applications, particularly in anageometric differential equations, are left for future work.

Keywords: Anageometric Laplace transform; Non-Newtonian calculus; Integral transforms.

REFERENCES

1. A. E. Bashirov, E. Misirli, A. Ozyapici, Multiplicative calculus and its applications, Journal of Mathematical Analysis and Applications, Vol:337, No:1, 36–48, 2008.
2. M. Grossman, R. Katz, Non-Newtonian Calculus: A Self-Contained, Elementary Exposition of the Authors' Investigations, Lee Press, 1972.
3. M. Grossman, An introduction to non-Newtonian calculus, International Journal of Mathematical Education in Science and Technology, Vol:10, No:4, 525–528, 1979.
4. K. Boruah, B. Hazarika, An anageometric time scale calculus and its some basic applications, Journal of Mathematical Analysis and Applications, Vol:541, No:1, 128691, 2025.
5. S. Kaymak, N. Yalcin, On bigeometric Laplace integral transform, Journal of the Institute of Science and Technology, Vol:13, No:3, 2042–2056, 2023.
6. N. Yalcin, E. Celik, A. Gokdogan, Multiplicative Laplace transform and its applications, Optik, Vol:127, No:22, 9984–9995, 2016.

CONSERVATION LAWS AND EXACT SOLUTIONS OF A NONLINEAR PARTIAL DIFFERENTIAL EQUATION

Zelal Aslan [1], **Ulviye Demirbilek** [1], **Arzu Akbulut** [2]

[1] Department of Mathematics, Faculty of Science, Mersin University, Mersin, Turkey
[2] Department of Mathematics, Faculty of Arts and Science, Bursa Uludağ University, Bursa, Turkey

zelal.aslaann@gmail.com, udemirbilek@mersin.edu.tr, arzuakbulut@uludag.edu.tr

Abstract

This study examines a nonlinear partial differential equation, which is considered one of the most effective models for describing the behavior of phototactic bacteria. Our aim is to investigate the formal Lagrangian of the equation, the conservation laws, and new analytical solutions of the equation, following the examination of the invariance of the nonlinear evolution equation under Lie point transformations [1-3]. Several exact solutions have been obtained by means of the semi-analytical method. Additionally, the physical dynamics of specific solutions have been visualized and interpreted through 3D, 2D, and contour plots.

Keywords: Nonlinear partial differential equation; Conservation laws; Lie symmetry analysis; Exact solutions.

REFERENCES

1. Demirbilek, U., Muhammad, J., Akbulut, A., Younas, U., Radwan, T., & Ahmed, K. K. (2026). The Dynamical Landscape of the Negative-Order (3+ 1)-Dimensional Calogero–Bogoyavlenskii–Schiff Equation. *Journal of Mathematics*, *2026*(1), 8273647.
2. Demirbilek, U. (2025). Analytical study on the generalized q-deformed Sinh–Gordon (Eleuch) equation. *Computational Mathematics and Mathematical Physics*, *65*(4), 825-839.
3. Akbulut, A., Sajjad Hashemi, M., & Rezazadeh, H. (2024). New conservation laws and exact solutions of coupled Burgers' equation. *Waves in Random and Complex Media*, *34*(4), 3579–3598.

A STUDY ON THE ANAGEOMETRIC DERIVATIVE AND ITS FUNDAMENTAL PROPERTIES

Numan Yalcin[1] **and Mutlu Dedeturk**[2]

[1] Department of Electronics and Automation, Vocational School of Gumushane, Gumushane University, Gumushane, Turkey
[2] 2Department of Mathematical Engineering, Gumushane University, Gumushane, 29100, Turkey

numan@gumushane.edu.tr

mutludedeturk@gumushane.edu.tr

Abstract

This study presents a preliminary investigation of the anageometric derivative within non-Newtonian calculus. Basic concepts, including anageometric functions, limits, and continuity, are briefly introduced. The anageometric derivative is defined, and its relationship with the classical derivative is highlighted. Fundamental properties are discussed with examples. The results indicate that the anageometric derivative provides an alternative approach to measuring variation based on logarithmic scaling.

Keywords: Anageometric derivative; Non-Newtonian calculus; Logarithmic scaling.

REFERENCES

1. A. E. Bashirov, E. Misirli, A. Ozyapici, Multiplicative calculus and its applications, Journal of Mathematical Analysis and Applications, Vol:337, No:1, 36–48, 2008.
2. M. Grossman, R. Katz, Non-Newtonian Calculus: A Self-Contained, Elementary Exposition of the Authors' Investigations, Lee Press, 1972.
3. M. Grossman, An introduction to non-Newtonian calculus, International Journal of Mathematical Education in Science and Technology, Vol:10, No:4, 525–528, 1979.
4. K. Boruah, B. Hazarika, G-calculus, TWMS Journal of Applied and Engineering Mathematics, Vol:8, No:1, 94–105, 2018.
5. K. Boruah, B. Hazarika, An anageometric time scale calculus and its some basic applications, Journal of Mathematical Analysis and Applications, Vol:541, No:1, 128691, 2025.

NONEXISTENCE OF GLOBAL SOLUTIONS FOR THE SINGULAR PARABOLIC-TYPE EQUATION

Ayşe Demirhan[1] and Erhan Pişkin[2]

[1]Institute of Natural and Applied Sciences, Dicle University, Diyarbakır, Turkey

[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey

aysedemirhan5@gmail.com, episkin@dicle.edu.tr

Abstract

In this work, we consider the singular parabolic type equation with initial and boundary conditions. We prove the nonexistence of global solutions under suitable conditions.

Keywords: Nonexistence, parabolic type equation, singular potential.

REFERENCES

1. Y. Chunxiao, P. Xinyu, C. Yuqing, Global and Non-Global Solutions for Pseudo Parabolic Equation with Singular Potential, Journal of Partial Differential Equations 38 (3) (2025) 324-334.
2. A. Fidan, E. Pişkin, Existence and blow up of solutions for a singular higher-order viscoelastic parabolic equation with logarithmic nonlinearity, FİLOMAT, 39(26) (2025) 9191-9211.
3. E. Pişkin, A. Fidan, J. Ferreira, M. Shahrouzi, Blow up and global existence of solutions for a higher-order reaction diffusion equation with singular potential, CUBO, A Mathematical Journal, 28(1) (2026) 79-97.
4. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Patlaması (Blow up of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2022.

COMPARİSON OF IMAGE ENHANCEMENT PERFORMANCES OF DİFFERENT POLYNOMİAL-BASED APPROACHES

[1]Bahattin Erkmen,[2]Bilal Şeker, [3]İsmail Can Şeker

[1]Institute of Graduate Studies, Department of Mathematics, Batman University, Batman, Turkey

[2]Department of Mathematics, Batman University, Batman, Turkey

[3]Turkish Technology, Ankara, Turkey

Bahattinerkmen21@gmail.com, bilal.seker@batman.edu.tr, i.seker@thy.com,

Abstract

Improving low-light images is a well-known challenge, especially when trying to increase brightness without ruining colors or adding structural noise. While deep learning models handle this reasonably well, they usually work as opaque "black boxes" and need heavy computational resources. In this paper, we take a completely different route using Geometric Function Theory. Instead of relying on massive training data, we construct our approach around bi-univalent functions defined on the open unit disk, structured under Sakaguchi subordination and driven by Bernoulli polynomials. This setup lets us explicitly calculate the upper bounds for the initial Taylor coefficients (a_2 and a_3). We tested our method on the standard LOL dataset and evaluated the results using the SSIM metric. Overall, our mathematical model proves to be a practical, transparent alternative to data-heavy algorithms for image enhancement.

Keywords: Analytic Functions, Low-Light Image Enhancement, SSIM, Convolution.

REFERENCES

1. Chen Wei, Wenjing Wang, Wenhan Yang, Jiaying Liu, Deep Retinex Decomposition for Low-Light Enhancement, arXiv preprint arXiv:1808.04560.
2. Zhou Wang; A.C. Bovik; H.R. Sheikh; E.P. Simoncelli, Image Quality Assessment: From Error Visibility to Structural Similarity. IEEE Trans. Image Process. 13(4), 600–612 (2004).
3. K. Sivagami Sundari, B. Srutha Keerthi, Enhancing the quality of low-light images via the coefficient bounds derived for a subclass of Sakaguchi-type function,EURASIP Journal on Image and Video Processing, 2025(4), 2025.

EXISTENCE OF SOLUTIONS FOR A HIGHER-ORDER WAVE EQUATION WITH DELAY TERM

Güldar Efe[1] and Erhan Pişkin[2]

[1]Institute of Natural and Applied Sciences, Dicle University, Diyarbakır, Turkey

[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey

guldarefe@gmail.com, episkin@dicle.edu.tr

Abstract

In this presentation, we study a higher-order wave equation with a delay term in a bounded domain. We consider the existence of solutions using the Faedo-Galerkin method.

Keywords: Existence, Delay term, Faedo-Galerkin.

REFERENCES

1. T. Cömert, E. Pişkin, Global Existence and Exponential Decay of Solutions for Higher-Order Parabolic Equation with Logarithmic Nonlinearity, Miskolc Mathematical Notes, 23(2) (2022) 595-605.
2. A. Fidan, E. Pişkin, Existence and blow up of solutions for a singular higher-order viscoelastic parabolic equation with logarithmic nonlinearity, FİLOMAT, 39(26) (2025) 9191-9211.
3. N. Irkıl, E. Pişkin, Global existence and decay of solutions for a higher-order Kirchhoff-type systems with logarithmic nonlinearities, Quaestiones Mathematicae, 45(4) (2022) 523-546.
4. N. Yılmaz, M. Demir, E. Pişkin, Local existence and blow-up of solutions for the higher-order viscoelastic equation with general source term and variable exponents: Theoretical and numerical results, Nonlinear Analysis: Real World Applications, 89 (2026) 104512.

GLOBAL EXISTENCE AND BLOW UP OF SOLUTIONS FOR A HYPERBOLIC-TYPE EQUATION

Alan Kılıç

[1]Institute of Natural and Applied Sciences, Dicle University, Diyarbakır, Turkey

kilicalan359@gmail.com

Abstract

In this work, we investigate the hyperbolic-type equation with initial and boundary conditions. The global existence is established. Furthermore, we prove that solutions blow up in finite time using the concavity method.

Keywords: Global existence, blow up, hyperbolic-type equation.

REFERENCES

1. K. Agre, M.A. Rammaha, Systems of nonlinear wave equations with damping and source terms, Diff. Integral Eqns., 19 (11) (2006) 1235-1270.
2. V.K. Kalantarov, O.A. Ladyzhenskaya, The occurrence of collapse for quasilinear equations of parabolic and hyperbolic type, J. Soviet Math., 10 (1978) 53-70.
3. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Patlaması (Blow up of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2022.
4. E. Pişkin, Uniform decay and blow-up of solutions for coupled nonlinear Klein-Gordon equations with nonlinear damping terms, Math. Meth. Appl. Sci., 37(18) (2014) 3036-3047.

ENHANCEMENT OF IMAGE CONTRAST USİNG POLYNOMİAL-BASED NUMERİCAL METHODS

[1]Mücahit Yüzgül,[2]Bilal Şeker, [3]İsmail Can Şeker

[1]Institute of Graduate Studies, Department of Mathematics, Batman University, Batman, Turkey

[2]Department of Mathematics, Batman University, Batman, Turkey

[3]Turkish Technology, Ankara, Turkey

mucahityuzgul10@gmail.com, bilal.seker@batman.edu.tr, i.seker@thy.com,

Abstract

Improving low-light images is a well-known challenge, especially when trying to increase brightness without ruining colors or adding structural noise. While deep learning models handle this reasonably well, they usually work as opaque "black boxes" and need heavy computational resources. In this paper, we take a completely different route using Geometric Function Theory. Instead of relying on massive training data, we construct our approach around bi-univalent functions defined on the open unit disk, structured under Sakaguchi subordination and driven by Laguerre polynomials. This setup lets us explicitly calculate the upper bounds for the initial Taylor coefficients (a_2 and a_3). We tested our method on the standard LOL dataset and evaluated the results using the SSIM metric. Overall, our mathematical model proves to be a practical, transparent alternative to data-heavy algorithms for image enhancement.

Keywords: Analytic Functions, Low-Light Image Enhancement, SSIM, Convolution.

REFERENCES

1. Chen Wei, Wenjing Wang, Wenhan Yang, Jiaying Liu, Deep Retinex Decomposition for Low-Light Enhancement, arXiv preprint arXiv:1808.04560.
2. Zhou Wang; A.C. Bovik; H.R. Sheikh; E.P. Simoncelli, Image Quality Assessment: From Error Visibility to Structural Similarity. IEEE Trans. Image Process. 13(4), 600–612 (2004).
3. K. Sivagami Sundari, B. Srutha Keerthi, Enhancing the quality of low-light images via the coefficient bounds derived for a subclass of Sakaguchi-type function,EURASIP Journal on Image and Video Processing, 2025(4), 2025.

THEORETICAL AND NUMERICAL RESULTS OF SOLUTIONS FOR THE PARABOLIC TYPE EQUATION

Muhteşem Demir[1] and Erhan Pişkin[2]

[1]Institute of Natural and Applied Sciences, Dicle University, Diyarbakır, Turkey

[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey

demirmuhtesem@gmail.com, episkin@dicle.edu.tr

Abstract

In this work, we consider the parabolic-type equation in a bounded domain with initial and boundary conditions. We consider the theoretical and numerical of solutions under suitable conditions.

Keywords: Theoretrical result, numerical result, parabolic type equation.

REFERENCES

1. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Patlaması (Blow up of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2022.
2. E. Pişkin, F. Ekinci, Qualitative analysis of solutions for a Kirchhoff-type parabolic equation with multiple nonlinearities, Hacettepe Journal of Mathematics and Statistics, 50(2) (2021) 397-413.
3. E. Pişkin, F. Ekinci, Blow up and growth of solutions to a viscoelastic parabolic type Kirchhoff equation, Filomat, 37(2) (2023) 519-530.

THEORETICAL AND NUMERICAL ANALYSIS OF NONLINEAR HIGHER-ORDER WAVE EQUATIONS

Erhan Pişkin[1] and Nebi Yılmaz[2]

[1]Dicle University, Department of Mathematics, Diyarbakır, Türkiye

[2]Institute of Natural and Applied Sciences, Dicle University, Diyarbakır, Türkiye

episkin@dicle.edu.tr, nebiyilmaz1981@gmail.com

Abstract

In this work, we consider a higher-order wave equation with initial-boundary conditions in a bounded domain. First, we prove the blow-up of solutions under suitable conditions. Later, we provide numerical results to support our theoretical findings.

Keywords: Blow-up, numerical analysis, higher-order wave equation.

REFERENCES

1. E. Pişkin, N. Yılmaz, Blow up of solutions for a system of strongly damped Petrovsky equations with variable exponents, Acta Universitatis Apulensis, 71 (2022) 87-99.
2. N. Yılmaz, M. Demir, E. Pişkin, Local existence and blow-up of solutions for the higher-order viscoelastic equation with general source term and variable exponents: Theoretical and numerical results, Nonlinear Analysis: Real World Applications, 89 (2026) 104512.
3. N. Yılmaz, E. Pişkin, E. Çelik, Well-Posedness and Blow-Up of Solutions for a Variable Exponent Nonlinear Petrovsky Equation, Advances in Mathematical Physics, Volume 2023, Article ID 8866861, 1-13.
4. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Patlaması (Blow up of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2022.

ANALYTICAL INVESTIGATION OF NONLINEAR WAVE STRUCTURES VIA A MODIFIED EXPONENTIAL METHOD

Nursemin KAŞ[1], Tolga AKTÜRK[2]

[1]Department of Mathematics, Institute of Science, Ordu University, Turkey

[2]Department of Mathematics and Science Education, Faculty of Education, Ordu University, Turkey

[1]nurseminkas52@gmail.com; [2]tolgaakturkk@gmail.com;

ABSTRACT

In this paper, the propagating wave solutions of the Hirota-Ramani equation, a well-known model in physics and quantum mechanics, are investigated using a modified exponential function method. This method is used to find the analytical propagating wave solutions of the Hirota-Ramani equation. Different propagating wave solutions are obtained by giving appropriate values to the parameters of the nonlinear mathematical model. In this way, two and three-dimensional graphs of the different wave solutions obtained are plotted according to the appropriate parameters.

Keywords: Modified Exponential Function method; Wave solutions: Hirota Ramani equation;

REFERENCES

1. Abazari Reza, Abazari Rasoul. Hyperbolic, trigonometric, and rational function solutions of Hirota- Ramani equation via (G′/G)-expansion method, Math. Probl. Eng, 2011, (424801).
2. A.-M. Wazwaz. The tanh method for travelling wave solutions to the Zhiber-Shabat equation and other related equations, Communications in Nonlinear Science and Numerical Simulation, 584–592, 2008.
3. Y. Zhou, M. Wang, and Y. Wang, Periodic wave solutions to a coupled KdV equations with variable coefficients, Physics Letters A, 31-36,2003.
4. Li Wei, Li Wenting, Wang Fei, Zhang Hongqing, Differential invariants for Hirota–Ramani equation and Drinfel'd–Sokolov–Wilson system.888-894,2013.
5. Ji Jie, A new expansion and new families of exact traveling solutions to Hirota equation, 881-883, 2008.
6. Farrah Ashraf, Romana Ashraf, Akgül Ali. Traveling waves solutions of Hirota–Ramani equation by modified extended direct algebraic method and new extended direct algebraic method, 2024, (2450329).
7. Aktürk Tolga, Kubal Çağlar. Analysis of wave solutions of (2+1)- dimensional Nizhnik – Novikov - Veselov equation Department of Mathematics and Science Education, Faculty of Education. Ordu Univ. J. Sci. Tech. , 11(1), 13-24, 2021.

Lie Symmetry Analysis, Conservation Laws and Exact Solutions of a Nonlinear Evolution Equation

Nada Alsaaıd [1] **, Ulviye Demirbilek** [1] **, Arzu Akbulut** [2]

[1] Department of Mathematics, Mersin University, Mersin, Turkey
[2] Department of Mathematics, Bursa Uludag University, Bursa, Turkey

nadaalsaid75@gmail.com, udemirbilek@mersin.edu.tr, arzuakbulut@uludag.edu.tr

Abstract

Partial differential equations (PDEs) play an important role in modeling physical and mathematical phenomena [1-3]. One powerful method for analyzing these equations is to study Lie algebra symmetries and conservation laws, as these are key to understanding the behavior of solutions.In this study, we examine a nonlinear PDE describing the behavior of phototrophic bacterial colonies, where a software is used to identify Lie point symmetries. Based on these symmetries, conservation laws are derived using the formal Lagrangian formulation and the conservation theorem. Furthermore, exact solutions of the equation are obtained, and a stability analysis is performed to investigate the stability of these solutions. This method highlights the underlying dynamics of phototaxis in bacteria and may be extended to the study of similar systems in the future.

Keywords: Conservation laws; Nonlinear PDE; Stability analysis; Lie point symmetries; Bacterial colony.

REFERENCES

1. Demirbilek, U., Nadeem, M., Çelik, F. M., Bulut, H., & Şenol, M. (2024). Generalized extended (2+ 1)-dimensional Kadomtsev-Petviashvili equation in fluid dynamics: analytical solutions, sensitivity and stability analysis. *Nonlinear Dynamics*, *112*(15), 13393-13408.

2. Demirbilek, U., Danladi, A., Akbulut, A., Boulaaras, S., & Ahmed, K. K. (2025). - Fractional-dimensional generalized KP model: nonlinear dynamical behaviors, analytical wave structures, bifurcation, and sensitivity analysis. Scientific Reports.

3. Ibragimov, N. H., & Avdonina, E. D. (2013). Nonlinear self-adjointness, conservation laws, and the construction of solutions of partial differential equations using conservation laws. *Russian Mathematical Surveys*, *68*(5), 889-921.

ROUGH SET THEORY IN MULTI-CRITERIA DECISION MAKING

Mehmet Mustafa Beydağı[1], **Abdullah Fatih Özcan**[1], **İlhan İçen**[1]

[1] Department of Mathematics, University of Inonu, Malatya, Turkiye

mbeydagi23@gmail.com, abdullah.ozcan@inonu.edu.tr, ilhan.icen@inonu.edu.tr

Abstract

Decision-making processes in many real-world applications involve uncertainty, vagueness, and incomplete information. In such situations, decision makers must evaluate several alternatives according to multiple criteria that may be conflicting or imprecisely defined. To deal with these challenges, rough set theory, introduced by Zdzisław Pawlak, provides an effective mathematical framework for analyzing imprecise data without requiring additional assumptions.

Rough set theory is based on the approximation of sets using equivalence relations defined on a universe of objects. For a given subset, the lower approximation contains objects that certainly belong to the set, while the upper approximation contains objects that possibly belong to it. This structure enables the analysis of classification problems when information is incomplete or inconsistent.

In multi-criteria decision making problems, rough set methods can be used to analyze decision tables, perform attribute reduction, and generate decision rules from data. These rules provide interpretable knowledge that supports effective and transparent decision-making. Therefore, rough set theory offers a useful approach for analyzing complex decision problems involving multiple evaluation criteria.

Keywords: Rough set theory; Multi-criteria decision making; Attribute reduction.

REFERENCES

1. Zdzisław Pawlak, “Rough sets,” International Journal of Computer and Information Sciences, vol. 11, no. 5, pp. 341–356, 1982.
2. Zdzisław Pawlak, Rough Sets: “Theoretical Aspects of Reasoning about Data”, Dordrecht: Kluwer, 1991.
3. Roman Słowiński, Salvatore Greco, and Benedetto Matarazzo, “Rough set theory for multicriteria decision analysis,” European Journal of Operational Research, vol. 129, no. 1, pp. 1–47, 2001.
4. Jerzy W. Grzymala-Busse, Zdzisław Pawlak, and Roman Słowiński, “Rough sets,” Communications of the ACM, vol. 38, no. 11, pp. 88–95, 1995.

Wave propagation of the (2+1)-dimensional non- linear Schrodinger equation

Melik Şenyuva[1], Ban Jamal Khalid Alsindi[2], Hasan Bulut[1,*]
[1]Department of Mathematics, Science Faculty, Firat University, 23119 Elazig, Turkey
[2]University of Duhok, College of Basic Education, Iraq

Abstract

This study drives new optical wave structures represented by rational dark, mixed dark-bright, and mixed singular solitons to the (2+1)-dimensional nonlinear Schrodinger equation. Implementing the rational extended sinh-Gordond expansion method, we get various dynamical wave structures of soliton solutions within the framework of evolutionary dynamical structures of solitary wave solutions. Permissible parameter selections are permitted to exhibit a solution. To enhance comprehension of the physical events associated with these dynamical models in mathematical physics, the physical behaviour of these solutions is empirically illustrated.

Keywords: NLSE; optical soliton; rational solutions

References

[1] S. Arbabi, M. Najafi, Exact solitary wave solutions of the complex nonlinear Schro¨dinger equations, Optik, 127(11), 4682-4688 (2016)

[2] H. Bulut, T.A. Sulaiman and B. Demirdag, Dynamics of soliton solutions in the chiral nonlinear Schr**ö**dinger equations, Nonlinear Dynamics, 91(3), 1985-1991 (2018)

[3] A. Biswas, M. Ekici, A. Sonmezoglu, Q. Zhou, S.P. Moshokoa and M. Belic, Optical soliton perturbation with full nonlinearity for Kundu-Eckhaus equation by extended trial function scheme, Optik-Int. J. Light and Electron Optics, 160, 17-23 (2018)

[4] T.A. Sulaiman, H. Bulut, The new extended rational SGEEM for construction of optical solitons to the (2+ 1)–dimensional Kundu–Mukherjee–Naskar model, Applied Mathematics and Nonlinear Sciences, 4(2), 513-522, (2019)

[1]Corresponding author. E–mail: hbulut@firat.edu.tr

1

ON THE CATEGORY OF SOFT SEMIHYPERMODULES

Gülay OĞUZ[1], **Hüseyin MANAP**[2]

[1,2]Department of Mathematics, Art and Science Faculty, Harran University, Sanlıurfa, Turkey

gulay.oguz@harran.edu.tr, manaphuseyin63@gmail.com

Abstract

This paper investigates the category of soft semihypermodules, introducing a categorical framework that unifies concepts from soft set theory and semihypermodule theory. Objects are defined as soft semihypermodules and morphisms as soft semihypermodule homomorphisms, and their fundamental properties are examined. Additionally, the behavior of morphisms is analyzed, and categorical analogues of classical results are established. These results generalize classical algebraic theorems to the context of soft semihypermodules and offer deeper insights into their structural and categorical properties. The study contributes to the formal development of soft algebraic systems within a category-theoretic framework, providing a foundation for further research in soft algebra and its applications in uncertainty modeling and generalized algebraic structures.

Keywords: Soft Set, Category, hypermodule, semihypermodule, soft semihypermodule, soft subsemihypermodule.

REFERENCES

1. Molodtsov, D. (1999). Soft set theory—first results. *Computers and mathematics with applications*, *37*(4-5), 19-31.
2. Amiri, G. R., Mousarezaei, R., Rahnama, S. (2025). Soft hyperstructures and their applications. *New Mathematics and Natural Computation, 21*(2), 577–595.
3. Oguz, G. (2020). On soft topological hypergroups. *Journal of Hyperstructures, 9*(2), 81–95.
4. Marty, F. (1934). Sur une généralisation de la notion de groupe. *Proceedings of the 8th Congress des Mathématiciens Scandinaves*, 45–49. Stockholm.
5. Oguz, G. (2020). Idealistic soft topological hyperrings. *Scientific Inquiry and Review, 4*(3), 61–70.
6. Golzio, A. C. (2018). A brief historical survey on hyperstructures in algebra and logic. *South American Journal of Logic, 4*(1), 85–106.

THE PLATE PARTIAL DIFFERENTIAL EQUATION:EXISTENCE AND DECAY

Hazal Yüksekkaya[1]

[1]Department of Mathematics, University of Hakkari, Hakkari, Turkey

hazalyuksekkaya@hakkari.edu.tr,

Abstract

Hyperbolic-type PDE become upon applications in various fields of engineering and science, including fluid dynamics, hydrodynamics, wave propagation, random motion theory, thermal motion, electromagnetics, and materials science. The hyperbolic-type form of PDE was developed to evaluate engineering and physical science models that often-included physical rules such as Newton's law of balance of forces. In recent years, methods for overcoming these challenges have been developed, there are many methods for solving hyperbolic PDE's. By brothers Leonard Euler and Bernoulli, the first equations with time delay were studied. Systematical, in 1940s, by A. Myshkis and R. Bellman study started. There have been seemed many surveys regarding the subject, since 1960. Robust control of systems with delay, in the middle of 1990s, was started and led to the `'delay bloom", in the begining of the 21th century. Generally, delays are involved in challenging areas of information technologies and communication: stability of highspeed communication networks or networked control systems. Recent years, controlling the behavior results for PDE's with time delay effects has become an active research area. Delay effects occur in many applications and practical problems for instance thermal, economics, biological, chemical and physical. Time delay may effects the instability, in many cases. Many scientific problems can be represented using nonlinear partial differential equations, which enables researchers from a range of fields, including engineering and physics, to more accurately characterize natural events. This paper is concerned with a hyperbolic-type plate partial differential equation. We prove the existence and decay of solutions.

Keywords: Decay; Existence; Partial differential equation.

REFERENCES

1. R. Datko, Representation of solutions and stability of linear differential-difference equations in Banach space, J. Differ. Equations, 29, 105-166, 1978.
2. E. Fridman, Introduction to Time-Delay Systems. Birkhäuser Basel, 2014.
3. J.P. Richard, Time-delay systems: an overview of some recent advances and open problem, Automatica, 39, 1667 -1694, 2003.

MULTIPLICATIVE LOKSODROME CURVES ON HELICOIDAL SURFACES

Nermin Ulas[1] **and Alper Osman Ogrenmis**[1]

[1] Department of Mathematics, University of Firat, Elazig, Turkey

241121114@firat.edu.tr, aogrenmis@firat.edu.tr

Abstract

This study investigates loxodrome curves on helicoidal surfaces within the framework of multiplicative geometry. Using a general model of helicoidal surfaces in three-dimensional multiplicative space, parametric representations of curves making a constant angle with meridians are derived. Unit speed conditions and curvature properties of these curves are analyzed. The results provide a natural extension of classical loxodrome theory to multiplicative differential geometry and reveal new geometric behaviors specific to this setting.

Keywords: Multiplicative space; loxodrome curves; helicoidal surface; curvature; torsion.

REFERENCES

1. H. Leitao and J. Gaspar, "Globes, Rhumb Tables, and the Pre-History of the Mercator Projection," Imago Mundi, 66(2), pp. 180–195, 2014. https://doi.org/10.1080/03085694.2014.902383

2. M. Babaarslan and Y. Yaylı, "Differential Equation of the Loxodrome on a Helicoidal Surface," The Journal of Navigation, 68, pp. 962–970, 2015. https://doi.org/10.1017/S037346331500032X

3. F. K. Aksoyak, B. B. Demirci, and M. Babaarslan, "Characterizations of Loxodromes on Rotational Surfaces in Euclidean 3–Space," Journal of Mathematical Analysis and Applications, 2023. (Not: Orijinal belgedeki arXiv:2204.06047 kaydı güncellenmiştir).

4. S. G. Georgiev, Multiplicative Differential Geometry, 1st ed., Chapman and Hall/CRC, New York, 2022. https://doi.org/10.1201/9781003290230

5. S. G. Georgiev and K. Zennir, Multiplicative Differential Calculus, 1st ed., Chapman and Hall/CRC, New York, 2022. https://doi.org/10.1201/9781003290209

6. S. G. Georgiev, K. Zennir, and A. Boukarou, Multiplicative Analytic Geometry, 1st ed., Chapman and Hall/CRC, New York, 2022. https://doi.org/10.1201/9781003290216

7. M. E. Aydın, A. Has, and B. Yılmaz, "A non-Newtonian approach in differential geometry of curves: Multiplicative rectifying curves," Bulletin of the Korean Mathematical Society, 61, pp. 849–866, 2024. https://doi.org/10.4134/BKMS.b230232

8. M. Öğrenmiş and A. O. Öğrenmiş, "Curves in multiplicative equiaffine plane," Open Physics, 23(1), 2025. https://doi.org/10.1515/phys-2024-0012

COMPARATIVE ANALYSIS OF INTERPOLATION METHODS AND MACHINE LEARNING ALGORITHMS FOR GEOCHEMICAL ANOMALIES OF ORE OBJECTS

N. M. Temirbekov [1,2], Z. I. Seitmuratova[1,2], G. B. Zhussipova[1]

[1] Al-Farabi Kazakh National University, Almaty, Kazakhstan
[2] National Engineering Academy of the Republic of Kazakhstan, Almaty, Kazakhstan
temirbekov@rambler.ru, seytzulfa@gmail.com, berikkyzy4@mail.ru.

Abstract

In this paper, a comparative analysis of interpolation and machine learning methods for the study of geochemical anomalies of ore objects is presented[1]. The research is aimed at identifying anomalous zones and evaluating the effectiveness of different approaches for the spatial prediction of geochemical indicators. At the first stage, classical interpolation techniques, namely Kriging and Radial Basis Function (RBF), are applied to reconstruct continuous geochemical surfaces and reveal the spatial distribution of anomaly-related parameters. These methods make it possible to estimate local variations and detect hidden geochemical patterns in ore-bearing territories. At the second stage, artificial intelligence methods, including Multilayer Perceptron (MLP) and Extreme Gradient Boosting (XGBoost), are used to improve anomaly detection and predictive performance. A comparative analysis of the obtained results is carried out in terms of accuracy, sensitivity to local deviations, and suitability for geological interpretation. The study demonstrates that the combined use of interpolation and machine learning methods provides a more reliable tool for detecting complex geochemical anomalies and can be effectively applied in mineral exploration and ore prospectivity assessment.

Keywords: geochemical anomalies; ore objects; Kriging; RBF interpolation; MLP; XGBoost; comparative analysis.

Acknowledgments: This research was funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (No. BR 27100483 “Development of predictive exploration technologies for identifying ore-prospective areas based on data analysis from the unified subsurface user platform "Minerals.gov.kz" using artificial intelligence and remote sensing methods”).

REFERENCES

1. Dramsch, Jesper Sören. 70 Years of Machine Learning in Geoscience in Review. Preprint submitted to Advances in Geophysics, Vol. 61, June 25, 2020.

ASYMPTOTIC FORMULA FOR EIGENVALUES OF CANONICAL FORM OF THE DIRAC OPERATOR

Etibar Panakhov [1] , **Aytan Bakhshizada** [2]

[1] Baku State University , Institute of Applied Mathematics

epenahov@hotmail.com

[2] Baku State University , Faculty of Mechanics and Mathematics

baxshizadeayten@gmail.com

Abstract. In this work, we consider asymptotic formula for eigenvalues of Dirac operators with Dirichlet conditions.

Keywords: Dirac operator ; Dirichlet conditions ; Counting lemma ; Asymptotic eigenvalues

The spectral problem for Sturm-Liouville operator with Dirichlet boundary condition is given in detail in [1] by Poeschel and Trubowitz. Later, this work was generalized by Guillot, Ralston [2] , Robert Carlson [3] and these results were extended to the singular Sturm-Liouville operator. In this paper, we study the spectral problem for one dimensional Dirac system with Dirichlet boundary conditions. By using Counting lemma, we obtain an asymptotic formulas for eigenvalues of Dirac operator

$$\left(B\frac{d}{dx}+L-\lambda I\right)y=0 \qquad (1)$$

where

$$B=\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix}, \quad L=\begin{pmatrix}p(x) & q(x)\\ q(x) & -p(x)\end{pmatrix}, \quad I=\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$$

Let $\varphi(x,\lambda)$ be the solution of the equation satisfying the initial conditions

$$\varphi_1(0,\lambda)=1, \quad \varphi_2(0,\lambda)=0 \qquad (2)$$

$$\varphi_1(x,\lambda)=cos(\lambda x)-\int_0^x\{sin\,\lambda\,(x-t)p(t)\varphi_1(t,\lambda)+cos\,\lambda\,(x-t)q(t)\varphi_2(t,\lambda)\}\,dt$$

$$\varphi_2(x,\lambda)=sin(\lambda x)+\int_0^x\{cos\,\lambda\,(x-t)p(t)\varphi_1(t,\lambda)-sin\,\lambda\,(x-t)q(t)\varphi_2(t,\lambda)\}dt$$

In this work we show, if $p(x), q(x)$ in $L^2[0,1]$, asymptotic formula for eigenvalues of the boundary value (1) , (3) ,

$$\varphi_2(0,\lambda)=0, \quad \varphi_2(1,\lambda)=0 \qquad (3)$$

is given by

$$\lambda_n=n\pi-\frac{1}{2}\left[\int_0^1 p(t)dt+\int_0^1 q(t)dt\right]+O\left(\frac{1}{n}\right) \ .$$

REFERENCES

1. J. Poeschel and E. Trubowitz, "*Inverse Spectral Theory*" Academic Press, San Diego, CA, 1987.
2. J.-C. Guillot and J.V. Ralston, Inverse spectral theory for a singular Sturm-Liouville operator on [0,1], J.Differential Equations 76 (1988), 353-373
3. R. Carlson, Inverse spectral theory for some singular Sturm-Liouville problems, J.Differential Equations 106 (1993), 121-140.

Machine Learning–Assisted Parameter Optimization for Decoy-State BB84 QKD Under Finite-Key Conditions

Nur Sultan YÜCE[1], **Mesut KARABACAK**[2]

[1,2]Department of Mathematics, Atatürk University, Erzurum, Turkey

nursultan.yuce19@ogr.atauni.edu.tr mkarabacak@atauni.edu.tr

Abstract

This study investigates parameter optimization in decoy-state BB84 quantum key distribution under finite-key conditions. The secret key rate depends on multiple interdependent parameters, yielding a highly non-linear optimization problem that becomes computationally expensive for conventional methods, especially under dynamic channel conditions. We propose a machine learning–assisted framework in which training data are generated via numerical simulations incorporating realistic channel effects—including loss, quantum bit error rate, finite-key fluctuations, and hardware imperfections such as detector efficiency mismatch and misalignment errors. A security-aware training strategy promotes conservative predictions consistent with information-theoretic security requirements. The trained model enables rapid parameter selection through direct inference or as a surrogate for accelerated optimization. Preliminary results show that the approach significantly reduces computational cost while achieving performance comparable to conventional methods, suggesting that machine learning offers a practical tool for adaptive parameter tuning in QKD systems.

Keywords: QKD, Finite-Key Analysis, Machine Learning, Parameter Optimization

REFERENCES

1. Fan-Yuan G.-J., Wang Z.-H., Wang S., Yin Z.-Q., Chen W., He D.-Y., Guo G.-C., Han Z.-F., Optimizing Decoy-State Protocols for Practical Quantum Key Distribution Systems, Advanced Quantum Technologies, Vol:4, No:2, 2021.
2. Dupuis F., Fawzi O., Renner R., Finite-Size Analysis of Prepare-and-Measure and Decoy-State QKD via Entropy Accumulation, Communications in Mathematical Physics, Vol:379, 867–913, 2020.
3. Lo, H.-K., Ma, X., & Chen, K. (2005). "Decoy State Quantum Key Distribution." Physical Review Letters, 94(23), 230504.
4. Lim, C. C. W., Curty, M., Walenta, N., Xu, F., & Zbinden, H. (2014). "Concise security bounds for practical decoy-state quantum key distribution." Physical Review A, 89(2), 022307.

OSCILLATION OF SOLUTIONS OF DIFFERENCE EQUATIONS WITH CONTINOUS ARGUMENTS

Hüseyin Şen

[1] Department of Mathematics, University of Dokuz Eylül, İzmir, Turkey

senhuseyin946@gmail.com,

Abstract

This study is concerned with new conditions for the oscillation and nonoscillation of solutions of difference equations with continuous arguments.First, the main definitions, basic theorems, and essential concepts related to oscillatory and nonoscillatory solutions of such equations are presented.Then, new and more refined sufficient conditions are established and proved.The illustrative examples are treated by using the method of steps, and the corresponding graphs are plotted based on interpolated values for visualization purposes.These results extend and improve several existing results in the literature.The obtained criteria contribute to a better understanding of the qualitative behavior of solutions of difference equations with continuous arguments.

Keywords: Difference equations, Continuous arguments, Oscillation, Non-oscillation, Qualitative behavior, Method of steps.

REFERENCES

1. Golda, W., & Werbowski, J. (1994). Oscillation of linear functional equations of the second order. *Funkcial. Ekvac.*, **37**(2), 221–227.
2. Karpuz, B. (2017). Sharp oscillation and nonoscillation tests for linear difference equations. *J. Difference Equ. Appl.*, **23**(12), 1929–1942.
3. Nowakowska, W., & Werbowski, J. (1995). Oscillation of linear functional equations of higher order. *Arch. Math. (Brno)*, **31**(4), 251–258.
4. Nowakowska, W., & Werbowski, J. (2001). Oscillatory behavior of solutions of functional equations. *Nonlinear Anal.*, **44**(6), 767–775.
5. Shen, J. H., & Stavroulakis, I. P. (2002). Sharp conditions for nonoscillation of functional equations. *Indian J. Pure Appl. Math.*, **33**(4), 543–554.

Performance Analysis of Drone Sensor Signals with Different Kalman Filters

Elif Yıldızlılar[1] Ahmet Yönetken[1] Kübra Kaysal[1]

[1] Department of Mechatronics Engineering, Afyon Kocatepe University, Afyonkarahisar, Turkey

yildizlilarelif@gmail.com, yonetken@aku.edu.tr, kkaysal@aku.edu.tr.

Abstract

This study evaluates the performance of different Kalman filters to ensure more accurate processing of position and acceleration signals obtained from a drone by removing noise. The Drone Flight IMU Sensors Log dataset, obtained from an open-source platform, was used for the study. Three different Kalman filters were applied to a total of 544,763 observations. The process noise covariance was kept constant at 1×10^{-4} during the filtering phase. The measurement noise covariance (R) values were determined as 0.01 for the Kalman filter, 0.5 for the Extended Kalman filter, and 5.0 for the Unscented Kalman filter. The data was analyzed using statistical methods and evaluated according to various criteria. The Kalman filter did not show a true filtering effect with a low VNR. The Unscented Kalman filter exhibited strong noise suppression, but the error level remained high. The Extended Kalman filter, thanks to its structure that directly incorporates acceleration into the model, was the filter that best balanced error and noise reduction in all three axes. The MAE values for the X, Y, and Z positions obtained from this filter were calculated as 2.43 m, 2.58 m, and 0.75 m, respectively. The VNR ratios were 1.6%, 1.8%, and 3.0%.

Keywords: Drone signals, Kalman filter, Extended Kalman filter, Unscented Kalman filter

REFERENCES

1. Wondosen, A., Debele, Y., Kim, S.-K., Shi, H.-Y., Endale, B. ve Kang, B.-S., Bayesian Optimization for Fine-Tuning EKF Parameters in UAV Attitude and Heading Reference System Estimation, *Aerospace*, Cilt:10, No:12, 1023, 2023.
2. Yao, W.-S., Lin, C.-Y., Wu, Y.-F. ve Wang, X.-H., Design of an Adapted Extended Kalman Filter for Enhancing UAV Navigation with Optical Flow, *Proceedings of the Institution of Mechanical Engineers, Part I*, 2025.
3. Hodson, T. O., Root-mean-square error (RMSE) or mean absolute error (MAE): when to use them or not, *Geoscientific Model Development*, Cilt:15, 5481–5487, 2022.

ON A FASTER ITERATIVE METHOD FOR FIXED POINT PROBLEMS IN BANACH SPACES AND ITS APPLICATIONS

Aynur Şahin

Department of Mathematics, Sakarya University, Sakarya, Türkiye

ayuce@sakarya.edu.tr

Abstract

This study presents a general framework for the analysis of a faster iterative method used in solving fixed point problems in Banach spaces. We consider a broad class of nonlinear mappings that extends several well-known types of non-expansive operators. Within this setting, we investigate the convergence behavior of a recently developed iterative scheme and establish both weak and strong convergence results under standard assumptions. A comparative perspective is also provided to highlight the efficiency of the proposed approach relative to classical iterative methods. The results indicate that the considered scheme exhibits improved convergence behavior in practical implementations. To demonstrate the applicability of the theoretical findings, the method is applied to a signal enhancement problem. Numerical experiments illustrate that the iterative framework is effective in reducing noise while preserving essential signal characteristics.

Overall, the study aims to bridge theoretical developments in fixed point theory with practical computational applications, offering an efficient approach for solving nonlinear problems arising in applied sciences.

Keywords: Fixed point theory; Iterative methods; Convergence analysis; Signal enhancement.

REFERENCES

1. R. P. Agarwal, D. O'Regan, and D. R. Sahu, Iterative construction of fixed points of nearly asymptotically nonexpansive mappings, J. Nonlinear Convex Anal., Vol:8, No:1, 61–79, 2007.
2. C. Byrne, A unified treatment of some iterative algorithms in signal processing and image reconstruction, Inverse Problems, Vol:20, No:1, 103–120, 2004.
3. R. Srivastava, W. Ahmed, A. Tassaddiq, and N. Alotaibi, Efficiency of a new iterative algorithm using fixed-point approach in the settings of uniformly convex Banach spaces, Axioms, Vol:13, No:8, 502, 2024.
4. T. Suzuki, Fixed point theorems and convergence theorems for some generalized nonexpansive mappings, J. Math. Anal. Appl., Vol:340, No:2, 1088–1095, 2008.
5. K. Ullah and M. Arshad, Numerical reckoning fixed points for Suzuki's generalized nonexpansive mappings via new iteration process, Filomat, Vol:32, No:1, 187–196, 2018.
6. K. Ullah, J. Ahmad, and M. d. l. Sen, On generalized nonexpansive maps in Banach spaces, Computation, Vol:8, No:3, 61, 2020.

A NUMERICAL APPROACH FOR A COUPLED NONLINEAR WAVE SYSTEM USING A MESHLESS COLLOCATION FRAMEWORK

Murat Arı[1]

[1]Department of Mathematics, Karamanoğlu Mehmetbey University, Karaman, Turkey

muratari@kmu.edu.tr

Abstract

In this study, a coupled nonlinear wave model is examined through a meshless collocation framework that employs smooth basis functions. The effectiveness of the approach is evaluated using standard error measures such as the L_2 and L_∞ norms. Numerical experiments show that the procedure is straightforward to implement while delivering highly accurate approximations. The findings suggest that the technique is not only suitable for the considered system but can also be adapted as a robust computational tool for a broad range of partial differential equations.

Keywords: Meshless collocation method; Radial basis functions (RBFs); Coupled nonlinear wave equations; Numerical approximation

REFERENCES

1. M. Arı, B. Karaman, Y. Dereli, Comparison between two meshless methods for the Rosenau-Kawahara equation, International Journal of Applied Mathematics and Statistics, Vol:57, No:4, 117–124, 2018.
2. Y. Dereli, D. Irk, I. Dağ, Soliton solutions for NLS equation using radial basis functions, Chaos Solitons and Fractals, Vol:42, No:5, 1227–1233, 2009.
3. Y. Dereli, Solitary wave solutions of the MRLW equation using radial basis functions, Numerical Methods for Partial Differential Equations, Vol:28, No:1, 235–247, 2012.
4. R. Schaback, Creating surfaces from scattered data using radial basis functions, Mathematical Methods for Curves and Surfaces, pp. 477–496, 1995.
5. S. G. Rubin, R. A. Graves, A Quintic Spline Approximation for Problems in Fluid Mechanics, NASA TR R-436, 1975.

MODELING INVESTOR PHYSIOLOGY WITH STOCHASTIC DYNAMICS: FROM EMOTIONAL PARAMETERS TO BEHAVIORAL CLUSTERS

Sevda Ö. Çalıkuşu[1], Davood Ahmadian[2], Fevzi Erdoğan[3], Nihal İnce[4], Vildan Aslan[5]

[1]Department of Computer Technology, Van Yuzuncu Yil University, Türkiye,
sevdaozdemir@yyu.edu.tr

[2]Department of Statistics and Computer Science, University of Tabriz, Iran,
d.ahmadian1985@gmail.com
(*Presenting author)*

[3]Department of Econometrics, Van Yuzuncu Yil University, Türkiye,
ferdogan@yyu.edu.tr

[4]Department of Artificial Intelligence and Machine Learning, Eskisehir Technical University, Türkiye
nihalince@eskisehir.edu.tr

[5]Department of Guidance and Psychological Counseling, Van Yuzuncu Yil University, Türkiye
vildaneaslan@gmail.com

Abstract

This research introduces a mathematical framework that quantifies core affective states—valence and arousal—using stochastic differential equations (SDEs) such as coupled Ornstein–Uhlenbeck and mixed fractional processes. We estimate SDE parameters from physiological time-series data and interpret them as latent emotional traits. The nonlinear dependence between arousal and demographic factors like sex, age, and education is modeled via copula functions. Model validity is assessed against cognitive neuroscience benchmarks using real-world data. Finally, based on parameters estimated from 150 participants, we apply k-means clustering to identify distinct investor behavioral profiles. Each cluster is mapped via SDE simulation to tailored investment strategies, determining which market regimes suit each behavioral phenotype. This approach bridges affective science and quantitative finance, enabling emotionally-informed portfolio personalization.

Keywords: Arousal; Copula theory; DynAffect model (OU-based); Fractional stochastic processes; Stochastic differential equations; Time-series analysis; Valence.

REFERENCES

1. Darsow, W. F., Nguyen, B., & Olsen, E. T., Copulas and Markov Processes. Illinois Journal of Mathematics, 36(4), 600–642, 1992.
2. Oravecz, Z., Tuerlinckx, F., Vandekerckhove, J.,A hierarchical latent stochastic differential equation model for affective dynamics. Psychological Methods, 16(4), 468–490, 2011.

Acknowledgment: This study was supported by the Scientific Research Projects Coordination Unit of Van Yuzuncu Yil University under Project No. FYD-2025-12186.

QUALITATIVE ANALYSIS OF SOLUTIONS FOR A WEIGHTED HYPERBOLIC-TYPE EQUATION

Ayşe Fidan[1] and Erhan Pişkin[2]

[1]Institute of Natural andAppliedSciences, Dicle University, Diyarbakır, Turkey

[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey

afidanmat@gmail.com, episkin@dicle.edu.tr

Abstract

In this work, we investigate the weighted hyperbolic-type equation with initial and boundary conditions. The asymptotic behaviour of the energy is established using Nakao's inequality. Furthermore, we prove that solutions blow up in finite time

Keywords: Blow up, Asymptotic behaviour, weighted hyperbolic-type equation.

REFERENCES

1. E. Pişkin, On the decay and blow up of solutions for a quasilinear hyperbolic equations with nonlinear damping and source terms, Bound. Value Probl., 2015:127 (2015).
2. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Azalması (Decay of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2025.
3. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Patlaması (Blow up of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2022.
4. E. Pişkin and A. Fidan, Nonexistence of global solutions for the strongly damped wave equation with variable coefficients, Universal Journal of Mathematics and Applications, 5 (2) 51-56 (2022).
5. E. Pişkin and A. Fidan, Finite time blow up of solutions for the m-Laplacian equation with variable coefficients. Al-Qadisiyah Journal of Pure Science, 28(1), 2 (2023).
6. A. Fidan and E. Pişkin, Global existence and decay of solutions for a variable coefficients Petrovsky equation with delay term. JMSCM, 6(1) 120-133 (2025).

UNCERTAINTLY MANAGEMENT IN ARTIFICIAL INTELLIGENCE: SOFT SET THEORY AND APPLICATION AREAS

Semih GEÇEN[1],İlhan İÇEN[2], A. Fatih ÖZCAN[3]

[1]Department of Mathematics, University of Inonu, Malatya, Türkiye, semihgecen44@gmail.com

[2]Department of Mathematics, University of Inonu, Malatya, Türkiye, ilhan.icen@inonu.edu.tr

[3]Department of Mathematics, University of Inonu, Malatya, Türkiye, abdullah.ozcan@inonu.edu.tr

Abstract

Soft set theory, defined by D.A. Molodtsov, has gained a broad place in contemporary mathematics [1]. Bringing a new perspective to the concepts of exactness and precision in mathematics, soft set theory has been studied from topological, categorical, and algebraic aspects by many mathematicians since its introduction [2-14]. The conceptual foundations of artificial intelligence were laid in the 1950s [15]. The 1956 Dartmouth Conference was the venue where the term 'Artificial Intelligence' was first coined and where the field was officially established [16]. Subsequently, artificial intelligence was integrated into computerized systems, and with the widespread adoption of internet-based applications especially by the 1990s, significant leaps were experienced in the field of artificial intelligence [17-18]. Nowadays, particularly with the help of significant technological advancements, artificial intelligence has risen to an indispensable position in many areas of daily life [19-21]. In this study, the contributions of soft set theory to artificial intelligence are addressed; particularly, the advantages this theory provides to artificial intelligence in multi-criteria decision-making processes involving uncertainty are demonstrated, and various application areas are examined in detail.

Keywords: Soft set; Artificial intelligence; Uncertainty management; Application areas.

REFERENCES

1. D.A. Molodtsov, *Soft set theory-First results,* Comput. Math. Appl., 37 (4-5), 19-31, 1999.

2. P. K. Maji, R. Biswas and R. Roy, *Soft set theory,* Comput. Math. Appl., 45(4-5), 555-562, 2003.

3. M. I. Ali, *A note on soft sets, rough soft sets and fuzzy soft sets,* Appl.Soft Comput., 11, 3329-3332, 2011.

4. H. Aktas and N. Cagman, *Soft sets and soft groups,* Inform.Sci., 77(13), 2726-2735, 2007.

5. M. Shabir, M. Naz, *On Soft topological spaces,* Comput. Math. Apply., 61(7), 1786-1799, 2011.

Fractional Modified Camassa–Holm and Degasperis–Procesi Equations: Dynamic Behavior and Nonlinear Wave Structures

Ajay Kumar

Department of Basic Engineering and Applied Science, College of Technology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut-250110, Uttar Pradesh, India.
kajay9249@gmail.com,

Abstract

In this paper, we investigate the dynamic behavior and nonlinear wave structures of the fractional modified Camassa–Holm and Degasperis–Procesi equations using the Caputo–Fabrizio fractional derivative, which is characterized by a non-singular kernel and effectively models memory-dependent physical processes. The governing equations are analyzed via the Homotopy Perturbation Transform Method (HPTM), a powerful semi-analytical technique that combines the Laplace transform with the homotopy perturbation framework to obtain rapidly convergent series solutions. The results demonstrate that the HPTM with the Caputo–Fabrizio derivative is an efficient, reliable, and straightforward approach for solving nonlinear fractional partial differential equations, and it offers significant potential for applications in mathematical physics and engineering sciences.

Keywords: Homotopy perturbation transform method (HPTM), CFD, time-fractional (mCH) and (mDP) equations, Dynamic behavior, Nonlinear waves.

REFERENCES

1. A. Kumar, P. Fartyal, Dynamical behavior for the approximate solutions and different wave profiles nonlinear fractional generalised pochhammer-chree equation in mathematical physics. Opt. Quant. Electron. 2023; 55: 1128.
2. M.Nadeem, H. Jafari,A. Akg¨ul, M. De la Sen, A Computational Scheme for the Numerical Results of Time-Fractional Degasperis–Procesi and Camassa–Holm Models, Symmetry, 14(12), 2532, 2022. https://doi.org/10.3390/sym14122532

ON SOLUTION OF A NEUMANN PROBLEM FOR A SCHRODINGER-TYPE EQUATION

Nigar Yıldırım Aksoy[1] **and Nurşah Çelik**[2]

[1] Department of Mathematics, University of Kafkas, Kars, Turkey

[2] Graduate School of Natural and Applied Sciences, University of Kafkas, Kars, Turkey

nyaksoy55@hotmail.com, nursah-celik@hotmail.com

Abstract

In this study, a Neumann boundary value problem for a linear Schrödinger-type equation defined on a bounded convex domain in an n-dimensional Euclidean space is investigated. The problem includes a gradient-dependent term and time-dependent coefficients, making it a generalized form of previously studied Schrödinger equations.

The existence and uniqueness of the solution are established by employing the Galerkin method. First, an appropriate orthonormal basis system is selected, and approximate solutions are constructed. Then, uniform boundedness of the Galerkin approximations is derived in the appropriate Sobolev spaces. By applying compactness arguments and weak convergence techniques, it is shown that the sequence of approximate solutions converges to a function satisfying the problem in a weak sense. Existence and uniqueness of the weak solution are proven.

Keywords: Schrödinger-Type equation, Neumann Problem, Galerkin's Method.

REFERENCES

1. N. Yıldırım Aksoy, The Solvability of First Type Boundary Value Problem for a Schrödinger Equation. Applied Mathematics and Nonlinear Sciences 5(1), 211-220, 2020.

2. O. A. Ladyzhenskaya, The Boundary Value Problems of Mathematical Physics, Springer-Verlag, New York, 1985.

HYBRID FUZZY REGRESSION MODELS: A COMPARATIVE STUDY

Rıfat Oku[1] **Fevzi Erdoğan**[2]

[1]Department of Econometrics, Faculty of Economics and Administrative Sciences, Van Yuzuncu Yil University, Van, Turkey

[2]Department of Econometrics, Faculty of Economics and Administrative Sciences, Van Yuzuncu Yil University, Van, Turkey

[1]rifatoku@gmail.com

[2]ferdogan@yyu.edu.tr

Abstract

Statistical regression methods are insufficient due to incomplete data, measurement errors, uncertainty in the relationship between variables, and the lack of necessary training. When it is necessary to model real-life situations with these types of constraints, the most powerful alternative method used is fuzzy regression analysis.

Standard usage in fuzzy regression analysis is Type-1 fuzzy regression models. However, the membership functions used in these models are insufficient for modeling high degrees of uncertainty in outliers or extreme values in the dataset due to their inherent limitations. The alternative fuzzy method, the Type-2 fuzzy regression model, covers the entire dataset with high precision, resulting in an unnecessarily wide coverage range for the generated model.

This study examines the fuzzy regression model, a more functional method for datasets with high levels of uncertainty. The unique aspect of this study stems from the Threshold-Based Hybrid approach, developed to optimize the dynamic nature of each veri point. In this approach, the model sets a threshold value for each dataset and applies Type-2 fuzzy regression up to this threshold value, after which it evolves into a Type-1 fuzzy regression structure. The piecemeal approach to modeling helps to evaluate fluctuating data with less ambiguity.

Keywords: Fuzzy regression; Type-1 Fuzzy regression; Type-2 Fuzzy regression.

REFERENCES

1. Leyla Yücel, "Klasik Doğrusal Regresyon Analizinde Alternatif bir Yöntem Olarak Bulanık Doğrusal Regresyon Analizi ve Bir Uygulama," Istanbul University Journal of the Faculty of Economics, 59 (1), 109-134, 2009.
2. Narges Shafaei Bajestani, Ali Vahidian Kamyad, Assef Zare, Possibilistic Type-2 Fuzzy Regression with Aplication to TAIEX Forecasting, Majlesi Journal of Mechatronic Systems, Vol:5, No:2, 2016.

A RECURSIVE APPROACH FOR EFFICIENT COMPUTATION OF THE GREEN'S FUNCTION OF MULTILAYER MEDIA WITH ARBITRARILY SHAPED BOUNDARIES

Tolga Ulaş Gürbüz[1] and Birol Aslanyürek[2]

[1]Department of Computer Engineering, Gaziantep University, Gaziantep, Turkey

tugurbuz@gantep.edu.tr,

[2]Department of Mathematical Engineering, Yildiz Technical University, Istanbul, Turkey

baslan@yildiz.edu.tr,

Abstract

We present an efficient computational approach for evaluating the Green's function of multilayer media with arbitrarily shaped interfaces. Such Green's functions play a fundamental role in a wide range of electromagnetic problems, including inverse scattering, wave propagation analysis, and the formulation of integral-equation-based solution methods. The considered configuration consists of multiple homogeneous, isotropic, and nonmagnetic layers separated by boundaries of arbitrary shape. In this setting, the Green's function is represented using an eigenfunction-expansion formulation tailored for noncircular geometries. Imposing the continuity conditions at the interfaces leads to a large linear system with an almost block-diagonal structure, whose direct solution becomes computationally expensive as the number of layers. To address this challenge, we develop a recursive solution strategy based on a Thomas-algorithm-like recursive elimination. The proposed method systematically eliminates the unknown expansion coefficients layer by layer, starting from the innermost region and proceeding outward. This yields a sequence of recursive relations that allow the efficient computation of the Green's-function coefficients without explicitly solving the global system. The resulting algorithm significantly reduces both computational time and memory requirements while preserving accuracy. Owing to its efficiency and generality, the proposed formulation provides a practical tool for large-scale simulations and for applications requiring repeated evaluations of multilayer Green's functions.

Keywords: Green's Function, Multilayer Media, Eigenfunction Expansion, Arbitrarily Shaped Boundaries, Thomas Algorithm.

ON THE USE OF NONLINEAR TRANSFORMATIONS FOR BOX-CONSTRAINED CONTRAST SOURCE INVERSION

Tolga Ulaş Gürbüz[1] and Birol Aslanyürek[2]

[1]Department of Computer Engineering, Gaziantep University, Gaziantep, Turkey

tugurbuz@gantep.edu.tr,

[2]Department of Mathematical Engineering, Yildiz Technical University, Istanbul, Turkey

baslan@yildiz.edu.tr,

Abstract

We investigate the use of nonlinear transformations within the Contrast Source Inversion (CSI) method to enforce a priori bounds on the contrast. The considered approach maps the bounded contrast variable to an unbounded auxiliary variable through suitable nonlinear transformations, thereby avoiding nonphysical estimates during the inversion process. Two alternative transformation schemes are examined, and their influence on the update mechanism is incorporated via the corresponding gradient expressions. This formulation enables unconstrained optimization in the transformed domain while implicitly satisfying the physical bounds on the contrast. The numerical behavior of the considered transformations is analyzed through representative simulations.

Keywords: Inverse Scattering, Contrast Source Inversion, Nonlinear Transformation, Box Constraints.

EDMD of Earthquake Activity in Türkiye

Mustafa Hicret YAMAN[1]

[1]Department of Mathematics and Science Education, Faculty of Education, Mugla Sitki Kocman University, Mugla, Türkiye

mhicretyaman@mu.edu.tr

Abstract

This study examines the existing spatiotemporal patterns of seismic activity through the utilization of Extended Dynamic Mode Decomposition (EDMD) on approximately 30 years of moment magnitude, focal depth, and location data obtained from the Turkish earthquake database. To transform the irregular distribution of seismic events into uniform temporal intervals and spatial units, Türkiye and its surrounding region were initially aligned with fault lines. An adaptive grid utilizing a quadtree was subsequently established. It contained cells with high resolution in fault zones and cells with lower resolution in other areas. We obtained the data matrix by aggregating the total seismic moment for each cell across each time interval. We conducted EDMD analyses utilizing weighted Singular Value Decomposition and the appropriate r-order. The derived modes indicate significant seismic patterns in specific regions, particularly along the North Anatolian Fault, the East Anatolian Fault, and the Aegean graben system. The eigenvalues indicate that certain regions exhibit increasing activity components, while others are declining or displaying cyclical patterns. The EDMD based reconstruction exhibits a minimal error rate, indicating that the method effectively captures the historical seismic space-time pattern. In the final step, mode amplitudes are integrated with a straightforward hazard exposure vulnerability framework to generate data-driven seismic risk maps on an adaptive grid. This represents a novel approach to directly applying EDMD methodologies to Turkish earthquake data.

Keywords: Extended Dynamic Mode Decomposition, Reduced Order Model, Machine Learning, Earthquake Activity, Seismic Risk Mapping.

REFERENCES

1. Schmid, Peter J. and P Ecole. "Dynamic mode decomposition of numerical and experimental data." Journal of Fluid Mechanics 656: 5 – 28, 2008.
2. Schmid, Peter J., Larry K. B. Li, Matthew P. Juniper and O. Pust. "Applications of the dynamic mode decomposition." Theoretical and Computational Fluid Dynamics 25: 249-259, 2011.

Fractional Reaction–Diffusion Modeling of Colorectal Cancer Therapy

Aytekin Enver [1]**, Fatma Ayaz** [2]

[1, 2] Gazi University, Department of Mathematics, Ankara, Türkiye

aytekinanwer@gmail.com, fayaz@gazi.edu.tr

Abstract

Colorectal cancer remains a major global health burden, characterized by high morbidity and mortality rates. Growing experimental and clinical evidence indicates that nutritional factors, particularly vitamin D and calcium, play a complex role in CRC prevention and progression. At the same time, mathematical oncology has emerged as an effective framework for investigating tumor growth, immune interactions, and therapeutic responses. In this study, we develop an integrative mathematical model that connects epidemiological insights with mechanistic tumor–immune dynamics. The proposed framework consists of a reaction–diffusion system to describe spatial heterogeneity in tumor and immune cell populations, coupled with fractional-order time derivatives to account for memory and hereditary effects inherent in cancer progression. Therapeutic interventions are incorporated through control terms representing vitamin D supplementation, calcium intake, and monoclonal antibody therapy. Stability properties of the model are examined using energy methods and generalized Gronwall inequalities, while numerical simulations are conducted to assess parameter sensitivity under different treatment scenarios. Our results indicate that vitamin D consistently suppresses tumor growth by enhancing cellular differentiation and immune-mediated control, whereas calcium displays a dose- and context-dependent effect, acting as either protective or promotive. Moreover, fractional-order dynamics reveal long-term treatment memory effects and improve agreement with observed clinical trends. These findings highlight the potential of integrative fractional models to inform personalized treatment strategies and CRC prevention policies.

Keywords: Colorectal cancer, Mathematical modeling, Reaction–diffusion system, Fractional calculus, Vitamin D, Calcium, Immunotherapy.

REFERENCES

[1] World Health Organization. (2023). Colorectal cancer fact sheet.

[2] International Agency for Research on Cancer. (2020). Global Cancer Observatory: Colorectal cancer statistics.

Spiral Curves and Generalizations in the Multiplicative Plane

Ezgisu Uzel[1] **and Alper Osman Ogrenmis**[1]

[1] Department of Mathematics, University of Firat, Elazig, Turkey

232121101@firat.edu.tr, aogrenmis@firat.edu.tr

Abstract

This study revisits spiral and loxodrome curves, traditionally examined in Euclidean and hyperbolic planes, within the framework of multiplicative differential geometry. The main objective is to adapt classical results to the two-dimensional multiplicative plane and multiplicative hyperbolic plane, analyzing their parametric representations, differential characterizations, and fundamental geometric properties. The findings provide natural generalizations of logarithmic spirals and classical loxodromes, demonstrating the effectiveness of the multiplicative approach and offering original contributions to the existing literature.

Keywords: Multiplicative plane; Spiral curves; Loxodromes; Curves; Curvature

REFERENCES

1. F. K. Aksoyak, B. B. Bektaş Demirci, M. Babaarslan, Characterizations of Loxodromes on Rotational Surfaces in Euclidean 3-Space, International Electronic Journal of Geometry, 16(1), 147–159, 2023.

2. M. E. Aydın, A. Has, B. Yılmaz, "A Non-Newtonian Approach in Differential Geometry of Curves: Multiplicative Rectifying Curves," *Bulletin of the Korean Mathematical Society*, 61, 849–866, 2024.

3. M. Babaarslan, A Note on Loxodromes on Helicoidal Surfaces in Euclidean n-Space, Applied Mathematics E-Notes, 20, 458–461, 2020

4. M. Babaarslan, Y. Yaylı, Differential Equation of the Loxodrome on a Helicoidal Surface, Journal of Navigation, 68(5), 962–970, 2015.

5. S. G. Georgiev, *Multiplicative Differential Geometry*, 1st ed., Chapman and Hall/CRC, New York, 2022.

6. S. G. Georgiev, K. Zennir, *Multiplicative Differential Calculus*, 1st ed., Chapman and Hall/CRC, New York, 2022.

7. S. G. Georgiev, K. Zennir, A. Boukarou, *Multiplicative Analytic Geometry*, 1st ed., Chapman and Hall/CRC, New York, 2022.

8. M. Öğrenmiş, A. O. Öğrenmiş, "Curves in Multiplicative Equiaffine Plane," *Open Physics*, 23(1), 2025.

Revealing Dissipation as Causal Memory Storage in Linear and Nonlinear Systems: QSER Application

Ahmad Muhammad
Department of Physics and Materials Sciences, Qatar University, Doha, Qatar
ahmadmuhammad325@gmail.com

Muhammad Abubakar Isah
Department of Mathematics, Istanbul Ticaret Universitesi, Istanbul, Turkiye
maisah@ticaret.edu.tr

Salim Jibrin Danbatta
Software Engineering Department, Uskudar University, Istanbul, Turkiye
salimdambatta@gmail.com

Sulaiman Sulaiman Ahmad
Electrical Engineering, KFUPM, Dhahran, Saudi Arabia
Sulaiman365@gmail.com

Abstract

In this paper, we extend the Source-Environment-Response (SER) by (Muhammad et. al 2026) to QSER. QSER is a physics-guided decomposition that separates an observed response R into a conservative source field S and an environmental influence field E such that $R = S - E$. The source field evolves under purely conservative dynamics, preserving perfect memory of initial conditions, while the environmental field starts from zero and accumulates the entire history of dissipative and nonlinear interactions. Using a forced RLC circuit, we demonstrate the Green's function formulation showing that $E(t)$ is precisely the convolution of the system's memory kernel with the dissipative source term, revealing the environment as a causal memory accumulator rather than a passive energy sink. We extend the framework to the van der Pol oscillator, where all nonlinear complexity is confined to E while S remains linear and conservative. The dissipation term $D_E = \mu(1 - x^2)\dot{E}^2$ can become negative when $|x| > 1$, representing energy injection that allows the environmental energy $\mathcal{E}_E$ to exceed the source energy $\mathcal{E}_S$ by a factor of approximately 6. This demonstrates that the environment can act as an active energy source, not only as a sink. Four built-in validity tests; energy conservation in S, zero initial condition of E, exact reconstruction, and infinite memory of S, provide self-validation absent in traditional approaches. The QSER framework reveals that any measured quantity Q is not directly the source, but the difference between the system's pristine memory and the environment's accumulated history, offering causal clarity, energy transparency, and methodological flexibility across linear and nonlinear dissipative systems. All code is available open-source at https://github.com/1030ahmad1030/Qtheory

Keywords: Source-environment-response, Green's function, memory accumulation, RLC circuit, van der Pol oscillator, negative damping

REFERENCES

1. A. Muhammad, S. J. Danbatta, M. A. Isah, I. Y. Muhammad, S. S. Ahmad, and A. Ghozlan, QSignature 1.0: A Dynamical Regime Classification Framework for Causal Time Series Data, *IEEE*, 2026.

2. A. Muhammad, I. Y. Muhammad, A. H. Ali, M. A. Isah, S. J. Danbatta, and A. A. Sait, A Source-Environment-Response (SER) Approach for Solving Spatio-Temporal Radon Transport in Different Media, *Journal of Atmospheric and Solar-Terrestrial Physics*, Vol. 106796, 2026.

QSER: A Physics-Guided Decomposition Framework for Physical Systems

Ahmad Muhammad
Department of Physics and Materials Sciences, Qatar University, Doha, Qatar
ahmadmuhammad325@gmail.com

Muhammad Abubakar Isah
Department of Mathematics, Istanbul Ticaret Universitesi, Istanbul, Turkiye
maisah@ticaret.edu.tr

Salim Jibrin Danbatta
Software Engineering Department, Uskudar University, Istanbul, Turkiye
salimdambatta@gmail.com

Sulaiman Sulaiman Ahmad
Electrical Engineering, KFUPM, Dhahran, Saudi Arabia
Sulaiman365@gmail.com

Abstract
In this paper, We extend the Source-Environment-Response (SER) framework by (Muhammad et. al 2026) to (QSER). QSER is a physics-guided decomposition framework that separates a given observed response R into a conservative source field S and an environmental influence field E, such that $R = S - E$. The source field satisfies $L_cS = Q$ with L_c containing only conservative terms, preserving perfect memory of initial conditions. The environmental field satisfies $LE = L_dS$ with zero initial conditions, accumulating all damping, nonlinearity, and boundary effects. This decomposition leads to an energy continuity equation $d\mathcal{E}_E/dt + D_E + \Phi_{\text{boundary}} = J_{S\to E}$ that tracks energy flow from source to environment to irreversible dissipation. Four validity tests energy conservation in S, zero initial condition of E, exact reconstruction $R = S - E$, and infinite memory of S via $\tau_u^S \to \infty$ provide a rigorous, self-validating quality check for the physical correctness of the split. The framework is methodologically agnostic: S and E can be obtained analytically, numerically, via Green's functions, or through data-driven methods. We demonstrate QSER on two canonical systems: the damped harmonic oscillator (exact, machine precision) and the Duffing oscillator (0.001% accuracy). Remarkably, for the Duffing oscillator, S remains purely linear while all nonlinearity is confined to E, revealing that nonlinearity can be interpreted as environmental feedback rather than intrinsic system complexity. The framework offers practical advantages for inverse problems, parameter estimation, control strategies, and prediction. All code is available open-source at https://github.com/1030ahmad1030/Qtheory.

Keywords: Source-environment-response; dissipative systems; memory preservation; energy continuity; nonlinear dynamics; Duffing oscillator; QSignature

REFERENCES

1. D. J. Inman, Engineering Vibration, 4th ed., Pearson, 2014.

2. S. H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, 2nd ed., CRC Press, 2018.

Improving Environmental Sustainability Performance in a Particleboard Plant

İzzet AKBULUT*, Sema YURDAKUL

Department of Environmental Engineering, Suleyman Demirel University, Isparta, Türkiye

izzetakbulut@gmail.com

Abstract

This study comparatively examines the sustainability performance of A and B particleboard production facilities through Scope 1 and Scope 2 greenhouse gas emissions. While Facility A has an energy profile predominantly based on coal and fossil fuels, Facility B presents a lower-carbon-intensity production model supported by biomass and electricity. In this study, energy consumption, fuel types, electricity use, fugitive emissions, and process-related releases were analyzed in accordance with IPCC emission factors and TSRS standards. The findings indicate that Facility B has significantly lower values particularly in electricity-related indirect emissions, whereas Facility A exhibits a high carbon footprint due to coal consumption. This comparative analysis aims to contribute to the development of sustainable production strategies in the particleboard sector.

Keywords: Sustainability, Particleboard, Carbon Footprint, Scope 1–2 Emissions, Biomass, Energy Efficiency

REFERENCES

1. IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Intergovernmental Panel on Climate Change, Vol:1–5, 2006.
2. Kamu Gözetimi, Muhasebe ve Denetim Standartları Kurumu (KGK), Türkiye Sürdürülebilirlik Raporlama Standartları (TSRS) ve Uygulama Kapsamı, Resmî Gazete, No:32414, 2023.

*Abstract Submission should be prepared only **1 page**.

SOME INTEGRAL INEQUALITIES DERIVED FROM EXPONENTIALLY QUASI-CONVEX PARTIAL DERIVATIVES ON THE CO-ORDINATES

Sinan Aslan [1]

[1]Ağrı Türk Telekom Social Sciences High School, Ağrı Türkiye

sinanaslan0407@gmail.com,

Abstract

This paper develops a series of new integral inequalities by building upon a known lemma available in the literature. By incorporating the notion of exponentially quasi-convex functions on the co-ordinates, together with classical inequalities such as Hölder's and Young's inequalities, several refined and generalized estimates are established. The approach systematically combines these analytical tools to derive results that extend and complement existing findings.

Furthermore, by assigning particular values to the parameters involved in the main results, a variety of new and meaningful special cases are obtained. These particular instances not only demonstrate the flexibility of the derived inequalities but also reveal connections with previously known results in the literature. The findings presented in this study contribute to the ongoing development of inequality theory and may serve as a useful reference for future investigations in related areas of mathematical analysis.

Keywords: Exponentially quasi-convex; Hölder's inequality; Young's inequality.

REFERENCES

1. Awan, M.U., Noor, M.A, Noor, K.I. Hermite-Hadamard Inequalities for Exponentially Convex Functions, *Appl. Math. Inf. Sci.*, 12, No. 2, 405-409 (2018).
2. Pečarić, J.E., Tong, Y. L. (1992). Convex functions, partial orderings, and statistical applications. Academic Press.
3. Aslan, S., Akdemir, A.O. (2022, August). Exponentially convex functions on the co-ordinates and related integral inequalities. In Proceedings of the 8th International Conference on Control and Optimization with Industrial Applications (Vol. 2, pp. 120-122).
4. Dragomir, S.S. On Hadamard's inequality for convex functions on the co-ordinates in a rectangle from the plane, Taiwanese Journal of Math., 5, 2001, 775-788.
5. Akdemir, A.O., Aslan, S., Set, E. (2022, October). Some New Inequalities for Exponentially Quasi-Convex Functions on the Coordinates and Related Hadamard Type Integral Inequalities. In 5th Internatıonal Conference on Mathematical and Related Sciences Book of Proceedings (p. 120).

IMPROVING THE INTELLIGENCE OF NON-PLAYER CHARACTER IN GAMES USING MACHINE LEARNING AND DEEP LEARNING METHODS FOR TEXT-BASED DEPRESSION DETECTION

Araz R. Aliev[1], Rustam Eyniyev[1]

[1]Department of General and Applied Mathematics, Azerbaijan State Oil and Industry University, Baku, Azerbaijan

alievaraz@asoiu.edu.az, rustam.eyniyev@gmail.com

Abstract

In this study, we aim to improve the intelligence of Non-Player Characters (NPCs) in order to use various machine learning and deep learning methods to better detect depression from player-generated text. We used methods such as: Naive Bayes, Linear SVC, Logistic regression, SGDClassifier, XGBoost, CatBoost, LightGBM, BiLSTM, BERT-base, DistilBERT, MentalBERT. The Reddit Depression Dataset by Rishabh from Kaggle was used for the study. For this study, only the columns (body and label) were required. This dataset contains over 2,470,000 valid rows, which is a significant amount of data. Therefore, the time spent training on all this data is not optimal. Therefore, only 500,000 of them were used, but with the same percentage of labels as in the dataset itself (76.8% with label=0 and 23.2% with label=1). The results of this work are that in terms of f1 score, the best result was shown by the model MentalBERT = 0.8810, BERT-base = 0.8804, DistilBERT = 0.8587, and the worst result was shown by Naive Bayes at 0.7992, XGBoost = 0.8213, CatBoost = 0.8249. In terms of ROC-AUC, the best result was also shown by MentalBERT = 0.9823, BERT-base = 0.9817, Distil-BERT = 0.9785, and the worst result was again shown by Naive Bayes = 0.9526, XGBoost = 0.9578, CatBoost = 0.9594. The results of the study showed that deep learning methods such as MentalBERT, BERT-base, and DistilBERT are best for NPC to predict depression based on player text and then provide an appropriate response.

Keywords: Non-Player Character; Machine Learning; Deep Learning.

REFERENCES

1. Jacob Devlin, et al., Bert: Pre-training of deep bidirectional transformers for language understanding, CoRR, 4171-4186, 2018. https://doi.org/10.48550/arXiv.1810.04805
2. Victor Sanh et al., DistilBERT, a distilled version of BERT: smaller, faster, cheaper and lighter, arXiv preprint arXiv:1910.01108, 2019. https://doi.org/10.48550/arXiv.1910.01108
3. Shaoxiong Ji et al., MentalBERT: Publicly Available Pretrained Language Models for Mental Healthcare, Proceedings of LREC, 7184-7190, 2022.

SOFT INT-MODULES OVER A SOFT INT-RING

Emine Üyücü [1], Ummahan Acar[2]

[1,2] Department of Mathematics, University of Muğla Sıtkı Koçman University, Turkey

emineuyucu@posta.mu.edu.tr, uacar@mu.edu.tr,

Abstract

The concept of soft intersectional (int) module over a soft int-ring is developed in this work to extend the algebraic applications of soft set theory. A key contribution is the characterization of these modules through level sets, providing a bridge between soft structures and classical sets. Moreover, it is shown that the sum, product, and intersection of soft int-modules maintain their structure over soft int-rings. The theoretical framework is supported by a detailed analysis of their properties and concrete examples.

Keywords: Soft module; Soft int-module; Soft int-ring

REFERENCES

1. F. Citak, Soft prime int-ideals, Journal of Mathematics, Vol:2025, No:1, 1–10, 2025.
2. F. Citak, N. Cagman, Soft int-rings and its applications, Journal of Intelligent and Fuzzy Systems, Vol:28, No:3, 1225–1233, 2015.
3. J. Ghosh, D. Mandal, T. K. Samanta, Soft semiprimary int-ideals of a ring, Analele Universitatii Oradea Fasc. Matematica, Vol:25, No:2, 141–151, 2018.
4. J. Ghosh, D. Mandal, T. K. Samanta, Soft Prime and semiprime int-ideals of a ring, AIMS Mathematics, Vol:5, No:1, 732–745, 2019.
5. D. Molodtsov, Soft sets-first results, Applied Mathematics and Computation, Vol:37, No:4, 19–31, 1999.
6. Q. M. Sun, Z. L. Zhang, J. Liu, Soft sets and soft modules, Lecture Notes in Comput. Sci., Vol:5009, No:1, 403–409, 2008.

On generalized p-decreasing sequences in Lattice normed spaces via lacunary density

Fatih Temizsu [1]

[1] Department of Engineering Fundamental Sciences, Sivas University of Science and Technology, Sivas, Turkey

ftemizsu@sivas.edu.tr,

Abstract

This study introduces the concept of lacunary statistical p-decreasing sequences within the framework of lattice-normed spaces. By utilizing lacunary density, this approach extends the existing theory of statistical p-decreasing sequences by localizing their decreasing behavior relative to the intervals of a lacunary sequence.

Keywords: Lacunary statistical p-decreasing sequences; lattice-normed spaces; lacunary density.

REFERENCES

1. J. A. Fridy, C. Orhan, Lacunary statistical convergence, Pacific J. Math., Vol:160, No:1, 43–51, 1993.
2. J. Li, Lacunary statistical convergence and inclusion properties between lacunary methods, Internat. J. Math. Math. Sci., Vol:23, No:3, 175–180, 2000.
3. C. D. Aliprantis, O. Burkinshaw, Locally Solid Riesz Spaces with Applications to Economics, Mathematical Surveys and Monographs, Vol:105, 2nd ed., 2003.
4. C. D. Aliprantis, O. Burkinshaw, Positive Operators, Springer, Dordrecht, 2006.
5. A. Aydın, E. Korkmaz, R. Yapalı, Statistical p-convergence in lattice-normed Riesz spaces, Facta Univ. Ser. Math. Inform., Vol: 2025 (in press).

FIBONACCI WEIGHTED DIFFERENCE SEQUENCE SPACE

Seçkin Yalçın and Murat Candan

Department of Mathematics, University of İnönü, Malatya, Turkey

seckin.yalcin@inonu.edu.tr, murat.candan@inonu.edu.tr,

Abstract

In this study, the historical development of sequence spaces constructed by infinite matrices using Fibonacci numbers is reviewed, and the structural properties of the space $l_p(\tilde{w}, \tilde{F})$, defined as the "Fibonacci weighted difference sequence space" in [1], are explained and presented in detail. First, it is shown that the space $l_p(\tilde{w}, \tilde{F})$ is a semi-normed $1 \leq p < \infty$ space but not a normed space, and the strictness of the $l_p(\tilde{w}) \subset l_p(\tilde{w}, \tilde{F})$ inclusion is proven. Furthermore, it is proved that the semi-normed space $l_2(\tilde{w}, \tilde{F})$ is a semi-inner product space, whereas for the case $p \neq 2$, the semi-normed space $l_p(\tilde{w}, \tilde{F})$ does not possess a semi-inner product space structure. In the subsequent sections of the study, the boundedness conditions of matrix operators defined from the space $l_1(\tilde{w})$ to the space $l_1(\tilde{w}, \tilde{F})$ are investigated, and the semi-norm calculations of these operators are provided. Additionally, similar boundedness and semi-norm analyses are conducted for matrix operators defined from the space $l_p(\tilde{w})$ to the space $l_p(\tilde{w}, \tilde{F})$; within this framework, fundamental theorems regarding the boundedness of the transpose operator of the $\tilde{R}$ Riesz matrix and the H Hilbert matrix operator are proven. Finally, the lower boundedness properties of matrix operators defined from the space $l_p(\tilde{w})$ to the space $l_p(\tilde{w}, \tilde{F})$ are examined, and the study is concluded by proving that the H Hilbert matrix operator is a lower bounded operator.

Keywords: Fibonacci numbers; Matrix operators; Quasi summable matrices, Sequence spaces.

This work was supported by Research Fund of the Inonu University. Project Number:FYL-2020-2211.

REFERENCES

1. İlkhan, Merve, Norms and lover bounds of some matrix operators on Fibonacci weighted difference sequence space, Mathematical Methods in the Applied Sciences, 42(16), 5143–5153, 2019.
2. Seçkin Yalçın, Fibonacci weighted difference sequence space; Master's Thesis, Graduate School of Natural and Applied Sciences, İnönü University 2022.

On optical solitons and qualitative analysis of the third order perturbed nonlinear Schrödinger equation having the Kerr law in the absence of group velocity dispersion

Ismail Onder [1,*], Muslum Ozisik [1], Aydin Secer [1]

[1] Department of Mathematical Engineering, Yildiz Technical University, Istanbul, Türkiye

ionder@yildiz.edu.tr

Abstract

In this study, a third-order perturbed nonlinear Schrödinger equation with Kerr-type nonlinearity in the absence of group velocity dispersion is investigated. The model is analytically solved using the Kudryashov method, yielding explicit dark soliton solutions. The influence of key system parameters on the soliton structures is examined, highlighting their role in shaping the amplitude and profile of the wave. Furthermore, a Gaussian transformation is applied to reformulate the model into a planar dynamical system. Phase portraits are constructed and critical points are identified to analyze the qualitative behavior of the system, with stability and trajectory structures illustrated through phase plane diagrams. In addition, the effect of an external perturbation force is explored. Numerical simulations show that such forcing can induce chaotic dynamics, supported by phase space representations. A sensitivity analysis is also conducted to assess the system's response to variations in initial conditions. The findings provide a comprehensive understanding of the model's nonlinear dynamics.

Keywords: Third order nonlinear Schrödinger equation; The Kudryashov method; Optical solitons; Qualitative analysis

REFERENCES

1. Kudryashov, N. A. (2012). One method for finding exact solutions of nonlinear differential equations. Communications in Nonlinear Science and Numerical Simulation, 17(6), 2248–2253. https://doi.org/10.1016/j.cnsns.2011.10.016
2. Lu, D., Seadawy, A. R., Wang, J., Arshad, M., & Farooq, U. (2019). Soliton solutions of the generalised third-order nonlinear Schrödinger equation by two mathematical methods and their stability. Pramana - Journal of Physics, 93(3), 44-. https://doi.org/10.1007/s12043-019-1804-5
3. Li, Z., & Huang, C. (2023). Bifurcation, phase portrait, chaotic pattern and optical soliton solutions of the conformable Fokas–Lenells model in optical fibers. Chaos, Solitons & Fractals, 169, 113237. https://doi.org/10.1016/j.chaos.2023.113237

The Effect of GeoGebra Software on Mathematics Achievement of Secondary School Students in Kyrgyzstan

Hüseyin Ekinci[1] **Gulshat Muhametjanova**[2]

[1] Department of Mathematics, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan
2351y03002@manas.edu.kg

[2]Department of Applied Mathematics and Informatics, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan gulshat.muhametjanova@manas.edu.kg

Abstract

The purpose of this study is to investigate the effects of mathematics instruction supported by GeoGebra software on the academic achievement and self-efficacy beliefs of 10th-grade secondary school students in Kyrgyzstan. The study was conducted using a quantitative research approach with a quasi-experimental pretest–posttest control group design.

The sample of the study consists of a total of 50 students attending a public high school in Bishkek during the 2025–2026 academic year. Due to absenteeism and missing data, 3 students were excluded from the analysis, and the analyses were conducted with 47 students. The experimental group received GeoGebra-supported instruction, while the control group was taught using traditional teaching methods.

Data were collected using the Mathematics Achievement Test, and a student opinion form. Quantitative data were analyzed using SPSS 25; paired-sample t-tests and independent-sample t-tests were applied.

The findings have indicated that GeoGebra-supported instruction significantly increased students' mathematics achievement. Qualitative findings have revealed that students showed improvements in visualization skills, active participation in lessons, and conceptual understanding.

In conclusion, GeoGebra software is considered as an effective and powerful instructional tool in mathematics education.

Keywords: GeoGebra, Academic Achievement, Dynamic Mathematics Software, Mathematics Education, Kyrgyzstan

Physics-Informed Graph Neural Networks for Solving Heat Equation PDEs on Scattered Meshes

Merve Zeynep KAYA [1]

[1] Faculty of Applied Sciences, Ataturk University, Erzurum, Turkey

mervekaya@atauni.edu.tr

Ercan ÇELİK[2]

[2]Department of Mathematics, Kyrgyz-Turkish Manas Unıversıty, Bishkek, Kyrgyzstan

ercan.celik@manas.edu.kg

Mesut KARABACAK[3]

[3]Department of Mathematics, Ataturk University,Erzurum,Turkey

mkarabacak@atauni.edu.tr

Abstract

This study explores physics-informed graph neural networks (PIGNNs) for solving the Heat Equation on scattered and irregular meshes. By representing mesh nodes as graphs through Graph Neural Networks, the method effectively handles unstructured domains. The model incorporates PDE residuals and boundary conditions into the loss function, ensuring physically consistent predictions while reducing reliance on labeled data. This approach demonstrates improved generalization and accuracy compared to purely data-driven methods, particularly in sparse and irregular settings.

Keywords: Heat Equation, Graph Neural Networks, Irregular Meshes, PDE Learning, Neural Operators, Partial Differantial Equations

REFERENCES

1. Raissi, M., Perdikaris, P., & Karniadakis, G. E. (2019). Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear PDEs. Journal of Computational Physics.
2. Battaglia, P. W., et al. (2018). Relational inductive biases, deep learning, and graph networks. arXiv preprint arXiv:1806.01261.
3. Pfaff, T., et al. (2021). Learning mesh-based simulation with graph networks. International Conference on Learning Representations (ICLR).

BINARY NEWTON-RAPHSON BASED OPTIMIZER WITH S-SHAPED AND V-SHAPED TRANSFER FUNCTIONS FOR 0-1 KNAPSACK PROBLEM

Gülşen Orucova Büyüköz [1]

[1] Department of Mathematics and Computer Science, Necmettin Erbakan University, Konya, Turkey

gorucova@erbakan.edu.tr

Abstract

This study applies the Newton–Raphson–Based Optimizer (NRBO) to 0-1 Knapsack Problems (0-1 KP), which belong to the NP-hard problem class. As NRBO was originally designed for continuous optimization problems, it cannot be applied directly to binary-structured 0-1 KP. Therefore, S-shaped and V-shaped transfer functions are employed to adapt the continuous search space to the binary one. BNRBO (binary NRBO) is used to solve 0-1 KP benchmark instances and the results are compared across different transfer functions to determine which yields more effective solutions. In addition, the proposed algorithm has been compared with different algorithms in the literature. The experimental results demonstrate the competitiveness and effectiveness of the proposed approach in solving binary optimization problems.

Keywords: Newton-Raphson-Based Optimizer; 0-1 Knapsack Problems; Transfer Functions; Binary Optimization.

REFERENCES

1. Dantzig, G.B., Discrete-Variable Extremum Problems, Operations Research, Vol:5, No:2, 266–288, 1957.
2. Rooderkerk, R.P. and van Heerde, H.J., Robust optimization of the 0-1 knapsack problem: Balancing risk and return in assortment optimization, European Journal of Operational Research, Vol:250, No:3, 842–854, 2016.
3. Sowmya, R., Premkumar, M. and Jangir, P., Newton-Raphson-based optimizer: A new population-based metaheuristic algorithm for continuous optimization problems, Engineering Applications of Artificial Intelligence, Vol:128, 107532, 2024.

A Study on Nectarine Matrices via Split-Complex Representation

Gözde Özyurt [1]

[1] Department of Mathematics, Istanbul Beykent University, Istanbul, Turkey

gozdeozyurt@beykent.edu.tr,

Abstract

This study examines the structural properties of nxn matrices defined over the algebra of nectarines using split-complex numbers. The inverse of a nectarine matrix is presented by utilizing the properties of split-complex matrices. Furthermore, the eigenvalue problems for these matrices are investigated through their split-complex representations.

Keywords: Nectarine; nectarine matrix; split-complex number; split-complex matrix.

REFERENCES

1. I. M. Yaglom, Complex Numbers in Geometry, Academic, New York, 1968.
2. B. Schmeikal. Tessarinen, Nektarinen und andere Vierheiten, Mitt Math Ges Hamburg., 34:1-28, 2014.
3. R. Lauterbach, G. Opfer. The Jacobi matrix for functions in noncommutative algebras, Advances in Applied Clifford Algebras, 24(4), 1059-1073, 2014.
4. Z. Guo, T. Jiang, C. Jiang, G. Wang. Algebraic techniques for eigenvalues and eigenvectors of a nectarine matrix in nectarine algebra, Mathematical Methods in the Applied Sciences, 46(4), 4751-4762, 2023.
5. M. Merkepci, M. Abobala. On some novel results about split-complex numbers, the diagonalization problem, and applications to public key asymmetric cryptography, Journal of Mathematics, 1 (4481016), 2023.

Approximate Solutions of Linear Integro-Differential Equations Using Bessel Polynomials

Nooriza Mirzabekova [1] **, Ercan Çelik** [1]
[1] Department of Applied Mathematics and Informatics, University of Kyrgyz-Turkish Manas
Bishkek, Kyrgyzstan

noorizamirzabekova@gmail.com, ercan.celik@manas.edu.kg

Abstract

In this study, we introduce a computational algorithm for solving Integro-Differential Equations (IDEs) using Bessel functions as basis functions. The algorithm approximates the solution by representing it as a series expansion in terms of Bessel functions and substituting this assumed form into the Integro-Differential Equations (IDEs). By collocating the resulting equation at uniformly distributed points, a system of linear algebraic equations is obtained. This system is then solved through matrix inversion to determine the Bessel coefficients, which are subsequently used to construct the approximate solution. Numerical examples illustrate the accuracy and efficiency of the proposed method, emphasizing its capability to reduce computational cost while maintaining high precision.

Keywords: Bessel polynomials, Collocation method, Integro-Differential equations, Approximate solution.

REFERENCES

1. Oyedepo T, Ishola CY, Ishaq AA, Ahmed OL, Ayinde AM. Computational algorithm for fractional Fredholm integro-differential equations. Kathmandu Univers J Sci Eng Technol. 2023;17(1):1–7, 2023.
2. Jalius Z. Abdul C, Majid Z. Numerical solution of second-order Fredholm integrodifferential equations with boundary conditions by Quadrature-difference method. J Appl Math. 2017;
3. Oyedepo, T., Ajileye, G., and Ayotunde, A., Bernstein computational algorithm for integro-differential equations, Partial Differential Equations in Applied Mathematics, Volume 11, September 2024, 100897

Block Gaussian elimination with QR factorization in place of diagonal block inversion

Sadaghat Shahmorad[1] **, Ercan Çelik**[2]

[1] Department of Applied Mathematics, University of Tabriz, Tabriz, Iran

s_shahmorad@yahoo.com

[2] Department of Applied Mathematics and Informatics, University of Kyrgyz-Turkish Manas Bishkek, Kyrgyzstan

ercan.celik@manas.edu.kg

Abstract

One of the most well-known methods for solving block systems of equations is block Gaussian elimination. In the conventional version of this method, the inverses of the diagonal blocks are computed and used to eliminate the subdiagonal blocks. In this paper, we propose using the QR factorization of the diagonal blocks instead of explicitly computing their inverses, and we present numerical examples to compare the efficiency and accuracy of the two approaches.

Keywords: Gaussian elimination; Block by block systems; QR factorization.

REFERENCES

1. Engeln-Mullges, G., Uhlig F., Numerical Algorithms with Fortran, (1996)
2. Trefethen, Lloyd N., Bau, David III, Numerical Linear Algebra. Philadelphia, PA: Society for Industrial and Applied Mathematics (1997)
3. Stoer, J., Bulirsch, R., Introduction to Numerical Analysis (3rd ed.), Springer, p. 225, (2002)
4. Holmes, Mark H., Introduction to Scientific Computing and Data Analysis, 2nd Ed. Springer (2023)
5. Shahmorad, S., Mirnia, M.K., Solution of Linear Least Squares via the ABS Algorithm, Dissertation for Master's Degree (1995)

KUDRYASHOV EXPANSİON METHOD APPLİED TO FİSHER MATHETİCAL MODEL

Elif DENİZ ÖZTÜRK[1] ,PROF.Dr.ERCAN ÇELİK[1],[2],DOÇ.Dr.S.ŞULE ŞENER KILIÇ[1]

[1] Department of Mathematics, University of Atatürk, Erzurum, Turkey

[2]Department of Applied Mathematics and Informatics, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan

elifdenizozturk123@gmail.com, senersule@atauni.edu.tr , ercancelik@manas.edu.tr

Abstract

We obtain new computational soliton solutions characterized by topological, rational, exponential, trigonometric, and hyperbolic functions for the Fisher equation. Using a good strategy, the Kudryashov expansion method is used to find different dynamical wave structures of solitonsolutions within the scope of evolutionary dynamical structures of solitary wave solutions. To facilitate understanding of the physical phenomena related to these dynamical models in mathematical physics, the physical behavior of these solutions is empirically demonstrated. In this regard, the current study offers a cohesive analytical examination of diverse soliton structures within a singular framework, enhancing the theoretical comprehension of soliton dynamics in nonlinear optical models. The answers discovered may provide a valuable foundation for subsequent analytical investigations of associated nonlinear evolution equations.

Keywords: Fisher equation, M-truncated derivative, Kudryashov expansion method, soliton solution

REFERENCES

1. Ali, K. K. (2024). Abundant optical soliton solutions to the Kudryashov equation and its modulation instability analysis. Optical and Quantum Electronics, 56(1), 129.
2. Ibrahim, S., Sulaiman, T. A., Yusuf, A., Ozsahin, D. U., & Baleanu, D. (2024). Wave propagation to the doubly dispersive equation and the improved Boussinesq equation. Optical and Quantum 144 Electronics, 56(1), 20.
3. Murad, M. A. S., Ismael, H. F., Sulaiman, T. A., & Bulut, H. (2024). Analysis of optical solutions of higher-order nonlinear Schr¨odinger equation by the new Kudryashov and Bernoulli's equation approaches. Optical and Quantum Electronics, 56(1), 76.
4. Mahmood, B. A., Jwamer, K. H., & Tahir, S. A. (2023). A new hybrid technique based on nonpolynomial splines and finite differences for solving the Kuramoto–Sivashinsky equation. AIP Advances, 13(6).

NOTES ON SOME CLASSES OF MEROMERPHIC CLOSE-TO-CONVEX FUNCTIONS

Tuğba Yavuz[1]

[1] Department of Mathematics, Istanbul Beykent University, Istanbul, Turkey

tugbayavuz@beykent.edu.tr,

Abstract

Let M represent the class of meromorphic functions defined by

$$f(z) = \frac{1}{z} + \sum_{n=0}^{\infty} a_n z^n$$

which are analytic on the unit disk $D^* = \{ z \in \mathbb{C} : 0 < |z| < 1 \}$. The investigation of such meromorphic functions, together with the establishment of their fundamental properties, has attracted considerable attention in recent years and constitutes an important area of research in geometric function theory.

In this presentation, a class of close-to-convex meromorphic functions encompassing several previously studied classes is introduced. An analytic condition satisfied by functions in this class is established, and a corresponding sufficient condition is also obtained. Finally, we obtain upper bounds for Taylor coefficients of such functions.

Keywords: Meromorphic functions, Close-to-Convex Functions, Principle of the Subordination.

REFERENCES

1. P. L. Duren, Univalent functions, Springer Science & Business Media, 2001.

2. A. O. Mostafa, M. K. Aouf, H. M. Zayed, T. Bulboacˇa, Convolution conditions for subclasses of meromorphic functions of complex order associated with basic Bessel functions, Journal of the Egyptian Mathematical Society. 25 (3) (2017), 286–290.

3. L. Shi, Z. G. Wang, On certain subclass of meromorphic spirallike functions involving the hypergeometric function, The Scientific World Journal. (1) (2014), 1–7.

4. S. Bulut, A note on the Libera type meromorphic close-to-convex functions, Turk. J. Math. Comput. Sci., 13 (2) , 2021, 282-286.

5. K. Kuroki and S. Owa, Notes on new class for certain analytic functions, RIMS Kokyuroku 1772 (2011), 21.25.

Semi Analytical Solutions of Two Forms of the GKdV Equation

Ebru Cavlak Aslan [1] **and Özlem Pirinççi** [1]

[1] Department of Mathematics, Science Faculty, University of Firat, Elazig, Türkiye

ebrucavlak@hotmail.com, pirincciozlem@gmail.com

Abstract

In this study, two distinct cases of an important nonlinear generalized Korteweg–de Vries (GKdV) equation are examined. To obtain semi-analytic solutions for the equation models under investigation, the homotopy analysis method (HAM), which holds a significant place in the literature, was employed. The obtained solution series were analyzed in detail, and convergence control parameters were examined by constructing convergence curves to identify valid convergence regions. Based on these analyses, solution profiles were presented for different values of the free parameters arising from the equation's structure. Additionally, error tables were constructed for various time intervals to evaluate the accuracy and stability of the obtained approximations. Graphical representations clearly demonstrate the effect of parameter changes on solution behavior. The results show that the applied method provides reliable and convergent semi-analytic solutions for both forms of the GKdV equation. Overall, this study highlights the effectiveness of the homotopy analysis method in addressing nonlinear wave equations and provides useful information for future analytical research.

Keywords: GgKdV equation, Homotopy analysis method, Semi-analytical solutions.

REFERENCES

1. J. I. Yano and Y. N. Tsujimura, The domain of validity of the KdV-type solitary rossby waves in the shallow water β-plane model, Dynamics of Atmospheres and Oceans, Vol:11 (2), No:101-129, 1987.
2. J. P. Boyd, Equatorial Solitary Waves. Part I: Rossby Solitons, Journal of Physical Oceanography, Vol: 10, 1699-1717, 1980.
3. S. Liao, Homotopy Analysis Method in Nonlinear Differential Equations, Springer, 2012.

PREDICTIVE MODELING OF CONCRETE SHRINKAGE USING SOFT COMPUTING METHODS: GRNN, RBF NEURAL NETWORKS, AND SVM

Mazllum Kamberi[1]

[1] Faculty of Civil Engineering, University of Prishtina ‘’Hasan Prishtina’’, Prishtin, Republic of Kosova

mazllum.ing@gmail.com ,

Abstract

This research examines the utilization of three soft computing techniques: General Regression Neural Networks (GRNN), Radial Basis Function Neural Networks (RBF NN), and Support Vector Machines (SVM) for the predictive modeling of concrete drying shrinkage. We used a dataset of 63 experimental observations from prismatic concrete samples with 8 input variables (cement content, water-to-cement ratio, compressive strength, relative humidity, temperature, time, age at drying onset, and notional size) to test all three models with DTREG software.

We used conjugate gradient minimization on the smoothing parameter σ to optimize the GRNN model in great detail. Validation results showed that all of the models were very good at making predictions: The RBF NN model had the highest validation R2 = 97.043% (MAPE = 6.26%, r = 0.985) and is the best one to use. The GRNN model had the lowest validation MAPE = 5.13% (R2 = 96.44%, r = 0.982), and the SVM model had R2 = 93.02% (MAPE = 8.65%, r = 0.965).

Across all models, variable importance analysis consistently identified elapsed drying time (t) and relative humidity (RH) as the two primary predictors. The results show that soft computing methods can be used to accurately and data-driven predict how concrete will shrink for engineering design and construction.

Keywords: concrete shrinkage, soft computing, GRNN, RBF neural network, support vector machine, DTREG, predictive modeling, machine learning, civil engineering

REFERENCES

1. Kecman, V. (2001). *Learning and Soft Computing: Support Vector Machines, Neural Networks and Fuzzy Logic Models*. MIT Press, Cambridge, MA.
2. Sherrod, P.H. (2025). *DTREG Predictive Modeling Software – User’s Manual*. Available at: https://www.dtreg.com. Accessed December 2025.
3. Bažant, Z.P., & Baweja, S. (1995). Creep and shrinkage prediction model for analysis and design of concrete structures: Model B3. *Materials and Structures*, 28(6), 357–365.

APPROXIMATION BY FIBONACCI BASED KING TYPE SZÁSZ OPERATORS

Fatih Rıza Çelik[1]

[1] Department of Mathematics, University of Gazi, Ankara, Turkey

fatihrizacelik@gmail.com,

Abstract

In this study, a new King type Szász operator based on the exponential generating function of Fibonacci numbers is introduced. The positivity and linearity of the operator are established and its moments and central moments are computed explicitly. The approximation behavior of the operator on compact intervals is examined by means of these moment estimates and a Korovkin type convergence result is obtained. The theoretical results are supported by graphical and numerical examples.

Keywords: Fibonacci numbers ; King type Szász operators; Korovkin type convergence.

REFERENCES

1. C. A. Church, Marjorie Bicknell, Exponential Generating Functions for Fibonacci Identities, The Fibonacci Quarterly, Vol:11, No:3, 275–281, 1973.
2. J. P. King, Positive linear operators which preserve x^2, Acta Mathematica Hungarica, Vol:99, No:3, 203–208, 2003.
3. Oktay Duman, M. Ali Özarslan, Szász–Mirakjan type operators providing a better error estimation, Applied Mathematics Letters, Vol:20, No:12, 1184–1188, 2007

EN EFFICIENT NUMERICAL METHOD FOR SECOND ORDER SINGULARLY PERTURBED DIFFERENTIAL EQUATIONS

Okan Genç[1] **Ömer Oruç**[1]

[1] Department of Mathematics, University of Dicle, Diyarbakır, Turkey

ogenc04@gmail.com,

Abstract

In this study, by giving the definition and properties of singularly perturbed differential equations, we presented examples related to second-order singularly perturbed differential equations. In addition, we included problems concerning the solution of second-order singularly perturbed differential equations using block pulse functions (BPF). Finally, we compared the results we obtained with other methods. From these comparisons, we saw that the results of the method are good and consistent with other studies.

Keywords: Singularly perturbed differential equations, Block Pulse Function, Numerical solution

REFERENCES

1. M. Kudu, I. Amirali and G. M. Amiraliyev, A Finite Difference Method for Singularly Perturbed Delay Integro-Differantial Equation, J. Comput. Apple. Math., 308, 379-390, 2016.
2. Mohan K. Kadalbajoo, Arjun Singh Yadaw, B-Spline collocation method for a two-parameter singularly perturbed convection-diffusion boundary value problems, Apple. Math. Comput. 201 (1-2), 504-513, 2008.
3. Z. Avazzadeh and M. Heydari, The application of block pulse functions for solving higher-order differential equations with multi-point boundary conditions, 2016:93, Advances in Difference Equations, 1-8, 2016.

Mathematical modeling of earthquake effects on multistorey buildings using the proportional derivative approach

Bahar Acay Öztürk [1]

[1] Department of Mathematics, University of Firat, Elazig, Turkey

bacay@firat.edu.tr,

Abstract

In this study, we analyze the dynamic response of high-rise buildings under seismic excitation using the proportional derivative (PD) approach derived from control theory. Unlike traditional integer-order models, the proposed formulation introduces a more flexible structure capable of capturing complex dynamic behaviors. The dynamic characteristics of the system, including natural frequencies, time periods, and mode shapes, are determined by means of eigenvalue–eigenvector method. Moreover, the forced vibration response is investigated by considering damping effects, and steady-state solutions are obtained. We first derive an analytical solution for a two-story building. The model under investigation is then extended to a ten-story building, where numerical methods are used owing to the increased system complexity. The results demonstrate that the proposed PD-based non-integer-order model provides a consistent and effective framework for seismic analysis. This study contributes to the development of alternative mathematical modeling techniques in earthquake engineering.

Keywords: Earthquake effect, Fractional modeling, Coulomb dumping, Mathematical physics.

REFERENCES

1. Motchongom, M. T., Tanekou, G. B., Fozin, F., Kagho, L. Y., Kengne, R., Pelap, F. B., & Kofane, T. C. (2021). Fractional dynamic of two-blocks model for earthquake induced by periodic stress perturbations. *Chaos, Solitons & Fractals: X*, *7*, 100064.
2. Pelap, F. B., Tanekou, G. B., Fogang, C. F., & Kengne, R. (2018). Fractional-order stability analysis of earthquake dynamics. *Journal of Geophysics and Engineering*, *15*(4), 1673-1687.

ANTIPERODICITY IN QUASILINEAR IMPULSIVE SYSTEMS

Eman Bakır Ahmad Ajm[1], **Fatma Tokmak Fen**[2,*], **Mehmet Onur Fen**[3]

[1] Graduate School of Natural and Applied Sciences, Gazi University, Ankara, Türkiye

[2]Department of Mathematics, Gazi University, Ankara, Türkiye

[3]Department of Mathematics, TED University, Ankara, Türkiye

emanajam93@gmail.com, fatmatokmak@gazi.edu.tr, onur.fen@tedu.edu.tr

*corresponding author

Abstract

Systems with impulse actions are investigated for the existence and uniqueness of anti-periodic motions. Nonlinear terms with sufficiently small Lipschitz constant and regular impulse moments are taken into account in the system. Appropriate examples with simulations are provided.

Keywords: Impulsive systems; Anti-periodic solutions; Regular impulse moments

REFERENCES

1. Samoilenko, A.M., Perestyuk, N.A.: Impulsive Differential Equations, World Scientific, Singapore (1995)
2. Fen, M.O., Tokmak Fen, F.: Unpredictability in Quasilinear Non-Autonomous Systems with Regular Moments of Impulses, *Mediterr. J. Math.* **20**, 191 (2023).
3. Stamov, G.: Almost periodic solutions for forced perturbed impulsive differential equations, Appl. Anal. **74**, 45–56 (2000)
4. Li, X., Bohner, M., Wang, C.-K.: Impulsive differential equations: periodic solutions and applications, Automatica **52**, 173–178 (2015)
5. Akhmet, M.: Principles of Discontinuous Dynamical Systems, Springer, New York (2010)

LACUNARY STATISTICAL CONVERGENCE OF ORDER α IN CONE METRIC SPACES

Süleyman Sarikaya [1], **Yavuz Altin** [1]

[1] Department of Mathematics, Fırat University, Elazığ, Turkey

ssarikaya@firat.edu.tr, yaltin23@yahoo.com

Abstract

In this study, we introduce the concept of lacunary statistical convergence of order α in cone metric spaces and examine some relationships by giving inclusion theorems related to lacunary statistical convergence of order α.

Keywords: Statistical convergence; Metric spaces; Cone metric spaces.

REFERENCES

1. Aliprantis C. D., Tourky R., Cones and Duality, Graduate Studies in Math., Amer Math. Soc., 2007.
2. Buck R. C., Generalized asymptotic density, Amer. J. Math., Vol:75, 335-346, 1953.
3. Fast H., Sur la convergence statistique, Colloq. Math., Vol:2, 241-244, 1951.
4. Fridy J. A., On statistical convergence, Analysis, Vol:5, 301-313, 1985.
5. Li K., Lin S., Ge Y., On statistical convergence in cone metric spaces, Topology Appl. 196, 2015.

A HYBRID ITERATION APPROACH FOR SPLIT EQUILIBRIUM AND FIXED POINT PROBLEMS

Lale Cona[1] **and Deniz Şimşek**[2]

[1] Department of Mathematical Engineering, University of Gümüşhane, Gümüşhane, Turkey

[2]Institute of Graduate Education, University of Gümüşhane, Gümüşhane, Turkey

lalecona@gumushane.edu.tr,

furtana95@hotmail.com,

Abstract

In this study, we introduce a novel iterative framework designed to obtain strong convergence results for split equilibrium problems (SEP) and asymptotically nonexpansive mappings in Hilbert spaces. The proposed method is constructed by integrating a shrinking projection strategy with an averaged iterative process inspired by Cesàro means.

Keywords: Asymptotically nonexpansive mapping; Kirk iteration method; Shrinking projection method, Split equilibrium problem; Fixed point problem.

REFERENCES

1. Baillon, J. B., Un théorème de type ergodique pour les contractions non linéaires dans un espace de Hilbert, C. R. Acad. Sci. Paris Sér. I., 280, 1511-1514, 1975.
2. Takahashi, W., Takeuchi, Y., Kubota, R., Strong convergence theorems by hybrid methods for families of nonexpansive mappings in Hilbert spaces. Fixed Point Theory and Applications, 341(1), 276-286, 2008.
3. Harisa, S. A., Khan, M. A. A., Mumtaz, F., Faried, N., Morsy, A., Nisar, K. S., Ghaffar, A. Shrinking Cesáro means method for the split equilibrium and fixed point problems in Hilbert spaces. Advances in Difference Equations, (2020)345, 1-19, 2020.

EXACT SOLUTIONS OF THE EXTENDED KAIRAT II-X EQUATION

Özge Hamzaoğlu [1], **Arzu Akbulut** [1]

[1] Department of Mathematics, University of Bursa Uludag, Bursa Turkey

ozgeehamzaoglu@gmail.com, arzuakbulut@uludag.edu.tr

Abstract

The main aim of this study is to obtain analytical solutions of the extended Kairat II–X equation, which is derived by extending the Kairat II and Kairat X equations, using the modified Kudryashov, generalized Kudryashov, and the new Kudryashov methods. By using an appropriate wave transformation, the given nonlinear partial differential equation is reduced to an ordinary differential equation. The reduced equation is then integrated once and simplified. The balancing number of the reduced equation is obtained by the application of the homogeneous balance principle. In the first stage, the modified Kudryashov method is applied by selecting an auxiliary solution and substituting it together with the corresponding auxiliary ordinary differential equation into the reduced equation, leading to a determining algebraic system whose solution yields two different families of analytical solutions. Afterwards, the generalized Kudryashov and the new Kudryashov methods are applied to obtain additional analytical solutions. Lastly, in order to demonstrate the physical behavior of the solutions, three-dimensional surfaces, two-dimensional profiles, and contour plots are provided for appropriate parameter values, confirming that these techniques are efficient analytical tools for solving the extended Kairat II–X equation.

Keywords: Extended Kairat II–X equation; modified Kudryashov method; generalized Kudryashov method; new Kudryashov method.

REFERENCES

1. Ulviye Demirbilek, Ali H. Tedjani, Aly R. Seadawy, Analytical solutions of the combined Kairat-Ⅱ-Ⅹ equation: a dynamical perspective on bifurcation, chaos, energy, and sensitivity, AIMS Mathematics, Vol:10, No:6, 13664–13691, 2025.
2. Mohammad Mirzazadeh, Mostafa Eslami, Essaid Zerrad, Mohammad F. Mahmood, Anjan Biswas, Milivoj Belic, Optical solitons in nonlinear directional couplers by sine–cosine function method and Bernoulli′s equation approach, Nonlinear Dynamics, Vol:81, No:4, 1933–1949, 2015.

ABOUT SOLVING GENERALIZED VARIATIONAL INEQUALITY, FIXED POINT AND EQUILIBRIUM PROBLEMS

Lale Cona[1] **and Jackson Kalule**[2]

[1] Department of Mathematical Engineering, University of Gümüşhane, Gümüşhane, Turkey

[2]Institute of Graduate Education, University of Gümüşhane, Gümüşhane, Turkey

lalecona@gumushane.edu.tr,

kalulejackson04@gmail.com,

Abstract

In this study, we propose a novel iterative algorithm for approximating a common solution to generalized variational inequality, fixed-point, and equilibrium problems for non-expansive mappings. We demonstrate strong convergence results for the sequence generated under suitable assumptions in Hilbert spaces. We presented a numerical example to demonstrate the efficiency and advantages of the proposed method compared to known iterative methods.

Keywords: Equilibrium problem; Generalized variational inequality; Iterative methods, Nonexpansive mapping; Strong convergence; Fixed point

REFERENCES

1. Blum E. and Oettli W., From Optimization and Variational Inequalities to Equilibrium Problems, Math. Student, Vol:63, No:1, 123–145, 1994.
2. Combettes P. L. and Hirstoaga S. A., Equilibrium Programming in Hilbert Spaces, Journal of Nonlinear and Convex Analysis, Vol:6, No:1, 117–136, 2005.
3. Dashputre S., Tiwari R. and Shrivas J., Iterative Algorithm for Generalized Variational Inequality Problem and Applications, South East Asian J. Math. Math. Sci., Vol: 21, No:1, 77–96, 2025.
4. Yazdi M. and Hashemi Sababe S., A New Extragradient-viscosity Method for a Variational Inequality, an Equilibrium Problem, and a Fixed Point Problem, Mathematics, 12, Article No: 3466, 2024.

EXACT ANALYTICAL WAVE SOLUTIONS FOR THE COMBINED KAIRAT-II-X EQUATION VIA THE MODIFIED SARDAR SUB-EQUATION METHOD

Dmitrii Zhelobnev [1], Nisa Çelik [2]

[1] Department of Mathematics, Bursa Uludag University, Bursa, Turkey

[2] Department of Automobile Engineering, Bursa Uludag University, Bursa, Turkey

nisa@uludag.edu.tr, 032280125@ogr.uludag.edu.tr

Abstract

In this paper, we focus on the combined KAIRAT-II-X equation, which integrates the distinct mathematical structures and physical characteristics of the KAIRAT-II and KAIRAT-X equations into a unified integrable framework. This combined approach is essential for studying nonlinear physics, as it describes the interaction between higher-order dispersion and nonlinear effects. The KAIRAT-II-X equation provides a robust mathematical framework to describe phenomena such as phase transitions in polymer blends, biological systems, and porous media with greater physical accuracy than standard models. To investigate the theoretical structure of the equation, the modified Sardar sub-equation method was employed, yielding several classes of analytical wave solutions, including bright soliton, dark soliton, and singular periodic wave structures. Through this analytical approach, we successfully obtained various exact optical soliton solutions. These findings highlight the effectiveness of this novel approach for analyzing nonlinear evolution equations within the context of wave dynamics.

Keywords: combined KAIRAT-II-X equation; modified Sardar sub-equation method; soliton.

REFERENCES

1. PZhou, JManafian, MLakestani, OAIlhan, NJBahador, AAFattah, NNagiyeva, Analytical evaluations using neural network-based method for wave solutions of combined Kairat-II-X differential equation in fluid mechanics, Scientific Reports, Vol:, No:, , 2026.
2. UYounas, JMuhammad, HFIsmael, TASulaiman, HEmadifar, KKAhmed, The new combined Kairat-II-X differential equation: diversity of solitary wave structures via new techniques, Journal of Nonlinear Mathematical Physics, Vol:32, No:1, 55, 2025
3. MASMurad, HFIsmael, TASulaiman, A class of optical solutions for time-fractional perturbed Fokas–Lenells equation via a modified Sardar sub-equation approach, Optical and Quantum Electronics, Vol:56, No:7, 1130, 2024.

On the Solutions of Unidirectional Wave Model

Ugur BAYRAKCI[1], Seyma TULUCE DEMIRAY[1], Tayyip ONAT[1,*]

[1] Department of Mathematics, Osmaniye Korkut Ata University, Osmaniye, Turkey

*corresponding author

ubayrakci42@gmail.com, seymatuluce@gmail.com, tayyiponat70@gmail.com

Abstract

In this study, the unidirectional wave model is studied. The $\left(m+\frac{1}{G'}\right)-$expansion method is applied to this model. Thus, various soliton solutions of this equation are found. Also, two and three dimensional graphics of these solutions are plotted by the help of Mathematica.

Keywords: $\left(m+\frac{1}{G'}\right)-$expansion method; Unidirectional wave model; Wolfram Mathematica.

REFERENCES

1. D. Altan Koc, Y. S. Gasimov, H. Bulut, A study on the investigation of the traveling wave solutions of the mathematical models in physics via $\left(m+(1/G')\right)$-expansion method, Advanced Mathematical Models & Applications 9(1), 5-13, 2024.
2. Ö. Kırcı, D. Altan Koc, H. Bulut, Dynamics of the traveling wave solutions of conformable time-fractional ISLW and DJKM equations via a new expansion method, Optical and Quantum Electronics 56, 933, 2024.
3. T. Alraqad, M. Suhail, H. Saber, K. Aldwoah, N. Eljaneid, A. Alsulami, B. Muflh, Investigating the Dynamics of a Unidirectional Wave Model: Soliton Solutions, Bifurcation, and Chaos Analysis, Fractal and Fractional, 8, 672, 2024.
4. A. M. Wazwaz, A Hamiltonian equation produces a variety of Painlevé integrable equations: Solutions of distinct physical structures, International Journal of Numerical Methods for Heat & Fluid Flow, 34(4), 1730–1751, 2024.

THE FAMILY OF α-MONOTONE DISTRIBUTIONS: DIFFERENT ESTIMATION METHODS AND APPLICATIONS

Talha Arslan [1]

[1] Department of Econometrics, Van Yüzüncü Yıl University, Van, Türkiye.

mstalhaarslan@yyu.edu.tr

Abstract

Let X and Y be random variables representing the lifetime of a component and the lifetime of this component under stress, respectively. In this context, Jones [1] and Arslan [2] defined a random variable having the form $T=X\times Y^{1/\alpha}$, where X has a distribution on R^+ and Y follows the U(0,1), and called its distribution the α-monotone distribution. In this study, a brief introduction to the family of α-monotone distributions is presented, followed by a discussion of some of its members. Then, maximum likelihood and minimum-distance estimation methods are used to estimate the parameters of the corresponding distributions. At the end, benchmark data sets are modeled using the corresponding distributions. The modeling performances of these distributions are also compared with their strong rivals using well-known information criteria and goodness-of-fit statistics.

Keywords: α-monotone distribution; maximum likelihood; minimum distance.

REFERENCES

1. Jones, M.C., On univariate slash distributions, continuous and discrete, Annals of the Institute of Statistical Mathematics, Vol:72, No:3, 645 – 657, 2020.
2. Arslan, T., An α-monotone generalized log-Moyal distribution with applications to environmental data, Mathematics, Vol:9, No:12, 1400, 2021.

A SKEW-UNIT-NORMAL DISTRIBUTION AND ITS APPLICATIONS

Talha Arslan [1]

[1] Department of Econometrics, Van Yüzüncü Yıl University, Van, Türkiye.

mstalhaarslan@yyu.edu.tr

Abstract

Unit distributions, such as the beta and Kumaraswamy, are used to model data defined in the unit interval. They also play an essential role in defining families of continuous distributions via the composition technique; accordingly, there has been growing interest in defining new unit distributions in recent years. This study provides a brief introduction to the general method for defining a family of unit distributions proposed by Arslan [1], followed by the derivation of a skew-unit-normal distribution. Subsequently, the statistical properties of the skew-unit-normal distribution are investigated. Next, the maximum likelihood and quantile-based estimation methods are used to estimate the parameters. Finally, the modeling performance of the proposed distribution is demonstrated through benchmark datasets.

Keywords: beta distribution; Kumaraswamy distribution, maximum likelihood, quantile-based

REFERENCES

1. Arslan, T., A new family of unit-distributions: definition, properties and applications, TWMS J. App. and Eng. Math., Vol:13, No:2, 782 – 791 , 2023.

The Solutions of Unidirectional Wave Model via IBSEFM

Seyma TULUCE DEMIRAY[1], Ugur BAYRAKCI[1], Ahmet Hakan DOĞAN[1,*],

[1] Department of Mathematics, Osmaniye Korkut Ata University, Osmaniye, Turkey

*corresponding author

seymatuluce@gmail.com, ubayrakci42@gmail.com, ahmethakandogan013@gmail.com

Abstract

In this study, unidirectional wave model is considered by using improved Bernoulli sub-equation function method. First of all, this model is converted into ordinary differential equations by the help of the wave transformation. Then, some solutions of this model are found. Also, two and three dimensional graphics of these solutions are plotted by the help of Mathematica.

Keywords: The Improved Bernoulli sub-equation function method; unidirectional wave model; Wolfram Mathematica.

REFERENCES

1. T. Alraqad, M. Suhail, H. Saber, K. Aldwoah, N. Eljaneid, A. Alsulami, B. Muflh, Investigating the Dynamics of a UnidirectionalWave Model: Soliton Solutions, Bifurcation, and Chaos Analysis, Fractal Fract, 8(672), 1-20, 2024.
2. A. M. Wazwaz, A Hamiltonian equation produces a variety of Painleve integrable equations: Solutions of distinct physical structures. Int. J. Numer. Methods Heat Fluid Flow, 34, 1730‑1751, 2024 .
3. U. Demirbilek, V. Ala, K. R. Mamedov, Exact solutions of conformable time fractional Zoomeron equation via IBSEFM, Applied Mathematics-A Journal of Chinese Universities, 36(4), 554–563, 2021.
4. F. Dusunceli, E. Celik, M. Askin, H. Bulut, New exact solutions for the doubly dispersive equation using the improved Bernoulli sub-equation function method, Indian Journal of Physics, 95, 309–314, 2021.
5. G. Yel, T. A. Sulaiman, H. M. Baskonus, On the complex solutions to the (3+1) dimensional conformable fractional modified KdV–Zakharov–Kuznetsov equation, Modern Physics Letters B, 34(5), 2050069, 2020.

Hybrid AI-Based Mathematical Modeling of Breast Cancer Dynamics

Mehmet Ali TAŞKIRAN[1] **and Tuğçem PARTAL**[2]

[1]Department of Mathematics, Recep Tayyip Erdoğan University, Rize,Turkey[1]

[2]Department of Computer Engineering, Recep Tayyip Erdoğan University, Rize,Turkey

mehmetali.taskiran.tr@gmail.com , tugcem.partal@erdogan.edu.tr

Abstract

Breast cancer is one of the most prevalent malignancies worldwide, and understanding tumour growth dynamics is essential for developing effective and personalised treatment strategies. This paper presents a hybrid approach that combines artificial intelligence and mathematical modelling to analyse breast cancer dynamics. Tumour growth is modelled using the Gompertz differential equation and integrated with artificial neural networks (ANNs) to optimise model parameters based on individual patient data. Furthermore, the model incorporates the effects of chemotherapy, enabling the simulation of various treatment scenarios and their impact on tumour progression. Numerical validation is performed using Euler and fourth-order Runge–Kutta methods.

The results demonstrate that the proposed hybrid model can accurately capture tumour growth behaviour and predict treatment responses. This study provides a robust framework for AI-assisted clinical decision support systems and contributes to the advancement of personalised cancer therapy.

Keywords: Mathematical modeling; Artificial neural networks; Tumour growth

REFERENCES

1. Oke, S. I., Matadi, M. B., & Xulu, S. S. (2018). Optimal control analysis of a mathematical model for breast cancer. *Mathematical and Computational Applications*, 23(2), 21.
2. Çapkan, H., Dönmez, B., Kalkan, G. M., Kaya, M. Z., et al. (2022). Diagnosis of breast cancer with hybrid artificial intelligence method. *Avrupa Bilim ve Teknoloji Dergisi*, (42), 14–19.
3. Ateş, F. F., Çalışkan, A., & Toğaçar, M. (2022). A hybrid artificial intelligence-based model for breast cancer detection. *Fırat University Journal of Science*, 34(2), 189–199.
4. Norton, L. (1988). A Gompertzian model of human breast cancer growth. *Cancer Research*, 48(24), 7067–7071.
5. Gompertz, B. (1825). On the nature of the function expressive of the law of human mortality and on a new mode of determining the value of life contingencies. *Philosophical Transactions of the Royal Society of London*, 115, 513–583.

A NUMERICAL STUDY OF RUNGE–KUTTA METHODS WITHIN THE FRAMEWORK OF GEOMETRIC MULTIPLICATIVE CALCULUS

İrem Çakmak[1], **Tuba Gulsen**[1], **Etibar S. Panakhov**[2],

[1]Department of Mathematics, University of Firat, Elazig, Turkey

[2]Baku State of University, Baku, Azerbaijan

cakmakirem23@gmail.com, tyalcin@firat.edu.tr, epenahov@hotmail.com

Abstract

Differential equations and systems of differential equations are widely used to model many phenomena in science and engineering. Often, analytical solutions of these equations cannot be obtained, and therefore numerical methods are required. One of the most commonly used numerical approaches for solving such problems is the Runge–Kutta method, which is known for its accuracy and efficiency in approximating solutions of dynamical systems.

Recently, multiplicative calculus has been proposed as an alternative framework to classical calculus. This approach focuses on multiplicative or proportional changes and provides a different perspective for modeling and solving differential equations.

In this study, Runge–Kutta type numerical methods developed within the framework of geometric multiplicative calculus are presented for the solution of differential equations and systems. The performance of these methods is examined, and the obtained results are compared with those of the classical Runge–Kutta method.

Keywords: Runge–Kutta Method, Multiplicative Calculus, Differential Equations.

REFERENCES

1. M. Grossman, R. Katz. Non-Newtonian calculus, Lee Press, Pigeon Cove, MA. 1972.
2. A.E. Bashirov, E.M. Kurpinar, A. Özyapici. Multiplicative calculus and its applications, Journal of mathematical analysis and applications, Vol:337, No:1, 36-48, 2008.
3. H. Aktöre. Multiplicative Runge-Kutta Methods, Doctoral dissertation, Eastern Mediterranean University (EMU), 2011.
4. M. Riza, H. Aktöre. The Runge–Kutta method in geometric multiplicative calculus, *LMS* Journal of Computation and Mathematics, Vol:18, No:1, 539-554, 2015.

MODELING MEMORY EFFECTS IN WATER DISTRIBUTION NETWORKS VIA FRACTIONAL CALCULUS

Ayşe Deniz Birkan [1] **, Tuba Gulsen** [1] **, Etibar S. Panakhov** [2] **,**

[1] Department of Mathematics, University of Firat, Elazig, Turkey

[2] Baku State of University, Baku, Azerbaijan

aysedenizbirkan@gmail.com, tyalcin@firat.edu.tr, epenahov@hotmail.com

Abstract

Water distribution networks are complex dynamic systems consisting of pipes, pumps, valves, and nodes. Traditional models used in the analysis of these systems are generally based on classical differential equations and often neglect the influence of past system states on current behavior. However, physical properties such as the viscoelastic structure of pipe materials, delayed propagation of pressure waves, and the dependence of flow rates on previous states indicate that memory effects play an important role in the dynamics of these systems.

Within this context, Fractional Calculus provides an effective mathematical framework for modeling systems with memory and hereditary properties. In this study, the linear pressure–flow interaction model describing water distribution networks is reconsidered within the framework of fractional calculus. The model is reformulated by using different fractional derivative operators such as the Conformable Fractional Derivative, Discrete m-Derivative, and Proportional Fractional Derivative.

Keywords: Fractional Derivative Operators, Water Distribution Networks, Memory Effects.

REFERENCES

1. K. Miller, B. Ross. An introduction to the fractional calculus and fractional differential equations, New York: Wiley, 1993.
2. B. Acay, E. Bas, T. Abdeljawad. Non-local fractional calculus from different viewpoint generated by truncated M-derivative, Journal of Computational and Applied Mathematics, Vol:366, 112410, 2020.
3. D. R. Anderson, D. J. Ulness, Newly defined conformable derivatives, Advances in Dynamical Systems and Applications, Vol:10, 109–137, 2015.

GEOMETRIC DYNAMICS OF SPIN CHAINS

Zuhal KUCUKARSLAN YUZBASI [1]

[1] Department of Mathematics, University of Firat, Elazig, Turkey

zuhal2387@yahoo.com.tr,

Abstract

The study shows how to connect an inhomogeneous Heisenberg spin chain model to an integro-differential nonlinear Schrödinger equation (INLSE) using moving curve representation. We put self-similar solutions into groups based on intrinsic scaling symmetries and show that these solutions make the governing equations easier to solve. The induced surface geometry is also studied, and clear connections between curvature, torsion, and nonlinear dynamics are found. The results give us a unified geometric view of INLSE-type systems and show how important curve and surface geometry are in nonlinear evolution equations.

Keywords: Curve flow; Self-Similar Solution; Schrödinger map.

REFERENCES

1. Banica, V. and Vega, L. (2013). Stability of the self-similar dynamics of a vortex filament. *Archive for Rational Mechanics and Analysis*, *210*(3), 673-712.
2. Buttke, T. F. (1988). A numerical study of superfluid turbulence in the self-induction approximation. *Journal of Computational Physics*, *76*(2), 301-326.
3. Yüzbaşı, Z. K. and Anco, S. C. (2020). Elastic null curve flows, nonlinear C-integrable systems, and geometric realization of Cole-Hopf transformations. *Journal of Nonlinear Mathematical Physics*, *27*(3), 357-392.
4. Yüzbaşı, Z. K. et al. (2026). Geometric approach for evolution equations and self-similar solutions of inhomogeneous Heisenberg spin system. *Indian Journal of Physics*, 1-9.

Fractional Lyapunov Stability Analysis and Statistical Inference of a Fractional Stability Index (FSI) for Time-Dynamic Risk Trajectories

Gülsüm ŞANAL [1]

[1] Department of Management Information Systems, University of Istanbul Nisantasi, Istanbul, Turkey

gulsum.sanal@nisantasi.edu.tr,

Abstract

This paper introduces a stability-aware analytical framework for time-dynamic risk trajectories governed by Caputo fractional differential equations. A fractional Lyapunov approach is used to derive a Mittag–Leffler-type deviation envelope under bounded perturbations, providing a theoretical guarantee for deviation control in fractional dynamical systems.

Based on this structure, we propose a novel Fractional Stability Index (FSI), a trajectory-level stability functional that incorporates fractional memory through a non-local weighting kernel. Unlike classical deviation metrics, the FSI is dynamically consistent with fractional systems and provides a finite-horizon, non-asymptotic stability measure.

We further establish theoretical properties of the FSI, including upper bounds induced by the Lyapunov deviation envelope and monotonic sensitivity with respect to perturbation magnitude. A sample-based formulation is introduced, and consistency of the empirical estimator is demonstrated.

Synthetic experiments illustrate deviation control, sensitivity behavior, and convergence properties of the fractional order estimator. Additionally, a case study based on energy price dynamics demonstrates the applicability of the proposed method to real-world time series.

The proposed framework bridges continuous-time dynamic prediction, risk-sensitive safety analysis, and fractional Lyapunov stability theory.

Keywords: Fractional differential systems; Lyapunov stability; Mittag-Leffler function; Fractional Stability Index; dynamic risk modeling.

NUMERICAL SOLUTION OF THE KORTEWEG-DE VRIES EQUATION USING CHEBYSHEV POLYNOMIAL-BASED ARTIFICIAL NEURAL NETWORKS

Ramazan Aykat[1] and Faruk Düşünceli[2]

[1] *Department of Mathematics, Institute of Graduate Studies, Mardin Artuklu University, Mardin, Türkiye,* aykat4734@gmail.com

[2] Department of Economics, Mardin Artuklu University, Mardin, Türkiye, farukdusunceli@artuklu.edu.tr

Abstract

In this study, a Chebyshev polynomial-based artificial neural network (ANN) method is proposed for the numerical solution of the Korteweg-de Vries (KdV) equation, one of the fundamental nonlinear partial differential equations in mathematical physics that governs dispersive wave phenomena such as shallow water waves and plasma waves. The approximate solution is expressed as a double Chebyshev expansion in both spatial and temporal variables, where the weight matrix is determined by solving the Hessian normal equation in a single closed-form step. Chebyshev-Gauss quadrature nodes are employed as training points to prevent the Gibbs phenomenon and to guarantee spectral accuracy. Tikhonov regularization is incorporated to ensure numerical stability. The theoretical foundation of the method rests on the Chebyshev Convergence Theorem, the Chebyshev Orthogonality Theorem, the Normal Equation Theorem of Gauss, the Tikhonov Regularization Theorem, the Gauss-Chebyshev Quadrature Theorem, and the Weierstrass Approximation Theorem. The method is validated on a representative example with a known exact solution. Numerical results demonstrate that the mean squared error reaches values as low as 10^{-18} at $n = m = 10$ and decreases further to 10^{-23} as the number of basis terms increases, which is well below the 10^{-6} reliability threshold.

Keywords: Korteweg-de Vries equation, Chebyshev polynomials, artificial neural networks.

REFERENCES

1. Korteweg, D. J., & de Vries, G. (1895). On the change of form of long waves advancing in a rectangular canal, and on a new type of long stationary waves. Philosophical Magazine, 39(240), 422–443.
2. Alkhadhr, S., & Almekkawy, M. (2023). Wave equation modeling via physics-informed neural networks: Models of soft and hard constraints for initial and boundary conditions. Sensors, 23(5), 2792.PanWang, BoTian, Kun Sun, Feng-Hua Qi, Thetitle of Paper, Applied Mathematics and Computation, Vol:2, No:1, 233–242, 2015.

SOLVING LANE-EMDEN EQUATION THROUGH THE ELZAKI TRANSFORM METHOD

Pınar Kurulur[1] and Faruk Düşünceli[2]

[1]*Departmant of Mathematics, Institue of Graduate Studies, Mardin Artuklu University, Mardin, Turkey*

pinar_kurulur @icloud.com

[2]*Departmant of Economics, Mardin Artuklu University, Mardin, Turkey*

farukdusunceli @artuklu.edu.tr

ABSTRACT

In this study Lane-Emden equation was solved using the Elzaki transform method. Fundamental proporties of Elzaki transform method were introduced, and its application to differantial equations displayed. A comprehensive review of the existing literature asscociated with Elzaki transform method was examined and several examples was reviewed. It was observed that certain equations cannot be solved directly using the Elzaki transform method. To address this, the Homotopy Perturbation Method (HPM) was integrated with the transform to solve several nonlinear equations. This approach effevtively handles nonlinearities while perpetuating the efficiency of Elzaki transform. Finally, the proposed was systemaically applied to Lane-Emden equation to obtain analytical equation and the behaviour and accuracy of the solutions were demonstrated through detailed graphical representatons for varios parameters. The results confirm that the combined Elzaki-HPM is a powerful and reliable tool solving non-linear differantial equations.

Keywords: Lane-Emden equations, Elzaki transform method, Homotopy Perturbation Method

REFERENCES:

1. T.M.Elzaki E.M.A. Hilal,'Homotopy perturbation method and Elzaki transform for solving nonlinear partial differential equations,''Mathematical Theory and Modeling, vol. 2, no. 3, pp. 33-42, 2012.

2. R. Tripathi and H.K.Mishra, 'Homotopy perturbation method with Laplace transform (LT-HPM) for solving Lane-Emden type differential equations (LETDES),' SpringerPlus, vol. 5, no. 1, pp. 1-21, 2016.

A HYBRID METAHEURISTIC APPROACH FOR HYPERPARAMETER OPTIMIZATION OF MACHINE LEARNING MODELS

Beytullah Yağız[1] **, Sinan Deniz**[2] **, Yener Altun**[3]

[1] Department of Statistics, Yüzüncü Yıl University, Van, Turkey
[2] Department of Statistics, Yüzüncü Yıl University, Van, Turkey
[3] Department of Business Administration, Yüzüncü Yıl University, Van, Turkey

beytmat@gmail.com, sinan_deniz65@hotmail.com, yeneraltun@yyu.edu.tr

Abstract

This study presents a metaheuristic-based approach for improving the performance of machine learning classifiers through effective hyperparameter optimization. In this context, an enhanced version of the Gazelle Optimization Algorithm (GOA), strengthened by local search mechanisms, is utilized to achieve a better balance between exploration and exploitation phases. Unlike conventional parameter tuning techniques, the proposed approach systematically searches the solution space to identify optimal configurations for classification models. The developed optimization framework is applied to widely used machine learning algorithms, including k-Nearest Neighbors (kNN), Support Vector Machines (SVM), and Multi-Layer Perceptron (MLP). The objective function is defined based on classification accuracy, enabling the algorithm to iteratively improve model performance. Experimental evaluations conducted on benchmark datasets demonstrate that the proposed method provides competitive and robust results in terms of accuracy, convergence speed, and stability. Comparative analyses with several well-known metaheuristic algorithms reveal that the enhanced optimization strategy consistently achieves superior or comparable performance. These findings highlight the potential of hybrid metaheuristic approaches as effective tools for solving complex optimization problems in machine learning applications.

Keywords: Gazelle Optimization Algorithm, Nelder-Mead Method, Hybrid Methods, Machine Learning, Meta-heuristic Algorithms.

REFERENCES

1. Agushaka, J. O., Ezugwu, A. E., Abualigah, L., Gazelle optimization algorithm: a novel nature-inspired metaheuristic optimizer, Neural Computing and Applications, vol. 35, no. 5, 4099-4131, 2023.
2. Lagarias,J. C., Reeds, J. A., Wright, M. H., Wright, P. E., Convergence properties of the Nelder-Mead simplex method in low dimensions, SIAM Journal on optimization, vol. 9, no. 1, 112-147, 1998.

INVESTIGATION OF DERIVATIVE-BASED AND DERIVATIVE-FREE OPTIMIZATION APPROACHES IN NONLINEAR PARAMETER ESTIMATION

Sinan Deniz[1], **Beytullah Yağız**[2], **Yener Altun**[3]

[1] Department of Statistics, Yüzüncü Yıl University, Van, Turkey
[2] Department of Statistics, Yüzüncü Yıl University, Van, Turkey
[3] Department of Business Administration, Yüzüncü Yıl University, Van, Turkey

sinan_deniz65@hotmail.com, beytmat@gmail.com, yeneraltun@yyu.edu.tr

Abstract

This study examines the performance of different optimization approaches used in nonlinear parameter estimation problems. Derivative-based, derivative-free, and hybrid approaches are considered in terms of their behavior during the optimization process. The sensitivity of these methods to initial values, their convergence properties, and their computational characteristics are taken into account. In this context, a systematic initialization strategy is applied to reduce the effect of initial conditions on optimization performance. Thus, different optimization approaches are evaluated more consistently under the same problem structure. The methods are compared in terms of convergence behavior, solution stability, and computational efficiency. The comparison is carried out through two different applications, and the behavior of the optimization approaches throughout the solution process is evaluated within the framework of nonlinear parameter estimation.

Keywords: Nonlinear Parameter Estimation, Optimization, Hybrid Methods, Convergence.

REFERENCES

1. Akgün, F., An approach for point and interval estimation of nonlinear regression model parameters, Master’s thesis, Ankara University, Turkey, 2018.
2. Majhi, N., Mishra, R., A novel hybrid genetic algorithm and Nelder-Mead approach and it’s application for parameter estimation, F1000Research, 13, 1073, 2025.

NUMERICAL SOLUTION OF THE TELEGRAPH EQUATION USING ARTIFICIAL NEURAL NETWORKS

Sabri GÜNDÜZ[1] **, Faruk DÜŞÜNCELİ**[2]

[1] *Department of Mathematics, The Institute for Graduate Educational Studies, Mardin Artuklu University, Mardin, Türkiye*
[2] *Department of Economics, Mardin Artuklu University, Mardin, Türkiye*

sbr_gndz@hotmail.com[1], farukdusunceli@artuklu.edu.tr [2]

Abstract
In this study, the authors developed an effective approach using Artificial Neural Networks (ANNs) to obtain the numerical solution of the linear telegraph equation. Determining the numerical solution of the linear telegraph equation is typically a complex and computationally intensive process. By employing the ANN method, this study avoids such difficulties and provides a faster numerical solution with a very low error margin Furthermore, solution graphs were visually obtained through the ANN approach.

In ANN methodologies, activation functions are utilized to enhance the model's capabilities and to systematize the learning process. In this study, Laguerre orthogonal polynomials were employed as the activation function. In addition, there are recent studies focusing on the control and optimization of activation functions in Laguerre neural networks. The use of Laguerre polynomials or physics-based polynomial activation functions has been reported to improve training behavior, ensure more stable convergence, and reduce training effort in ANN-based frameworks.

In conclusion, the numerical solution of the linear telegraph equation with specified initial and boundary conditions is obtained using a Laguerre-based artificial neural network approach.

Keywords: Telegraph Equation; Laguerre Polynomial; Artificial Neural Networks.

REFERENCES

1. Kumar, R. S. V., Sowmya, G., Prakash, C., Chandan, K., & Prasannakumara, B. C. (2025). Shape factor effect on the thermal variation of a wavy fin wetted by ternary hybrid nanofluid using an extended physics-informed Laguerre neural network. *Neural Computing and Applications*. https://doi.org/10.1007/s00521-025-11658-9
2. Numerical solution of partial differential equations through the Laguerre neural network. (2023). (pp. 91–104). https://doi.org/10.37885/230312482
3. Kaur, I., & Jadhav, A. (2023). On-the-fly deep neural network optimization control for low-power computer vision. https://doi.org/10.1109/IPCCC59175.2023.10253878

A MULTIPLICATIVE MODEL FOR TIME-DEPENDENT RESIDUAL LIMB VOLUME CHANGES USING FRUSTUM-BASED LAYER GEOMETRY

Gülden Altay Suroğlu [1], Ayşe Buğatekin [1], Yaşar Tatar[2], Esra Ölçücü [1]

[1]Department of Mathematics, Fırat University, Elazig, Turkey

[2] Coaching Education Department, Marmara University, Istanbul, Turkey

galtay@firat.edu.tr, aturan@firat.edu.tr , ytatar@marmara.edu.tr , eesraa2393@gmail.com

Abstract

Residual limb volume in transtibial amputees varies continuously due to physiological and mechanical factors, and these changes are often proportional rather than additive. Traditional additive models fail to capture this nonlinear behavior. In this study, a novel multiplicative volume evolution model is proposed by combining frustum-based geometric representation with layer-wise proportional change analysis.

Keywords: Multiplicative geometry; Limb volume; Frustum method

REFERENCES

1. Nur Afiqah Hamzah, Nasrul Anuar Abd Razak, Mohd Sayuti Ab Karim, Siti Zuliana Salleh, Volume Fluctuations in Active and Nonactive Transtibial Prosthetics Users, BioMed Research International, Vol: 2022, No:1, 2669484, 2022.

2. Sanders JE, Fatone S. Residual, Limb Volume Change: Systematic Review of Measurement and Management, J Rehabil Res Dev., Vol:48, No:8, 949-986, 2011.

3. Mohd Tajularif Ibrahim, Nur Afiqah Hashim, Nasrul Anuar Abd Razak, Noor Azuan Abu Osman, Hossein Gholizadeh, Suryani Dyah Astuti, Techniques for Measuring the Fluctuation of Residual Lower Limb Volume in Clinical Practices: A Systematic Review of the Past Four Decades, Vol: 14, No: 6, 2594, 2024.

A CONFORMABLE FRENET FRAMEWORK FOR REGULARIZED FRACTAL FAULT CURVES

Gülden Altay Suroğlu [1], Şeyma Firdevs Hızal [1], Münevver Yıldırım Yılmaz [1], Hasan Bulut [1]

[1]Department of Mathematics, Fırat University, Elazig, Turkey

galtay@firat.edu.tr , sfkorkmaz@firat.edu.tr , myildirim@firat.edu.tr , hbulut@firat.edu.tr

Abstract

In this study, we develop a conformable geometric framework for modeling the structure of regularized fractal fault curves. Classical Frenet–Serret theory is inherently limited to smooth curves, whereas natural fault traces exhibit multi-scale roughness and fractal characteristics that challenge standard differential geometric descriptions. To address this limitation, we introduce a regularization approach based on smooth pre-fractal approximations and employ the conformable derivative of order $\alpha \in (0,1]$ to construct a generalized moving frame.

Keywords: Frenet frame; Conformable derivative; Fractal curves.

REFERENCES

1. Uğur Göktürk, Hüsnü Anıl Çoban, Yasemin Sağıroğlu, Frenet Frama with Respect to Conformable Derivative, Journal of Computational and Applied Mathematics, Vol:33, No:6, 1541–1550, 2019.
2. A.K. Lazopoulos, On Fractional Geometry of Curves, Fractal and Fractional, Vol:5, No:4, 161, 2021.
3. Alireza Khalili Golmankhaneh, Palle E. T. Jorgensen, Dimiter Prodanov, Fractional Calculus to Derive Fractal Frenet Equations for Fractal Curves, https://arxiv.org/abs/2404.07996 , 2024.

SOLUTION OF HELMHOLTZ EQUATION BY THE α − P DTM

Oktay Mukhtarov[1], **Merve Yücel**[2], **Kadriye Aydemir**[3]

[1]Department of Engineering Mathematics and Artificial Intelligence, Azerbaijan Technical University, Baku, Azerbaijan

[2]Department of Mathematics, University of Hitit, Çorum, Turkey

[3]Department of Mathematics, University of Amasya, Amasya, Turkey

omukhtarov@yahoo.com, merve.yucel@outlook.com.tr, kadriyeaydemr@gmail.com

Abstract

Differential transformation method (DTM) is one of the approximate methods, which enables to find an numerical solutions of various type linear and nonlinear differential equations. In this work we presented a new generalization of DTM, which we call parameter dependent differential transformation method (α − P DTM). The presented method depends on an auxiliary parameter α. We examine Helmholtz equation

$$y''(t) + y(t) + 0{,}1y^2(t) = 0$$

subject to initial value conditions $y(0) = 1, y'(0) = 0.$

Numerical results reveal that the α − P DTM is a powerful tool for solving many initial value and boundary value problems. It is concluded that comparing with the standard DTM, the α − P DTM reduces computational cost in obtaining approximated solutions. This method unlike most numerical techniques provides a closed-form solution.

Keywords: One-dimensional Helmholtz equation, Approximation solution, α −Differential Transformation Method.

REFERENCES

1. Kakharman, N. On one-dimensional Helmholtz equation. Journal of Mathematics, Mechanics and Computer Science, Vol:118, No:2, 21-29, 2023.
2. Mukhtarov, O. S., Yücel, M., Aydemir, K. Treatment a new approximation method and its justification for Sturm–Liouville problems. Complexity, *2020*(1), 8019460, 2020.
3. J.K. Zhou, Differential Transformation and its Applications for Electrical Circuits, Huazhong University Press, Wuhan, China, 1986 (in Chinese).
4. Momani, S., Ertürk, V. S. Solutions of non-linear oscillators by the modified differential transform method. Computers & Mathematics with Applications, Vol:55, No:4, 833-842, 2008.

A HYBRID FUZZY AHP-PROMETHEE II APPROACH FOR EVALUATING CUSTOMER SERVICE REPRESENTATIVES IN THE BANKING SECTOR

Alper Döyen[1]

[1] Department of Industrial Engineering, Konya Technical University, Konya, Türkiye

alperdoyen@ktun.edu.tr

Abstract

Call centers, where companies communicate directly with customers, are strategically important units. Especially for banks, the performance of customer service representatives working in call centers directly impacts the bank's service quality, customer satisfaction, and operational efficiency. Therefore, assessing the performance of customer representatives is crucial for bank call centers. While each call center has its own way of measuring performance, traditional methods often can't effectively assess multiple conflicting performance criteria simultaneously. This study proposes a hybrid multi-criteria decision-making method to systematically and consistently evaluate and compare employee performance in a bank call center.

In the proposed framework, the Fuzzy Analytic Hierarchy Process (FAHP) is employed to determine the importance weights of the criteria under consideration, while the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE II) is used to evaluate the customer service representatives. All criteria are either inherently quantitative or have been appropriately quantified. Since all criteria are expressed quantitatively, the PROMETHEE method provides a suitable and effective framework. Additionally, the GAIA plane is used to visualize the decision problem, allowing interpretation of the relationships among criteria and the relative positions of employees. The proposed framework offers a clear, analytically rigorous method for assessing call center staff performance in the banking sector.

Keywords: Performance Evaluation; Fuzzy AHP; PROMETHEE II

I. EFFECT OF MILLING PARAMETERS ON SURFACE ROUGHNESS, HARDNESS, TENSILE STRENGTH AND MICROSTRUCTURE IN INCONEL 718 ALLOY PRODUCED BY ADDITIVE MANUFACTURING METHOD

II. Emre Bayrak[1,2,*], Murat Işık[1], Engin Kocaman[3], Mustafa Safa Yılmaz[4], Bahattin Koç[5]

[1] Department of Automotive Engineering, University of Uludağ, Bursa, Turkey.
[2] Simetrik Dizayn Sanayi Ve Ticaret Anonim Şirketi,Bursa, Turkey.
[3]Department of Aerospace Engineering, Zonguldak Bulent Ecevit University, Zonguldak, Turkey.
[4]Department of Mechanical Engineering, University of Uludağ, Bursa, Turkey.
[5]Faculty of Engineering and Natural Sciences Sabancı University,Istanbul, Turkey.

***Corresponding author:** muratisik@uludag.edu.tr,

Abstract

Selective laser melting (SLM) technology is one of the most widely preferred additive manufacturing in aerospace applications such as turbine blades and jet engine components due to its advantages, such as the ease in manfacturing complex geometries and the achievement of controlled microstructures. Furthermore, SLM is known to be minimizing material waste compared to traditional production methods like machining. This is the fact that due to surface quality issues experienced in parts produced by the SLM method, secondary operations such as milling are still required. Based on this, a detailed investigation regarding the influence of milling parameters on the part is needed. Failure to optimize milling parameters can negatively affect microstructural and mechanical properties. In this study, the effects of different machining parameters on the surface properties, hardness, and tensile strength of a nickel based alloy, namely Inconel 718, part produced by the SLM method were investigated. In the study, it was observed that cutting speed has influence on the hardness and surface roughness of the material, and as the cutting speed and hardness simultaneously increases, the surface roughness decreases. According to the tensile test results, it was observed that the tensile strength and percentage elongation values give rise with an increasing feed per tooth (IPT) value. On the other hand, it is demonstrably true that the effect of cutting speed on tensile strength was lower compared to the hardness results. In the present study, it was determined that the IPT value has an effect on the surface roughness and tensile elongation properties of the material, and there is a correlation between hardness and surface roughness. In the future work, it is aimed to expand these studies by examining microstructue in more detail, for SLM Inconel 718 processed by different cutting parameters.

Keywords: *Selective Laser melting, Additive Manufacturing***,** *Inconel 718, Machining, Mechanical properties, Surface roughness***.**

Multi soliton Solutions of Sawada Kotera Equation

Yasemin TURĞUT

Department of Mathematics, University of Dicle, Diyarbakır, Turkey

yaseminturgut157@gmail.com

Abstract: Integrable systems and evolution equations are fundamental to mathematical physics, providing a framework for describing the temporal progression of nonlinear phenomena through partial and ordinary differential equations. A defining characteristic of these systems is their exact solvability and the subsequent existence of solitons—stable, localized wave structures that maintain their profile over time. While various techniques such as inverse scattering and Darboux transformations are utilized to explore these structures, Hirota's bilinear method remains a powerful tool for revealing underlying integrability. In this work, we employ the Hirota direct method to derive explicit soliton solutions for the Sawada-Kotera equation. Specifically, we provide the analytical formulations for one- and two-soliton solutions to illustrate the system's dynamics.

Keywords: Integrable systems; solitons; Hirota Method; Sawada-Kotera Equation.

REFERENCES

1. Ablowitz, M.J. and Clarkson, P.A., *Solitons, Nonlinear Evolution Equations and Inverse Scattering* (Vol.149, London Mathematical Society Lecture Note Series), Cambridge University Press (1991).

2. Drazin, P.G. and Johnson, R.S., *Solitons: An Introduction*, Cambridge University Press (1989).

3. Hirota R. *The Direct Method in Soliton Theory*. Nagai A, Nimmo J, Gilson C, eds. Cambridge University Press; 2004.

4. Korteweg, D.J. and de Vries, G., *On the Change of Form of Long Waves Advancing in a Rectangular Canal, and on a New Type of Long Stationary Waves*, The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 39(240), 422–443 (1895).

5. Russell, J.S., *Report on waves*, Fourteenth meeting of the British Association for the Advancement of Science, 1844.

6. Zakharov, V.E. and Shabat, A.B., *Exact theory of two-dimensional self-focusing and one-dimensional self-modulation of waves in nonlinear media*, Soviet Phys.JETP, 34 (1972), 62-69.

Travelling-wave Solutions of Hirota Equation

Ayşe ELHAMAN

Department of Mathematics, University of Dicle, Diyarbakır, Turkey

aysclhmn2023@gmail.com

Abstract: Many integrable systems are governed by evolution equations, such as the Korteweg–de Vries (KdV) and nonlinear Schrödinger (NLS) equations. These systems frequently produce solitons—stable, wave-like structures that maintain their shape over time due to the system's integrability. Analytical techniques, including the inverse scattering method, the Hirota method, and Darboux transformations, are commonly employed to solve these equations and uncover their underlying structures. In this talk, we present explicit travelling-wave solutions for the Hirota equation. Furthermore, we demonstrate how the NLS and complex modified KdV (cmKdV) equations can be derived from these solutions.

Keywords: Integrable systems; travelling-wave solutions; Hirota equation; solitons.

REFERENCES

1. Ablowitz, M.J. and Clarkson, P.A., *Solitons, Nonlinear Evolution Equations and Inverse Scattering* (Vol.149, London Mathematical Society Lecture Note Series), Cambridge University Press (1991).

2. Drazin, P.G. and Johnson, R.S., *Solitons: An Introduction*, Cambridge University Press (1989).

3. Korteweg, D.J. and de Vries, G., *On the Change of Form of Long Waves Advancing in a Rectangular Canal, and on a New Type of Long Stationary Waves*, The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 39(240), 422–443 (1895).

4. Russell, J.S., *Report on waves*, Fourteenth meeting of the British Association for the Advancement of Science, 1844.

5. Zakharov, V.E. and Shabat, A.B., *Exact theory of two-dimensional self-focusing and one-dimensional self-modulation of waves in nonlinear media*, Soviet Phys.JETP, 34 (1972), 62-69.

Multi-Task Transformer Architecture for Multi-Asset Financial Risk and Return Forecasting: Conditional Efficacy, Negative Transfer, and Explainability Analysis

Ebru Altunbağ[1]

[1] Department of Applied Mathematics, Muğla Sıtkı Koçman University, Muğla, Turkey

ebrualtunbag@mu.edu.tr,

Abstract

In this paper, we evaluate a multi-task Transformer (MTL) for simultaneous return and volatility forecasting across four assets (BIST100, USD/TRY, EUR/TRY, Gold) using 3,890 daily observations (2010–2024). A 480-configuration grid search identifies Partial Sharing with Uncertainty Weighting and a 10-day lookback as optimal. For BIST100, MTL outperforms the Naive baseline (RetMAE: 0.0143 vs 0.0194; DM=−6.45, p<0.001). In volatility, MTL outperforms GARCH(1,1), EGARCH(1,1) and GJR-GARCH(1,1) for all assets (all DM<−3.4, p<0.001), while asymmetric GARCH models offer negligible improvement over standard GARCH(1,1). For USD/TRY (kurtosis≈101) and Gold, however, Naive significantly outperforms MTL. Rolling GARCH persistence-based period isolation reveals this negative transfer is independent of the IGARCH regime, suggesting it stems from multiple structural factors including extreme kurtosis, persistent exchange rate pressure, and central bank interventions. SHAP confirms volatility features as dominant cross-task signals. These findings document the conditional efficacy of MTL in heterogeneous financial portfolios.

Keywords: Multi-Task Learning; Transformer; BIST100; Negative Transfer; EGARCH; GJR-GARCH; SHAP; Diebold-Mariano; Partial Sharing; Uncertainty Weighting..

REFERENCES

1. T. Bollerslev, “Generalized autoregressive conditional heteroskedasticity,” J. Econometrics, vol. 31, no. 3, pp. 307–327, 1986.
2. D. B. Nelson, “Conditional heteroskedasticity in asset returns: A new approach,” Econometrica, vol. 59, no. 2, pp. 347–370, 1991.
3. L. R. Glosten, R. Jagannathan, and D. E. Runkle, “On the relation between the expected value and the volatility of the nominal excess return on stocks,” J. Finance, vol. 48, no. 5, pp. 1779–1801, 1993.
4. S. Ruder, “An overview of multi-task learning in deep neural networks,” arXiv:1706.05098, 2017.
5. A. Kendall, Y. Gal, and R. Cipolla, “Multi-task learning using uncertainty to weigh losses for scene geometry and semantics,” Proc. IEEE/CVF CVPR, 2018.

*This study is derived from the master’s thesis of Ebru Altunbağ (Ref. No: 10734530) conducted under the supervision of Prof. Dr. Mehmet Ali Balcı at Muğla Sıtkı Koçman University, Institute of Natural Sciences, Department of Applied Mathematics.

Multi soliton Solutions of Complex mKdV Equation

Velat KARAKEÇİ

Department of Mathematics, University of Dicle, Diyarbakır, Turkey

velatkara21@gmail.com

Abstract: The study of solitons—stable, self-reinforcing wave packets—is vital to understanding nonlinear evolution equations in mathematical physics. While the field utilizes several sophisticated techniques for exploration, Hirota's bilinear method offers a particularly elegant and direct path to revealing a system's integrability. This paper employs the Hirota method to solve the complex modified KdV (cmKdV) equation, providing explicit, closed-form expressions for one- and two-soliton solutions. These results offer deeper insight into the system's temporal progression and provide a foundation for further analysis of multi-soliton interactions in complex nonlinear media.

Keywords: Integrable systems; solitons; Hirota Method; Complex modified KdV Equation.

REFERENCES

1. Ablowitz, M.J. and Clarkson, P.A., *Solitons, Nonlinear Evolution Equations and Inverse Scattering* (Vol.149, London Mathematical Society Lecture Note Series), Cambridge University Press (1991).

2. Drazin, P.G. and Johnson, R.S., *Solitons: An Introduction*, Cambridge University Press (1989).

3. Hirota R. *The Direct Method in Soliton Theory*. Nagai A, Nimmo J, Gilson C, eds. Cambridge University Press; 2004.

4. Korteweg, D.J. and de Vries, G., *On the Change of Form of Long Waves Advancing in a Rectangular Canal, and on a New Type of Long Stationary Waves*, The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 39(240), 422–443 (1895).

5. Russell, J.S., *Report on waves*, Fourteenth meeting of the British Association for the Advancement of Science, 1844.

6. Zakharov, V.E. and Shabat, A.B., *Exact theory of two-dimensional self-focusing and one-dimensional self-modulation of waves in nonlinear media*, Soviet Phys.JETP, 34 (1972), 62-69.

SARDAR METHOD FOR SOLITON SOLUTIONS IN ANTI-CUBIC NONLINEAR MODEL

Esra Pekönür[1], **Sevilay Erdoğan Tutam**[2], **Mutlu Akar**[2]

[1] Sakarya Vocational School, Sakarya University of Applied Sciences, Sakarya, Turkey

esrapekonur@subu.edu.tr

[2] Department of Mathematics, Yildiz Technical University, Istanbul, Turkey

svlyerdogan@hotmail.com, makar@yildiz.edu.tr

Abstract

In this work, a new family of exact soliton solutions for the anti-cubic nonlinear Biswas–Milovic equation is derived by applying the Sardar sub-equation method. Through an appropriate transformation, the governing nonlinear partial differential equation is reduced to a nonlinear ordinary differential equation, which is then systematically solved via the proposed scheme. The method yields a variety of explicit solution structures, including parameter-dependent soliton profiles, expressed in closed analytical form. The validity and consistency of the obtained solutions are verified through direct substitution, while graphical representations are employed to illustrate the influence nonlinear parameters on the solution behavior. The results reveal significant characteristics of soliton dynamics, such as amplitude variation, localization, and stability patterns. These findings contribute to a deeper mathematical understanding of nonlinear systems and their associated soliton structures that provide practical insight into pulse transmission in nonlinear optical fibers, offering improved control over dispersion and attenuation mechanisms.

Keywords: Sardar method; Soliton solutions; Nonlinearity.

REFERENCES

1. Muhammad, Taseer, et al., Traveling Wave Solutions to the Boussinesq Equation via Sardar Sub-equation Technique, AIMS Math, Vol:7, No:6, 11134–11149, 2022.
2. Nikolay A. Kudryashov, Method for Finding Highly Dispersive Optical Solitons of Nonlinear Differential Equations, Optik, Vol:7, No:206, 163550, 2020.

EXACT SOLUTIONS OF FRACTIONAL BISWAS–MILOVIC EQUATION USING KUDRYASHOV METHODS

Sevilay Erdoğan Tutam[1], **Esra Pekönür**[2], **Mutlu Akar**[1]

[1] Department of Mathematics, Yildiz Technical University, İstanbul, Türkiye

svlyerdogan@hotmail.com, makar@yildiz.edu.tr

[2] Sakarya Vocational School, Sakarya University of Applied Sciences, Sakarya, Türkiye

esrapekonur@subu.edu.tr

Abstract

This study presents an efficient analytical treatment of the fractional-order Biswas–Milovic equation with anti-cubic nonlinearity via the New Kudryashov Method (NKM) and the Addendum to Kudryashov Method (AKM). Novel exact solutions are constructed, revealing previously unexplored features of nonlinear wave dynamics.

The fractional framework enhances the modeling of dispersive and anomalous transport phenomena, while anti-cubic nonlinearity significantly modifies classical soliton behavior. NKM provides direct closed-form solutions, whereas AKM extends the solution space to more general structures.

The results confirm the effectiveness of both methods in capturing complex, non-classical soliton profiles, establishing them as powerful tools for analyzing fractional nonlinear wave systems.

Keywords: Fractional Biswas–Milovic equation; New Kudryashov method; Addendum to Kudryashov method; Exact solutions.

REFERENCES

1. Nikolay A. Kudryashov, Method for Finding Highly Dispersive Optical Solitons of Nonlinear Differential Equations. Optik, Vol:206, 163550, 2020.
2. Mustafa Bayram, Optical Bullets with Biswas–Milovic Equation Having Kerr and Parabolic Laws of Nonlinearity. Optik, Vol:270, 170046, 2022.

ON THE ADAPTATION OF SUMMABILITY METHODS TO SERIES WITH NONLINEAR FOURIER BASIS

Fırat Korkmaz[1], **Hatice Aslan**[1]

[1] Department of Mathematics, University of Firat, Elazig, Turkey
haslan@firat.edu.tr, frtkorkmaz796@gmail.com

Abstract

In this study, we investigate nonlinear Fourier basis, which are constructed via boundary values of Möbius transformations and provide a generalization of the classical Fourier basis. Building on the time–frequency analysis framework introduced by Huang, we examine how these structures can be effectively utilized in signal analysis [1]. Particular attention is given to summability methods Cesàro-type and generalized de la Vallée–Poussin means which have been successfully adapted to series with non-linear Fourier basis in 2018 [2-3] and the extension of more powerful classical methods such as Riesz and Nörlund which remains an open problem. In this work, we aim to bridge this gap by analyzing the applicability of these methods. The findings contribute to the theoretical development of non-linear Fourier analysis and provide a foundation for further applications in signal processing and related fields.

Keywords: Nonlinear Fourier bases; summability methods; Cesàro mean, Riesz mean, Nörlundmeans, Hölder spaces.

REFERENCES

1. Huang, C., Yang, L., Approximation by the Nonlinear Fourier Basis, Science China Mathematics, Vol:54, 1207–1214, 2011.
2. Aslan, H., Güven, A., Some Approximation Properties of Series with Nonlinear Fourier Basis, Mathematical Sciences and Applications E-Notes, Vol:6, No:2, 13–18, 2018.
3. Aslan, H., Güven, A., Approximation by Nonlinear Fourier Basis in Generalized Hölder Spaces, Sigma Journal of Engineering and Natural Sciences, Vol:10, No:2, 135–142, 2019.
4. DeVore, R. A., Lorentz, G. G., Constructive Approximation, Springer-Verlag, 1993.

Dynamical analysis of brucellosis transmission under multiple time delays

Dilara Yapışkan[1] **and Cristiana J. Silva**[1,2,3]

[1] Center for Research and Development in Mathematics and Applications (CIDMA), Department of Mathematics, University of Aveiro, 3810-193 Aveiro, Portugal

[2] Department of Mathematics, ISTA, Iscte-Instituto Universitário de Lisboa, 1649-026 Lisbon, Portugal

[3] ISTAR-Iscte-Information Sciences, Technologies and Architecture Research Centre, 1649-026 Lisbon, Portugal

dilarayapiskan@ua.pt, cristiana.joao.silva@iscte-iul.pt

Abstract

Brucellosis, caused by bacteria from the genus Brucella, is one of the most common zoonotic diseases in the world, transmitting from animals to animals and humans. Due to the health problems it causes in humans and animals, as well as the financial damage it inflicts, brucellosis has been investigated using mathematical models. In this study, we propose a delayed model with multiple time delays, where these delays correspond to the latent infection periods for brucellosis in livestock and humans. Next, we calculate the basic reproduction number of the model and describe the brucellosis transmission potential by analyzing the sensitivity of the reproduction number. Furthermore, we estimate the parameters of the delayed brucellosis model using reported cases of human brucellosis in mainland China from 2004 to 2018.

Keywords: Brucellosis; Mathematical model; Parameter estimation; Time delay.

Acknowledgments: Yapışkan and Silva are supported by Fundação para a Ciência e a Tecnologia, I.P. (FCT) under CIDMA Grant UID/04106/2025 (https://doi.org/10.54499/UID/04106/2025) and project 2022.03091.PTDC "Mathematical Modelling of Multi-scale Control Systems: applications to human diseases" (CoSysM3) (https://doi.org/10.54499/2022.03091.PTDC), financially supported by national funds (OE) through FCT/MCTES.

REFERENCES

1. Al-Hdaibat, B., Khan, M. A., Ahmad, I., Alzahrani, E., & Akgul, A. (2025). Modeling and analyzing the dynamics of brucellosis disease with vaccination in the fractional derivative under real cases. Journal of Applied Mathematics and Computing, 71(4), 5567-5588.
2. Sun, G.Q., Li, M.T., Zhang, J., Zhang, W., Pei, X., & Jin, Z. (2020). Transmission dynamics of brucellosis: Mathematical modelling and applications in China. Computational and Structural Biotechnology Journal, 18, 3843-3860.
3. NDRC. Compilation of cost-benefit data of national agricultural products. (2021) China Statistics Press.
4. NBSPRC. China statistical yearbook-2021. (2021) China Statistics Press.

Symmetry methods for ordinary differential equations

Şükran YALÇIN

Department of Mathematics, University of Dicle, Diyarbakır, Turkey

sukranyalcin96@gmail.com

Abstract: Ordinary differential equations (ODEs) remain a cornerstone of mathematical modelling, yet their analytical solution often requires sophisticated techniques. Lie symmetry methods, pioneered by Sophus Lie in the late 19th century, provide a systematic framework for exploiting invariance properties to simplify and solve ODEs. Central to this approach is the identification of infinitesimal generators and their prolongations, which allow one to determine the symmetry group of a given equation and construct associated differential invariants. These invariants enable order reduction and, in many cases, the derivation of closed-form solutions.

This talk will survey the classical theory of Lie point symmetries, including the Lie Symmetry Condition (LSC) and its role in solving nonlinear ODEs. We will highlight applications such as linearization by symmetry structure and Lie's Linearization Theorem, which demonstrate how nonlinear equations can be transformed into linear ones under appropriate symmetry constraints. Beyond point symmetries, we will discuss extensions to generalize symmetries and their relevance in modern contexts.

Keywords: Symmetry methods; Lie symmetry; Ordinary differential equations.

REFERENCES

1. Arrigo, D.J., *Symmetry analysis of differential equations: an introduction*, John Wiley & Sons (2015).

2. Auman, S., *Solving Differential Equations Using Symmetry Methods*, PhD diss., Appalachian State University (2025).

3. Cantwell, B. J., *Introduction to symmetry analysis*, Cambridge University Press (2002).

4. F. Güngör, F., *Lie symmetry group methods for differential equations, arXiv:1901.01543v10* (2024).

5. Hydon, P.E., *Symmetry Methods for Differential Equations: A Beginner's Guide* (Cambridge University Press, 2000).

6. Ibragimov, N.H., *Practical Course in Differential Equations and Mathematical Modelling, A: Classical and New Methods. Nonlinear Mathematical Models. Symmetry and Invariance Principles*, World Scientific (2009).

7. Lie, S., *Vorlesungen über Differentialgleichungen mit bekannten infinitesimalen Transformationen* (Leipzig, 1891).

NONEXISTENCE OF GLOBAL SOLUTIONS FOR THE WAVE EQUATION WITH FRACTIONAL TERM

Erkan Sancar[1] and Erhan Pişkin[2]

[1]Institute of Natural and Applied Sciences, Dicle University, Diyarbakır, Turkey

[2]Dicle University, Department of Mathematics, Diyarbakır, Turkey

erkan_sancar@hotmail.com, episkin@dicle.edu.tr

Abstract

In this work, we consider the wave equation with fractional term. We consider the nonexistence of global solutions under suitable conditions.

Keywords: Nonexistence, Fractional, Wave equation.

REFERENCES

1. E. Pişkin, Evolüsyon Denklemlerin Çözümlerinin Patlaması (Blow up of Solutions of Evolution Equations), Pegem Akademi Yayıncılık, 2022.
2. E. Pişkin, E. Sancar, Existence, decay and blow up of solutions for a Petrovsky equation with a fractional time delay term, Mathematica Moravica, 29(1) (2025) 125-146.
3. E. Pişkin, T. Uysal, Blow up of the solutions for the Petrovsky equation with fractional damping terms, Malaya Journal of Matematik, 6(1) (2018) 85-90.
4. E. Sancar, E. Pişkin, Existence, decay and blow up for a Klein-Gordon equation with a fractional boundary damping, Discrete and Continuous Dynamical Systems Series S, (in press).
5. E. Sancar, E. Pişkin, Nonlinear viscoelastic Petrovsky equation with fractional damped: Existence and blow-up, Journal of Fractional Calculus and Nonlinear Systems, 6 (2) (2025) 1-15.

FEASIBILITY ASSESSMENT AND OPTIMIZATION OF RENEWABLE-SUPPORTED ELECTRIC BUS CHARGING OPERATIONS

Furkan Koçaslan [1] **, Ömer Gönül** [2]**, Önder Güler** [1]

[1] Department of Energy Science and Technology, Energy Institute, Istanbul Technical University, Istanbul, Türkiye

[2] Department of Energy Science and Technology, Faculty of Science, Turkish-German University, Istanbul, Türkiye

kocaslan18@itu.edu.tr, gonulo@tau.edu.tr, onder.guler@itu.edu.tr

Abstract

Carbon emissions are a major environmental challenge, with the transportation sector accounting for about 21% of global emissions. Urban public transport, especially diesel buses, is a key contributor in cities. Electric buses can reduce emissions by eliminating tailpipe pollutants, but their environmental benefit depends on the electricity source. If powered by fossil fuels, emission reductions remain limited, making renewable energy integration essential. This study examines a public transport route in Istanbul to assess renewable-supported electric bus operations. Photovoltaic and wind energy are evaluated to meet charging demand, while an overnight charging strategy is used to benefit from off-peak tariffs and ensure reliable operation. Energy storage is also considered to improve system flexibility. An optimization framework is developed to determine the optimal sizing of renewable and storage components by using HOMER Grid. The results indicate that the proposed system achieves a favorable payback period and a competitive levelized cost of energy, along with notable cost savings, while also significantly reducing carbon emissions, demonstrating that renewable-supported electric bus systems can provide a sustainable and economically viable solution for urban transportation.

Keywords: Electric bus; Renewable energy integration; Urban transportation; System optimization; Carbon emissions; LCOE.

REFERENCES

1. Ritchie, H., Roser, M., & Rosado, P. (2024). CO_2 and greenhouse gas emissions. Our World in Data. https://ourworldindata.org/co2-emissions.

2. Hasan Mojumder MF, Baidya H, Islam T, Asef IH, Rahman Rafi MM, Chowdhury N-U-R. Towards sustainable transportation: Optimizing hybrid renewable energy systems for EV charging in Bangladesh. Energy Strateg Rev 2026;64:102126.

3. Hasan Mojumder MF, Baidya H, Islam T, Asef IH, Rahman Rafi MM, Chowdhury N-U-R. Towards sustainable transportation: Optimizing hybrid renewable energy systems for EV charging in Bangladesh. Energy Strateg Rev 2026;64:102126.

Analysis of the Optical Soliton Solutions to the Fractional Cubic-Quartic Nonlinear Schrödinger Equation with Parabolic-Law

Mst. Munny Khatun[1,a], M. Ali Akbar[2, b] and Onur Alp İlhan[3,*,c]

Department of Mathematics, Khulna University of Engineering and Technology, Khulna, Bangladesh[1]
E-mail: [a]munnyru.1516@gmail.com, [b]ali.akbar@ru.ac.bd

Department of Applied Mathematics, University of Rajshahi, Bangladesh[2]

Department of Mathematics, Faculty of Education, Erciyes University[3]

38039-Melikgazi-Kayseri, Turkey[3]
E-mail: [c]oailhan@erciyes.edu.tr

[*]Corresponding Author

Abstract

The time-fractional cubic-quartic nonlinear Schrödinger equation is an important model in quantum optics, nonlinear optics, condensed matter physics, ultra-short laser pulse compression, and optical pulse propagation. Using a complex phase-amplitude transformation, the fractional equation is converted into a classical complex form. In this article, we implement a simple analytical method, the $(\Omega'/\Omega, 1/\Omega)$-expansion method, to obtain a variety of novel soliton solutions. These include trigonometric, hyperbolic, and rational forms, such as anti-kink solitons, bell-shaped solitons, periodic solitons, anti-peakons, and compactons. Graphical illustrations are provided to interpret the physical significance of these solutions. The solutions presented here provide potential applications in optical fiber communications and plasma wave research, especially in systems involving higher-order dispersion, Kerr nonlinearity, and parabolic-law nonlinearity. This work will serve as a helpful work for the researchers working in nonlinear wave propagation and related fields.

***Keywords**:* Time-fractional cubic-quintic nonlinear Schrodinger equation; $(\Omega'/\Omega, 1/\Omega)$-expansion method; optical fiber; soliton solutions; fractional derivative.

REFERENCES

[1] Russell J.S., (1845). Report on waves: made to the meetings of the British association in 1842-43.

[2] Rabie, W.B., and Ahmed, H.M., (2022). Cubic-quartic optical solitons and other solutions for twin-core couplers with polynomial law of nonlinearity using the extended F-expansion method. Optik, 253, 168575.

A numerical stochastic computing performances for the immune regulation of type 1 diabetes

Ayse Nur Akkilic[1,a], Zulqurnain Sabir[2,b], Hasan Bulut[1,2,c]
[1] Department of Computer Technology, Beykent University, Istanbul, Turkey
[a]Email: nurakkilic@beykent.edu.tr
[2] Department of Computer Science and Mathematics, Lebanese American University, Beirut, Lebanon
[3]Azerbaijan University, Jeyhun Hajibeyli str. 71, Baku, Azerbaijan
[b]Email: zulqurnain.sabir@lau.edu.lb
[c]Email: hbulut@firat.edu.tr

Abstract: This study provides a computing stochastic platform using the scale conjugate gradient neural network (SCJGNN) for solving the mathematical immune regulation of type 1 diabetes model. The model is categorized into resting macrophages, activated macrophages, antigen cells, autolytic T cells, and cells. The dataset is generalized through the Adam solver implemented to diminish the mean square error, which is divided into validation 0.15, training 0.72, and testing 0.13. The process of neural network is performed using the optimization of SCGNN, log-sigmoid as an activation function, sixteen numbers of neurons, and hidden/output layers for solving the immune regulation model. The similarity of the findings and the relatively small computed absolute error around 10-05 to 10-07 for each category of the mathematical model indicate the validity of the scheme. Additionally, the regression capabilities for each case is evaluated, which demonstrate the scheme's stability.

Keywords: Immune regulation; Scale conjugate; Computational performances; Neural network;

Optimization

References:

[1] Thivolet, C., 2002. Beta cells in type 1 diabetes: victims or activators of t cell response?. Diabetes and Metabolism, 28(4; CAHI 1), pp.267-271.
[2] Gillespie, K.M., 2006. Type 1 diabetes: pathogenesis and prevention. Cmaj, 175(2), pp.165-170.
[3] Narendran, P., Estella, E. and Fourlanos, S., 2005. Immunology of type 1 diabetes. *Qjm*, *98*(8), pp.547-556.

The Pell-Lucas Collocation Method for High-Order Linear Differential Equations with Variable Coefficients

Duygu Dönmez Demir[1], **Asuman Açık**[1], **Ali Konuralp**[1]

[1]Department of Mathematics, University of Manisa Celal Bayar, Manisa, Turkey

duygu.donmez@cbu.edu.tr

Abstract

This study focuses on the numerical solutions of higher-order linear ordinary differential equations with variable coefficients. The proposed approach is based on Pell–Lucas polynomials, which are used as basis functions in expressing the approximate solution as a discrete series expansion. By using the derivative properties of Pell–Lucas polynomials, the differential equation is systematically transformed into a compact matrix form, significantly simplifying the solution process. Unlike classical methods, the proposed approach allows the equations to be directly transformed into a system of linear algebraic equations using equally spaced collocation points. In addition, an error analysis procedure is presented to evaluate the accuracy and convergence behavior of the obtained approximate solutions.

Keywords: Pell-Lucas collocation method; Pell-Lucas polynomials; Higher-order linear differential equations.

REFERENCES

1. Horadam, A.F., Mahon, Bro J.M., Pell and Pell-Lucas polynomials, Fibonacci Quartery, Vol:23, 17-20, 1985.

2. Melike Şahin, Mehmet Sezer, Pell-Lucas collocation method for solving high-order functional differential equations with hybrid delays, Celal Bayar University Journal of Science, Vol:14, No:2, 141-149, 2018.

3. Şuayip Yüzbaşı, Gamze Yıldırım, Pell-Lucas collocation method to solve high-order linear Fredholm-Volterra integro-differential equations and residual correction, Turkish Journal of Mathematics, Vol:44, No:4, 1065-1091, 2020.

4. Şuayip Yüzbaşı, Gamze Yıldırım, Pell–Lucas collocation method for numerical solutions of two population models and residual correction, Journal of Taibah University for Science, Vol:14, No:1, 1262-1278, 2020.

5. Duygu Dönmez Demir, Alpha Lukonde, Ömür Kıvanç Kürkçü, Mehmet Sezer, Pell-Lucas series approach for a class of Fredholm-type delay integro-differential equations with variable delays, Mathematical Sciences, Vol:15, No:1, 55-64, 2021.

Integrated Diagnosis and Treatment Strategies for Breast Cancer: An Optimal Control Perspective

Mehmet Yavuz[1,2]

[1] Department of Mathematics and Computer Sciences, Necmettin Erbakan University, 42090 Konya, Türkiye
[2] Department of Applied Mathematics and Informatics, Kyrgyz-Turkish Manas University, Bishkek 720038, Kyrgyzstan

mehmetyavuz@erbakan.edu.tr, mehmet.yavuz@manas.edu.kg,

Abstract

Mathematical modeling plays a crucial role in analyzing complex biological systems and supporting decision-making processes, particularly in cancer research. Breast cancer remains one of the leading causes of mortality worldwide, emphasizing the need for effective diagnostic and treatment strategies. In this study, a compartmental model describing the progression of breast cancer, including diagnosis and treatment mechanisms, is proposed. The model is examined through analyses of positivity, boundedness, equilibrium points, and their stability to confirm its biological validity. The basic reproduction number is computed, and a sensitivity analysis is performed to assess the impact of key parameters. Moreover, optimal control theory is incorporated by introducing control variables associated with diagnosis and treatment, converting the model into an optimal control framework. Three distinct strategies are evaluated using numerical simulations to identify the most effective approach. The findings reveal that the simultaneous implementation of all control measures produces the best outcomes, underscoring the importance of combining early detection with appropriate treatment to enhance survival rates.

Keywords: Breast cancer modeling; Optimal control; Compartmental model; Sensitivity analysis, Early diagnosis

Gauss-Seidel progressive iterative approximation for Catmull-Clark surfaces interpolation

Yuusf Fatihu Hamza [1]

[1] Department of Mathematics, Northwest University, Kano. Nigeria

yfhamza@nwu.edu.nh, yusuffatihu@gmail.com

Abstract

Catmull–Clark subdivision scheme is one of the most well-known and widely used approximation subdivision schemes in the literature. However, the limit surface generated by the Catmull-Clark subdivision scheme does not interpolate the vertices of the given mesh. To address this issue, we present a Gauss-Seidel progressive iterative approximation (GS-PIA) method for Catmull-Clark subdivision surface interpolation by combining the classical Gauss-Seidel iterative technique for solving linear systems with the progressive iterative approximation framework for geometric data interpolation. The proposed scheme is developed to generate interpolatory Catmull-Clark subdivision surfaces while preserving the geometric features of the given control mesh. The convergence of the proposed iterative process is established through matrix analysis and the spectral properties of the associated iteration matrix. Several numerical experiments are presented to validate the accuracy, computational efficiency, and effectiveness of the proposed method for Catmull–Clark subdivision surface interpolation.

Keywords: Catmull-Clark subdivision scheme; Gauss-Seidel iterative method ; Progressive- iterative approximation (PIA).

ASYMPTOTIC ANALYSIS OF THE CAUCHY PROBLEM FOR A SINGULARLY PERTURBED LINEAR SCALAR INTEGRO-DIFFERENTIAL EQUATION

Asan Omuraliev[1], Ella Abylaeva[2]

[1] Department of Applied Mathematics and Informatics, Kyrgyz State Technical University named after I. Razzakov (KSTU), Bishkek, Kyrgyzstan, asan.omuraliev@mail.ru

[2] Department of Applied Mathematics and Informatics, Kyrgyz Turkish Manas University, Bishkek, Kyrgyzstan, ella.abylaeva@manas.edu.kg

Abstract

In this paper, we study the Cauchy problem for a linear scalar integro-differential equation with a small perturbation parameter. Such equations play a significant role in modern mathematical analysis due to their ability to describe processes with memory effects and rapid transitions. The presence of the small parameter leads to solutions characterized by boundary layers and asymptotic behavior. We assume that the coefficient function, the kernel, and the source term are sufficiently smooth. Furthermore, the problem is analyzed within the framework of singular perturbation theory, and special attention is given to the role of the Dirac delta function as a powerful analytical tool. The structure of the solution and its qualitative properties are discussed, providing insight into both theoretical aspects and potential applications.

Keywords: Integro-differential equations; Cauchy problem; Singular perturbation; Dirac delta function; Asymptotic behavior.

REFERENCES

1. Lomov, S. A. Asymptotic Methods in the Theory of Singularly Perturbed Integro-Differential Systems. Moscow: Nauka, 1981, 312 p.
2. Safonov, V. F. Asymptotic Methods for Singularly Perturbed Integral Equations. Moscow: Nauka, 1988, 256 p

SOLITON GAS IN NON-INTEGRABLE SYSTEMS

Marcelo V. Flamarion [1]

[1] Sección Matemáticas, Departamento Académico de Ciencias, Pontificia Universidad Católica del Perú, Peru

mvellosoflamarionvasconcellos@pucp.edu.pe

Abstract

We investigate the formation of extreme waves, often referred to as rogue or freak waves, which pose significant risks in oceanic environments and also arise in systems such as plasmas and financial models. Their generation is studied through Monte Carlo simulations of soliton ensembles with randomly distributed amplitudes, a regime commonly known as soliton gas, within the Schamel and modified Korteweg–de Vries equations. We analyze the resulting statistical properties of this turbulence, including wave spectra, higher-order moments, and probability distribution functions, providing insight into the mechanisms underlying the emergence of extreme events.

Keywords: Soliton; KdV equation; Non-integrable systems.

REFERENCES

1. E. Didenkulova, M. V. Flamarion, E. Pelinovsky, KdV-like soliton gas: similarity and difference in integrable and non-integrable models, Physica D: Nonlinear Phenomena, Vol. 481, 134815, 2025.

2. M. V. Flamarion, E. Pelinovsky, E. Didenkulova, Non-integrable soliton gas: The Schamel equation framework, Chaos, Solitons & Fractals, Vol. 180, 114495, 2024.

3. M. V. Flamarion, E. Pelinovsky, Nonlinear random wave fields within a Boussinesq system, Physics Letters A, Vol. 520, 129677, 2024.

4. M. V. Flamarion, E. Pelinovsky, E. Didenkulova, Dynamics of irregular wave fields in the Schamel equation framework, Physics of Wave Phenomena, Vol. 33, 9–19, 2025.

Local Existence for Solutions of a Damped Wave Equation of Variable Coefficient

Hatice Taskesen, [1] **Zehra Cabir** [1]

[1] Department of Mathematics, Van Yuzuncu Yil University, Van, Turkey

haticetaskesen@yyu.edu.tr

Abstract

In this work, we study the existence and uniqueness of the local solution for the initial-boundary value problem of a double dispersive and dissipative wave equation with variable coefficient via Galerkin approximation and fixed point theory.

Keywords: Dissipative wave equation; Galerkin approximation; Variable coefficient.

REFERENCES

1. Du, F., Hao, J., BoTian, Kun Sun, Feng-Hua Qi, Stability for variable-coefficient wave equation with local fricitional damping and memory type dynamic boundary conditions, Evolution Equations and Control Theory, Vol:13, No:6, 1584–1608, 2024.
2. Jin, K.P., Wang, L. Uniform decay estimates for the semi-linear wave equation with locally distributed mixed-type damping via arbitrary local viscoelastic versus frictional dissipative effects, Advances in Nonlinear Analysis, 12:20220285, 2023.

MONTE CARLO–BASED NUMERICAL VERIFICATION OF CLINICAL ELECTRON BEAM DOSIMETRY USING FLUKA

Gazmend Nafezi[1], **Eros Halili**[1], **Mazllum Kamberi**[1] *

[1] University of Prishtina, Prishtina, Kosovo

*mazllum.ing@gmail.com

Abstract

Reliable dosimetric verification of clinical electron beams is essential for quality assurance in external beam radiotherapy. This study investigates the feasibility of using Monte Carlo dose calculations based on the FLUKA code as an independent verification tool for electron beam dosimetry. Electron beams with nominal energies of 6, 9, 12, and 15 MeV were simulated in a homogeneous water phantom under clinically relevant irradiation conditions.

Percent depth dose (PDD) curves, depth–dose parameters (R_{100}, R_{90}, R_{50}), output characteristics, and effective beam energies (E_0) were derived and compared with measurements from a clinical linear accelerator. Agreement between simulations and measurements was evaluated using a dual acceptance criterion, including a local ±5% dose difference with a minimum 90% pass rate, as well as stricter ±3% and ±2% tolerances.

For 9 MeV and 15 MeV beams, pass rates of 93% and 90.4% were achieved under the ±5% criterion, with deviations mainly observed in high-gradient regions. Depth–dose parameters and effective energies showed strong agreement, with relative differences in R_{50} and E_0 generally below 1%.

These results demonstrate that FLUKA accurately reproduces clinically relevant electron beam dosimetric characteristics and can serve as a reliable Monte Carlo–based tool for independent dose verification in radiotherapy.

Keywords: Monte Carlo simulation, FLUKA, electron beam dosimetry, radiotherapy QA

REFERENCES

1. Ferrari, A., Sala, P. R., Fasso, A., & Ranft, J. (2005). *FLUKA: a multi-particle transport code*. CERN-2005-10.
2. Ferrari, A. et al. (2007). "Validation of FLUKA Monte Carlo code for radiotherapy applications." *Physics in Medicine & Biology*, 52(9), 2399–2415.
3. Skordis, E., Vlachoudis, V., & Welsch, C. P. A Monte Carlo approach to imaging and dose simulations in realistic phantoms using a compact x-ray source.

GLOBAL EXISTENCE OF SOLUTIONS TO THE MIXED PROBLEM FOR A SYSTEM OF NONLINEAR PSEUDO-HYPERBOLIC EQUATIONS

Asif Pashayev[1,2]
[1]Azerbaijan University, Baku, Azerbaijan
[2]Institute of Mathematics, Baku, Azerbaijan

asif.pashayev@au.edu.az

In this work the existence of global solutions for a system of nonlinear pseudo-hyperbolic equations, consisting of two coupled equations, is investigated. The Galerkin method is employed to construct approximate solutions, followed by the derivation of a'priori estimates. By utilizing Hölder's and Young's inequalities, the boundedness of the solutions within specific functional spaces is established.

The Banach-Alaoglu theorem is invoked to demonstrate the existence of a weak-star solution. Finally, the limit transition is performed by applying the Aubin-Lions compactness theorem in conjunction with the weak convergence of sequences, thereby establishing the global existence of the solution to the posed problem.

Keywords. System of nonlinear pseudo-hyperbolic equations, Laplacian operator, Galerkin's method, Holder's inequality, Young inequality, Banach-Alaoglu theorem, Aubin-Lions theorems.

REFERENCES

1. Pashayev, A. (2018). Existence of global solutions of the mixed problem for a system of nonlinear wave equations with Q-Laplacian operators. *Advanced Mathematical Models and Applications*, *3*(2), 168-176.
2. Gao, H., &Ma, T.F. (1999). Global solutions for a nonlinear wave equation with the p-Laplacian operator.*Electronic Journal of Qualitative Theory of Differential Equations*, *1999*(11), 1-13.
3. Hongjun, G., & Hui, Z. (2007). Global nonexistence of the solutions for a nonlinear wave equation with the q-Laplacian operator. *J. Partial Diff. Eqs*, 71-79.
4. Levine, H.A. (1974). Instability and nonexistence of global solutions to nonlinear wave equations of the form $Pu\_\ \{tt\}$=-Au+ $\mathscr{F}(u)$.*Transactions of the American mathematical society*, *192*, 1-21.
5. Georgiev, V., & Todorova, G. (1994). Existence of a solution of the wave equation with nonlinear damping and source terms.*Journal of differential equations*, *109*(2), 295-308.
6. Medeiros, L. A., & Miranda, M. M. (1990). On a nonlinear wave equation with damping.*Revista Matemática de la Universidad Complutense de Madrid*, *3*(2-3), 213-231.
7. Aliev, A.B., & Yusifova, G.I. (2017). Nonexistence of global solutions of Cauchy problems for systems of semilinear hyperbolic equations with positive initial energy. *Electronic Journal of Differential Equations*, *211*(2017), 1-10.
8. Wang, Y. (2009). Non-existence of global solutions of a class of coupled non-linear Klein–Gordon equations with non-negative potentials and arbitrary initial energy. *IMA Journal of Applied Mathematics*, *74*(3), 392-415.
9. Ye, Y. (2014). Global existence and nonexistence of solutions for coupled nonlinear wave equations with damping and source terms. *Bull. Korean Math. Soc.*, *51*(6), 1697-1710.

ON THE OPTIMALITY OF SINGULAR CONTROLS IN AN OPTIMAL CONTROL PROBLEM DESCRIBED BY A SYSTEM OF STOCHASTIC NONLINEAR INTEGRO-DIFFERENTIAL EQUATIONS

Rashad Mastaliyev[1,2], Khayala Alasgerova[2], Asif Pashayev[1]

[1] Department of Mathematics and Informatics, University of Azeribaijan, Baku, Azerbaijan
[2] Institute of Mathematics, Baku, Azerbaijan
[3] Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan
rashad.mastaliyev@au.edu.az; khayala.alasgarova@unec.edu.az; asif.pashayev@au.edu.az

Abstract

In this work first order necessary optimality condition is obtained in the form of the stochastic analog of Pontryagin's maximum principle for an optimal control problem described by a system of stochastic integro-differential equations. A singular case (in the considered sense) is investigated, and second order necessary optimality conditions of singular controls are derived.

Keywords: Stochastic integro-differential equations; Optimal control; Pontryagin's maximum principle; Singular controls.

REFERENCES

1. Bonaccorsi S., Da Prato G., Tubaro L., Asymptotic behavior of a class of nonlinear stochastic heat equations with memory effects, SIAM Journal on Mathematical Analysis, Vol:44, No:6, 4031–4053, 2012.
2. Mastaliyev R.O., Alesgerova Kh.H., Optimality conditions in a stochastic optimal control problem of integro-differential systems, Tomsk State University Journal of Control and Computer Science, Vol:63, No:1, 16–22, 2023.

BEYOND THE INTEGER-ORDER REALITY: FRACTAL TİME-DYNAMICS OF SEMİCONDUCTORS ENCODED VIA FYTRONIX HARDWARE-IN-THE-LOOP (HIL) MODELING

Fahrettin Yakuphanoglu
Fırat University, Faculty of Science , Physics Department, Elazıg, TURKEY
Fytronix High-Techonology Institute, Fırat Technology Development Region, Elazig TURKEY

Abstract

Current semiconductor characterization is "trapped" in a static, integer-order chronology. This paper shatters the classical Markovian assumption by treating the organic thin film not as a passive material, but as a Fractional-Time Memory Cell. We introduce a "Hardware-In-The-Loop" (HIL) mathematical architecture where the Fytronix characterization system acts as the physical solver for Caputo-fractional differential operators. For the first time, we demonstrate that the "noise" in transient measurements is not a statistical error, but the Topological Signature of anomalous diffusion, decoded through a sub-diffusive Mittag-Leffler kernel.

Keywords: Hil modeling, Fractal time, Fytronix Hardware

RECURSIVE SINGULARITY MAPPING: A DIVERGENT NUMERICAL PARADIGM FOR SYNCHRONOUS SIGNAL EVOLUTION IN SUB-DECAMETRIC DEFENCE ELECTRONICS

Fahrettin Yakuphanoglu

Fırat University, Faculty of Science , Physics Department, Elazıg, TURKEY

Fytronix High-Techonology Institute, Fırat Technology Development Region, Elazig TURKEY

fyhanoglu@firat.edu.tr

Traditional defense-grade computational models treat electronic linearity and nonlinearity as mutually exclusive domains, often leading to catastrophic failure when sensors encounter high-energy spectral interference. This research introduces a Non-Euclidean Kinetic Solver (NEKS), a radical departure from conventional drift-diffusion simulators. Instead of approximating nonlinearities as error residuals, this architecture treats them as emergent geometric properties of the carrier transport manifold in nano-scale defense hardware. By moving away from standard grid-based approximations, this work implements a topological flux-tracking algorithmthat views electronic signals as continuous surfaces subjected to "folding" under extreme stress. This allows for the simultaneous resolution of predictable linear outputs and chaotic, high-entropy transients without the need for computational restarts.

The architecture's core originality is anchored by three distinct numerical layers:

- Asymptotic Boundary Decoupling: A novel technique that isolates the quantum-well interfaces of the sensor, applying a non-local "shadow operator" to predict how atomic-scale lattice vibrations trigger macro-scale nonlinear signal drift.
- Hyper-Transient Spectral Stitching: A temporal discretization method that replaces fixed-step solvers with an intelligence-led variable-entropy integrator, capable of capturing femtosecond-scale nonlinear spikes during electromagnetic pulse (EMP) saturation that are invisible to standard defense models.
- Phase-Space Signature Deciphering: Rather than filtering noise, this module employs a Reconstructive Attractor Logic to map the "shape" of the interference. This allows the sensor to identify whether a signal distortion is a natural thermal fluctuation or a deliberate, nonlinear masking attempt by an adversary.

NONLINEAR STOCHASTIC MAPPING AND ATTRACTOR STABILIZATION IN FYTRONIX NANOSTRUCTURED SOLAR SIMULATION SYSTEMS

Fahrettin Yakuphanoglu

Fırat University, Faculty of Science , Physics Department, Elazıg, TURKEY

Fytronix High-Techonology Institute, Fırat Technology Development Region, Elazig TURKEY

fyhanoglu@firat.edu.tr

The precision of high-end Fytronix solar simulators is fundamentally linked to the stability of the spectral output during prolonged high-intensity exposure. However, when interfacing with nanostructured photovoltaic cells, the photocurrent feedback often exhibits complex, non-periodic fluctuations that traditional linear controllers fail to suppress. This study develops a customized numerical framework designed specifically for the Fytronix hardware architecture, treating these fluctuations not as system errors, but as high-order chaotic transients within the carrier injection manifold. This research moves beyond standard power-supply smoothing techniques, introducing a State-Space Predictive Logicthat synchronizes the simulator’s electronic driving pulse with the intrinsic relaxation times of the nanostructured test device. Original methodologies integrated into this Fytronix-centric model include: Transient Attractor Reconstruction: Utilizing the specific sampling rates of Fytronix instrumentation to map the "shape" of photocurrent jitter in phase space, allowing for the identification of deterministic chaos patterns hidden within seemingly random noise. Thermal-Optical Coupling Feedback: A proprietary numerical layer that predicts how localized heat accumulation in the simulator's LED/Xenon arrays interacts with the plasmonic resonance of the sample, triggering nonlinear "S-curve" stability shifts. Stochastic Resonance Tuning: A radical approach where controlled, low-level white noise is injected into the Fytronix control loop to enhance the detection of weak signals through the Benzi-Parisi effect, effectively stabilizing the system's dynamic equilibrium. By applying this Recursive Stability Zoning to Fytronix platforms, we demonstrate a significant reduction in spectral drift and a 40% improvement in the repeatability of efficiency measurements for third-generation solar cells. This work redefines the Fytronix simulator as more than a light source; it transforms it into a dynamic co-processor capable of anticipating and neutralizing the nonlinear instabilities inherent in advanced nanomaterial characterization.

Keywords: Solar simulation, Fytronix, Stochastic Mapping

THE MEMORY OF MATTER: A FRACTIONAL ONTOGENY OF BIO-ORGANIC SENSING INTERFACES

Ayşegül DERE

Vocational School of Technical Science, Department of Electric and Energy, Firat University, Elazig, Türkiye

a.dere@firat.edu.tr

Nature does not operate in integer steps, yet our sensors are historically shackled to the "memoryless" constraints of Newtonian calculus. The junction where an organic electronic device meets a living cell is a temporal labyrinth—a zone where ionic currents carry the weight of their own history. This research deconstructs the conventional "Ohmic" view of bio-interfaces, proposing instead a Fractional Ontogeny: a model where the interface is defined not by its instantaneous state, but by its spatiotemporal trajectory. By deploying non-local operators, we dissolve the artificial boundary between the "soft" stochasticity of the bio-system and the "hard" deterministic response of the organic transducer. We demonstrate that the fractional exponent (α) is not merely a fitting parameter but a fundamental metabolic clock, capturing the sub-diffusive "stutter" of ions through the protein-dense polymer matrix. Our framework reveals that the so-called "constant phase" behavior of these sensors is a macroscopic manifestation of a deeper, fractal-time logic inherent in living systems. This study shifts the goal of bio-electronics from "measuring signals" to "synchronizing memories," paving the way for organic interfaces that can truly "feel" the history of the biological tissues they inhabit.

Keywords: Temporal Labyrinth, Fractional Ontogeny, Bio-Digital Synchronization, Fractal-Time Logic, Memory-Encoded Sensing, Non-Euclidean Transduction.

BEYOND LINEAR APPROXIMATION: MULTI-PHYSICS NUMERICAL ARCHITECTURES FOR CAPTURING NON-EQUILIBRIUM OPTOELECTRONIC FLUX IN DISORDERED THIN-FILM TRANSISTORS

Ayşegül DERE

Vocational School of Technical Science, Department of Electric and Energy, Firat University, Elazig, Türkiye

a.dere@firat.edu.tr

While standard analytical models often treat light interaction as a minor perturbation, modern Thin-Film Transistors (TFTs) operating in high-sensitivity environments exhibit deep non-linearity driven by the complex interplay of localized state kinetics and photon-induced carrier generation. This study introduces a bespoke numerical framework designed to bypass the limitations of closed-form solutions by focusing on the stochastic-deterministic hybrid modeling of charge transport under non-steady-state illumination. The proposed methodology shifts away from traditional global convergence techniques, instead utilizing a modular adaptive-mesh refinement strategy that prioritizes the semiconductor-dielectric interface—the primary site of photogenerated carrier accumulation. To accurately map the non-linear response, we implement several novel computational layers: Dynamic Trap-State Integration: A numerical module that recalculates the occupancy of the Gaussian and exponential tail states in real-time, reflecting the instantaneous shift in the quasi-Fermi levels during illumination. Non-Linear Source Term Coupling: Integration of a non-local photogeneration rate into the Scharfetter-Gummel discretization, allowing for the simulation of "optical screening" effects where excessive carrier density modifies the local electric field. Accelerated Jacobian Preconditioning: A customized solver designed to handle the stiff matrices resulting from the abrupt transition between dark and illuminated states, significantly reducing the computational cost of transient simulations.

By decoupling the thermal and optical generation components within a self-consistent iterative loop, this framework successfully predicts the "S-shaped" output characteristics and the non-linear responsivity roll-off often observed but rarely modeled in organic and metal-oxide TFTs. The simulation results provide a unique look into the Persistent Photoconductivity (PPC) phenomenon, offering a predictive pathway for designing sensors that require rapid recovery times despite high trap densities. This numerical approach serves as a robust virtual laboratory for engineering the next generation of light-responsive thin-film architectures.

Keywords: Analytical models, Thin-Film Transistors, Stochastic-deterministic hybrid modeling

SCULPTING THEVOID: THE TOPOLOGICAL NARRATIVE AND FRACTAL SOVEREIGNTY OF VACUUM-GROWN ATOMIC LANDSCAPES

Ayşegül DERE

Vocational School of Technical Science, Department of Electric and Energy, Firat University, Elazig, Türkiye

a.dere@firat.edu.tr

Thin-film deposition is often misconstrued as a passive accumulation of matter; in reality, it is a kinetic drama played out in the shadow-play of vacuum physics. This work moves beyond the rudimentary metrics of "roughness" to explore the topological scars left by atomic bombardment. We treat the vacuum-deposited surface not as a flat plane, but as a fractal archive—a non-Euclidean history of every collision, diffusion event, and shadow-casting shadow that occurred during growth. By interrogating the surface through a synthesis of Minkowski functionals and computational topology, we uncover a "geometric metabolism" hidden within the film's morphology. We demonstrate that fractal surfaces are not random defects but are the deterministic fingerprints of thermodynamic exhaustion. Our analysis proves that the "void-space architecture"—the topology of what *isn't* there—is just as influential on the film's electronic destiny as the atoms themselves. By decoding the scaling laws of these chaotic terrains, we propose a new law of "Topological Ancestry,"where the initial nucleation "memory" dictates the fractal complexity of the macroscopic layer. This research transforms the way we perceive thin films: no longer as static coatings, but as living geometries whose functional power lies in the deliberate engineering of their own structural chaos.

Keywords: Atomic Landscapes, Topological Scars, Geometric Metabolism, Void-Space Architecture, Fractal Sovereignty, Thermodynamic Exhaustion.

Sparse Model Inference in High-Dimensional Data: Correlation-Sensitive Adaptive LASSO Method and Performance Analysis

Büşra Ceylan Kuzu[1], **Yunus Güral**[1]

[1] Department of Statistics, University of Firat, Elazig, Turkey

busra_ceylan_23@hotmail.com,

Abstract

In multivariate statistical analysis, the structure of the covariance matrix plays a central role, from regression models to dimensionality reduction techniques. Methods such as Principal Component Analysis and Ridge Regression, developed in the classical period, offered different solutions to the multicollinearity problem. The sparsity paradigm, which began with the introduction of the LASSO method in the 1990s, enabled coefficient shrinkage and automatic variable selection in modeling. However, the instability and redundancy issues encountered by LASSO and its improved variants, such as Adaptive LASSO and Elastic Net, persist as significant limitations, particularly in highly correlated data structures.

In modern datasets, the number of observations is often less than the number of variables ($n < p$), leading to distortions in the spectral structure of the sample covariance matrix. This necessitates the direct integration of inter-variable dependence into the modeling process. This thesis proposes a Correlation-Sensitive Adaptive LASSO (CDA-LASSO) method to address the deficiency of existing methods in adequately considering this structural dependence. The proposed approach introduces a hybrid weighting mechanism that integrates the penalty term with both coefficient magnitudes (relevance) and correlation geometry (redundancy).

Simulation studies confirm that CDA-LASSO produces more parsimonious and interpretable models, reducing model complexity by approximately 50% compared to classical methods. The findings reveal that the proposed method significantly reduces the false discovery rate, especially in highly correlated structures, improves F1 score stability, and exhibits robust performance even under heavy-tailed error structures. By incorporating data geometry into the optimization process without requiring any predefined graphical structure, this study offers a unique perspective to the high-dimensional data analysis literature.

Note: This study is derived from master's thesis entitled "Sparse Model Inference in High-Dimensional Data: Correlation-Sensitive Adaptive LASSO Method and Performance Analysis".

Keywords: Covariance Matrix; Regularization, Variable Selection; LASSO; CDA-LASSO; High-Dimensional Data Analysis.

THE PROPERTIES OF SOLUTIONS TO THE WEAKLY DISSIPATIVE MODIFIED CAMASSA-HOLM EQUATION

Nurhan Dündar[1]

[1] The Ministry of National Education, Diyarbakir, Türkiye

nurhandundar@hotmail.com,

Abstract

In this paper, we examine a modified model of the Camassa-Holm equation, an equation that models shallow water waves, with a weakly dispersive term. Initially, we obtain local well-posedness for this equation. After finding a conservation law, we obtain a new global existence result.

Keywords: Modified Camassa-Holm equation; weakly dissipative; local well-posedness; global existence

REFERENCES

1. R. Mclachlan, X. Zhang, Well-posedness of modified Camassa-Holm equations, J. Differential Equations 246, 3241-3259, 2009.
2. N. Dündar and N. Polat, Local well-posedness for a generalized integrable shallow water equation with strong dispersive term, }, Appl. Math. Inf. Sci. 15 (4), 429-436, 2021.
3. N. Dündar, Qualitative results for a generalized 2-component Camassa-Holm system with weak dissipation term, Turkish Journal of Mathematics, 48 (2), 163-185, 2024.

Exact Solutions of a Nonlinear Coupled System via Extended Hyperbolic Function Method

Ebru Cavlak Aslan[1], **Emine Şimşek**[1]

[1] Department of Mathematics, Science Faculty, University of Firat, Elazig, Turkey

ebrucavlak@hotmail.com, emn.23.smsk@gmail.com

Abstract

In this study, a coupled nonlinear evolution system is investigated using the extended hyperbolic function method. By applying a traveling wave transformation, the model is reduced to a system of ordinary differential equations, and various exact solutions are obtained. The method yields different wave structures including bright, dark, and periodic soliton solutions expressed in hyperbolic function forms. The effects of system parameters on the existence of these solutions are also discussed. The results show that the considered model possesses rich nonlinear wave dynamics and that the applied method is an effective tool for constructing exact solutions.

Keywords: Extended hyperbolic function method; Optical Soliton solutions.

REFERENCES

1. Nauman Raza, Zuha Khalid, Erkabov Davletov, Ikram Davletov and Hijaz Ahmad, Modulation instability and soliton dynamics in birefringent optical fibers governed by the complex Ginzburg–Landau equation, Z. Angew. Math. Phys., Vol 77, No:103, 1-25, 2026.
2. Mohammad A. Al Zubi, Kallekh Afef, Emad A. Az-Zo'bi, Assorted Spatial Optical Dynamics of a Generalized Fractional Quadruple Nematic Liquid Crystal System in Non-Local Media, Symmetry, Vol: 16, No: 778, 1-16.

Designing Advanced Neural Network Algorithms for Biological Models

Soukaina Zayat[1]**, Dumitru Baleanu**[1]

[1] Department of Computer Science and Mathematics, Lebanese American University, Beirut, Lebanon Mathematics

soukaina.zayat@lau.edu.lb, dumitru.baleanu@lau.edu.lb

Abstract

Recently, fractional order epidemiological modeling have captured the attention of researchers due to its strength in capturing hereditary and memory characteristics. However, it is considered challenging to solve such models due to its complex and nonlinear nature. The prediction heart disease system consists of seven dynamics: inflammation, blood pressure, heart rate, cholesterol, plaque accumulation, heart disease risk, and insulin. In this study, we propose an advanced dual layered neural network computational scheme for solving the fractional order heart disease prediction model using two activation functions along with different number of neurons. Moreover, several tests are applied for achieving precision, such as regression, error histogram, and state transitions.

Keywords: Biological modeling; Fractional calculus; Neural network with two layers; Activation function.

REFERENCES

1. Sabir, Z., Bhat, S.A., Raja, M.A.Z. and Alhazmi, S.E., 2023. A swarming neural network computing approach to solve the Zika virus model. Engineering Applications of Artificial Intelligence, 126, p.106924.
2. Sabir, Z., Wahab, H.A., Umar, M., Sakar, M.G. and Raja, M.A.Z., 2020. Novel design of Morlet wavelet neural network for solving second order Lane–Emden equation. Mathematics and Computers in Simulation, 172, pp.1-14.
3. Umar, M., Sabir, Z., Raja, M.A.Z., Shoaib, M., Gupta, M. and Sánchez, Y.G., 2020. A stochastic intelligent computing with neuro-evolution heuristics for nonlinear SITR system of novel COVID-19 dynamics. Symmetry, 12(10), p.1628.
4. Akkilic, A.N., Sabir, Z., Bhat, S.A. and Bulut, H., 2024. A radial basis deep neural network process using the Bayesian regularization optimization for the monkeypox transmission model. Expert Systems with Applications, 235, p.121257.

Exploring Complex Behaviors in a Refuge-Based Discrete Predator–Prey Model

Özlem Ak Gümüş[1]

[1] Department of Mathematics, University of Adiyaman, Adiyaman, Turkey

akgumus@adiyaman.edu.tr,

Abstract

This paper explores the bifurcation behavior and chaos control in a discrete-time predator–prey model incorporating a prey refuge mechanism. The model, which accounts for the Allee effect induced by predator pressure on prey populations at low densities, is further developed by introducing a refuge threshold to reflect realistic protective behaviors in ecological environments. Fixed points and their local stability are analyzed. The onset of complex dynamical patterns is investigated through bifurcation analysis, where conditions for flip (period-doubling) and Neimark–Sacker bifurcations are rigorously established using the center manifold theorem and normal form theory. To mitigate chaotic dynamics, a linear state feedback control method is proposed and applied to the system. The analytical findings are validated through numerical simulations. The results highlight the role of the refuge mechanism in shaping the long-term dynamics of the interacting populations.

Keywords: Predator–prey model, Discrete-time system, Bifurcation analysis, Chaos control, Prey refuge, Allee effect, Center manifold theorem, Normal form theory, Stability analysis

REFERENCES

1. Murray, J. D., Mathematical biology: I. An introduction, Vol. 17 (Springer Science & Business Media), 2007.
2. Kuznetsov, Y. A., Kuznetsov, I. A. & Kuznetsov, Y., Elements of applied bifurcation theory, Vol. 112, (Springer),1998.
3. Mokni, K., Elaydi, S., Ch-Chaoui, M. & Eladdadi, A., Discrete evolutionary population models: a new approach, Journal of Biological Dynamics 14, 454–478, 2020.

Optimizing Sequential Data Projections via Non-Parametric Error Correction: A Composite Modeling Approach

Yasemin DEMİREL[1]

[1]Istanbul Topkapi University, Department of Data Science and Analytics, Istanbul, Türkiye

yasemindemirel@topkapi.edu.tr

Abstract

This paper investigates the computational synchronization of parametric time-series estimation and non-parametric machine learning techniques for forecasting non-stationary data subject to heavy structural discontinuities. Initially, we formalize the underlying trend of the sample sequence using polynomial least squares, subsequently accommodating periodic oscillations via Seasonal Auto-Regressive Integrated Moving Average (SARIMA) operators. However, traditional linear estimators systematically generate expanding residual variances when confronted with abrupt, exogenous structural breaks. To solve this optimization limitation, we introduce a composite algorithmic architecture that leverages Extreme Gradient Boosting (XGBoost) to recursively minimize the structural residuals extracted from the SARIMA baseline using a heavily penalized objective function. Subjected to an empirical dataset of 53 discrete intervals containing a statistically verified nonlinear shift, the hybrid SARIMA-XGBoost specification drastically reduced the loss metrics compared to its isolated parent models. The mathematical evidence confirms that superimposing gradient-boosted decision trees onto classical autoregressive models provides a highly optimal variance-reduction mechanism for volatile sequential data.

Keywords: Ordinary Least Squares Regression, ARIMA, SARIMA, Random Forest,XGBoost

REFERENCES

1. Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2015). Time Series Analysis: Forecasting and Control (5th ed.). Wiley.
2. Chen, T., & Guestrin, C. (2016). XGBoost: A scalable tree boosting system. Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 785–794.
3. Makridakis S, Spiliotis E, Assimakopoulos V (2018) Statistical and Machine Learning forecasting methods: Concerns and ways forward. PLOS ONE 13(3): e0194889. https://doi.org/10.1371/journal.pone.0194889

Fractional-Order Modeling of Malware Spread using the Homotopy Perturbation Method

Yerra Shankar Rao[1], Kishan Kumar[2], Mehmet Yavuz[3,4], Binayak Dihudi[5]

[1] Department of Mathematics NIST University Berhampur, 761008, Odisha, India
[2] Department of Mathematics Research Scholar, NIST University Berhampur, 761008, Odisha, India
[3] Department of Mathematics and Computer Sciences, Necmettin Erbakan University, 42090 Konya, Türkiye
[4] Department of Applied Mathematics and Informatics, Kyrgyz-Turkish Manas University, Bishkek 720038, Kyrgyzstan
[5] Department of Mathematics KIST Jatani Bhubaneswar, Odisha India, 752050
sankar.math1@gmail.com, nibeditta2006@gmail.com, mehmet.yavuz@manas.edu.kg, bdihudi@gmail.com

Abstract

Malicious software, commonly referred to as malware, is a type of computer program that infiltrates and harms the actual computer system without obtaining user consent. It poses a significant threat to information security. To address this concern, precise sensor networks have been developed to characterize and assess the spread of malicious objects across networks. In this paper, a fractional-order malware transmission model has been created to depict the dissemination of malware within a wireless sensor network. This model employs fractional differential equations to account for memory effects in the transmission dynamics. Given that the resulting system is nonlinear and challenging to solve exactly, the homotopy perturbation method (HPM) is utilized to derive approximate analytical solutions. Numerical simulations are provided to demonstrate the model's behavior and to analyze the impact of the semi-analytical method on the spread of disease. The findings indicate that the homotopy perturbation method is an effective approach for solving fractional epidemic models and offers valuable insights into the dynamics of malware transmission.

Keywords: Fractional-Order Model, Homotopy Perturbation Method, Malware Transmission, Nonlinear System of Differential Equation

References

1. Mouaouine, A., Boukhouima, A., Hattaf, K. & Yousfi, N. (2018). A fractional order SIR epidemic model with nonlinear incidence rate. Advances in Difference Equations, 2018(160). https://doi.org/10.1186/s13662-018-1613-z.
2. Nandi, T. R., Saha, A. K., & Roy, S. (2024). Analysis of a fractional order epidemiological model for tuberculosis transmission with vaccination and reinfection. Scientific Reports, 14(28290). https://doi.org/10.1038/s41598-024-73392-x.

A SECOND-ORDER ACCURATE NUMERICAL SCHEME FOR SINGULARLY PERTURBED BOUNDARY LAYER PROBLEMS WITH ERROR ANALYSIS

Derya Arslan[1]

[1] Department of Mathematics, University of Bitlis Eren, Bitlis, Turkey

d.arslan@beu.edu.tr,

Abstract

This study investigates a numerical approach to solving singularly perturbed boundary value problems exhibiting boundary layer behavior. A benchmark problem with a known analytic solution is used to verify the accuracy and robustness of the proposed method. Error analysis is performed using maximum norms, and convergence behavior is examined through log-log plots. The numerical results show that the method provides uniform second-order convergence with respect to the perturbation parameter.

Keywords: Singular perturbation; Boundary layer; Finite difference method; Error analysis; Convergence rate.

REFERENCES

1. Amiraliyev G.M., Mamedov, Y.D. Difference schemes on the uniform mesh for singularly perturbed pseudo-parabolic equations, Turkish Journal of Mathematics, Vol:19, 207–222-386, 1995.
2. Bakhvalov N.S. The optimization of methods of solving boundary value problems with a boundary layer, USSR Comp. Math. Math. Phys., Vol: 9, 139–166, 1969.
3. Arslan, D. Stability and convergence analysis on Shishkin mesh for a nonlinear singularly perturbed problem with three-point boundary condition, Quaestiones, Mathematicae, Vol:43, No:11, 1527–1540, 2020.

BOUNDARY CONTROL OF HEAT CONDUCTION UNDER THE FADING MEMORY EFFECT

Beyza Billur İSKENDER EROĞLU [1], **Derya AVCI** [1]

[1] Department of Mathematics, Balikesir University, Balikesir, Turkey

dkaradeniz@balikesir.edu.tr,

Abstract

In many heat transfer processes, managing temperature gradients is essential to maintain thermal stresses within optimal limits and to prevent structural deformation. This study investigates a boundary value problem for a heat conduction model that incorporates fading memory effects. The main objective is to determine the temperature control function that regulates the thermal state within the region from the boundary. In this problem, while one boundary is maintained at a homogeneous temperature, the other boundary is governed by a control function designed to optimize the resulting thermal stress. By employing analytical integral transform techniques, the problem is formulated into Volterra-type integral equations and solved via an iterative method to reveal the dynamic behavior of this control function. This research provides a critical framework for precision thermal management, presenting a novel approach to boundary control under memory-dependent heat conduction laws that has not been previously addressed in the literature.

Keywords: Thermal stress; Boundary control; Fading memory; Volterra integral equation.

REFERENCES

1. Cattaneo, C. (1948). Sulla conduzione del calore. Atti del Seminario Matematico e Fisico dell'Università di Modena e Reggio Emilia, 3, 83-101.
2. Hristov, J. (2017). Derivatives with non-singular kernels from the Caputo-Fabrizio definition and beyond: Appraising analysis with emphasis on diffusion models. Frontiers in Fractional Calculus, 1, 270-342.
3. Dekhkonov, F. (2023). Boundary control problem for a parabolic equation with heating process of a rod. Bulletin of the Institute of Mathematics, 6(1), 32-38.

A NOVEL MODEL FOR THE DYNAMIC INTERACTION OF ADDICTION, UNEMPLOYMENT, AND CRIME

Aylin YETİM[1], Derya AVCI[1]

[1] Department of Mathematics, Balikesir University, Balikesir, Turkey

dkaradeniz@balikesir.edu.tr,

Abstract

In contemporary society, addiction, unemployment, and crime represent some of the most rapidly spreading social contagion problems, necessitating rigorous analysis within the framework of mathematical epidemiology. While existing literature has extensively examined the pairwise interactions between these phenomena, a comprehensive model that integrates all three interconnected factors remains a significant gap. This study proposes a novel deterministic mathematical model to investigate the dynamic interplay between addiction, unemployment, and crime. We conduct a detailed systematic analysis, including the derivation of the basic reproduction number and stability analysis of the equilibrium points. Furthermore, numerical simulations are performed to illustrate the transitions between different social states and to evaluate the long-term behavior of the system. The results provide critical insights into how these three social challenges reinforce one another, offering a theoretical foundation for developing integrated intervention strategies. By addressing the tripartite relationship for the first time in a unified mathematical structure, this research contributes a new perspective to the modeling of social epidemics.

Keywords: Mathematical modeling; Addiction; Unemployment; Crime; Stability analysis; Numerical simulation.

REFERENCES

1. Mataru, B., Abonyo, J. O., & Malonza, D. (2023). Optimal Control Strategies for Crime in Developing Countries. Global Journal of Pure and Applied Mathematics, 19(2), 523-546.
2. Nantomah, K. K., Seidu, B., & Bornaa, C. S. (2022). A Mathematical Model of Drug-Crime Dynamics. (Eğer yayın bilgisi elindeyse: Journal Name, Vol(Issue), Page numbers eklenebilir).
3. Ademosu, J. A., Olaniyi, S., Abimbade, S. F., Chuma, F. M., Ogbonna, R. C., Lebelo, R. S., & Okosun, K. O. (2025). Modelling Population Dynamics of Substance Abuse in the Presence of Addicted Immigrant With Real Data of Rehabilitation Cases. Journal of Applied Mathematics, 2025(1), 2241780.

ON MODIFIED FRACTIONAL OPERATOR WITH MITTAG-LEFFLER KERNEL

Dumitru Baleanu[1,2]

[1] Department of Computer Science and Mathematics,Lebanese American University, Beirut,Lebanon

[2]Institute of Space Sciences,a subsidiary of INFLPR,Magurele-Bucharest,Romania

dumitru.baleanu@lau.edu.lb

,

Abstract

In this presentation, I will discuss the advantages of using newly introduced singular modified fractional operator [1] with Mittag-Leffler kernel (MABC).Some illustrative examples will be presented.

Keywords: Fractional calculus; MABC operator;Fractional dynamics.

REFERENCES

1. Mohammed Al-Refai, Dumitru Baleanu, On an extension of the operator with Mittag-Leffler Kernel, Fractals, Vol:30, No:05, 2022. https://doi.org/10.1142/s0218348x22401296

COMPARISON OF NUMERICAL SOLUTION METHODS IN TUMOR-IMMUNE INTERACTIONS

Binar Elmahmud[1], **Durmuş Yarımpabuç**[1], **Özlem Öcal**[1]

[1] Department of Mathematics, Osmaniye Korkut Ata University, Osmaniye, Turkey

durmusyarimpabuc@osmaniye.edu.tr,

Abstract

Mathematical modeling is a critical tool in understanding cancer dynamics, optimizing treatment strategies, and predicting tumor growth. This study investigates the complex interactions between tumor cells and immune system components consisting of natural killer (NK) cells, dendritic cells (DC), and cytotoxic CD8+ T cells under chemotherapy and immunotherapy interventions. The main objective of the study is to evaluate the performance of different numerical methods in solving commonly used ordinary differential equation (ODE) systems and the effect of biological parameters on the system. In this context, in addition to the Runge-Kutta 4th Order (RK4), Explicit Euler, and Heun methods frequently used in the literature, Backward Differential Formulas (BDF), which can better manage the rigid character of the system, and Adaptive Step Interval (RKF45), which is more effective in capturing variable dynamics, are included in the analysis.

Keywords: Tumor Growth Models; Quantitative Methods; Chemotherapy and Immunotherapy,

REFERENCES

1. Unni, P., Seshaiyer, P. (2019). Mathematical modeling, analysis, and simulation of tumor dynamics with drug interventions. *Computational and Mathematical Methods in Medicine*, *2019*, Article 4079298. https://doi.org/10.1155/2019/4079298
2. El Haout, S., Fatani, M., Abu Farha, N. K. M., AlSawaftah, N. M., Mortula, M., Husseini, G. A. (2021). Modeling the effects of chemotherapy and immunotherapy on tumor growth. *Journal of Biomedical Nanotechnology*, *17*(10), 1–14. https://doi.org/10.1166/jbn.2021.3214
3. Song, G., Liang, G., Tian, T., Zhang, X. (2022). Mathematical modeling and analysis of tumor chemotherapy. *Symmetry*, *14*(4), 704. https://doi.org/10.3390/sym14040704

GOTTMAN-MURRAY PROBLEM ON BIGEOMETRIC MULTIPLICATIVE CALCULUS

Zehra Özdemir [1], **Canan Yanilmaz** [1], **Emrah Yilmaz** [1]

[1] Department of Mathematics, Firat University, Elazığ, Türkiye

eyilmaz@firat.edu.tr,

Abstract

This study will examine Gottman-Murray problem, a significantly different mathematical model, using bigeometric multiplicative analysis techniques instead of classical analysis. A stability analysis of the problem will also be conducted. By transferring classical stability analysis to the bigeometric plane, critical thresholds in marital equilibrium will be defined for the first time beyond conventional arithmetic methods. The aim is to reveal the nonlinear cumulative effects of interactions in the relationship more precisely by remodeling traditional additive change dynamics with multiplicative derivatives, which are more appropriate to the growth nature of biological and social systems. The study will also be supported by a numerical example.

Keywords: Gottman-Murray Model; Bigeometric Multiplicative Calculus.

REFERENCES

1. J. M. Gottman, J. D. Murray, C. C. Swanson, R. Tyson and K. R. Swanson, *The Mathematics of Marriage: Dynamic Nonlinear Models*, Cambridge, MA: MIT Press, 2002.
2. J. D. Murray, *Mathematical Biology: Vol. 1. An Introduction*, New York, NY: Springer-Verlag, 2002.
3. M. Grossman, R. Katz, Non-Newtonian Calculus, Pigeon Cove, Massachusetts, 1972.
4. M.Ç. Yilmazer, S. Goktas, E. Yilmaz, M. Et, Adams-Bashforth methods on bigeometric calculus. AIMS Mathematics, 2025, 10(8): 18627-18640.
5. S. Georgiev, K. Zennir, Multiplicative Differential Calculus, New York, Chapman and Hall/CRC, 2022.

Nonlinear Dynamics of a Predator-Prey Model with Fear Refuge Mechanism and Prey Harvesting

M. Sivabalan*[1], A. Ashwin[1], Mehmet Yavuz[2,3], T. Nandha Gopal[1], T. Megala[1]

[1] Department of Mathematics, Sri Ramakrishna Mission Vidyalaya College of Arts and Science, Periyanaickenpalayam, Coimbatore, Tamil Nadu 641 020, India

[2] Department of Mathematics and Computer Sciences, Necmettin Erbakan University, Konya, Turkiye

[3] Department of Applied Mathematics and Informatics, Kyrgyz-Turkish Manas University, Bishkek 720038, Kyrgyzstan

*Corresponding author: siva8890@gmail.com

Abstract

This paper develops and analyzes a three-species food web model describing diseased prey--predator interactions. The prey population is divided into infected and susceptible classes, both assumed to grow logistically in the absence of predation. A fear effect induced by infected prey is incorporated to capture behavioral changes in susceptible prey. Predation is modeled using a Beddington-DeAngelis (B.D) functional response to account for predator interference during both searching and handling processes. Harvesting susceptible as well as infected prey populations must be added into the equation. The existence and feasibility of all biologically meaningful equilibrium points are established, and their local and global stability properties are rigorously investigated. Transcritical bifurcation is analyzed with respect to the basic reproduction number R_0, while Hopf bifurcation is studied in relation to the harvesting rate h_1, revealing the onset of oscillatory dynamics. Numerical simulations are provided to illustrate the analytical findings and to demonstrate the complex dynamical behaviors arising from predator prey disease interactions.

Keywords: Prey harvesting, Prey refuge, stability, Transcritical bifurcation, Hopf-bifurcation.

REFERENCES

1. Divya, A., Sivabalan, M., Yavuz, M., Ashwin, A., & Pradeep, M. S. (2025). Dynamical analysis of a Crowley-Martin Eco-epidemiological model with impact of fear, prey refuge and harvesting. Jambura Journal of Biomathematics (JJBM), 6(4), 363-375.
2. Sarrah, A., Alanazi, F. J., Yavuz, M., & Saber, S. (2026). The Effects of Fluctuating Carrying Capacity on the Dynamics of a Holling-Type III Predator–Prey Model. Journal of Mathematics, 2026(1), 5067259.
3. Naik, P., Eskandari, Z., Shahkari, H. E., & Owolabi, K. M. (2023). Bifurcation analysis of a discrete-time prey-predator model. Bulletin of Biomathematics, 1(2), 111-123.
4. Resmawan, R., Suryanto, A., Darti, I., & Panigoro, H. S. (2025). Global stability and bifurcation analysis of a predator-prey model involving Allee effect and Monod-Haldane functional response. Mathematical Modelling and Numerical Simulation with Applications, 5(3), 3.

Relationship Between Univalent Functions and Fractal Geometry

Hakan Faik ER and Halit ORHAN

Faculty of Science, Department of Mathematics, Atatürk University, Erzurum, Turkiye
hkner50@gmail.com, horhan@atauni.edu.tr

Abstract

This study explores the role of univalent (schlicht) functions, key objects linking complex analysis and fractal geometry in the formation and analysis of fractal structures. It aims to demonstrate, through both theoretical and numerical methods, how the conformal properties of these functions contribute to the emergence of self-similar and scale-invariant geometries. The work introduces the class $\mathcal{S}$ and its principal subclasses, starlike ($\mathcal{S}^*$) and convex (K) functions, alongside fundamental notions of fractal geometry such as Hausdorff and box-counting dimensions. In the applied section, inverse iteration, Schwarz–Christoffel mappings, and Möbius transformations are employed to analyze the iterative behavior of univalent functions. Fractal boundaries, such as the Julia and Mandelbrot sets, and conformally deformed iterated function systems are visualized computationally. The findings indicate that univalent functions constitute not only a theoretical framework but also an effective tool for modeling and visualizing complex fractal structures.

Keywords: Univalent Functions, Fractal Geometry, Conformal Mapping, Iterated Function Systems, Julia Sets.

REFERENCES

1. Pommerenke, Ch.(1975), Univalent Functions, Vandenhoeck and Ruprecht, Göttingen.

2. Duren, P. L. (1983). Univalent Functions. Springer Verlag, New York Inc.

3. Falconer, K.J. (2003) Fractal Geometry: Mathematical Foundations and Applications. 2nd Edition, John Wiley Sons Ltd, Chichester.

Comparative Analysis of Exponential, Logistic, and Gompertz Tumor Growth Models and Mathematical Evaluation of the Treatment Effect

Cihan Öksüz[1] , **Etibar Penahlı**[2] , **Münevver Tuz**[3]

[1,3]Department of Mathematics, University of Firat, Elazig, Turkey

[2]Department of Mathematics, University of Baku State, Baku, Azerbaycan

cihanoksuz05@gmail.com , epenahov@hotmail.com, mtuz@firat.edu.tr

Abstract

This study systematically examines exponential, logistic, and Gompertz models to understand cancer tumor growth dynamics. Equilibrium points and linear stability analyses were performed based on the differential equation formulations of the models. As a result of the analyses, it was determined that the exponential model exhibits unlimited growth, while the logistic and Gompertz models reach asymptotic stability at the carrying capacity K. It was found that the Gompertz model shows the highest fit to clinical data and advanced-stage tumor behavior due to the exponential decrease in growth rate. In extended models including treatment effects, the critical threshold condition for tumor eradication, $\delta \geq r$, was theoretically established. The study emphasizes the importance of mathematical stability analysis in developing dynamic treatment strategies.

Keywords: Tumor growth models; Stability analysis; Gompertz model; Differential equations; Mathematical oncology

REFERENCES

1. Helen Byrne , Mathematical modelling of avascular tumour growth, Applied Mathematics, Vol:17, 241–267, 1997.
2. Nicola Bellomo et al., Toward a mathematical theory of cancer growth, Mathematical Models Methods Applied Sciences , Vol: 18, No: 4, 593–646, 2008.
3. Philip Gerlee, The model muddle: in search of tumor growth laws, Cancer Research, Vol: 73, 2407–2411, 2013.
4. Avner Friedman, Mathematical Analysis and Challenges Arising from Models of Tumor Growth, Springer, 2015.
5. Anna Kane Laird, Dynamics of tumour growth, Br. J. Cancer, Vol: 18, 490–502, 1964.

Asymptotic Analysis of Singularly Perturbed Volterra-Type Integral Equations

Asan Omuraliev[1], Peyil Esengul kyzy[2]

[1] Department of Applied Mathematics and Enformatics, Kyrgyz State Technical University named after. I. Razzakova, Bishkek, Kyrgyzstan

[2] Department of Mathematics, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan

peyil.esengul@manas.edu.kg,

Abstract

The asymptotic behavior of the solution to a singularly perturbed Volterra-type integral equation is investigated. The equation contains a small parameter multiplying the unknown function, which leads to the formation of a boundary layer. To analyze this problem, Lomov's regularization method is applied. This approach is based on the introduction of a stretched variable, which enables the correct description of the boundary layer structure. An extended solution is constructed as the sum of a regular part and a boundary layer correction, ensuring the matching condition with the original solution. The application of Lomov's method allows for the systematic derivation of a uniform asymptotic expansion and provides an effective framework for studying singularly perturbed integral equations.

Keywords: singular perturbation, Volterra integral equation, boundary layer, asymptotic analysis, Lomov's method, regularization, stretched variable, uniform asymptotic expansion.

REFERENCES

1. Lomov, S. A. *Introduction to the General Theory of Singular Perturbations*. American Mathematical Society, 1992.
2. Verhulst, F. *Methods and Applications of Singular Perturbations*. Springer, 2005.
3. Linz, P. *Analytical and Numerical Methods for Volterra Equations*. SIAM, 1985.
4. Kevorkian, J., Cole, J. D. *Multiple Scale and Singular Perturbation Methods*, Springer, 1996.

10TH INTERNATIONAL CONFERENCE ON COMPUTATIONAL MATHEMATICS AND ENGINEERING SCIENCES

24-26 APRIL, 2026

Istanbul – Türkiye

cmescongress.org