DEPARTMENT OF MATHEMATICS
FACULTY OF SCIENCE
OBAFEMI AWOLOWO UNIVERSITY
ILE-IFE, NIGERIA

CONFERENCE BOOK OF ABSTRACTS

Theme:

MATHEMATICAL SCIENCES: AN INDISPENSABLE TRAJECTORY TO SUSTAINABLE DEVELOPMENT

In Honour of:

Professor A. G. Adeagbo-Akeyo

Professor Titilola Olakunjo Obilade

Dr. Peter Folorunso Fasogbon

Mr. Adekunle Mojubaade Ogunfidodo

Tuesday, 20th February 2024

Contents

National Anthem

National Anthem

Stanza 1
Arise, O compatriots
Nigeria's call obey
To serve our fatherland
With love and strength and faith.
The labour of our heroes past Shall never be in vain
To serve with heart and might
One nation bound in freedom
peace and unity.

Stanza 2
O God of creation
Direct our noble cause
Guide our leaders right
Help our youth the truth to know
In love and honesty to grow
And living just and true
Great lofty heights attain
To build a nation where peace and justice reign.

Welcome Messages

On behalf of the Department of Mathematics and the Organizing Committee of this conference, we welcome you to attend this event taking place physically in the Faculty Board Room and Department of Mathematics at Obafemi Awolowo University, Ile-Ife, Nigeria, and over the Internet today, 20th February 2024. We hope that an annual conference, a well-established series of popular and high-quality conferences, will be established in the near future, focusing on the theory and methodology of mathematical sciences and their applications.

This conference aims to:

- Honour our retired colleagues who have served not only the department, faculty, and university but also the entire society at large.
- Provide a high-level international forum for scientists, engineers, and students to gather and present and discuss the latest progress in mathematical sciences research and applications in diverse areas.
- Encourage open discussion and exchange of ideas. We believe that it will extensively promote research in the various fields of mathematical sciences and its applications.

This conference received 53 abstract submissions, which show a sign of a good beginning, despite the economic hardship in the country. After the conference, the submitted papers will be reviewed. After rigorous peer reviews, the accepted papers will be published in a reputable journal. The received abstracts cover many topics in pure and applied mathematics, mathematical statistics and computing, and so on. In addition to the submitted abstracts, the conference includes a welcome address by the Host:

Professor Memudu O. Olatinwo
Head, Department of Mathematics
Obafemi Awolowo University, Ile-Ife, Nigeria.

An address by the Chief Host, Dean, Faculty of Science:

Professor Olufemi Adeyinka Adesina
Dean, Faculty of Science
Obafemi Awolowo University, Ile-Ife, Nigeria.

An opening speech by the Chairman:

Professor Simeon Adebayo Bamire
Vice-Chancellor,
Obafemi Awolowo University
Ile-Ife, Nigeria.

A keynote speech by world-renowned mathematics scholar:

Professor Adewale Roland Tunde Solarin
FMAN, FPNGMS, FNMS
Honorary President, African Mathematical Union

Many volunteers made great contributions toward the success of this conference. We would like to express our sincere gratitude to the alumni of this great department who are in the United Kingdom under the leadership of Dr. Shola Adeyemi for their sponsorship, and many thanks to our amiable Dean of the Faculty of Science, Professor Olufemi Adeyinka Adesina, and Professor Suraju Olusegun Ajadi for linking us up with these wonderful alumni, students of our retired colleagues, and the academic and administrative staff of this department for their cooperation toward the success of this conference. We would also like to sincerely thank all the committee members for their great efforts in organizing the conference. Finally, we would like to thank all the speakers, authors, and participants (both physical and virtual) for their support.

Professor A. T. Ademola

Chairman

PROFESSOR ADEBOYO SIMEON BAMIRE

Vice Chancellor

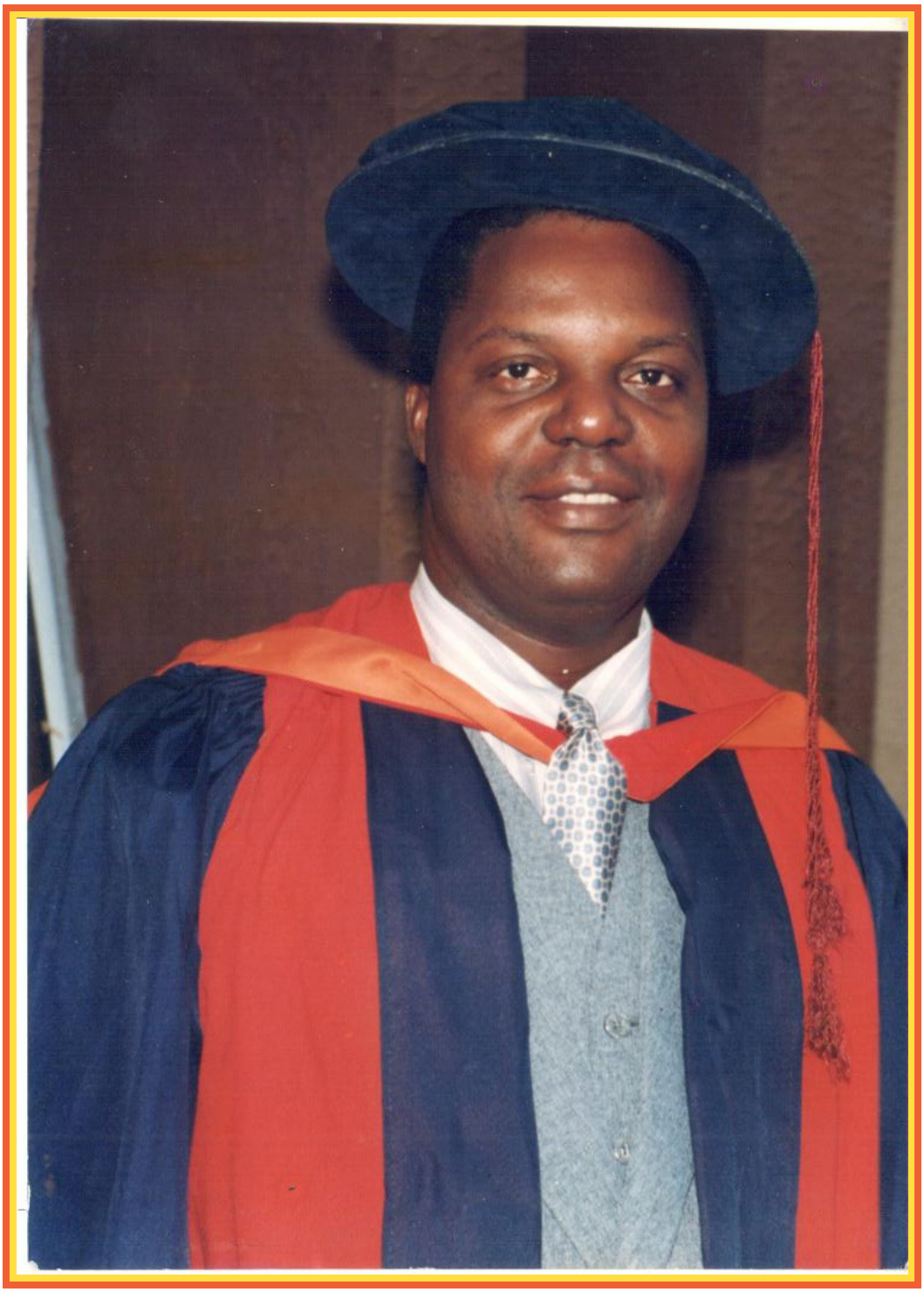
Obafemi Awolowo University, Ile-Ife, Nigeria

Chief Host

PROFESSOR OLUFEMI ADEYINKA ADESINA
Dean, Faculty of Science
Obafemi Awolowo University, Ile-Ife, Nigeria

Host

PROFESSOR MEMUDU O. OLATINWO
Head, Department of Mathematics
Obafemi Awolowo University, Ile-Ife, Nigeria



Keynote Address

PROFESSOR ADEWALE ROLAND TUNDE SOLARIN
FMAN, FPNGMS, FNMS
Honorary President, African Mathematical Union.

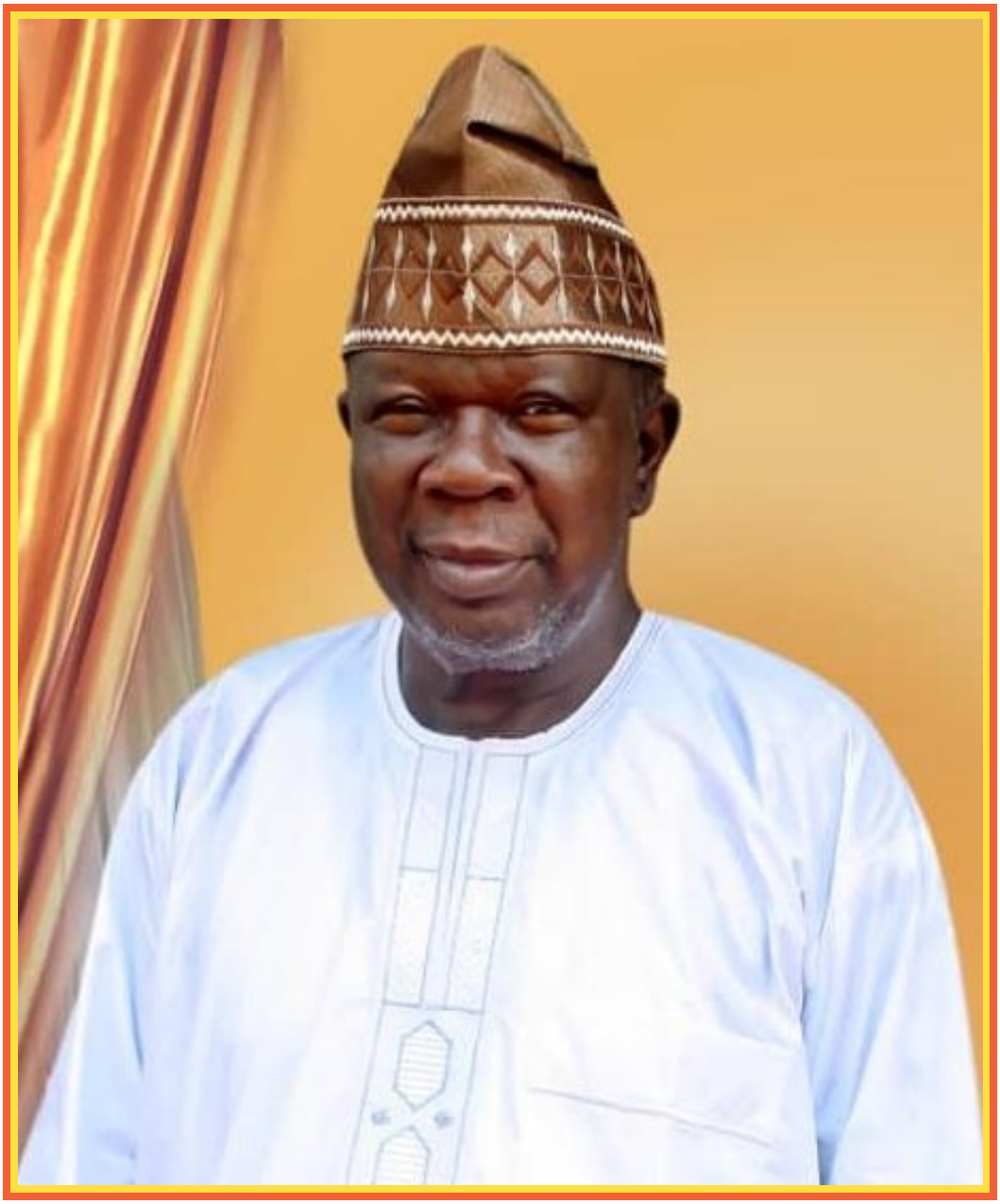
Chairman, Organising Committee

PROFESSOR ADELEKE TIMOTHY ADEMOLA

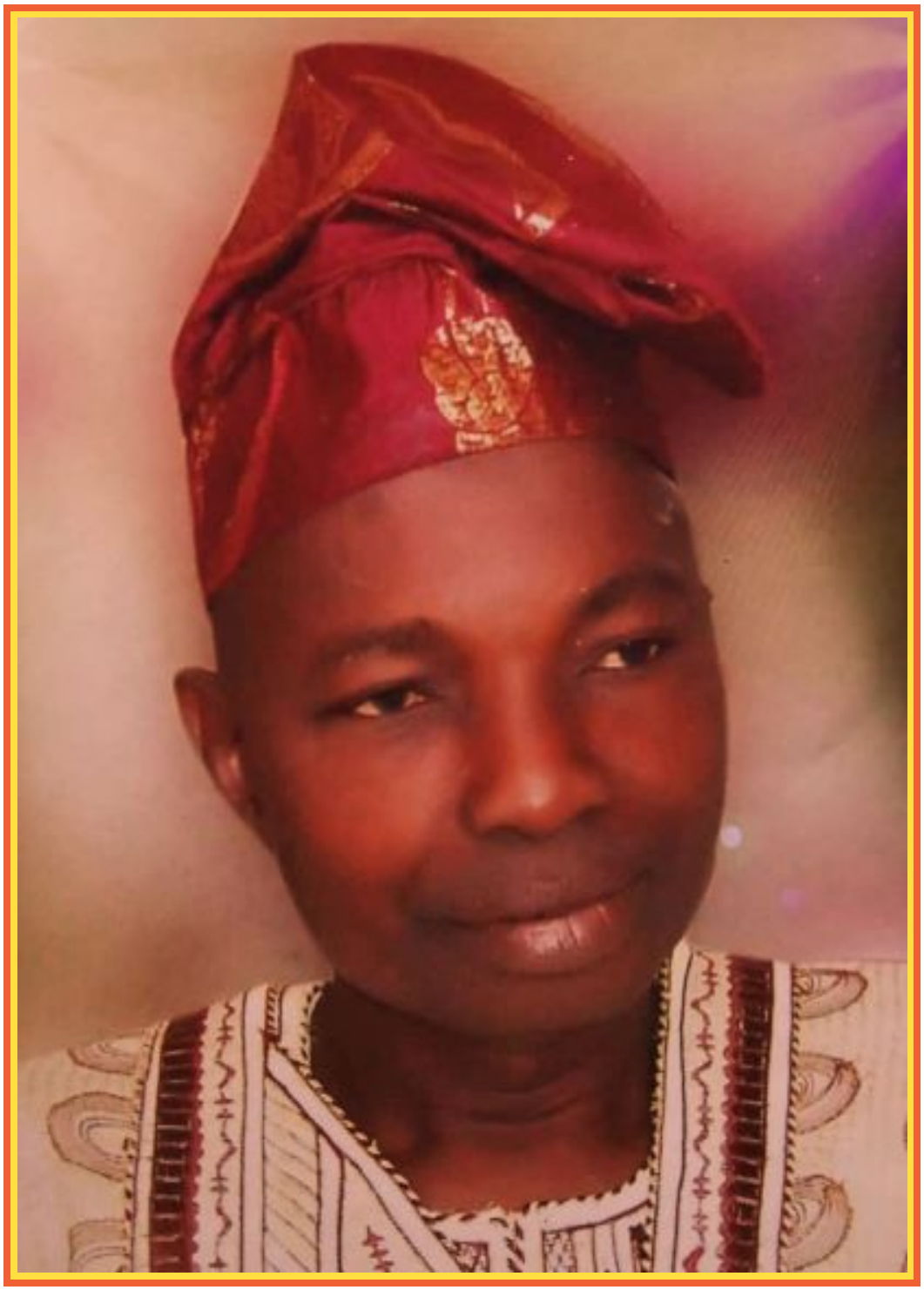
Department of Mathematics

Obafemi Awolowo University, Ile-Ife, Nigeria

PROFESSOR ABDULAZIZ GBADEBO AKEYO
Department of Mathematics
Obafemi Awolowo University, Ile-Ife
Retired - August, 2017



PROFESSOR TITILOLA OLAKUNJO OBILADE
Department of Mathematics
Obafemi Awolowo University, Ile-Ife
Retired - 7th February, 2022



DR. PETER FOLORUNSO FASOGBON
Department of Mathematics
Obafemi Awolowo University, Ile-Ife
Retired - 4th October 2019

MR. ADEKUNLE MOJUBAADE OGUNFIDODO
Department of Mathematics
Obafemi Awolowo University, Ile-Ife
Retired - 14th August 2018

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Technical Sessions

Technical Session I	Venue:	Seminar Room MBB 213
Applied Mathematics(AM) One:	–	Abstract No: 1.1 - 1.11
Time:	–	1.00 - 3.45 pm
Chairman:	–	Professor S. O. Ajadi
Rapporteur:	–	Dr. B. A. Olokuntoye

Panelists : Prof. A. P. Akinola Dr. A. S. Borokinni Mr. Y. T. Lawal

S/N	Abstract No.	Abstract Title	Time
1.	1.1	A Within Host Spatial Mathematical Model Investigating the Dynamics of Malaria Parasite Influence on Airway of Asthmatic Humans. - *Ogunmiloro and Idowu*	1.00 - 1.15 pm
2.	1.2	SmartHIV Manager: The Evolution of Patient Flow Modelling from Research through Development and Innovation. - *Adeyemi & Demir*	1.15 - 1.30pm
3.	1.3	Integration of Modified Classical Conjugate Gradient Methods for Unconstrained Optimization. - *Onuoha et al.*	1.30 - 1.45 pm
4.	1.4	Iterative Method for the Numerical Solution of Optimal Control Model for Mosquito and Insecticide. - *Adamu et al.*	1.45 - 2.00 pm
5.	1.5	Optimized Hybrid One-Step Method for Efficient Direct Numerical Integration of Second-Order Initial Value Problems. - *Oludare & Ojo*	2.00 - 2.15 pm
6.	1.6	Stationarity in Prophet Model Forecast: Performance Evaluation Approach. - *Omotoye & Rotimi*	2.15 - 2.30 pm
7.	1.7	Mises Flow Rules for Distortion Gradient Plastic Materials in Finite Deformation. - *Borokinni et al.*	2.30 - 2.45 pm
8.	1.8	Numerical and Statistical Analysis of the Influence of Temperature-dependent Thermophysical Properties of Tetra-Hybrid Nanofluid Along a Vertical Porous Surface With Suction. - *Aselebe et al..*	2.45 - 3.00 pm
9.	1.9	MHD Casson Flow Over a Non-linear Convective Inclined Plate With Chemical Reaction and Arrhenius Activation Energy. - *Akindele et al.*	3.00 - 3.15 pm
10.	1.10	An Improved Ceaser Cipher. - *A. Hassan*	3.15 - 3.30 pm
11.	1.11	On a University Time Tabling Problem. - *Dikko et al.*	3.30 - 3.45 pm

Technical Session II Venue: Seminar Room MBA 213
Applied Mathematics(AM) Two: – Abstract No: 1.12 - 1.22
Time: – 3.45 - 6.15 pm
Chairman: – Professor O. P. Layeni
Rapporteur: – Dr. A. A. Aderogba
Panelists : Prof. S. S. Okoya Dr. O. O. Fadodun Mr. R. A. Adetona

S/N	Abstract No.	Abstract Title	Time
1.	1.12	Runge-Kutta Like Method for the Solution of Optimal Control Model of Real Investment and Fish Management. - *Adamu et al.*	3.45 - 4.00 pm
2.	1.13	On the Differential Equations of Artificial Intelligence Systems: Ifa Divination Corpus. - *Bamidele Oluwade*	4.00 - 4.15 pm
3.	1.14	Bifurcation Analysis of the Impact of Prep on HIV/AIDS Dynamics With Inflow of Infectives Immigrants. - *Oladejo & Odebiyi*	4.15 - 4.30 pm
4.	1.15	Role of Magnetic Field and Heat Source/Sink on Fluid Flow in a Channel. - *Saifullahi Yusuf*	4.30 - 4.45 pm
5.	1.16	Legendre Collocation Method for Six-order Boundary Value Problems. - *Oyedepo et al.*	4.45 - 5.00 pm
6.	1.17	Modelling and Simulation of Drilling Mud Rheological Properties. - *Opadiran & Okoya*	5.00 - 5.15 pm
7.	1.18	Path Planning of Multi-Rotor UAVs via Enhanced A* Particle Swarm Optimization Algorithm. - *Adisa & Oyekan*	5.15 - 5.30 pm
8.	1.19	Axial Force Influence on Dynamic Response to Moving Load of Shear Beam Resting on Elastic Foundation. - *Ajijola et al.*	5.30 - 5.45 pm
9.	1.20	Sensitivity Analysis of Pertussis Transmission Dynamics - *Edogbanya & Johnson*	5.45 - 6.00 pm
10.	1.21	A Novel Approach to Environmental Monitoring With Fused Satellite Data Using Sparse Convolutional Neural Network. - *Oyebamiji Oluwole*	5.45 - 6.00 pm
11.	1.22	Lyapunov Stability and Sensitivity Analysis of a Recurrent Malaria Dynamics. - *Abimbade S. F., Olaniyi S., & Ajala O. A.*	6.00 - 6.15 pm

Technical Session III Venue: Computing Lab.: Room MBA 216
Math. Stat. and Compu.(MSC) – Abstract No: 2.1 - 2.11
Time: – 1.00 - 3.45 pm
Chairman: – Professor A. A. Olosunde
Rapporteur: – Dr. I. O. Ayodeji
Panelists : Dr. O. K. Agunloye Dr. A. J. Saka Dr. S. O. Ezeah

S/N	Abstract No.	Abstract Title	Time
1.	2.1	Volatility Modeling and Forecasting using Range-based GARCH Models. - *Ogunwole & Agunloye*	1.00 - 1.15 pm
2.	2.2	A New Improved Estimator For Population Distribution Function Using Auxiliary Variable Under Simple Random Sampling. - *Rabiu & Abubaka*	1.15 - 1.30 pm
3.	2.3	Mathematical Approaches to Enhance Energy Efficiency in Construction for Sustainable Development in Nigeria. - *Yusuf Ahmad*	1.30 - 1.45 pm
4.	2.4	Model for the Prediction of Cholera Incidence. - *James et al.*	1.45 - 2.00 pm
5.	2.5	Backtesting Methods for Evaluating the Viability of Stock Prices in Nigeria. - *Taiwo et al.*	2.00 - 2.15 pm
6.	2.6	Digital Distraction and Personality Trait as Correlate of Knowledge Retention of Undergraduate Mathematics in Tertiary Institutions in Ondo State. - *Adekolu and Olupona*	2.15 - 2.30 pm
7.	2.7	Omiyale: Sounding the Mathematics of the Rain and Flood Disaster in Ibadan City, Nigeria. - *Olusegun Stephen Titus*	2.30 - 2.45 pm
8.	2.8	Semiparametric Lognormal Shared Frailty Modeling of Diabetes Patients with Acute Coronary Syndrome. - *Adeleke et al.*	2.45 - 3.00 pm
9.	2.9	A Comparative Analysis of Option Pricing Models: Assessing Their Applicability in Valuing European Options. - *Akin-Alamu & Oyekan*	3.00 - 3.15 pm
10.	2.10	Prediction of Covid-19 Pandemic Using Machine Learning Markov Chain Models. - *Bisiriyu & Agunloye*	3.15 - 3.30 pm
11.	2.11	Efficiency Study of Presence of Non-Response on the Family of Binary-Type Estimator for Estimating Population Mean under Simple Random Sampling. - *S. Dahiru, B. W. Afolabi, & G. I. Onwuka*	3.30 - 3.45 pm

Technical Session IV Venue: Fac. of Sci. Board Room
Pure Mathematics(PM) One: – Abstract No: 3.1 - 3.10
Time: – 1.00 - 3.30 pm
Chairman: – Professor B. S. Ogundare
Rapporteur: – Dr. O. O. Fabelurin
Panelists : Prof. M. O. Ogundiran Prof. A. T. Ademola Mr. A. K. Olurode

S/N	Abstract No.	Abstract Title	Time
1.	3.1	Hyers-Ulam-Rassias Stability of the Nonlinear Second-Order Differential Equations With Forcing Term. - *Fakunle et al.*	1.00 - 1.15 pm
2.	3.2	Strongly Continuous Semigroup on Decoherence-Free Subalgebra of Quantum Markov Semigroup. - *Oluwafemi et al.*	1.15 - 1.30 pm
3.	3.3	Analysis of Weak Associativity in Some Hyper-Algebraic Structures That Represent Dismutation Reactions. - *Ilori & Jaiyéọlá*	1.30 - 1.45 pm
4.	3.4	On the Extension of Γ_1-Nonderanged Permutation Group. - *Anas Yusuf*	1.45 - 2.00 pm
5.	3.5	On the Uniform Stability and Ultimate Boundedness of Solutions to a Class of Second-order Neutral Functional Differential Equations with Delay. - *Ademola et al.*	2.00 - 2.15 pm
6.	3.6	On Distributional Henstock-Kurzweil-Stieltjes-$\diamondsuit$-Integral for Inner Product space-valued functions on Time scales. - *Afariogun et al.*	2.15 - 2.30 pm
7.	3.7	On the Characterization of Some Variants of Inverse Properties in Conjugate Loop. - *Jaiyéọlá et al.*	2.30 - 2.45 pm
8.	3.8	On Semi-symmetric (α, β, γ)-inverse Quasigroup. - *Ilemobade and Jaiyéọlá*	2.45 - 3.00 pm
9.	3.9	Partial Differential Formulation of Covid-19. - *Obabiyi & Edward*	3.00 - 3.15 pm
10.	3.10	On the Operator Fourier Transform of the Harish-Chandra Scwartz Algebra. - *Olufemi O.Oyadare*	3.15 - 3.30 pm

Technical Session V Venue: Fac. of Sci. Board Room
Pure Mathematics(PM) Two: – Abstract No: 3.11 - 3.20
Time: – 3.30 - 6.00 pm
Chairman: – Professor T. G. Jaiyéọlá
Rapporteur: – Dr. O. A. Adewumi
Panelists : Prof. D. O. Makinde Dr. G. Akinbo Dr. O. O. Oyadare

S/N	Abstract No.	Abstract Title	Time
1.	3.11	Existence of Fixed Points via C^*-Algebra-Valued Simulation Function. - *Mohammed Shehu Shagari*	3.30 - 3.45 pm
2.	3.12	On Fixed Point Results of Hybrid $F-$contractive Operators. - *Ogbumba & Shagari*	3.45 - 4.00 pm
3.	3.13	On Fixed Point of Quasi Contraction With Application to Integral Equation. - *Chiroma et al.*	4.00 - 4.15 pm
4.	3.14	Fixed Point Results of Hardy-Rogers-Type Contraction in Generalized Metric Space via Interpolation. - *Jiddah*	4.15 - 4.30 pm
5.	3.15	On Stability, Controllability and Feedback Control of Nonlinear Autonomous Systems. - *Dikko & Onifade*	4.30 - 4.45 pm
6.	3.16	On The Full Scalar-Valued Bochner Theorem on Real Reductive Groups. - *Olufemi O. Oyadare*	4.45 - 5.00 pm
7.	3.17	Fourier Transform of Schwartz Algebras on Groups in the Harish-Chandra class. - *Olufemi O. Oyadare*	5.00 - 5.15 pm
8.	3.18	A Fixed Point Theorem of Quasi-Contraction in C^*-Algebra-Valued Metric. - *Ahmad & Shagari*	5.15 - 5.30 pm
9.	3.19	Common Fixed Points of Enriched Contractions in Banach Spaces. - *O. J. Omidire*	5.30 - 5.45 pm
10.	3.20	On Continuous Dependence of the Fixed Point for Modified Kirk-Mann Iterative Process in Banach Spaces. - *B. T. Ishola*	5.45 - 6.00 pm

Group 1

Applied Mathematics(AM)

1.1 A Within Host Spatial Mathematical Model Investigating the Dynamics of Malaria Parasite Influence on Airway of Asthmatic Humans

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[2]*Department of Mathematics, Faculty of Science*
University of Ilorin, Ilorin, Nigeria
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Abstract

In this work we present a spatial within-host mathematical model that explores the dynamics between the malaria parasite and airway-related processes in asthmatic individuals. Asthma, a chronic respiratory condition characterized by airway constriction, inflammation, and excessive mucus production, can be further complicated by the presence of a malaria parasite infection. To investigate this coexistence, we develop a mathematical model that captures the spatial distribution of smooth cells in airway constriction, inflamed immune cells, and mucus formation in goblet cells within the respiratory system of asthmatic individuals infected with the malaria parasite. Qualitatively, we establish the model bounded ness of the positive global solution of the spatial model using appropriate theorem. Finally, we employ the finite difference scheme coded in python computational software to simulate the model, and elucidate the complex interplay between the malaria parasite and the host's immune response, examining how the parasite affects airway constriction, inflammation, and mucus formation. Our findings contribute to a deeper understanding of the pathophysiology of asthma-malaria confection and highlight the importance of considering both diseases in tandem for comprehensive management strategies.

Keywords: Model, existence and boundedness, spatial, finite difference

References

1. Carswell, F., Merrett, J., Merrett, T. G., Meakins, R., Harland, P.S. (1977). IgE, parasites and asthma in Tanzanian children. Clinical Experimental Allergy, 7.

2. Cesar, A. C. G., Nascimento, L. F. C., Mantovani, K. C. C., Vieira, L. C. P. (2016). Fine particulate matter estimated by mathematical model and hospitalizations for pneumonia and asthma in children. Revista Paulista de Pediatria, 34, 18-23.

3. Le, D. (1997). Dissipativity and global attractors for a class of quasilinear parabolic systems, Commun. Partial Differ. Equ., 22, 413 - 433

4. Erle, D. J., Sheppard, D. (2014). The cell biology of asthma. The Journal of Cell Biology, 205, 621 - 631.

5. Hafalla, J. C., Silvie, O., Matuschewski, K. (2011). Cell biology and immunology of malaria. Immunological Reviews, 240.

6. Hargreave, F. E., Nair, P. (2009). The definition and diagnosis of asthma. Clinical Experimental Allergy, 39(11), 1652-1658.

7. Hovette, P., Camara, P., Burgel, P., Mbaye, P. S., Sane, M., Klotz, F. (1998). [Pulmonary manifestations associated with malaria]. Revue de pneumologie clinique, 54(6), 340-5.

8. Joseph, G. A., Balamuralitharan, S. (2018, April). A Nonlinear differential equation model of Asthma effect of environmental pollution using LHAM. In Journal of Physics: Conference Series (Vol. 1000, No. 1, p. 012043). IOP Publishing.

9. Kim, Y., Lee, S., Kim, Y. S., Lawler, S., Gho, Y. S., Kim, Y. K., Hwang, H. J. (2013). Regulation of Th1/Th2 cells in asthma development: a mathematical model. Mathematical Biosciences Engineering, 10(4), 1095.

10. Lee, J., Adler, F. R., Kim, P. S. (2017). A mathematical model for the macrophage response to respiratory viral infection in normal and asthmatic conditions. Bulletin of mathematical biology, 79(9), 1979-1998.

11. Lotfi, E.M., Maziane, M., Hattaf, K., Yousfi, N. (2014). Partial Differential Equations of an Epidemic Model with Spatial Diffusion.

12. Martonen, T., Fleming, J., Schroeter, J., Conway, J., Hwang, D. (2003). In silico modeling of asthma. Advanced drug delivery reviews, 55(7), 829-849.

13. Mohan, A., Sharma, S. K., Bollineni, S. (2008). Acute lung injury and acute respiratory distress syndrome in malaria. Journal of vector borne diseases, 45(3), 179-93.

14. Murdoch, J. R., Lloyd, C. M. (2006) Chronic inflammation and asthma. Mutat Res. 2010 Aug 7;690(1-2):24-39. doi: 10.1016/j.mrfmmm.2009.09.005. Epub 2009 Sep 19. PMID: 19769993; PMCID: PMC2923754.

15. Patella V, Bocchino M, Steinhilber G. Asthma is associated with increased susceptibility to infection. Minerva Med. 2015 Aug;106(4 Suppl 3):1-7. PMID: 27427119.

16. Pradhan, V., Ghosh K. Immunological disturbances associated with malarial infection. J. Parasit Dis. 2013 Apr;37(1):11-5. doi: 10.1007/s12639-012-0174-4. Epub 2012 Sep 27. PMID: 24431533; PMCID: PMC3590368.

17. Shah, N. H., Suthar, A. H., Pandya, P. M. (2021). Mathematical Modeling for Asthma due to Air Pollution. Journal of Applied Nonlinear Dynamics, 10(02), 219-228.

18. Sittka, A., Vera, J., Lai, X., Schmeck, B. T. (2013). Asthma phenotyping, therapy, and prevention: what can we learn from systems biology?. Pediatric research, 73(2), 543-552.

19. Song, T., Wang, C. C., Tian, B. (2019). Mathematical models for within-host competition of malaria parasites. Mathematical biosciences and engineering: MBE, 16(6), 6623-6653.

20. Suthar, A. H., Pandya, P. M. (2020). Controlling Asthma Due to Air Pollution. In Mathematical Models of Infectious Diseases and Social Issues (pp. 1-22). IGI Global.

21. Schlender, A., Alperin, P. E., Grossman, H. L., Sutherland, E. R. (2012). Modeling the impact of increased adherence to asthma therapy. PLoS One, 7(12), e51139.

22. Winkler, T., Venegas, J. G., Harris, R. S. (2015). Mathematical modeling of ventilation defects in asthma. Drug Discovery Today: Disease Models, 15, 3-8.

23. Xie, C., Fang, S. (2019). Finite difference scheme for time?space fractional diffusion equation with fractional boundary conditions. Mathematical Methods in the Applied Sciences, 43, 3473 - 3487

24. Zhuang, Q., Wang, J. (2021). A spatial epidemic model with a moving boundary. Infectious Disease Modelling, 6, 1046 - 1060.

1.2 SmartHIV Manager: The Evolution of Patient Flow Modelling from Research through Development and Innovation

Shola Adeyemi[1] and Eren Demir[2]
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Abstract

This abstract delineates the evolution of patient flow modelling within the context of the SmartHIV Manager a comprehensive healthcare innovation tailored for HIV patient care and service management, [Adeyemi, et al].
The research phase commences with an exploration of healthcare systems specific to HIV care and management, employing established methodologies. Queueing theory is applied to analyse hospital operations, resource allocation, and patient pathways modelling [Adeyemi, et. al] within the realm of HIV patient management.

In the development phase, the integration of electronic health records (EHRs), systematic reviews, expert opinions and the implementation of simulation models tailored to HIV patient flow become pivotal. These models, rooted in discrete-event simulation, offer a dynamic representation of the HIV patient journey, facilitating scenario analyses and optimizing resource allocation with a computer environment.
The innovation phase introduces the SmartHIV Manager's unique features, notably the integration of predictive analytics. Machine learning algorithms leverage comprehensive datasets to predict HIV patient flow patterns, enabling proactive resource allocation and mitigating potential bottlenecks. Real-time monitoring systems, empowered by advanced sensors and analytics, dynamically adjust workflows to enhance efficiency in HIV care and management.
A distinctive innovation within the SmartHIV Manager is the implementation in a web application using human-centric design principles to deliver an easy-to-use, real-time planning platform. This approach goes beyond logistical considerations, ensuring that the patient experience is central to the optimization of HIV care workflows.
In conclusion, the SmartHIV Manager exemplifies the evolution of patient flow modelling, showcasing a dynamic interplay between research, development, and innovation. Continuous advancements, interdisciplinary collaboration, and a commitment to patient-centric solutions underscore the ongoing journey of optimizing HIV patient care through refined patient flow.

Keywords: Modelling, patient flow, queueing theory, discrete-event simulation, innovation

References

1. Adeyemi S., Demir E., Chaussalet T. Towards an evidence-based decision-making healthcare system management: Modelling patient pathways to improve clinical outcomes. Decision Support Systems, (2013) 55 (1) , pp. 117-125.
http://dx.doi.org/10.1016/j.dss.2012.12.039

2. Adeyemi S, Demir E, Yakutcan U, Adeoti A, Kengne A P, Kayode G A, Aliyu A, Idika N, Isichei C. SmartHIV Manager: a web-based computer simulation system for better management of HIV services. J Public Health Emergency 2021;5:13 (25 June 2021). doi: 10.21037/jphe-20-133

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1.3 Integration of Modified Classical Conjugate Gradient Methods for Unconstrained Optimization

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Abstract

The integration of modified classical conjugate gradient methods (CGMs) for unconstrained optimization represents a crucial and evolving area of research within the field of optimization algorithms. Over time, numerous studies have put forth diverse modifications and novel approaches to enhance the effectiveness of classical CGMs. These modifications aim to address specific challenges and improve the overall performance of optimization algorithms in unconstrained scenarios. This ongoing research endeavors to unify various classical CGMs aimed at addressing unconstrained optimization challenges while fostering a deeper understanding of their synergies. Classical CGMs have demonstrated efficacy in optimization tasks, and the strategic modification of these methods has yielded a number of diverse approaches. This paper focuses on consolidating these modified variants, specifically emphasizing those exhibiting similarities in their numerators. The integration process involves systematically merging the advantageous aspects of these modified methods to develop not only innovative but also more resilient approaches to unconstrained optimization problems. The ultimate goal of this unification effort is to leverage the strengths inherent in different approaches and create a cohesive framework that significantly enhances overall optimization performance. To thoroughly assess the efficacy of the integrated methods, a series of comprehensive performance tests are conducted. These tests include a meticulous comparison of outcomes with those of classical CGMs, providing valuable insights into the relative strengths and weaknesses of the modified approaches across diverse optimization scenarios. The evaluation criteria encompass convergence rates, and computational efficiency. The conclusive outcome demonstrates that the unified approaches consistently outperform individual methods across all evaluation criteria.

Keywords: Classical conjugate gradient methods, optimization problems, performance tests, convergence rates, computational efficiency

References

1. Andrei, N. (2008a). *New accelerated conjugate gradient algorithms for unconstrained Optimization.* Research Institute for Informatics, center for Modelling and Optimization.

2. Dai, Y. H. and Yuan, Y. (1999). A nonlinear conjugate gradient method with a strong global convergence property. *SIAM Journal on optimization.* 10, 177-182.

3. Dai, Y. H. and Liao, L. Z. (2001). New conjugacy conditions and related nonlinear conjugate gradient method. *Applied Mathematics and Optimization.* 43, 87-101.

4. Dai, Z. and Wen, F. (2012). Another improved Wei-Yao-Liu nonlinear conjugate gradient method with sufficient descent property. *Applied Mathematics and Computation.* 218, 7421-7430.

5. Dolan, E. D. and More, J. J. (2002). Benchmarking optimization software with performance profiles. *Mathematical Programming.* 91, 201-213.

6. Du, X. W., Zhang, P. and Ma, W. (2016). Some modified conjugate gradient methods for unconstrained optimization. *Journal of Computational and Applied Mathematics.* 305, 92-114.

7. Fang, M., Wang, M., Sun, M., and Chen, R. (2021). A modified hybrid conjugate gradient method for unconstrained optimization. *Journal of Mathematics*, Article ID 5597863, 9 pages.

8. Fletcher, R. (1987). *Practical Method of Optimization,* 2nd Edn. New York: John Wiley and Sons.

9. Fletcher, R. and Reeves, C. M. (1964). Function minimization by conjugate gradients. *The Computer Journal.* 7, 149-154.

10. Hager, W. W. and Zhang, H. (2006). A survey of nonlinear conjugate gradient methods. *Pacific Journal of Optimization.* 2, 35-58.

11. Hestenes, M. R. and Stiefel, E. (1952). Methods of conjugate gradients for solving linear systems. Journal of Research of the National Bureau of Standards. 9, 409-436.

12. Liu, Y. and Storey, C. (1991). Efficient generalized conjugate gradient algorithms part 1, theory. *Journal of Optimization theory and Application.* 69, 322-340.

13. Mehamdia, A. E., Chaib, Y. and Bechouat, T. (2023). Two modified conjugate gradient methods for solving unconstrained optimization and application. *Rairo Operations Research.* 57, 333-350.

14. Mahammed, H., Mohd, R., Mustafa, M. and Zabidin, S. (2015). A conjugate gradient method with inexact line search for unconstrained optimization. *Applied Mathematical Sciences.* 9(37), 1823-1832.

15. Nezhadhosein, S. (2020). A Modified Descent Spectral Conjugate Gradient Method for Unconstrained Optimization. *Iranian Journal of Science and Technology, Transactions A: Science.* 45, 209-220.

16. Polak, E. and Ribiere, G. (1969). Note Sur la Convergence de directions conjugees. *ESAIM: Mathematical Modelling and Numerical Analysis.* 3, 35-43.

17. Polyak, B. T. (1969). The conjugate gradient method in extreme problems. *USSR Computer and Mathematical Physics.* 9, 94-112.

18. Reid, J. K. (1970). *On the method of conjugate gradients for the solution of large sparse systems of linear equations.* In Catherine, St. (Ed.). Large Sparse Sets of Linear Equations (pp. 231-254). London: Oxford Academic Press.

19. Zhang, L. (2009). New versions of the Hestenes-Stiefel nonlinear conjugate gradient method based on the secant condition for optimization. Journal of Computational and Applied Mathematics. 28, 111-133.

1.4 Iterative Method for the Numerical Solution of Optimal Control Model for Mosquito and Insecticide

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Abstract

A linear multistep method is transformed into an iterative method based on Patade and Bhalekar technique for the numerical solution of optimal control problem modelled for mosquito and insecticide management using forward-backward sweep methods via Pontryaginís principle. Stability and convergence analysis of the iterative method is carried out and it is found to be stable, convergent and of order four. A MATLAB code using MATLAB 2018a is written for the implementation of the new iterative technique. The result obtained by the method clearly shows that, the population of mosquitoes can be minimized to a large extent using the new iterative method while reducing the harmful effect of the insecticide which subsequently reduce the spread of malaria.

Keywords: Malaria, mosquito, insecticide, optimal control problem, mathematical model.

References

1. Patade, J. & Bhalekar, S., A new numerical method based on Daftardar-Gejji and Jafari technique for solving differential equations. *World Journal of Modeling and Simulation*, 11(4), 256-271, 2015.

2. Bashir, A. B. H., Hassan, O. B. E. & Almahi, O. A., Modeling optimal control for mosquito and insecticide. Mathematical Theory and Modeling, 10(5), 58-63, 2020.

3. Garret, R. R., Numerical Methods for Solving Optimal Control Problems. Tennessee Research and Creative Exchange, University of Tennessee, Knoxville, 2015.

4. Adamu, S., Numerical Solution of Optimal Control Problems using Block Method. Electronic Journal of Mathematical Analysis and Applications, 11(2), 1-12, 2023.

5. Lenhart, S. & Workman, J. T., *Optimal Control Applied to Biological Models.* Chapman & Hall/CRC, London New York, 2007.

6. Adamu, S., Aduroja, O. O. & Bitrus, K., Numerical Solution to Optimal Control Problems using Collocations Method via Pontrygin's Principle. FUDMA Journal of Sciences, 7(5), 228-233. DOI: https://doi.org/10.33003/fjs-2023-0705-2016, 2023.

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1.5 Optimized Hybrid One-Step Method for Efficient Direct Numerical Integration of Second-Order Initial Value Problems

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Abstract

This work develops and analyzes an efficient optimized hybrid block one step method for integrating general second-order ODE IVPs. Leveraging the strengths of hybrid and block methodologies, the method delivers an accurate implicit

numerical integrator. Further, an enhanced adaptive step-size formulation is presented, improving performance on benchmark problems.

Keywords: One step, hybrid, block method, error constant, optimization strategy, order.

References

1. R. Singla, G. Singh, H. Ramos V. Kanwar, An efficient optimized adaptive step-size hybrid block method for integratingw $w'' = f(t, w, w')$ directly, Journal of Computational and Applied Mathematics. 420 (2023) 114838.

2. S. N. Jator, A continuous two-step method of order 8 with a block extension for $y'' = f(x, y, y')$, Appl. Math. Comput. 219 (2012) 781-791.

3. J. Vigo-Aguiar, H. Ramos, Variable-step-size Chebyshev-type methods for the integration of second-order I.V.P.'s., J. Comput. Appl. Math. 204(1) (2007) 102?113.

4. E. Hairer, G. Wanner, A theory for Nyström methods, Numer. Math. 25 (1976) 383-400.

5. J. Vigo-Aguiar, H. Ramos, Variable step-size implementation of multi-step methods for $y'' = f(x, y, y')$, J. Comput. Appl. Math. 192 (2006) 114-131.

6. H. Ramos, S. Mehta, J. Vigo-Aguiar, A unified approach for the development of $k-$step block falkner-type methods for solving general second-order initial-value problems in ODEs, J. Comput. Appl. Math. 318 (2017) 550?564.

7. H. Ramos, G. Singh, A tenth order A-stable two-step hybrid block method for solving initial value problems of ODEs, Appl. Math. Comput. 310 (2017) 75?88.

8. H. Ramos, G. Singh, A note on variable step-size formulation of a Simpson's-type second derivative block method for solving stiff systems, Appl. Math. Lett. 64 (2017) 101-107.

9. H. Ramos, M.A. Rufai, Third derivative modification of $k-$step block Falkner methods for the numerical solution of second order initial-value problems, Appl. Math. Comput. 333 (2018) 231-245.

10. T. A. Anake, D. O. Awoyemi, A. O. Adesanya, One-step implicit hybrid block method for the direct solution of general second order ordinary differential equations, Int. J. App. Math. 42 (4) (2012) 224-228.

1.6 Stationarity in Prophet Model Forecast: Performance Evaluation Approach

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Abstract

Stationarity is a common assumption in time series analysis. However, the influence of stationarity on the properties and behavior of the forecasting model could be significant and sometimes cause misleading results. In this paper, the effects of stationarity on the forecast obtained from a non-stationary time series using the Prophet Model algorithm in R studio, a scalable forecasting model by Facebook based on a generalized additive model is examined and assessed. We compare the forecast obtained from the non-stationary data to the stationary version resulting from the first differencing method. The forecasts obtained

from both non-stationary data and stationary data are not significantly different from their respective actual values and also indicate strong correlation coefficients, although performance metrics results from RMSE, MAE, and coverage indicate that the Prophet model performs better with stationary data.

Keywords: Forecast, Prophet, stationarity, performance metrics

References

1. Gujarati, D.N. (2006). Essentials of Econometrics. 3rd Edition, McGraw-Hill.

2. van Greunen, J., Heymans, A., van Heerden, C., & van Vuuren, G. (2014). The Prominence of Stationarity in Time Series Forecasting. Studies in Economics and Econometrics, 38(1), 1-16. DOI: 10.1080/10800379.2014.12097260

3. Velicer, W. F., & Plummer, B. A. (1998). Time series analysis in historiometry: a comment on Simonton. Journal of Personality, 66(3), 477?493. DOI: 10.1111/1467-6494.00020

4. Adhikari, R., & Agrawal, R. K. (2013). An Introductory Study on Time Series Modeling and Forecasting. ArXiv, abs/1302.6613.

5. Petropoulos, F., Apiletti, D., Assimakopoulos, V., Babai, M. Z., Barrow, D. K., Taieb, S. B., Florian Ziel (2021). Forecasting: Theory and practice. arXiv 2021, arXiv:2012.03854.

6. Qiu, J., Wang, B., & Zhou, C. (2020). Forecasting stock prices with long-short term memory neural network based on attention mechanism. PLOS ONE, 15(1), e0227222. doi:10.1371/journal.pone.0227222

7. Taylor, S. J., & Letham, B. (2017). Forecasting at Scale. The American Statistician, 72(1), 37-45. DOI: 10.1080/00031305.2017.1380080

8. Makridakis, S., Spiliotis, E., and Assimakopoulos, V. (2018). Statistical and Machine Learning forecasting methods: Concerns and ways forward. PLOS ONE, 13(3), e0194889. doi:10.1371/journal.pone.0194889

9. uni, E., Korjeni, K., Hodi, K., & onko, D. (2020). Application of Facebook's Prophet Algorithm for Successful Sales Forecasting Based on Real-world Data. International Journal of Computer Science and Information Technology, 12(2), 23-36. doi:10.5121/ijcsit.2020.12203

10. Taylor, S. J., & Letham, B. (2017). Forecasting at Scale. The American Statistician, 72(1), 37?45. doi:10.1080/00031305.2017.1380080

11. Topping, D., Watts, D., Coe, H., Evans, J., Bannan, T. J., Lowe, D., Jay, C., and Taylor, J. W. (2020). Evaluating the use of Facebook's Prophet model v0.6 in forecasting concentrations of NO2 at single sites across the UK and in response to the COVID-19 lockdown in Manchester, England. Geosci. Model Dev. Discuss. [preprint], https://doi.org/10.5194/gmd-2020-270, 2020

12. Menculini, L., Marini, A., Proietti, M., Garinei, A., Bozza, A., Moretti, C., & Marconi, M. (2021). Comparing Prophet and Deep Learning to ARIMA in Forecasting Wholesale Food Prices. Forecasting, 3(3), 1-19

13. Chan, W.N. (2020). Time-Series Data Mining: Comparative Study of ARIMA and Prophet Methods for Forecasting Closing Prices of Myanmar Stock Exchange. J. Comput. Appl. Res., 1, 75-80.

14. Yenidoan, I., Çayir, A., Kozan, O., Da, T., & Arslan, Ç. (2018). Bitcoin Forecasting Using ARIMA and PROPHET. 2018 3rd International Conference on Computer Science and Engineering (UBMK), 621-624.

15. Khayyat, M., Laabidi, K., Almalki, N., & Al-zahrani, M. (2021). Time Series Facebook Prophet Model and Python for COVID-19 Outbreak Prediction. Computers, Materials & Continua. DOI: 10.32604/cmc.2021.014918.

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1.7 Mises Flow Rules for Distortion Gradient Plastic Materials in Finite Deformation

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Abstract

This work presents a framework for which gradient theories of plastic materials under large deformation can be studied using the principle of maximum plastic dissipation. It is assumed that the deformation gradient admits the Kroner-Lee decomposition into a product of elastic and plastic distortions. The principle of virtual power, frame-indifference, and the free-energy imbalance are used to obtain the force balances, constitutive relations, and plastic flow laws. Rate-independent gradient theory is studied, and it is shown that the theory mimics the classical theory through the Mises flow relations for gradient materials.

Keywords: Mises flow rule, maximum plastic dissipation, large deformation, plastic flow rule, distortion gradient plasticity.

References

1. E. C. Aifantis, *On the microstructural origin of certain inelastic models*, Trans. ASME J. Eng. Mater. Tech. 106, 326-330, 1984.

2. M. F. Ashby, *The deformation of plastically non-homogeneous materials*, Phil. Mag. 21, 399-424, 1970.

3. A. S. Borokinni, *A gradient theory based on Aifantis theory using the Gurtin-Anand strain gradient plasticity approach*, J. Mech. Behav. Mater. DOI: 10.1515/jmbm-2018-0012, 2018.

4. G. Del Piero, *The variational structure of classical plasticity*, Math. Mech. Complex Syst. 6, 37-180, 2018.

5. N. A. Fleck and J. W. Hutchinson, *A phenomenological theory for strain gradient effects in plasticity*, J. Mech. Phys. Solids. 41, 1825-1857, 1994.

6. N. A. Fleck and J. W. Hutchinson, *Strain gradient plasticity*, Adv. Appl. Mech. 33, 295-361, 1997.

7. P. Gudmunson and C. F. O. Dahlberg, *Isotropic strain gradient plasticity model based on self-energies of dislocations and the Taylor model for plastic dissipation*, Int. J. Plast. 121, 1-20, 2019.

8. M. E. Gurtin, and L. Anand, *A theory of strain-gradient plasticity for isotropic plastically irrotational materials. Part I: Small deformations*, J. Mech. Phys. Solids. 53, 1624-1649, 2005.

9. M. E. Gurtin and L. Anand, *Thermodynamics applied to gradient theories involving the accumulated plastic strain: The theories of Aifantis and Fleck and Hutchinson and their generalization*, J. Mech. Phys. Solids. 57, 405-421, 2009.

10. M. E. Gurtin, E. Fried and L. Anand, *The mechanics and thermodynamics of continua*, Cambridge University Press, Cambridge, 2010.

11. W. Han and B. D. Reddy, *Plasticity: Mathematical theory and numerical analysis*, New York: Springer-Velag, 2013.

12. R. Hill, *A theory of yielding and plastic flow of anisotropic metals*, Proc. Roy. Soc. A. 193, 281-297, 1948.

13. R. Hill, *Constitutive dual potentials in classical plasticity*, J. Mech. Phys. Solids. 35, 39-63, 1987.

14. J. W. Hutchinson, *Plasticity at the micron scale*, Int. J. Solids Struct. 37, 225-238, 2000.

15. B. D. Reddy, F. Ebobisse and A. McBride, *Well-posedness of a model of strain gradient plasticity for plastically irrotational materials*, Int. J. Plast. 24, 55-73, 2008.

16. J. R. Willis, *Some forms and properties of model of strain-gradient plasticity*, J. Mech. Phys. Solids. 123, 348-356, 2019.

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1.8 Numerical and Statistical Analysis of the Influence of Temperature-dependent Thermophysical Properties of Tetra-Hybrid Nanofluid Along a Vertical Porous Surface With Suction

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Abstract

The impact of thermophysical properties of Tetra hybrid nanofluid cannot to overemphasized in the improvement of the rate of heat transmission in the heat exchangers, automobile, and solar storage. These features can be tampered with when nanoparticles are been mixed with the base fluid to produce an improved heat carrier fluid for the system. This study explored both numerical and statistics methods to investigate the influence of the temperature dependent thermophysical properties on dissipative movement TiO_2 $-SiO_2$ $-ZnO$ $-Fe_2O_3$/PAO Tetra hybrid nanofluid in the presence of suction along a vertical porous outward. The system of governing Partial Differential Equations (PDEs) was formulated and later transformed into the system of coupled nonlinear third order Ordinary Differential Equations (ODEs) by similarity techniques. The nonlinear third order boundary value problems of ODEs were reduced into the system of first order initial value problems, and the unknown values of initial conditions were determined by shooting approach. The fourth order Runge-Kutta method explored to solve the ODEs with the aid of Maple 18.0 software package. The impact of the thermophysical parameters of TiO_2 $-SiO_2$ $-ZnO$ $-Fe_2O_3$/PAO Tetra hybrid nanofluid on the velocity and temperature profile were displayed graphically, similarly, their effects on the skin friction coefficient and Nusselt number were shown through tables and the relationship between the independent variables (thermophysical parameters)

and the dependent variables (skin friction coefficient and Nusselt number) was analyzed by linear regression using Python 3.0 language. It was found that as variable thermal conductivity parameter upsurges both the skin friction coefficient and Nusselt number intensify at the rate of **0.011697519** and **8.043581616**. As both the viscosity and density parameters escalate the velocity profile upsurgesdue to the presence of buoyancy force, conversely, the temperature profile declines as variable specific heat capacity parameter increases.

Keywords: Tetra hybrid nanofluid, shooting technique, numerical method, statistics approach, thermophysical properties.

References

1. T. Sajid, A. A. Gari, W. Jamshed, M. R. Eid, N. Islam, K. Irshad, G. C. Altamirano, S. M. El Din. Case study of autocatalysis reactions on tetra hybrid binary nanofluid flow via Riga wedge: Biofuel thermal application. Case Studies in Thermal Engineering. 47, 2023, 103058. https://doi.org/10.1016/j.csite.2023.103058

2. P. Kumam, W. Watthayu, F. Jarad. Exploring the Potential of Heat transfer and entropy generation of generalized dusty Tetra hybrid nanofluid in a microchannel. Chinese Journal of Physics. 2023. https://doi.org/10.1016/j.cjph.2023.10.006

3. J. Zhao, S. Tian, H. Xie, X. Zhang. Study of time-varying laws of stability and wettability of $SiO_2 - H_2O$ nanofluids with different particle sizes. Industrial and Engineering Chemistry Research. 62(34), 2023, 13529-40. https://doi.org/10.1021/acs.iecr.3c02110

4. M. M. Rashidi, M. A. Nazari, I. Mahariq, N. Ali. Modeling and sensitivity analysis of thermal conductivity of ethylene glycol-water based nanofluids with alumina nanoparticles. Experimental Techniques. 47(1), 2023, 83-90. https://doi.org/10.1007/s40799-022-00567-4

5. X. Wang, Y. Song, C. Li, Y. Zhang, H. M. Ali, S. Sharma, R. Li, M. Yang, T. Gao, M. Liu, X. Cui. Nanofluids application in machining: a comprehensive review. The International Journal of Advanced Manufacturing Technology. 4, 2023, 1-52.

6. W. Ajeeb, R. R. da Silva, S. S. Murshed. Experimental investigation of heat transfer performance of Al_2O_3 nanofluids in a compact plate heat exchanger. Applied Thermal Engineering. 218, 2023119321. https://doi.org/10.1016/j.applthermaleng.2022.119321

7. H. Younes, M. Mao, S. S. Murshed, D. Lou, H. Hong, G. P. Peterson. Nanofluids: Key parameters to enhance thermal conductivity and its applications. Applied Thermal Engineering. 207, 2022, 118202. https://doi.org/10.1016/j.applthermaleng.2022.118202

8. M. M. Tawfik. Experimental studies of nanofluid thermal conductivity enhancement and applications: A review. Renewable and Sustainable Energy Reviews. 75, 2017, 1239-53.https://doi.org/10.1016/j.rser.2016.11.111

9. H. Yasmin, S. O. Giwa, S. Noor, M. Sharifpur. Thermal conductivity enhancement of metal oxide nanofluids: A critical review. Nanomaterials. 13(3), 2023, 597.https://doi.org/10.3390/nano13030597

10. M. Pavía, K. Alajami, P. Estellé, A. Desforges, B. Vigolo B. A critical review on thermal conductivity enhancement of graphene-based nanofluids. Advances in Colloid and Interface Science. 294,2021,102452. https://doi.org/10.1016/j.cis.2021.102452

1.9 MHD Casson Flow Over a Non-linear Convective Inclined Plate With Chemical Reaction and Arrhenius Activation Energy

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Abstract

This study examines the Magnetohydrodynamics (MHD) Casson flow passing over a nonlinear convective inclined plate with incorporating a chemical reaction and Arrhenius activation energy. However, the magneto-hydrodynamic flow of two-dimensional radiative Casson fluid (CF) across a non-linear convective inclined plate in the existence of heat generation is addressed theoretically and numerically. The Arrhenius activation energy and chemical reaction are two additional impacts that have been added to the innovative nature of the model. By applying the appropriate transformations, PDEs (partial differential equations) were converted into coupled ODEs (ordinary differential equations) in terms of similarity variables combined with the boundary conditions. The finite difference method (FDM) and MAPLE 18.0 software were used to solve the resultant equations numerically. According to the findings, the thermal Grashof number and the mass Grashof number of the nano-fluid flow model were able to improve the strength of the drag coefficient, the rate of heat transfer at the surface of the plate, and the Sherwood number. Additionally, there was a reduction in the velocity gradient as the magnetic field strength increased. The concentration decreases when a chemical reaction is present, but it improves as the activation energy rises. These findings will help engineers create devices with strong heat and mass transfer rates. The results were compared to previously published research to assess their validity and discovered a large degree of consistency.

Keywords: MHD, thermal Grashof number, mass Grashof number, chemical reaction, Arrhenius activation energy.

References

1. Goud Bejawada, S., Dharmendar Reddy, Y., Jamshed, W., Nisar, K. S., Alharbi, A. N., and Chouikh, R. (2022). Radiation effect on MHD CF flow over an inclined non-linear surface with chemical reaction in a Forchheimer porous medium: Radiation effect on MHD CFflow over an inclined non-linear surface. Alexandria Engineering Journal, 61(10), 8207-8220. https://doi.org/10.1016/j.aej.2022.01.043

2. Shaw, S., Mahanta, G., and Sibanda, P. (2016). Non-linear thermal convection in a CFflow over a horizontal plate with convective boundary condition. Alexandria Engineering Journal, 55(2), 1295-1304. https://doi.org/10.1016/j.aej.2016.04.020

3. Rana, B. M. J., Roy, R., Ali, L. E., and Ahmmed, S. F. (2017). Radiation Absorption and Variable Electrical Conductivity Effect on High Speed MHD Free Convective Flow past an Exponential Accelerated Inclined Plate. World Journal of Mechanics, 07(08), 211-241. https://doi.org/10.4236/wjm.2017.78019

4. Shaw, S., Kameswaran, P. K., and Sibanda, P. (2016). Effects of slip on nonlinear convection in nanofluid flow on stretching surfaces. Boundary Value Problems, 2016(1), 1-11. https://doi.org/10.1186/s13661-015-0506-2

5. Ogunsola. A. W, Akindele. A. O. Mixture of Al2O3-Cu/H2O-(CH2OH)2 MHD hybrid nanofluid flow due to a stretchable rotating disks system under the influence of non-uniform heat source or sink and thermal radiation. J. Math. Comput. Sci, (2022), 12:8. ISSN: 1927-5307.https://doi.org/10.28919/jmcs/6624

6. Makinde , D. O , Abdul Aziz,Boundary layer flow of a nanofluid past a stretching sheet with a convective boundary condition(July 2011) International Journal of Thermal Sciences50(7)

7. Ghadikolaei S. S , Yassari .M, Sadeghi , Dawood D. GInvestigation on thermophysical proper ties of Tio 2Cu/H 2 O hybrid nanofluid transport dependent on shape factor in MHD stagnation point flow (2017) Powder Technology

8. Omar, N. S., Bachok, N., and Arifin, N. Md. (2015). Stagnation Point Flow Over a Stretching or Shrinking Cylinder in a Copper-Water Nanofluid. Indian Journal of Science and Technology, 8(31). https://doi.org/10.17485/ijst/2015/v8i31/85405

9. Tayebi, T., and Chamkha, A. J. (2016). Free convection enhancement in an annulus between horizontal confocal elliptical cylinders using hybrid nanofluids. Numerical Heat Transfer; Part A: Applications, 70(10), 1141-1156.

10. Kamel, M. S., Al-Oran, O., and Lezsovits, F. (2020). Thermal conductivity of Al2 O3 and CeO2 nanoparticles and their hybrid based water nanofluids: An experimental study. PeriodicaPolytechnica Chemical Engineering, 65(1), 5-60.

11. Lund, L. A., Omar, Z., Khan, I., Raza, J., Sherif, E. S. M., and Seikh, A. H. (2020). Magnetohydrodynamic (MHD) flow of micropolar fluid with effects of viscous dissipation and joule heating over an exponential shrinking sheet: Triple solutions and stability analysis. Symmetry, 12(1). https://doi.org/10.3390/sym12010142

12. Mjankwi, M. A., Masanja, V. G., Mureithi, E. W., and James, M. N. O. (2019). Unsteady MHD Flow of Nanofluid with Variable Properties over a Stretching Sheet in the Presence of Thermal Radiation and Chemical Reaction. International Journal of Mathematics and Mathematical Sciences, 2019.
https://doi.org/10.1155/2019/7392459

13. Sobamowo, M. G., Akinshilo, A. T., and Yinusa, A. A. (2018). Thermo-Magneto-Solutal Squeezing Flow of Nanofluid between Two Parallel Disks Embedded in a Porous Medium: Effects of Nanoparticle Geometry, Slip and Temperature Jump Conditions. Modelling and Simulation in Engineering, 2018.

14. Waini, I., Amira Zainal, N., Safwa Khashi, N., Basyaruddin Abdul Rahman, M., Rahman MohdKasim, A., and Farahain Mohammad, N. (2018). Numerical study of unsteady CFflow and heat transfer over a stretching surface with modified magnetic field effects. https://www.researchgate.net/publication/341149313

15. Goud Bejawada, S., Dharmendar Reddy, Y., Jamshed, W., Nisar, K. S., Alharbi, A. N., and Chouikh, R. (2022). Radiation effect on MHD CFflow over an inclined non-linear surface with chemical reaction in a Forchheimer porous medium: Radiation effect on MHD CFflow over an inclined non-linear surface. Alexandria Engineering Journal, 61(10), 8207-8220. https://doi.org/10.1016/j.aej.2022.01.04

16. Mukhopadhyay, S., De, P. R., Bhattacharyya, K., and Layek, G. C. (2013). CFflow over an unsteady stretching surface. Ain Shams Engineering Journal, 4(4), 933-938. https://doi.org/10.1016/j.asej.2013.04.004

17. Akindele. A. O, Ogunsola. A. W. A study of non-isothermal permeable flow of nano-fluid in a stretchable rotating disk system. J. Math. Comput. Sci. (2021) 11, No. 2, 1486-1498. ISSN: 1927-5307.

18. Obalalu. A. M., Ajala. O. A, Abdulraheem. A, Akindele. A. O. The influence of variable electrical conductivity on non-DarcianCassonnanofluid flow with first and second-order slip conditions.Partial Differential Equations in Applied Mathematics.(2021). 4, 100084.

19. Obalalu. A. M, Ajala. A. O, Akindele. A. O, Oladapo. O. A, Adepoju. O, Jimoh. O. M. Unsteady squeezed flow and heat transfer of dissipative CFusing optimalhomotopy analysis method: An application of solar radiation. Partial Diff Equ Appl Math. (2021):100146. http://dx.doi.org/10.1016/j.padiff.2021.100146.

20. Akindele. A. O., Ogunsola. A. W., Obalalu. A. M, Adegbite. P, Ajala. O. A, Alao. S. Mhd flow of nano-fluid with non-uniform heat source or sink in the presence of chemical reaction and activation energy. Journal of Advance Research in Applied Science(2021) ISSN: 2208-2352.Volume-8 — Issue-5.

21. Obalalu. A. M, Ajala. O. A, Akindele. A. O, Alao. S, Adepoju. O. Effect of melting heat transferonelectromagnetohydrodynamic non-newtoniannanofluid flow over a riga plate with chemical reaction and Arrhenius activation energy; Eur. Phys. J. Plus (2021) 136:891. https://doi.org/10.1140/epjp/s13360-021-01869-z

22. Obalalu. A. M, Ajala. O. A, Adeosun. T. A, Akindele. A. O, Oladapo. O. A, Olajide. O. A, Adegbite. P. Significance of variable electrical conductivity on non-Newtonian fluid flowbetween two vertical plates in the coexistence of Arrhenius energy andexothermic chemical reaction. Partial Diff Equ Appl Math. (2021): https://doi.org/10.1016/j.padiff.2021.100184.

23. Akindele. A. O, Ajala. O. A, Adegbite. P, Ogunsola. A. W. Convective Flow of Nanofluids Using Blasius-Rayleigh-Stoke Variable with Slip Effect, IOSR Journal of Mathematics(2021). (IOSR-JM) e-ISSN: 2278-5728. 17(3) 01-08, p-ISSN: 2319-765X.

24. Mate, O. S., Obalalu, A. M., Ajala, O. A., Bakare, T. B., Ogunsola, A. W., and Akindele, A. O. (2023). Thermal radiation effect on non-newtonian casson fluid through a porous material over a magnetic field with buoyancy. International Journal of Thermofluid Science and Technology, 10(1). https://doi.org/10.36963/IJTST.2023100103.

25. Obalalu, A. M., Salawu, S. O., Memon, M. A., Olayemi, O. A., Ali, M. R., Sadat, R., Odetunde, C. B., Ajala, O. A., and Akindele, A. O. (2023). Computational study of Cattaneo Christov heat flux on cylindrical surfaces using CNT hybrid nanofluids: A solar-powered ship implementation. Case Studies in Thermal Engineering, 45.

26. Obalalu, A. M., Salawu, S. O., Olayemi, O. A., Odetunde, C. B., and Akindele, A. O. (2023). Computational study of bioconvection rheological nanofluid flow containing gyrotactic microorganisms: a model for bioengineering nanofluid fuel cells. International Journal of Modelling and Simulation. https://doi.org/10.1080/02286203.2023.2204209.

27. I. Ullah, S. Shafie, I. Khan, Effects of slip condition and Newtonian heating on MHD flow of CFover a nonlinearly stretching sheet saturated in a porous medium, J. King Saud Univ. Sci. 29 (2017) 250-259.

28. Rafael Cortell, Viscous flow and heat transfer over a nonlinearly stretching sheet, Appl. Math. Comput. 2007; 184: 864-873.

1.10 An Improved Ceaser Cipher

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Abstract

The conventional Caesar cipher, traditionally reliant on alphabet letters, has undergone a modification in this research. The innovation involves the combination of both alphabets and special characters, resulting in a strong cipher text. This alteration serves a dual purpose: facilitating uncomplicated decryption for the intended recipient while presenting a complex challenge for potential intruders, by expanding the character set to encompass special characters, the cipher attains a maximum complexity. This not only enhances the security of the encoded message but also fortifies the resistance against unauthorized deciphering attempts. The strategic utilization of special characters introduces an additional layer of security, rendering the cipher less susceptible to conventional decryption methods. The primary objective remains to create a cryptographic system that strikes a delicate balance between accessibility and security. The intentional inclusion of special characters not only diversifies the encoding possibilities but also contributes to the creation of a dynamic cipher system. This adaptive approach ensures that the communication remains safeguarded against adversaries seeking to compromise the confidentiality of the information. In essence, this evolved Caesar cipher becomes a potent tool in the hands of the sender and a formidable enigma for those attempting unauthorized access.

Keywords: Ciphertext, encryption, decryption, cryptography, crypt-analysis.

References

1. Hassan, A., Garko, A., Sani, S., Abdullahi, U and Sahalu, S (2023). Combined Techniques of Hill Cipher and Transposition Cipher, *Journal of Mathematics Letters.* 1(822) pp 1-8, DOI:10.31586/jml.2023.822

2. Sharma, S. and Gupta, Y. (2017). Study on Cryptography and Techniques. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology,* 2(1)-ISSN: 2456-3307. pp 249-252.

3. Kasturia, P. and Maheswa, K. (2017). Critical Analysis of Various Cryptographic Algorithms. *Journal of Ultra Computer and Information Technology.* 8(1), pp 5-9.

4. Alhassan, M. J; Hassan, A; Sani, S. and Alhassan, Y. (2021). A Combined Technique of an Affine Cipher and Transposition Cipher *Quest Journals Journal of Research in Applied Mathematics* Volume 7. Issue 10 (2021) pp: 08-12.

5. Azzam A. and Sumarsono (2017), A Modifying of Hill Cipher Algorithm with 3 Substitution Ceaser Cipher. *Proceedings International Conference of Science and Engineering,* Indonesia.1: 157-163.

6. Fahrul I, K., Hassan F, S., Toras P. and Rahmat W. (2017), Combination of Ceaser Cipher Modification with Transposition Cipher. *Advances in Science Technology and Engineering Systems Journal.* 2(5): 22-25.

7. Hassan, A; Alhassan, M. J; Alhassan, Y. and Sani, S. (2021). Cryptography as a Solution for a Better Security. *International Journal of Advances in Engineering and Management* (IJAEM :3(12). pp: 849-853.

8. Kashish G. and Supriya K. (2013) Modified Ceaser Cipher for a Better Security Enhancement. *International Journal of Computer Application.*73:26-31.

9. Mishra A. (2013), Enhancing security of Ceaser cipher using different methods. *International Journal of Research in Engineering and Technology.* 2(09):327-332.

10. Pooja S. and Pintu S. (2017), Enhancing security of Ceaser cipher using 'Divide and Conquer Approach.'*International Journal of Advance Research in Science and Engineering.* 06(02):144-150.

11. Rajput Y., Naik D. and Mane C. (2014), An improved cryptographic technique to encrypt Text message using double encryption. *International Journal of Computer Applications* 86(6):24-28.

12. Sriramoju A. B. (2017), Modification affine ciphers algorithm for cryptography password, Programmer Analyst, Ramstad Technologies, EQT Plaza 625 Liberty Avenue, Suite 1020, Pittsburgh, Pennsylvania -15222, USA.

13. Shahid B. D. (2014), Enhancing the security of Ceaser cipher using double substitution method. International *Journal of Computer Science and Engineering Technology.* 5: 772-774.

1.11 On a University Time Tabling Problem

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Abstract

The University timetabling problem is a combinatorial Optimization problem that requires the assignment of time and resources to academic events while satisfying various constraints and optimizing specific objectives. In this paper we model a university course allocation timetabling problem using Faculty of Science, University of Ibadan as a case study. We further use a python code to generate and automate the process.

Keywords: Schedule, resource allocation, heuristic timetabling, optimization algorithm, software code

References

1. Árton P., Dorneles Olinto C. B. de Araújo, Luciana S. Buriol (2014). *A fix-and-optimize heuristic for the high school timetabling problem,Computers and Operations Research,Volume 52, Part A*, Pages 29-38,ISSN 0305-0548, https://doi.org/10.1016/j.cor.2014.06.023.

2. Dimopoulou, M., and Miliotis, P. (2001). *Implementation of a university course and examination timetabling system. European Journal of Operational Research*, *130*(1), 202-213.

3. Lemos, A., Monteiro, P. T., and Lynce, I. (2021). *Disruptions in timetables: a case study at Universidade de Lisboa. Journal of Scheduling*, *24*, 35-48.

4. Pierre Hansen, Nenad Mladenovi, *Variable neighborhood search: Principles and applications, European Journal of Operational Research, Volume 130*, Issue 3 (2001),Pages 449-467, ISSN 0377-2217, https://doi.org/10.1016/S0377-2217(00)00100-4

5. Wan Muhamad, W. Z. A., Adnan, F., Yahya, Z. R., Junoh, A. K., and Zakaria, M. (2018). *Solving university course timetabling problems using FET software. AIP Conference Proceedings*, *2013*, 020052. https://doi.org/10.1063/1.5054251

6. Arratia-Martinez, N. M., Avila-Torres, P. A., and Trujillo-Reyes, J. C. (2021). *Solving a University Course Timetabling Problem Based on AACSB Policies. Mathematics*, *9*(19), 2500. https://doi.org/10.3390/math9192500.

7. Bahriah Binti Malik, and Syarifah Zyurina Nordin (2018). *Mathematical model for timetabling problem in maximizing the preference level. AIP Conference Proceedings*, *1974*, 020037. https://doi.org/10.1063/1.5041568.

8. Maqsood Ahmad. (2013). *Mathematical models and methods based on metaheuristic approach for timetabling problem.* Other [cs.OH]. Université Blaise Pascal - Clermont-Ferrand II. ffNNT: 2013CLF22393ff. fftel-01226540.

9. Chávez-Bosquez O., Hernández-Torruco J., Hernández-Ocaña B., Canul-Reich J. *Modeling and Solving a Latin American University Course Timetabling Problem Instance.* Mathematics. 2020; 8(10):1833. https://doi.org/10.3390/math8101833

10. Mohit Kumar Kakkar *et al.* (2021) *Class Schedule Generation using Evolutionary Algorithms* J. Phys.: Conf. Ser. 1950 012067DOI 10.1088/1742-6596/1950/1/012067

1.12 Runge-Kutta Like Method for the Solution of Optimal Control Model of Real Investment and Fish Management

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Abstract

A one step linear multistep method with highbrid point is transformed into Runge-Kutta Like Method (RKLM) using Daftardar-Gejji and Gafari series, based on Patade and Bhalekar approach. Stability properties of the RKLM is tested and found to be stable and convergent. Forward-backward sweep algorithms for the RKLM are written, and MATLAB code for the implementation of the RKLM also written. The RKLM is used to solve physical optimal control problems on investment and fish management using the forward-backward sweep algorithms via Pontryagin's principle. The results obtained in the first problem shows that, as the investment decreases, the capital first increase in order to increase production before the capital depreciate. The result obtained in the second problem shows that, when the weight parameter of the fish is higher, the harvesting rate get to zero faster, and the total fish mass reach maximum level quicker. The results obtained show that, forward-backward sweep methods together with RKLM can effectively solve optimal control problems.

Keywords: First Boubaker polynomials, fish, investment, model, optimal control problem.

References

1. Alkali, A. M., Ishiyaku, M., Adamu, S. & Umar, D., Third derivative integrator for the solution of first order initial value problems, Savannah Journal of Science and Engineering Technology 1(5) (2023) 300-306.

2. E. A. Areo, R. B. Adeniyi, A self-starting linear multistep method for direct solution of initial value problems of second order ordinary differential equations, International Journal of Pure and Applied Mathematics 82 (3) (2013) 345-364.

3. R. R. Garret, Numerical Methods for Solving Optimal Control Problems. Tennessee Research and Creative Exchange, University of Tennessee, Knoxville, (2015).

4. O. Andres-Martinez, Optimal control and the Pontryagin's principle in chemical engineering, History, theory and challenges, AIChE Journal (2022) 1-76.

5. S. Lenhart, J. T. Workman, Optimal Control Applied to Biological Models, Chapman & Hall/CRC, London New York (2007).

6. S. Adamu, Numerical Solution of Optimal Control Problems using Block Method. Electronic Journal of Mathematical Analysis and Applications, 11(2) (2023) 1-12. http://ejmaa.journals.ekb.eg/

7. H. S. Rodrigues, M. T. T. Monteiro, D. F. M. Torres, Systems Theory: Perspectives, Applications and Developments, Nova Science Publishers, (2014).

8. E. Naevdal, Numerical Optimal Control in Continuous Time Made Easy, Computer in Higher Education Economics Review 15(1) (2002) 1-14.

9. H. Musa, I. Saidu, M. Y. Waziri, A Simplified Derivation and Analysis of Fourth Order Runge Kutta Method, International Journal of Computer Applications 9(8) (2010) 0975-8887.

10. M. R. Odekunle, Some semi-implicit rational R-K schemes, Bagale Journal of Pure and Applied Sciences 1(1) (2000) 11-14.

11. M. R. Odekunle, N. D. Oye, S. O. Adee, A class of inverse Runge-Kutta schemes for the numerical integration of singular problems, Applied Mathematics and Computation 158(2004) 149-158.

12. F. B. Hildebrand, Introduction to Numerical Analysis, Second Edition, Tata McGraw-Hill Publishing Co. Limited, New Delhi, (1974).

13. A. S. Usman, M. R. Odekunle, M. M. Ahmad, A class of three stage implicit rational Runge-Kutta schemes for approximation of second-order ordinary differential equations, Mathematical Theory and Modeling 3(11) (2013) 121-130.

14. J. Patade, S. Bhalekar, A new numerical method based on Daftardar-Gejji and Jafari technique for solving differential equations, World Journal of Modeling and Simulation 11(4), (2015) 256-271.

15. J. C. Butcher, A history of Runge-Kutta Methods, Applied Numerical Mathematics 20(1996) 247-260

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1.13 On the Differential Equations of Artificial Intelligence Systems: Ifa Divination Corpus

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(being Abstract of paper intended for presentation at the conference organized by the Department of Mathematics, Obafemi Awolowo University, Ile-Ife, Nigeria in honour of four retiring senior academic staff, 20th February, 2024. Theme: Mathematical Sciences: An Indispensable Trajectory to Sustainable Development).

Abstract

(Dedicated to all my past teachers in the Department of Mathematics, Obafemi Awolowo UniversIty, Ile-Ife, Osun State, Nigeria.)

The (qualitative) theory of differential equations (TDE) is one of the most applicable areas of mathematics. Of particular importance is the concept of autonomy of differential equations (DE). This may be described, for instance, by the first order autonomous ordinary DE with a polynomial nonlinear part given by (Oluwade, 1999: Oluwade and Afuwape, 2004)

$$x' = f(x) = \sum a_i x^i \quad i = 0, 1, 2, \cdots, n-1 \ \text{ and } \ a_{n-1} \neq 0. \tag{1}$$

In artificial intelligence (AI), autonomy plays a central role with respect to intelligent agents (Russell and Norvig, 1995). Among others, the concept of autonomy is used to describe the operational performance of batteries in engineering systems such as solar energy applications. Ifa Divination Corpus (IDcorp) presents an interesting synergy between TDE and AI. From the perspective of AI, IDcorp is a natural language processing (NLP) system (Thanaki, 2017; Oluwade, 2003). And from the lens of the qualitative TDE, the books (technically called 'odus' or 'odu ifa') of IDcorp can be represented by a combination of the set $S = \{\text{Attractor } (A), \text{Repellor } (R), \text{Positive Shunt } (P), \text{Negative Shunt } (N)\}$, which is the set of phase portraits of equation (1) when $n = 2$. That is, each of the 256 odus can be modelled as a phase portrait when $n = 8$. IDcorp practice was conceived and codified by Orunmila, a Yoruba pioneer philosopher and spiritual leader. IDcorp also serves as the origin of the Yoruba counting system - the Yoruba vigesimal number system (base 20), as attested to by the first book, called Eji Ogbe (Longe, 2009A; Longe, 2009B; Abimbola, 1975; Abimbola, 1977A). There is a $1-1$ correspondence between the divinities and the 256 books. There are 16 major odus and 240 (i.e. $16P_2$) minor odus. Every book has thousands of chapters where each chapter is a poem. The typical Ifa divination process via the divining chain technique has four sequential stages, namely: casting of divining chain, statement of the signature, reading of relevant poem and interpretation (Longe, 1983; Oluwade and Longe, 2003; Abimbola, 1977B). In an earlier paper (Oluwade and Longe, 2003), the authors presented a representation of IDcorp in terms of the discrete structure of computer science. That is, the algebraic characteristics of the IDcorp was shown to have some similarities with the $8-$bit Extended Binary Coded Decimal Interchange Code (EBCDIC) of systems programming, of order 256 (Oluwade and Longe, 2003; Oluwade, 2004). In a recent study (Olagunju *et al.,* 2023), the authors presented additional properties of IDcorp. It was shown, among others, that the set of 16 major odus forms an abelian group under matrix addition mod 2. In the present paper, aspects of the AI representation of IDcorp are presented from the perspectives of the qualitative TDE. For example, following the work of Oluwade (2005), it is shown that one of the odus is the phase portrait $x_1, x_2, \cdots, x_n$ defined by ANNRPPAR, where $x_i \in \{A, R\}$ if x_i is a convex side of a half nut of the divining chain and $x_i \in \{P, N\}$ if otherwise, where $i = 1, 2, \cdots, 8$.

Keywords: Differential equations, artificial intelligence, ifa divination corpus, EBCDIC code, phase portrait.

References

1. Abimbola, Wande (1975), Sixteen Great Poems of Ifa, UNESCO, Niamey.

2. Abimbola, Wande (1977A), Ifa Divination Poetry, Nok Publishers, New York.

3. Abimbola, Wande (1977B), Ifa: An Exposition of Ifa Literary Corpus, Oxford University Press, Ibadan.

4. Longe, Olu (1983), Ifa Divination and Computer Science, Inaugural Lecture, Department of Computer Science, University of Ibadan, Nigeria (reprinted/republished in 1998).

5. Longe, Olu (2009A), A Yoruba Vigesimal Number System, Book Builders, Ibadan, Nigeria.

6. Longe, Olu (2009B), A Yoruba Decimal Number System, Book Builders, Ibadan, Nigeria.

7. Olagunju, Adeyemi Sunday; James, Adewale Adeyemi; Adeyefa, Emmanuel Oluseye; and Joseph, Folake Lois (2023), 'Algebraic Characterization of Ifa Main Divination Codes', Scientific African, Vol. 20, e01729.

8. Oluwade, Bamidele (1999), Qualitative Equivalence of Autonomous Ordinary Differential Equations, Master of Science Thesis, Obafemi Awolowo University, Ile-Ife, Nigeria.

9. Oluwade, (Bami)dele (2003), An Introductory Course on Computer Science (with exercises), Peerless Grace Prints & Publishing, Ibadan, Nigeria.

10. Oluwade, (Bami)dele, and Longe, Olu (2003), 'On the Code Characteristics of the Ifa Divination Codes', Journal of Computer Science & Its Applications (Journal of the Nigeria Computer Society), Vol. 9, No. 1, pp. 23 - 28.

11. Oluwade, (Bami)dele and Afuwape, Anthony Uyi (2004), 'On the Qualitative Equivalence of First Order Autonomous ODEs of the Transcendental Type', Appreciating Mathematics in Contemporary World - Proceedings of the International Conference in Honour of Prof. E.O. Oshobi and Dr. J. O. Amao, Department of Mathematics, Faculty of Science
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12. Oluwade, Bamidele (2004), Design and Analysis of Computer-Coded Character Sets, PhD Thesis, University of Ibadan, Nigeria.

13. Oluwade, (Bami)dele (2005), 'Modelling Fractal Patterns via the Qualitative Equivalence of a Nonlinear ODE', Nonlinear Analysis, 63, pp. e2409-e2414.

14. Russell, Stuart J. and Norvig, Peter (1995), Artificial Intelligence: A Modern Approach, Prentice Hall, Inc.

15. Thanaki, Jalaj (2017), Python Natural Language Processing, Packt Publishing.

1.14 Bifurcation Analysis of the Impact of Prep on HIV/AIDS Dynamics With Inflow of Infectives Immigrants

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Abstract

To investigate the impact of Pre-exposure prophylaxis (PrEP) on the dynamical spread of HIV/AIDS with direct influx of HIV-infected immigrants in the population, a deterministic mathematical model comprising of six compartments, incorporating PrEP and the presence of infective immigrants was proposed. However, as long as infective immigrants continue to enter the population, achieving a disease-free equilibrium becomes unattainable. Consequently, the model possesses only the endemic equilibrium which also exhibit a

forward bifurcation.The global asymptotic stability of the endemic equilibrium was confirmed through the application of a quadratic Lyapunov function and LaSalle's invariance principle. The findings indicate that the disease persists when there is a direct influx of infective immigrants. Further numerical simulations demonstrate that despite the influx of infective immigrants, PrEP can mitigate the spread of HIV transmission in the population with individuals? migrants who are infected.

Keywords: Pre-exposure prophylaxis, effective immigrants, forward bifurcation, Lyapunov function.

References

1. F. Brauer & P. Van den Driessche, *Models for transmission of disease with immigration of infectives*, *Math. Biosci*,**171**, 2001, pp. 143-154.https://doi.org/10.1016/S0025-5564(01)00057-8.

2. T. T. Tadele, R. K. Purnachandra, T. M. Temesgen, *Modeling the Combined Effect of Vertical Transmission and Variable Inflow of Infective Immigrants on the Dynamics of HIV/AIDS*, *American Journal of Applied Mathematics*, vol. **1**, 2016, 4(1): 11-19.https://doi.org/10.11648/j.ajam.20160401.12

3. M. I. Dabbo and B. Seidu and O. D. Makinde, *Modeling the Combine Effect of Careless Susceptible and Infective Immigrants on the Dynamics of HIV/AIDS*, *Journal of public Health and epidemiology*, vol. 3(1), 2013, pp. 362-369.https://doi.org/10.5897/JPHE12.092

4. N. Ram, T. Agraj, and S. Dileep, *Modeling and analysis of the spread of AIDS epidemic with immigration of HIV infectives*, *Math and Comp*, vol. 49, 2009, pp. 880-892. https://doi.org/10.1016/j.mcm.2008.09.013.

5. WHO Policy Brief, *WHO Expands its Recommendation on the use of oral PrEP on HIV infection*, *Geneva*, 2015.

6. WHO Recommends long acting Cabotegravir for HIV prevention, https://www.who.int/news/item/28-07-2022-who-recommends-long-acting-cabotegravir-for-hiv-prevention

7. K. O. Okosun, O. D. Makinde, I. Takaidza, *Impact of optimal control on the treatment of HIV/AIDS and screening of unaware infectives. Applied Mathematical Modelling*, *Elsevier Inc. pone.0012777*, vol.37, 2012, pp. 3802-3820.https://doi.org/10.1016/j.apm.2012.08.004.

8. D. Okuonghae, *Mathematical Analysis of Epidemiological models*, *CIMPA/AMS*, 2016, pp. 14-15.

9. J. K. Oladejo, T. O. Oluyo, *Effects of PrEP on the HIV/AIDS dynamic with immigration of infectives*, IJMAM, vol. 5(2), 2022, pp. 264-283. www.tnsmb.org

10. C. J. Silva and D. F. M. Torres, *Modeling and Optimal Control of HIV/AIDS Prevention through PrEP*, *Ar Xiv:1703.06446v2[math.oc]*, 2017, http://dx.doi.org/10.3934/dcdss.2018008

11. P. Van den Dressche, J. Watmough, *Reproduction numbers and sub-threshold endemic equilibria for compartmental models of disease transmission*, Math. biosci. 180, 29-48, 2002. http://dx.doi.org/10.1016/S0025-5564(02)00108-6

12. O. Diekmann, J. A. P. Heesterbeek, A. P. Metz, *on the definition and computation of the basic ratio Ro in the model of infectious disease in heterogeneous population*, Math. biol. 2(1), 265-382, 1990.http://dx.doi.org/10.1007/BF00178324

13. C. Castillo-Chavez and B. Song, *Dynamical models of tuberculosis and their applications*, Math. biosci. Eng, vol 1, no.2, pp. 361-404, 2004.http://dx.doi.org/10.3934/mbe.2004.1.361

14. J. P. Lasalle, *The stability of dynamical systems*, SIAM,1976.http://dx.doi.org/10.1137/1021079

1.15 Role of Magnetic Field and Heat Source/Sink on Fluid Flow in a Channel

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Abstract

This paper presents analytical study of the combined effect of magnetic field and heat source/sink on fully developed natural convection flow in a channel. The governing equations are obtained and solved for temperature, velocity, Nusselt number and skin friction by perturbation method. Result shows that temperature increases for positive values of heat source parameter as a result of increased kinetic energy of the molecules. velocity profile is observed to decreased with increasing value of magnetic field parameter.

Keywords: Heat source, perturbation, natural convection, magnetic field.

1.16 Legendre Collocation Method for Six-order Boundary Value Problems

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Abstract

The study aims to employ Legendre polynomials as basis functions for numerically solving six-order The goal of the study is to use Legendre polynomials as basis functions to numerically solve six-order Boundary Value Problems(BVPs). Using collocation points, the method transforms the differential problem into a set of algebraic equations, which are subsequently resolved by matrix inversion. Three test problems are discussed for validation. The proposed method yields results that are accurate and quite close to the exact solution. Additionally, the accuracy and effectiveness of the procedure are described using tables and figures. In comparison to other methods in the literature, the results obtained using the proposed method demonstrate that it is more accurate and effective.

Keywords: Legendre polynomials, boundary value problems, collocation approach, approximate solution, absolute error.

References

1. Ullah, I., Khan, H., Rahim, M. T. *Numerical solutions of fifth and sixth order nonlinear boundary value problems by Daftardar Jafari method.* Journal of Computational Engineering 2014, Article ID 286039, 1–8 (2014). doi.org/10.1155/2014/

2. Noor, M. A., Din, S. T. M., *Variational iteration technique for solving higher order boundary value problems.* Applied Mathematics Computation, 189, 1929–4192 (2007).
dio:10. 1016/j.amc.2006.12.

3. Noor, M. A., Din, S. T. M., *Homotopy perturbation method for solving sixth-order boundary value problems.* Computer and Mathematics with Application 55(12), 2953-2972 (2008). doi.org/10.1016/j.camwa.2007.11.026.

4. Caglar, H., Caglar, N., Elfaituri, K. *B-spline interpolation compared with finite difference, finite element and finite volume methods which applied to two-point boundary value problems.* Applied Mathematics Computation 175(1), 72–79(2006). dio: 10.1016/j.amc.2005.07.019

5. Akram, G., Siddiqi, S. S. *Solution of sixth order boundary value problems using non-polynomial spline technique.* Applied Mathematics Computation 181(1), 708–720 (2006).dio. 10.1016/j.amc.2006.01.053

6. Tirmizi, I. A., Khan, M. A. *Non-polynomial splines approach to the solution of sixth-order boundary-value problems.* Applied Mathematics Computation, 195(1), 270–284 (2008).

7. Pervaiz, A., Ahmad, A., Zafar, Z., Ahmad, M. *Numerical solution of sixth order BVPs by applying non-polynomial spline method.* Pakistan Journal Science 66(2), 110–116 (2014).

8. Idrees, M., Haq, S., Islam, S. *Application of Optimal homotopy asymptotic method to special sixth order boundary value problems.* World Applied Sciences Journal 9(2), 138–143 (2010).

9. Lang, F. G., Xu, X. P. *A new cubic B-spline method for linear fifth order boundary value problems.* Journal Applied Mathematics Computing 36(1), 101-116 (2011).

10. Kalyani, P., Rama, P. S., Chandra, R. *Solution of Boundary Value Problems by Approaching Spline Techniques.* Hindawi Publishing Corporation International Journal of Engineering Mathematics Volume 2013, Article ID 482050, 1-9 (2013).
http://dx.doi.org/10.1155/2013/482050.

11. Siddiqi, S. S., *Akram,G. Solution of eighth-order boundary value problems using the nonpolynomial spline technique*, International Journal of Computer Mathematics 84(3) (2007), 347–368.

12. Golbabai, A. and Javidi, M. *Application of homotopy perturbation method for solving eighth order boundary value problems*, Applied Mathematics Computation 191 (2007), 334-346.

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1.17 Modelling and Simulation of Drilling Mud Rheological Properties

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Abstract

Drilling mud and oil-based fluids play a crucial role in drilling operations. Second-grade fluid model can help simulate and analyze the flow behaviour of drilling mud under different conditions aiding design of drilling operations and selection of appropriate mud formulations. This study, therefore, aims at analyzing the flow and heat transfer phenomena as well as the interplay between radiation effects and viscous dissipation on the drilling mud as it flow around the drilling pipe in the wellbore wall. We described a non-linear radiation effect and viscous dissipation, which can result in intricate temperature and viscosity profiles that further influence the flow characteristics of the mud. The second-grade fluid flow was modeled with a system of non-linear coupled partial differential equations, which was non-dimensionalized and reduced to a set of nonlinear coupled ordinary differential equations using stream functions and series approximation. The numerical solution to the governing equations was obtained by the standard trapezoidal technique on the Maple Platform. An increasing influence of radiation in the wellbore was found to increase the flow(velocity) and temperature of the mud. While, a quantitative increase in the dissipation effect marginally affects the flow and temperature profiles. Comparisons of the obtained results with existing reports in the literature were also examined.

Keywords: Drilling mud, non-linear radiation, second-grade fluid, numerical solution, natural convection flow, viscous dissipation.

References

1. H. Schlichting, and K. Gersten, Boundary Layer Theory. Springer, 2017.

2. J. E. Dunn, R. L. Fosdick, Thermodynamics, stability and boundedness of fluids of complexity 2 and fluids of second-grade, Arch. Rat. Mech. Anal. 56 (1974) 191-252.

3. R. L. Fosdick and K. R. Rajagopal. Anomalous features in the model of second-order fluids. Arch ration. Mech. Analysis 70 (1979) 145-152.

4. T. E. Akinbobola, , S. S. Okoya, , 2015. The flow of second-grade fluid over a stretching sheet with variable thermal conductivity and viscosity in the presence of heat source/sink. J. Niger. Math. Soc. 34 (3), 331-342.

5. T. Hayat, S. Ahmad, M. I. Khan, A. Alsaedi and M. Waqas, Investigation of second-grade fluid through temperature dependent thermal conductivity and non-Fourier heat flux. Results in Physics 9 (2018) 871-878.

6. Wu, W.-T.; Massoudi, M. Heat Transfer and Dissipation Effects in the Flow of a Drilling Fluid. Fluids 2016, 1, 4.

7. A. V. Minakov, M. I. Pryazhnikov, E. I. Mikhienkova1, A. L. Neverov, A. V. Matveev, A. V. Zhigarev and D. V. Guzei, Numerical research of heat transfer processes at the drilling wells in permafrost rocks, Journal of Physics: Conference Series 1382 (2019) 012091.

8. A. Toth and E. Bobok, Flow and Heat Transfer During Drilling Operations, Flow and Heat Transfer in Geothermal Systems, 2017, 299-342.

9. L. Esfahanizadeh, B. Dabir and F. Goharpey, CFD modeling of the flow behavior around a PDC drill bit: effects of nano-enhanced drilling fluids on cutting transport and cooling efficiency, Engineering Applications of Computational Fluid Mechanics, 16:1, (2022) 977-994.

10. L. Prandtl, Uber Flussigkeitsbewegungen bei sehr kleiner Reibung. Verhandlg. III. Intern. Math. Kongr. Heidelberg, 484-491. See also: L. Prandtl: Gesammelte-Abhandlungen zur angewandten Mechanik, Hydro- und Aerody-namik, in 3 Teilen (1961). [XXI, 29, 95, 145, 293], 1904.

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1.18 Path Planning of Multi-Rotor UAVs via Enhanced A^* Particle Swarm Optimization Algorithm

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Abstract

In this work, we studied how practical high-quality flight paths are crucial for the effective functioning of an Unmanned Area Vehicle (UAV). We proposed an enhanced path planning algorithm for multi-rotor UAVs using a combination of the A^* algorithm and Particle Swarm Optimization (PSO). Through the A^* algorithm we obtain an initial path for UAVs based on heuristic search by leveraging a combination of information about the current state of the UAV, known as the "start"state, and the desired goal state. Then PSO optimizes the initial path by considering various factors, such as the desired objectives (e.g., obstacle avoidance, energy efficiency, smoothness), constraints, and performance metrics. By iteratively refining the path based on these factors, the PSO algorithm aims to find an optimized path that exhibits improved quality and performance compared to the initial path generated by the A^* algorithm. The simulation and comparison of the enhanced A^* PSO is conducted using MATLAB R2007b and the path planning results show that the algorithm outperforms other path planning algorithms. The optimized path of multi-rotor UAVs obtained through this approach contributes to advancing the capabilities and effectiveness of UAV systems in various practical scenarios.

Keywords: A^* algorithm, multi-rotor UAVs, particle swarm optimization, unmanned area vehicle.

References

1. Borowska, B. (2016). Dynamic inertia weight in particle swarm optimization. In L. Rutkowski, M. Korytkowski, R. Scherer, R. Tadeusiewicz, L. A. Zadeh, & J. M. Zurada (Eds.), Artificial intelligence and soft computing (p. 58-69). Springer.

2. Chen, J., Zhao, H., & Wang, L. (2021). Three dimensional path planning of uav based on adaptive particle swarm optimization algorithm. Journal of Physics: Conference Series, 1846(1), 012007. doi:10.1088/1742-6596/1846/1/012007

3. Dai, X., Long, S., Zhang, Z., & Gong, D. (2019). Mobile robot path planning based on ant colony algorithm with a^* heuristic method. Frontiers in Neurorobotics, 13, 15. doi:10.3389/fnbot.2019.00015

4. Gasparetto, A., Boscariol, P., Lanzutti, A., & Vidoni, R. (2015). Path planning and trajectory planning algorithms: A general overview. In A. Gasparetto & M. Ceccarelli (Eds.), Motion and operation planning of robotic systems (p. 3-27). Springer.

5. Kennedy, J., & Eberhart, R. C. (1995). Particle swarm optimization. In Proceedings of the ieee international conference on neural networks (Vol. 4, p. 1942-1948).

6. Kuffner, J., J. J., & LaValle, S. M. (2000). Rapidly-exploring random trees: A new method for motion planning. In Proceedings of the ieee international conference on robotics and automation (icra 2000) (p. 960-967)). IEEE.

7. Shi, Y., & Eberhart, R. (1998). A modified particle swarm optimizer. In 1998 ieee international conference on evolutionary computation proceedings. ieee world congress on computational intelligence (p. 69-73). doi: 10.1109/ICEC.1998.699146

1.19 Axial Force Influence on Dynamic Response to Moving Load of Shear Beam Resting on Elastic Foundation

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Abstract

Aim: The aim of this study is to determine the influence of axial force on the deflection of shear beam resting on elastic foundation when traversed by moving load.
Method: The governing equations are simultaneous partial differential equations and the main objective of this study is to obtain a closed form solution to this class of dynamical problem. In order to obtain this solution, the method of integral transformation was used. In particular, finite Fourier series was used to reduce the equations to coupled second order ordinary differential equations. Thereafter, the simplified simultaneous equations were then solved by Laplace transformation in conjunction with convolution theory to obtain the solution.
Result: The closed form solution obtained was analyzed to obtain the effects of axial force and foundation stiffness on the response of shear beam when under the action of the moving load and the results were displayed in plotted curves. Analysis in this study revealed that the response amplitude of the shear beam decreases with increasing values of axial force. The same result and analysis were obtained when values of foundation stiffness were increased.
Conclusion: The axial force influence on dynamic response to moving load of shear beam resting on elastic foundation has been examined. This study has provided vital information on the effects of axial force and foundation stiffness on the response of shear beam resting on elastic foundation and under moving load. From the graphs, interesting results were obtained. Increase in the values of structural parameters reduces the transverse displacement of the Shear beam. Practically speaking, increase in the values of structural parameters reduces the resonance risk of the vibrating system.

Keywords: Axial force, shear beam, moving load, elastic foundation.

1.20 Sensitivity Analysis of Pertussis Transmission Dynamics

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Abstract

Pertussis generally known as whooping cough is an airborne infectious disease which spreads through respiratory droplets and vaccine preventable. Whooping cough primarily affects infants and young children. Due to the disruption in basic routine immunization programs caused by the recent COVID-19 pandemic, the disease reemergence stands as a double burden and a significant global health concern for both developed and developing countries. In this paper, a comprehensive analysis of pertussis transmission dynamics is presented via a five (5) non-linear mathematical model. The developed model considers the impact of Vaccination, Treatment and maternally derived immunity on disease spread. The stability of the systems equilibrium point was analyzed and the basic reproduction number R0 obtained using the next generation matrix method. The Normalized forward sensitivity index analysis for R0 was conducted to find the most crucial parameters to be targeted upon for disease intervention strategy. MATLAB 2021a was used to carry out numerical simulations to validate theoretical findings, corresponding results interprets that periodic vaccination from birth, disease treatment in adults, vaccination of pregnant women will specifically lower the basic reproduction number and in turn cushion or eradicate disease spread.

Keywords: Pertussis, steady state, basic reproduction number, sensitivity analysis.

References

1. World Health Organization. (2014). Laboratory Manual for the diagnosis of whooping cough caused by bordetella pertussis/bordetella parapertussis: update 2014 (No. WHO/IVB/14.03). World Health Organization.

2. Guiso, N., & Wirsing von König, C. H. (2016). Surveillance of pertussis: methods and implementation. Expert review of anti-infective therapy, 14(7), 657-667.

3. World Health Organization. (2015). Pertussis vaccines: WHO position paper?August 2015. Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire, 90(35), 433-458.

4. Gavi, the Vaccine Alliance, The Zero Dose Children: Explained, April 2021. Available online: https://www.gavi.org/vaccineswork/zero-dose-child-explained (accessed on 25 January 2023).

5. GPEI. Wild Polio (WP1) Remains Endemic Only in Two Countries Afghanistan and Pakistan. Malawi Confirmed Detection of WP1 in February 2022, 17 February 2022. Available online: https://polioeradication.org/polio-today/polio-now/ (accessed on 25 January 2023).

6. WHO. Third Round of the Global Pulse Survey on Continuity of Essential Health Services during the COVID-19 Pandemic; WHO: Geneva, Switzerland, 2022.

7. NCDC. Public Health Advisory Amidst Outbreak in Nigeria. 2022. Available at: *https://ncdc.gov.ng/news/435/diphtheria-public-healthadvisory-amidst-outbreak-in-nigeria.* [Accessed 20 January 2023].

8. Dalby, T., Harboe, Z. B., & Krogfelt, K. A. (2010). Seroprevalence of pertussis among Danish patients with cough of unknown etiology. Clinical and vaccine immunology, 17(12), 2016-2023.

9. Baxter, R., Bartlett, J., Rowhani-Rahbar, A., Fireman, B., & Klein, N. P. (2013). Effectiveness of pertussis vaccines for adolescents and adults: case-control study. Bmj, 347.

10. Guzman-Holst, A., Gomez, J. A., Cintra, O., Van Oorschot, D., Jamet, N., & Nieto-Guevara, J. (2023). Assessing the Underestimation of Adult Pertussis Disease in Five Latin American Countries. Infectious Diseases and Therapy, 1-16.

11. Olson?Chen, C., Swamy, G. K., Gonik, B., Forsyth, K., Heininger, U., Hozbor, D., ... & Tan, T. Q. (2024). The current state of pertussis vaccination in pregnancy around the world, with recommendations for improved care: Consensus statements from the Global Pertussis Initiative. International Journal of Gynecology & Obstetrics.

12. Stein-Zamir, C., Shoob, H., Abramson, N., Brown, E. H., & Zimmermann, Y. (2023). Pertussis outbreak mainly in unvaccinated young children in ultra-orthodox Jewish groups, Jerusalem, Israel 2023. Epidemiology & Infection, 151, e166.

13. *https://www.cdc.gov/pertussis/about/diagnosis-treatment.html*

14. Alqarni, M. M., Nasir, A., Alyami, M. A., Raza, A., Awrejcewicz, J., Rafiq, M., ... & Mahmoud, E. E. (2022). A SEIR Epidemic Model of Whooping Cough-Like Infections and Its Dynamically Consistent Approximation. Complexity, 2022.

15. Yakubu, A. A., Abdullah, F. A., Ismail, A. I. M., & Yatim, Y. M. (2020, October). Dynamical analysis of pertussis with maternally derived immunity. In AIP Conference Proceedings (Vol. 2266, No. 1). AIP Publishing.

16. Safan, M., Barley, K., Elhaddad, M. M., Darwish, M. A., & Saker, S. H. (2022). Mathematical Analysis of an SIVRWS Model for Pertussis with Waning and Naturally Boosted Immunity. Symmetry, 14(11), 2288.

17. Izzati, N., & Andriani, A. (2021, April). Dynamical analysis of diphtheria epidemic model with natural immunity rate on exposed individuals. In Journal of Physics: Conference Series (Vol. 1869, No. 1, p. 012117). IOP Publishing.

18. Johnson, O. S., Edogbanya, H. O., Emmanuel, J., & Olukanni, S. E. Stability Analysis of COVID-19 Model with Quarantine.

19. Deressa, C. T., Mussa, Y. O., & Duressa, G. F. (2020). Optimal control and sensitivity analysis for transmission dynamics of Coronavirus. Results in Physics, 19, 103642.

20. *https://www.cdc.gov/vaccines/pubs/pinkbook/pert.html*

21. *https://www.bbc.com/news/uk-wales-68067829*

1.21 A Novel Approach to Environmental Monitoring With Fused Satellite Data Using Sparse Convolutional Neural Network

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Abstract

Monitoring tailing dams and water reservoirs for structural damages is crucial for developing risk assessment models and emergency response plans to better prepare for potential disasters or incidents. Remote sensing data has proven highly effective in monitoring water leakage and dam movement. The change in vegetation levels using spectra indices is a reliable indicator of limited or excessive water. This paper presents a novel technique for spatio-temporal data modelling that integrates Sparse Convolutional Neural Networks (SCNN) and Long Short-Term Memory (LSTM) networks. Bayesian optimization is used to optimize the model. The model is designed to efficiently capture spatial dependencies in data while preserving computational resources through sparsity. The memory-retaining capabilities of LSTM networks are used to address temporal correlations. The hybrid method was applied to Normalized Difference Vegetation Index (NDVI) data derived from multisensor data fusion techniques for selected reservoirs across the UK. Our empirical results show that the proposed methods are efficient and accurate for predicting and identifying short and longer-term changes in vegetation. This information is useful for monitoring dam structures to ensure their stability and prevent catastrophic failures.

Keywords: Bayesian optimization, cloud masks, water reservoirs, NDVI, SCNN-LSTM model.

References

1. Oyebamiji, O. K., Nemeth, C., Harrison, P. A., Dunford, R. W. and Cojocaru, G., 2023. Multivariate sensitivity analysis for a large-scale climate impact and adaptation model. Journal of the Royal Statistical Society Series C: Applied Statistics, 72(3), pp.770-808.

2. Skakun, S., Wevers, J., Brockmann, C., Doxani, G., Aleksandrov, M., Batic, M., ⋯ & Zust, L. (2022). Cloud Mask Intercomparison eXercise (CMIX): An evaluation of cloud masking algorithms for Landsat 8 and Sentinel-2. Remote Sensing of Environment, 274, 112990.

3. Chang, D. T., 2021. Probabilistic deep learning with probabilistic neural networks and deep probabilistic models. arXiv preprint arXiv:2106.00120.

4. Filgueiras *et al.,* 2019, Crop NDVI Monitoring Based on Sentinel 1, DOI: 10.3390/rs11121441.

5. Schmitt, M. and Zhu, X. X., 2016. Data fusion and remote sensing: An ever growing relationship. IEEE Geoscience and Remote Sensing Magazine, 4(4), pp.6-23.

1.22 Lyapunov Stability and Sensitivity Analysis of a Recurrent Malaria Dynamics

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Abstract

In this study, a mathematical model of malaria featuring recrudescence, relapse, and reinfection is presented and analysed. The well-possedness of the gorverning model is established through the theory of positivity and boundedness of solution with Lipschitz condition. The model exhibits backward bifurcation property in the presence of reinfection. However, global asymptotic dynamics of the model around equilibrium points in the absence of reinfection are examined through suitably developed Lyapunov functions. In addition, the influence of model parameters on the basic reproduction number is investigated using the normalized forward sensitivity index.

Keywords: Mathematical model, recurrent malaria, reinfection, backward bifurcation, Lyapunov function, sensitivity analysis.

References

1. Centres for Diseases Control and Prevention (CDC) (2020)., http://www.cdc.gov/malaria/malaria-worldwide/reduction/itn.html. Accessed: September, (2022).
2. WHO, World Malaria Report. World Health Organization Press, Geneva, (2019).
3. WHO, World Malaria Report. World Health Organization Press, Geneva, (2021).
4. Olaniyi, S. and Obabiyi, O. S.: Qualitative analysis of malaria dynamics with nonlinear incidence function. Appl. Math. Sci. **8** (78) (2014) 3889–3904. https://dx.doi.org/10.12988/ams.2014.45326
5. Obabiyi, O. S. and Olaniyi, S.: Global stability analysis of malaria transmission dynamics with vigilant compartment. Electronic Journal of Differential Equation. **9**, (2019) 1–10.
6. Abimbade, S. F., Olaniyi, S., Ajala, O. A.: Recurrent malaria dynamics: insight from mathematical modelling, Eur. Phys. J. Plus (2022) 137:292. https://doi.org/10.1140/epjp/s13360-022-02510-3
7. Abidemi A., Ahmad R., Aziz N.A.B.: Global stability and optimal control of dengue with two coexisting virus serotypes. Matematika Special Issue. 149–170 (2019).
8. Abimbade, S. F., Olaniyi, S., Ajala, O. A., Ibrahim, M. O.: Optimal control analysis of a tuberculosis model with exogenous re-infection and incomplete treatment. Optim Control Appl Meth. **41**, 2349–2368 (2020). https://doi.org/10.1002/oca.2658
9. Olaniyi, S., Obabiyi, O. S., Okosun, K. O., Oladipo, A. T., Adewale, S. O.: Metamathematical modelling and optimal cost-effective control of COVID-19 transmission dynamics, Eur Phys J Plus, (2020), 135:938.
10. Driessche, P. van den., and Wamough, J.: Reproduction numbers and sub-threshold endemic equilibria for compartmental models of disease transmission. Math. Biosci. 180(2002) 29–48. https://doi.org/10.1016/S0025-5564(02)00108-6

Group 2

Mathematical Statistics and Computing(MSC)

2.1 Volatility Modeling and Forecasting using Range-based GARCH Models

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Abstract

This paper compares forecast performance of symmetric and asymmetric GARCH models with symmetric and asymmetric range-based GARCH models. Of particular interest is investigation of whether inclusion of range in the conditional variance equation has significant impact on forecast performance of the range-based GARCH models. The models examined in this paper are GARCH(1,1), TARCH(1,1), RGARCH(1,1), and RTARCH(1,1) models. The forecast performance of these models is evaluated by several loss functions. Using range-based GARCH models, the results of data analysis showed that allowing for a leptokurtic error distribution leads to significant improvements in volatility forecasts compared to using the normal distribution. This result holds for daily, weekly as well as monthly forecast horizon.

Keywords: Volatility, conditional variance, range-based GARCH, leptokurtic distribution, loss function and forecast horizon

References

1. Andersen, T. G., Bollerslev, T., Christoffersen, P. F., and Diebold, F. X. (2005): Volatility Forecasting. PIER (Penn Institute for Economic Research) Working Paper 05-01, 1-110.

2. Andersen, T. G., Bollerslev, T., Diebold, F. X. and Labys, P. (2003): Modeling and Forecasting Realized Volatility. Econometrica, 71, 579-625.

3. Andersen, T. G., Bollerslev, T. and Meddahi, N. (2005): Correcting The Errors: Volatility Forecasting Evaluation Using High-Frequency Data and Realized Volatilities. Econometrica, 73, 279-296.

4. Awartani, B. M. A. and Corradi, V. (2005): Predicting The Volatility of The S & P-500 Stock Index via GARCH Models:The Role of Asymmetries, *International Journal of Forecasting*, 21, 167-183.

5. Brailsford, T. J. and Faff, R. W. (1996): An Evaluation of Volatility Forecasting Techniques. *Journal of Banking and Finance*, 20, 419-438.

6. Brandt, M. and Jones, C. S. (2006): Volatility Forecasting With Range-Based EGARCH Models. *Journal of Business and Economic Statistics*. 24, 470-486.

7. Chou, R. Y. (2005): Forecasting Financial Volatilities With Extreme Values: The Conditional Autoregressive Range (CARR) Model. *Journal of Money, Credit and Banking.* 37, 561-582.

8. Diebold, F. X. and Lopez, J. A. (1996): Forecast evaluation and combination. Handbook of Statistics, Vol. 14, Statistical Methods in Finance, Maddala GS, Rao CR (eds). NorthHolland: Amsterdam; 241-268.

9. Hansen, P. R. and Lunde, A. (2005). A forecast comparison of volatility models: does anything beat a GARCH(1,1)?. *Journal of Applied Econometrics*, 20:873-889.

10. Leandro, Dos S. M. and Rosangela Ballini (2017). Value-at-Risk Modeling and Forecasting With Range-Based Volatility Models: Empirical Evidence. R Cont. Fin.-USP,Sao Paulo, Vol.28, No.75, p.361-376.

11. Lopez, J. A. (2001). Evaluation of predictive accuracy of volatility models. *Journal of Forecasting*, 20(1).

12. Poon, S. and Granger, C. (2001). Forecasting financial market volatility: A Review. Department of Economics.

13. Sardorsky, P. (2006). Modeling and Forecasting Petroleum Futures Volatility, Energy Economics, 28, 467-488.

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2.2 A New Improved Estimator For Population Distribution Function Using Auxiliary Variable Under Simple Random Sampling

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Abstract

To gain insight into various phenomena of interest, cumulative distribution function (CDF) can be used to analyze survey data. The purpose of this study was to present an efficient estimator for estimating a population cumulative function using auxiliary variable under simple random sampling. The properties of the proposed estimator bias and mean square error (MSE) were derived up to first order degree of approximation using Taylor's series expansion. The proposed estimator was compared theoretically and empirically with the adjusted estimators in the literature. The proposed estimator was found to be better than adjusted estimators based on the percentage relative efficient(PRE) gain and MSE under some condition.

Keywords: Auxiliary variable, simple random sampling, cumulative distribution function.

References

1. Ahmad, S., Hussain, S., and Ahmad, S. (2021). Finite population distribution function estimation using auxiliary information under simple random sampling. Statistics, Computing and Interdisciplinary Research, 3(1):29?38.

2. Ahmad, S., Ullah, K., Zahid, E., Shabbir, J., Aamir, M., Alshanbari, H. M., and El-Bagoury, A. A.-A. H. (2023). A new improved generalized class of estimators for population distribution function using auxiliary variable under simple random sampling. Scientific Reports, 13(1):5415.

3. Berger, Y. G. and Munoz, J. F. (2015). On estimating quantiles using auxiliary information. Journal of Official Statistics, 31(1):101-119.

4. Chambers, R. L. and Dunstan, R. (1986). Estimating distribution functions from survey data. Biometrika, 73(3):597-604.

5. Cochran, W. (1940). The estimation of the yields of cereal experiments by sampling for the ratio of grain to total produce. The journal of agricultural science, 30(2):262-275.

6. Gupta, R. K. and Yadav, S. (2018). Improved estimation of population mean using information on size of the sample. American Journal of Mathematics and Statistics, 8(2):27-35.

7. Hussain, S., Ahmad, S., Akhtar, S., Javed, A., and Yasmeen, U. (2020). Estimation of finite population distribution function with dual use of auxiliary information under non-response. Plos one, 15(12):e0243584.

8. Hussain, S., Akhtar, S., and El-Morshedy, M. (2022). Modified estimators of finite population distribution function based on dual use of auxiliary information under stratified random sampling. Science Progress, 105(3):00368504221128486.

9. Khalid, A., Sanaullah, A., Almazah, M. M., and Al-Duais, F. S. An efficient ratio-cum-exponential estimator for estimating the population distribution function in the existence of non-response using an srs design. Mathematics, 11(6):1312.

10. Martnez, S., Rueda, M., Arcos, A., and Martnez, H. (2010). Optimum calibration points estimating distribution functions. Journal of computational and applied mathematics, 233(9):2265-2277.

11. Yaqub, M. and Shabbir, J. (2020). Estimation of population distribution function involving measurement error in the presence of non response. Communications in Statistics-Theory and Methods, 49(10):2540-2559.

2.3 Mathematical Approaches to Enhance Energy Efficiency in Construction for Sustainable Development in Nigeria

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Abstract

This research addresses the imperative of integrating mathematical methodologies to optimize energy efficiency within the Nigerian construction sector, aligning with the broader goals of sustainable development. The introduction delineates the urgency of mitigating energy consumption in construction and underscores the potential impact of mathematical models on enhancing sustainability. The research objectives are framed to develop robust mathematical models, identify key variables influencing energy efficiency, integrate mathematical approaches into decision-making, evaluate environmental and economic impacts, and provide actionable recommendations for sustainable development in Nigerian construction. A comprehensive literature review examines existing research, emphasizing the significance of sustainable construction practices, the impact of materials and design on energy efficiency, and the need for interdisciplinary approaches. The integration of mathematical modeling in construction is explored, highlighting its potential to optimize various facets of the construction lifecycle. The methodology employs primary data

collection through surveys and interviews with diverse stakeholders, while the instrumentations include structured questionnaires and interview guides. Descriptive statistics are employed to analyze the collected data, incorporating measures of central tendency and dispersion to provide a quantitative overview of energy efficiency practices. Findings indicate a collective recognition of critical factors influencing energy efficiency, challenges in current construction practices, and a consensus on the importance of specific design features. Stakeholders demonstrate a high awareness of sustainable practices, and challenges in implementation are acknowledged. The conclusion synthesizes the research findings, emphasizing the importance of addressing challenges, promoting interdisciplinary collaboration, and advocating for sustainable practices. The recommendations propose actionable steps, including promoting collaboration, enhancing education, integrating mathematical models, incentivizing sustainable practices, and advocating for supportive policies. In essence, this research contributes valuable insights to the discourse on sustainable development in the Nigerian construction sector. By leveraging mathematical approaches, stakeholders have the potential to usher in a transformative era of energy-efficient practices, aligning with global aspirations for a more sustainable future.

Keywords: Mathematical approaches, enhance energy efficiency, sustainable development in Nigeria

References

1. Adeyemi, K., Ojo, T., & Ahmed, B. (2018). "A Review of Sustainable Construction Practices in Developing Countries: Case of Nigeria."

2. Smith, J., Johnson, M., & Brown, A. (2019). "Optimizing Building Design for Energy Efficiency: A Mathematical Modelling Approach."

3. Patel, S., Gupta, A., & Kumar, R. (2020). "Mathematical Optimization Techniques for Sustainable Project Management in Construction."

4. Garcia, R., Chen, L., & Wang, Q. (2017). "Energy-Efficient Materials Selection: A Systematic Literature Review."

5. Li, H., Zhang, Z., & Wang, X. (2021). "Assessing the Environmental Impact of Construction: A Life Cycle Analysis Approach."

2.4 Model for the Prediction of Cholera Incidence

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Abstract

Cholera remains a significant health challenge in Nigeria, particularly in North - western Nigeria, where poor sanitation, contaminated water sources, and limited healthcare access contribute to its spread. This paper investigates the modeling and forecasting of the cholera cases in one of the hospital in Kebbi State, North-western Nigeria over five years. Quarterly data, from 2002 to 2019 was analyzed. The Box and Jenkins method was used. Stationarity was confirmed through KPSS and ADF tests. ARIMA model (2, 1, 2) was chosen based on the lowest AIC, indicating its suitability for predicting cholera cases. The study reveals a closer relationship between mean, median, maximum, and minimum values from the first quarter of 2011 to the fourth quarter of 2020.

The ARIMA (2, 1, 2) model predicts a gradual increase in cholera cases in the next two years. This research emphasizes the importance of sanitation improvements and hygiene education to mitigate cholera outbreaks in Kebbi State.

Keywords: Cholera, ARIMA, prediction.

References

1. Smith, J., et al. (2023). "Cholera Incidence and Its Impact on Public Health in North-western Nigeria." Public HealthJournal, 45(2), 123-135.

2. World Health Organization (WHO). (2022). "Global Perspectives on Cholera: A Comprehensive Review." World Health Reports, 78(4), 567-580.

3. Ahmed, K., et al. (2021). "Assessing the Relationship between Water Quality and Cholera Outbreaks in Sub-Saharan Africa." Environmental Health Perspectives, 112(8), 987-995.

2.5 Backtesting Methods for Evaluating the Viability of Stock Prices in Nigeria

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Abstract

Backtesting is a method that is utilized to evaluate the effectiveness of a trading strategy or forecasting strategy by applying it to data that has been collected in the past. Backtesting is a technique that is used to analyze how well a model or strategy would have performed on historical data. This evaluation is done with the purpose of assisting analysts and researchers in comprehending the possible usefulness of the model or strategy in everyday situations. The purpose of this article is to evaluate the viability of the stock prices of a few Nigerian banks by combining the stylized GARCH model with the Long-short term memory (LSTM) model. On the basis of the Box-Jenkins method for analyzing time series, the models were identified, the parameters were estimated by employing the method of maximum likelihood, the models were evaluated by utilizing their mean square errors, the models were utilized to forecast, and the forecasts were evaluated by employing the backtesting methods.

Keywords: GARCH models, long-short term memory (LSTM), backtesting, value at risk (VaR), expected shortfall (ES).

References

1. Amirshahi, B., & Lahmiri, S. (2023). Hybrid deep learning and GARCH-family models for forecasting volatility of cryptocurrencies. Machine Learning with Applications, 12, 100465.

2. D'Amato, V., Levantesi, S., & Piscopo, G. (2022). Deep learning in predicting cryptocurrency volatility. Physica A: Statistical Mechanics and its Applications, 596, 127158.

3. García-Medina, A., Aguayo-Moreno, E.(2023). LSTMGARCH Hybrid Model for the Prediction of Volatility in Cryptocurrency Portfolios. Comput Econ (2023). https://doi.org/10.1007/s10614-023-10373-8

4. Gu, S., Kelly, B., & Xiu, D. (2020). Empirical asset pricing via machine learning. The Review of Financial Studies, 33(5), 2223-2273.

5. Koo, E., & Kim, G. (2022). A hybrid prediction model integrating garch models with a distribution manipulation strategy based on lstm networks for stock market volatility. IEEE Access, 10, 34743-34754.

6. Liu, M., Ye, J., & Yu, L. (2022). Volatility Prediction via Hybrid LSTM Models with GARCH Type Parameters. Proceedings of Business and Economic Studies, 5(6), 37-46.

7. Ray, S., Lama, A., Mishra, P., Biswas, T., Das, S. S., & Gurung, B. (2023). An ARIMA-LSTM model for predicting volatile agricultural price series with random forest technique. Applied Soft Computing, 149, 110939.

8. Wang, Y., Liu, P., Zhu, K., Liu, L., Zhang, Y., & Xu, G. (2022). A Garlic-Price-Prediction Approach Based on Combined LSTM and GARCH-Family Model. Applied Sciences, 12(22), 11366.

9. Zhang, J., Liu, H., Bai, W., & Li, X. (2024). A hybrid approach of wavelet transform, ARIMA and LSTM model for the share price index futures forecasting. The North American Journal of Economics and Finance, 69, 102022.

10. Zolfaghari, M., & Gholami, S. (2021). A hybrid approach of adaptive wavelet transform, long short-term memory and ARIMA-GARCH family models for the stock index prediction. Expert Systems with Applications, 182, 115149.

2.6 Digital Distraction and Personality Trait as Correlate of Knowledge Retention of Undergraduate Mathematics in Tertiary Institutions in Ondo State

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Abstract

This study examines the relationship between digital distractions, personality traits as correlates of knowledge retention of Mathematics undergraduates in Nigerian Universities. The study adopted a descriptive research design of the survey type, the population of the study comprised of 175 undergraduates who were selected from Tertiary Institutions in Ondo State using simple random sampling technique. Data collected for this study was analyzed using descriptive and inferential statistics such as frequency counts, percentages and mean and Regression analysis. The result of the study revealed that there is high level of digital distraction with a mean score of (= 3.45) and high level of knowledge retention with a mean score of (= 2.96) among mathematics undergraduates in Tertiary Institutions in Ondo State. The level of openness records a mean of (= 3.27), conscientiousness (= 3.35), agreeableness (= 2.85), extraversion (= 2.75) and emotional instability (= 2.48) was high among undergraduates in Tertiary Institutions in Ondo State. Furthermore, the study revealed that there is a relationship between digital distraction and knowledge retention of mathematics undergraduates in Tertiary Institutions in Ondo State $[F(174) = 20.146; p_i 0.05]$. There is no significant relationship between personality traits and knowledge retention of mathematics undergraduates in Tertiary Institutions in Ondo State $[F(174) = 0.026; p_i 0.05]$. Based on the findings of the study, It was recommended among others that undergraduates are encouraged to minimize the number of times they spend on their

digital devices as this would help improve their knowledge retention and boost their confidence to embrace any mathematical challenges.

Keywords: Digital distraction, personality traits, knowledge retention, undergraduates.

References

1. Aaron, L. S.; Lipton, T. Digital Distraction: Shedding Light on the 21st-Century College Classroom. J. Educ. Technol. Syst. 2017, 46, 363-378.

2. Adekolu, A. G. & Omotunde, S. O. (2021). A correlational study of internet addiction, personality traits and academic performance of female University students in Ondo state. AAUA Journal of Science and Technology Education, 3(2), 134-144.

3. Adobor, H., Kudonoo, E. & Daneshfar, A. (2019). Knowledge management capability and organizational memory: a study of public sector agencies. International Journal of Public Sector Management, 32(6), pp. 671-687.

4. Awofala, A. O. A. Olabiyi, O.S. Awofala, A. A. Ojo, O. T. Okunuga R. O. & Lawani, A. O. (2020). Investigating Digital Distraction among Pre-service Science, Technology, and Mathematics Teachers in Nigeria. Digital Education Review - 37,: 32-48.

5. Bonvin, G. & Sanchez, E. (2017). Social Engagement in a Digital Role-Playing Game Dedicated to Classroom Management. In Games and Learning Alliance. GALA. Lecture Notes in Computer Science; Dias, J., Santos, P., Veltkamp, R., Eds.; Springer: New York, NY, USA, 2017; Volume 10653.

6. Nauert, G. (2017). Internet use, Computers in Human Behavior, New York: Gills Press.

7. Sumbal, M. S., Tsui, E., See-to, E. & Barendrecht, A. (2017). Knowledge retention and aging workforce in the oil and gas industry: A multi perspective study. Journal of Knowledge Management, 21(4), pp. 907-924

2.7 Omiyale: Sounding the Mathematics of the Rain and Flood Disaster in Ibadan City, Nigeria

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Abstract

Research on Yoruba popular music has tended to draw attention to its interest in romance and the accumulation of wealth. Inadequate attention has been paid to its engagement with the environment. Ibadan, the capital of Oyo State in Nigeria has witnessed perennial flood disasters, and this has been a concern of Yoruba musicians. This article is an ethnographic investigation of the place of music in the rain and flood disasters of Ibadan as addressed in the songs of Yoruba musicians, Kollinton Ayinla, Foyeke Ajangila, Ebenezer Obey and Agbada Owo. And it is based on ecomusicology theory. The article describes the connections between the volume and measures of rain fall, the cultural past, when indigenous knowledge was respected and flooding was avoided, and the present, when it was forgotten, and flooding became a constant. Based on the very specific, local context of Ibadan, I argue that calls for the return of indigenous knowledge as propagated in popular music could be a way forward

in environmental crises currently experienced around the globe.

Keywords: Omiyale, environmental degradation, flood and rain, popular music, performance studies, measurements.

References

1. Allen, S. A. and Dawe, K. (2016). Current Directions in Ecomusicology: Music, Culture and Nature. Routledge.

2. Groffman, J. and Titus, O. S. (2022) Hearing nature, sounding nature: approaching environmental communication through music and sound. Julia Metag *et al.* (Edits) International Trends in Environmental Communication. (routledge.com) https://www.taylorfrancis.com/chapters/edit/10.4324/9780367275204-36/hearing-nature-joshua-groffman-olusegun-stephen-titus. 479-498

3. Titus, O. S. (2023) Music and Poetry Representations of Oil Exploration, Honeybees (Dis)placement and Endangerment in the Niger Delta of Nigeria. BEEWORLD Journal Tailor and Francis. Volume 99, (2) 61-65 https://doi.org/10.1080/0005772X.2021.1993667

4. Titus, O. S. (2023) Sounding the Environmental Benefits of the COVID-19 Pandemic in Nigeria, in Climate Psychology in a Pandemic: Environmental Health in Lockdown. Sam Mickey and E. Douglas (edit) Oxford University Press 173-186.

2.8 Semiparametric Lognormal Shared Frailty Modeling of Diabetes Patients with Acute Coronary Syndrome

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Abstract

Modelling and estimation of common risks in lifetimes of individuals with similar features say organs, medical centers, and in short, clusters are best done using shared frailty models. A number of publications have been devoted to estimation methods in shared frailty but few to the use of pseudo-full-likelihood(PFL) method of estimation and application into the patients and acute coronary syndrome. This study aims to model the survival time as well as obtain cluster-specific frailty starting with a simulation study based on semiparametric lognormal shared frailty distribution using the PFL method and obtaining a prediction interval for a random effect. To explore this further, we used data from UK Biobank to investigate the existence of shared frailty in diabetes patients characterized by hypoglycemia and history of ACS (STEMI and NSTEMI) and also to see how the observed variabilities affect the hazards. The results suggest the presence of frailty influence within the clusters and indicate cluster time dependence in the study population.

Keywords: Acute coronary syndrome, diabetes mellitus, lognormal frailty model, pseudo-full-likelihood, shared frailty model.

References

1. Adeleke, K A & Grover, Gurprit (2019). Parametric frailty models for clustering of survival data with application to prostate cancer. *J Stat Appl Pro Lett* 6, 89–99

2. Collins, Rory. (2012). What makes UK Biobank special? *Lancet (London, England)*, 379, 1173–1174.

3. Cox, David R. (1972). Regression models and life-tables. *Journal of the Royal Statistical Society: Series B (Methodological)*, 34, 187–202.

4. Petermann-Rocha, Fanny, Parra-Soto, Solange, Gray, Stuart, Anderson, Jana, Welsh, Paul, Gill, Jason, Sattar, Naveed, Ho, Frederick K., Celis-Morales, Carlos, & Pell, Jill P. (2021). Vegetarians, fish, poultry, and meat-eaters: Who has higher risk of cardiovascular disease incidence and mortality? A prospective study from UK Biobank. *European Heart Journal*, 42, 1136–1143.

5. Thakur, Arpan Kumar, Grover, Gurprit, & Adeleke, Kazeem. (2019). Effect of Prognostic Factors on Survival Time of Patients of Cardiovascular Disease using Quantile Regression. *Journal of Communicable Diseases (E-ISSN: 2581-351X & P-ISSN: 0019-5138)*, 51(3), 15–21.

6. Zucker, David M., Gorfine, Malka, & Hsu, Li. (2008). Pseudo-full likelihood estimation for prospective survival analysis with a general semiparametric shared frailty model: Asymptotic theory. *Journal of Statistical Planning and Inference*, 138, 1998–2016.

2.9 A Comparative Analysis of Option Pricing Models: Assessing Their Applicability in Valuing European Options

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Abstract

In this work, we did a comparative analysis of the Black-Scholes and Binomial Option Pricing models to evaluate their effectiveness in valuing European options. The comparative analysis involves an examination of the performance of both models undervarious market conditions, interest rates, and time to maturity. Historical market data is employed to simulate pricing outcomes and rigorously assess the accuracy of each model's predictions. Furthermore, the research explores the practical implications of the findings for investors and option traders. It investigates which model performs more reliably in different market scenarios,offering insights into when and how these models should be employed for optimal decision- making in option trading and risk management. By the conclusion the results shows that the error incurred by the Binomial model is small, therefore makes the Binomial model good for pricing European options. This will help with equipping readers to make more informed choices when valuing European options. This work contributes to the ongoing discourse in the financial industry concerning the refinement and adaptation of option pricing techniques to suit dynamic market conditions.

Keywords: Black-Scholes option model, Binomial option pricing model, European option.

References

1. Urama, T. (2018). Stochastic calculus and derivatives pricing in the Nigerian Stock Market. Doctoral dissertation, Sheffield Hallam University.

2. Dar Aa, Anuradha N. (2017) Probability default in Black-Scholes formula: A Qualitative Study. J. Bus Econ Dev 2: 99-106.

3. Nwozo, C. R., & Fadugba, S. E. (2014). On the Accuracy of Binomial Model for the valuation of standard options with dividend yield in the context of Black-Scholes Model. International Journal of Applied Mathematics, 44(1).

4. Oduro F. T. (2012). The Binomial and Black-Scholes option pricing Models: A Pedagogical Review with VBA Implementation. Int J Bus Inf Technology 2.

5. Feng, Y., & Kwan, C. C. (2012). Connecting Binomial and Black-Scholes option pricing models: A spreadsheet-based illustration. Spreadsheets in Education, 5(3), 4595.

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2.10 Prediction of Covid-19 Pandemic Using Machine Learning Markov Chain Models

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Abstract

The Covid-19 is a global pandemic, which swept across the world from 2019 to 2020. It presented a severe threat to mankind, creating a perilous situation leading to economic downturn throughout the period it lasted. Numerous researchers explored different mathematical models to study the dynamics of the pandemic. The present study employs a Markov chain model, based on a 5-element state space for the highest wave of Covid-19 and a 4-element state space for the lowest wave. The objective of this paper is to examine predictive ability of Markov chain model for Covid-19 spread using both the highest and lowest waves of the pandemic. We demonstrated that a machine learning Markov chain model provides a robust and accurate prediction for Covid-19 spread.

Keywords: Covid-19, Markov Chain, state space, machine learning technique, prediction.

References

1. Georey, R. *et al.,* (2001): Probability and Random Processes, Oxford University Press, USA; 3rd edition.

2. Ibrahim N. A. *et al.,*. (2008): Decision tree for competing risks survival probability in breast cancer study, International Journal of Biomedical Sciences, Volume 3 Number 1.

3. Jackson, C. (2007): Multi-State modeling with R: The msm package, version 0.7.4.1 October.

4. Jorge L. R. (2020): A Markov Chain Model for Covid-19 Survival Analysis, http://web.cortland.edu/romeu/

5. Kurt Jacobs (2020): Stochastic Processes for Physicists: Understanding Noisy Systems, Cam bridge University Press .

6. Yuan T. *et al.,* (2020): Forecasting COVID-19 cases using Machine Learning models Paper presented at 33rd Conference on Neural Information Processing Systems (NeurIPS 2019), Vancouver, Canada.

7. Abdelghafour Marfak *et al.,* (2020): The hidden Markov chain modelling of the COVID-19 spreading using Moroccan dataset, https://doi.org/10.1016/j.dib.2020.106067

8. Painuli, D. *et al.,* (2021): Forecast and Prediction of COVID-19 using Machine Learning.Data Science for COVID-19, Academic Press.doi.org/10.1016/B978-0-12-824536-1.00027-7.

9. Moulaei, K. *et al.,* (2022): Comparing machine learning algorithm for predicting COVID-19 mortality BMC Medical Informatics and Decision Making 22:2 https://doi.org/10.1186/s12911-021-01742-0

10. Zhaobin Xu *et al.,* (2022): A Continuous Markov-Chain Model for the Simulation of COVID-19 Epidemic Dynamics, https://doi.org/10.3390/biology11020190

2.11 Efficiency Study of Presence of Non-Response on the Family of Binary-Type Estimator for Estimating Population Mean under Simple Random Sampling

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Abstract

In statistical estimation processes, accurate estimation of parameters is crucial. Incorporating valid auxiliary information can improve estimators by considering correlated variables. This study focused on binary type estimators for predicting population mean under SRSWOR in scenarios with non-response. The Mean Square Error (MSE) and Bias characteristics of the proposed estimators were derived, along with identifying the optimal MSE. The proposed family of estimators exhibited higher efficiency compared to existing estimators, as supported by both theoretical and empirical investigations.

Keywords: Auxiliary variable, bias, mean square error, binary-type estimator, non-response.

References

1. Bhougal, S., Kumar, S., Singh, H.and Gupta, R. (2011), 'A class of ratio-cum-product type estimators under double sampling in the presence of non-response', Hacettepe Journal of Mathematics and Statistics, 40, 589-599.

2. Choudhary, R. K., Bathal, H. V. L. and Sud, U. C. (2004)."On Non-response in Sampling on Two Occasions", J. Ind. Soc. Agril. Statist. 58, 331-343.

3. Hansen, M. and Hurwitz, W. (1946), 'The problem of non-response in sample surveys', Journal of American Statistical Association 41, 517-529.

4. Khare, B. B. and Sinha, R, R. (2009). On the class of estimators for population mean using multi auxiliary characters in the presence of non-response. Statistics in Transition-New Series. 10 (1), pp. 3-14.

5. Khare, B. B. and Sinha, R, R. (2011). Estimation of the ratio of the two population means using multi auxiliary characteristics in the presence of non-response. In Statistical Techniques in Life Testing, Reliability, Sampling Theory and Quality Control. 1, pp. 63-171.

6. Khare, B. B. and Sinha, R, R. (2012). Improved classes of estimators for ratio of two means with double sampling the non-respondents.Statistica. 49 (3), pp. 75-83.

7. Muneer, S., Shabbir, J. and Khalil, A. (2017). Estimation of finite population mean in simple random sampling and stratified random sampling using two auxiliary variables. Communication in Statistics Theory and Methods. 46 (5), pp. 2181-2192.

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Group 3

Pure Mathematics(PM)

3.1 Hyers-Ulam-Rassias Stability of the Nonlinear Second-Order Differential Equations With Forcing Term

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Abstract

In this paper, we consider the Hyers-Ulam-Rassias stability of nonlinear second-order differential equations with a forcing term. By using the Bihari inequality and the Gronwall-Bellman-Bihari integral inequality, we obtain new criteria for the Hyers-Ulam-Rassias stability of the considered nonlinear second-order differential equations.

Keywords: Hyers-Ulam-Rassias stability, second-order differential equations, the Bihari inequality, the Gronwall-Bellman-Bihari integral inequality.

References

1. M. R. Abdollahpour, R. Aghayari, M. TH. Rassias: *Hyers-Ulam stability of assosiated Lagurre differential equations in a subclass of analytic functions.* Journal of Mathematical Analysis and Applications. 437(2016),605-612.

2. Q. H. Aligfiary, S. M Jung: *On the Hyers-Ulam Stability of Differential Equations of Second Order.* Hindawi Publishing Cooperation Abstract and Appliedd Analysis. (2014),1-8.

3. C. Alsina, R. Ger: *On Some Inequalities and Stability Result Related to the Exponential Function.* J. Inequl. Appl. 2(1988),373-380.

4. T. Aoki: *On the Stability of the linear transformation in Banach spaces.* J. Math. Soc. Japan. 2(1950), 64-66.

5. I. Bihari: *Researches of the Boundedness and Stability of the Solutions of nonlinear differential Equations.* Acta. Math Acad, Sc. Hung 7(1957),278-291.

6. D. G. Bourgin: *Classes of tranformations and bordering transformations.* Bull. Amer. Math. Soc. 57(1988), 223-237.

7. S. Czerwik *Functional equation and Inequalities in several variables.* World Sci.,Publ., Singapore, 2002.

8. S. Czerwik *On the stability of the quadratic mapping in nomed spaces.* Abh. Math. Sem. Univ. Hamburg, 62(1991), 59-64.

9. U. D. Dhongade, S. G. Deo: *Some Generalisations of Bellman-Bihari Integral Inequalities.*, Journal of Mathematical Analysis and Applications. 44(1973),218-226.

10. I. Fakunle and P.O. Arawomo: *Hyers-Ulam stability Theorems for Second Order Nonlinear Damped Differential Equations with Forcing Term.* Journal of the Nigerian Mathematical Society, 42(2023)19-35.

11. I. Fakunle and P. O. Arawomo: *Hyers-Ulam-Rassias stability of Nonlinear Second Order of A Perturbed Ordinary Differential Equation.* To appear in Proyecciones Journal of Mathematics. 2023.

12. I. Fakunle and P. O. Arawomo: *On Hyers-Ulams stability of a Perturbed Nonlinear Second Differential using Gronwall-Bellman-Bihari Inequality.* Nigerian Journal of Mathematics and Applications 32(1)(2022) 189-201.

13. I. Fakunle, P. O. Arawomo: *Hyers-Ulam Stability of Certain Class of Nonlinear Second Order Differential Equations.* International Journal of Pure and Applied Mathematical Sciences. 11(1)(2018),55-65.

14. I. Fakunle, P. O. Arawomo: *On Hyers-Ulam Stability of Nonlinear Second Order Ordinary and Functional Differential Equations.* International Journal of Differential Equations and Applications 17(1)(2018),77-88.

15. I. Fakunle, P. O. Arawomo: *Hyers-Ulam Stability of a Perturbed Generalised Lienard Equation.* International Journal of Applied Mathematics. 32(3)(2019),479-489.

16. P. Gavruta: *A generalisation of the Hyers-Ulam-Rassias stability of approximately additives Mappings.* J. Math.Anal.Appl. 184(1994)431-436.

17. L. Gravruta, P. Gavruta: *On a problem of John M. Rassias concerning the stability in Ulam sense of Euler-Lagrange equation.* in:Functional Equations, Difference Inequalities and Ulam stability notions(J. M. Rassias ed.) Nova Science Publishers, (210)47-53.

18. D. H. Hyers: *On the Stability of the Linear functional equation.* Proceedings of the National Academy of Science of the united States of America, 27(1941), 222-224.

19. S.-M. Jung: *Hyers-Ulam Stability of Linear Differential Equations of First Order(II).* Appl. Math. Lett. 19(2006), 854-858.

20. S.-M. Jung: *Hyers-Ulam Stability of Linear Differential Equations of First Order(III).* J. Math. Anal. Appl. 311(2005),139-146.

21. S.-M. Jung: *Hyers-Ulam Stability of an system of first order linear differential equation with constant coefficients,* Math. Lett. Appl. 320(2006), 549-651.

22. S.-M. Jung, M. TH. Rassias, C. Mortici: *On a functional equation of trigonometric type.* Applied Mathematics and computation. 252(2015), 294-303.

23. S.-M. Jung: *Hyers-Ulam-Rassias Stability of functional equations in nonlinear analysis, Springer Optimization and its applications.* Vol 48 Springer,New York, 2011.

24. S.-M. Jung, D. Popa, and M. TH. Rassias: *On the Stability of the linear functional in a single variable on complete metric groups.* J. Global Optim. 59 (1)(2014) 165-171.

25. Y. Li, Y.Shen: *Hyers-Ulam Stability of Linear Differential Equations of Second Order.* Appl. Math. Lett. 23(2010), 306-309.

26. R. S. Murray: *Schum's Outline of Theory and Problem of Calculus.* SI(Metric) Edition, International Edition 1974.

27. T. Miura, S. Miyajima, S. E. Takahasi: *A characterisation of Hyers -Ulam Stability of first order linear differential operators.* J. Math. Anal. Appl. 286(2003), 136-146.

28. T. Miura, S. Miyajima, S. E. Takahasi: *Hyers -Ulam Stability of linear differential operators with Constant Coefficients.* Math. Nachr.258(2003), 90-95.

29. M. N. Qarawani:*Hyers-Ulam Stability of Linear and Nonlinear Differential Equations of Second Order.* Int. Journal of Applied Mathematical Research. 1, 4(2012), 422-432.

30. M. N. Qarawani: *Hyers-Ulam Stability of a Generalised Second Order Nonlinear Differential Equations.* Applied Mathematics. 3(2012), 1857-1861.

31. TH. M. Rassias : *On the Stability of the Linear Mapping in Banach Spaces.* Proceedings of the American Mathematical Society, 72, 2(1978), 297-300.

32. I. A. Rus: *Ulam Stability of Ordinary Differential Equation.* Studia Universities Babes-Bolyal Mathematical. 54, 4(2010), 306-309.

33. I. A. Rus: *Ulam stability of Ordinary Differential Equations in a Banach Space.* Carpathian, J. Math. 126(2010), 103-107.

34. S. E. Takahasi, T. Miura, S. Miyajima: *On the Hyers-UIam Stability of the Banach Space-Valued Differential Equation* $y' = \lambda y$*.Bulletin of the Korean Mathematical Society.* 392(2002), 309-315.

35. S. E. Takahasi, H. Miyajima T. Miura, S. Miyajima: *The Hyers-UIam Stability Constants of first order Linear differential Operators,* J. Math. Anal. Appl. 296(2004) 309-409.

36. S. M. Ulam: *Problems in Modern Mathematics Science Editions.* wily, New York. NY, USA, Chapter 6, 1960.

37. G. Wang, M. Zhou, L. Sun: *Hyers-Ulam stability of linear differential equations of first order.* Appl. Math. Lett. 21(2008), 1024-1028.

38. J. Wang *Some further generalisation of the Ulam-Hyers-Rassias stability of functional equation.* Journal of Mathematics Analysis and Application. **263**,(2001) 406-423.

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3.2 Strongly Continuous Semigroup on Decoherence-Free Subalgebra of Quantum Markov Semigroup

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Abstract

In this work, we shall be concerned with strongly continuous semigroup on decoherence-free subalgebra of quantum Markov semigroup. A derivation for the infinitesimal generator of decoherence-free subalgebra was first established. The derivation was then used to establish a theorem for the characterization of a strongly continuous semigroup on decoherence-free subalgebra of quantum Markov semigroup.

Keywords: Strongly continuous semigroup, decoherence-free subalgebra, quantum Markov semigroup, infinitesimal generator.

References

1. J. Agredo, F. Fagnola and D. Poletti, Gaussian Quantum Markov Semigroups on a One-Mode Fock Space: Irreducibility and Normal Invariant States. *Open Sys. Information Dyn.* **28** (1) 2150001 (2021).

2. J. Agredo, F. Fagnola and R. Rebolledo, Decoherence free subspaces of a quantum Markov semigroup, *J. Math. Phys.* **4** 1343-1362 (2014).

3. Alicki, R. and Lendi, K. (1987). *Quantum Dynamical Semigropus and Applications.* Lect. Notes Phys. 286, Springer- Verlag.

4. Blanchard, P. and Olkiewicz, R. (2006). Decoherence as iireversible dynamical process in open quantum systems. *Open quantum systems, Recent developments* Vol. III, Springer-Verlag Berlin, 117-159.

5. Blanchard, P. H. and Olkiewicz, R. (2003). Rev. Math. Phys. **15** ,217.

6. Bratelli, O. and Robinson, D. W. (1987). *Operator Algebras and Quantum Statistical Mechanics*, Vol. 1, Springer-Verlag, 2nd edition.

7. Chebotarev, A. M. and Fagnola, F. (1998).Sufficient conditions for conservativity of minimal quantum dynamical semigroups *J. Funct. Anal.* 153, 382-404.

8. Carbone, R., Sasso, E. and Umanita, V. (2017). infin. Dimens. Anal. *Quantum Probab. Relat. Top.* **20**, 1750012.

9. Davies, E. B.(1979). Generators of dynamical semigroups *J. Funct. Anal.*, 34, 421-432.

10. Dhari, A., Fagnola, F. and Rebolledo, R. (2010). infin, Dimens. Anal. *Quantum Probab. Relat. Top.* **13** , 413.

11. K. Engel, R. Nagel, One parameter Semigroups for Linear Evolution Equations. Graduate Texts in Mathematics, 194, Springer-Verlag, New York, 2000.

12. Fagnola, F. and Rebolledo, R. (2006). Notes on the Qualitative Behaviour of Quantum Markov Semigroups *Open quantum systems, Recent developments.* Vol. III, Spinger Berlin, 161-205.

13. Fagnola, F. (1999). Quantum Markov semigroups and quantum flows, *Proyecciones, J. Math.*, 18,(3), 1-144.

14. Fagnola, F., Rebolledo, R. and Saavedra, C. (1994). Quantum flows associated to master equation in quantum optics, *J. Math. Phys.*, 35, no 1, 1-12.

15. Fagnola, F. and Rebolledo, R. (2008). Infin. Dimens. Anal. *Quantum Probab. Relat. Top.* **11**, 467.

16. Fagnola, F., Sasso, E. and Umanita, V. (2017). Structure of uniformly continuous Quantum Markov Semigroups with Atomic Decoherence-free subalgebra. *Open system and information Dynamics.* **24** , 3.

17. Frigerio, A. and Verri, M. (1982). Long-time asymptotic properties of dynamical semigroups on w^*-algebras, *Math. Zeitschrift*, 180, no. 2, 275-286.

18. M. Haase, The Functional Calculus for Sectorial Operators. Operator Theory: Advances and Applications, vol. 169, Birkhauser Verlag, Basel, 2006.

19. Holevo, A. S. (1995). On the structure of covariant dynamical semigroups, *J. Funct. Anal.* 131 (2), 255-278.

20. Lindblad, G. (1976). Commun. Math. Phys. **48**, 119.

21. Lidar, D. A. and Whaley, K. A. (2003). Decoherence-free subspaces and subsystems, *Lect. Notes phys.* **622**, 83.

22. Pazy, P. (1983). *Semigroups of linear operators and applications to partial differential equation.* Springer-Verlag New York, inc.

23. Ticozzi, F. and Viola, L. (2008). IEEE Transaction on Automatic control **53**,2048.

24. Tomiyama, J. (1957). Proc. Japan Acad. Sci **33**, 125.

25. Umanita, V. (2006). probab. Theory Relat. Fields **134**, 603.

26. Reed, M. and Simon, B. (1975).*Methods of Modern Mathematical Physics II , Fourier Analysis, Self- Adjointness*, Academic Press.

27. Williams, F. T. (2013). *Introduction to real analysis.* Library of congress cataloging-in-publication Data. ISBN 0-13-045786-8.

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3.3 Analysis of Weak Associativity in Some Hyper-Algebraic Structures That Represent Dismutation Reactions

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Abstract

In this paper, some chemical systems of Tin (Sn), Indium (In) and Vanadium (V) which are represented by hyper-algebraic structures $(S_{Sn}, \oplus)$, $(S_{In}, \oplus)$ and $(S_V, \oplus)$ were studied. The analyses of their algebraic properties and the probabilities of elements in dismutation reactions were carried out. It was shown that in the dismutation reactions, the left nuclear (N_λ)-probability, middle nuclear (N_μ)-probability and right nuclear (N_ρ)-probability for each of the hyper-algebraic structures $(S_{Sn}, \oplus)$, $(S_{In}, \oplus)$ and $(S_V, \oplus)$ is less than 1.000. This implies that, $(S_{Sn}, \oplus)$, $(S_{In}, \oplus)$ and $(S_V, \oplus)$ are non-associative hyper-algebraic structures. Also, from the results obtained for FLEX-probability, it was shown that, $(S_{Sn}, \oplus)$, $(S_{In}, \oplus)$ and $(S_V, \oplus)$ have flexible elements because the values of their FLEX-probabilities are 1.000 each. Hence, $(S_{Sn}, \oplus)$, $(S_{In}, \oplus)$ and $(S_V, \oplus)$ are flexible.

Keywords: Hypergroup, polygroup, polyloop.

References

1. Corsini, P. and Leoreanu, V. (2003), *Applications of hyperstructure theory*, Advances in Mathematics (Dordrecht), 5. Kluwer Academic Publishers, Dordrecht.

2. Davvaz, B., Dehghan-Nezhad and Benvidi A. (2012), *Chemical Hyperalgebra: Dismutation Reactions*, MATCH Commun. Math. Comput. Chem 67 (2012) 55-63.

3. Davvaz, B. (2013), *Polygroup Theory and Related System*, World Scientific Publishing Co., Singapore.

4. Davvaz, B. (2016), *Semihypergroup Theory*, Elsevier/Academic Press, London.

5. Davvaz, B. (2016), *Weak Algebraic Hyperstructures as a model for Interpretation of Chemical Reactions*, Iranian Journal of Mathematical Chemistry, Vol. 7, No. 2, 2016, 267-283.

6. Davvaz, B. (2020), *A brief survey on algebraic hyperstructures: Theory and applications*, Journal of Algebraic Hyperstructures and Logical Algebras, 1, 3, 15-29.

7. Davvaz, B., Dehghan Nezhad, A. and Moosavi Nejad, S. M. (2020), *Algebraic Hyperstructure of Observable Elementary Particles Including the Higgs Boson.* Proc. Natl. Acad. Sci., India, Sect. A Phys. Sci., 90, 169-176. https://doi.org/10.1007/s40010-018-0553-z

8. Davvaz, B., Nezhad, A. Dehghan and Heidari, M. M. (2013), *Inheritance examples of algebraic hyperstructures*, Inform. Sci. 224, 180-187.

9. Davvaz, B., and Vougiouklis, T. (2019), *A Walk Through Weak Hyperstructures Hv-Structures*, World Scientific Publishing Co. Pte. Ltd, Singapore.

10. Heidari, D., Mazaheri, D. and Davvaz, B. (2019), *Chemical Salt Reaction as Algebraic Hyperstructures*, Iranian J. Math. Chem. 10(2), 93-102.

11. International Union of Pure and Applied Chemistry. "Disproportionation", Compendium of Chemical Terminology Internet edition, http://en.wikipedia.org/wiki/Disproportionation.

12. Marty, F. (1934), *Sur une généralization de la notion de groupe, 8th Congress Math.* Scandenaves, Stockholm, 45-49.

13. Nezhad, A. D., Nejad, S. M. M., Nadja?khah, M. and Davvaz, B. (2012), *A physical example of algebraic hyperstructures: Leptons*, Indian J. Phys. 86 (11), 1027-1032.

14. Nezhad, A. D., Nejad, S. M. M., Nadjakhah, M. (2010), *The algebraic hyperstructure of elementary particles in physical theory*, arXiv:1008.0772 [math-ph].

15. Oyebola, O. O. and Jaiyéọlá, T. G. (2019), *Non-associative algebraic hyperstructures and their applications to biological inheritance*, Monografías Matemáticas García de Galdeano 42, 229-241.

16. Jaiyeola, T. G. and Ilori, K. G. and Oyeyemi, O. O. (2023), *On some non-associative Hyper-algebraic Structure*, Algebraic and Geometric Methods of Analysis, 52.

17. Usan, J. and Galic, R (2004), *On Hyperquasigroups*, Mathematica Moravica, 8, 1, 63-71.

18. Vougiouklis, T. (1994), *Hyperstructures and their representations*, Hadronic Press Monographs in Mathematics. Hadronic Press, Inc., Palm Harbor, FL.

3.4 On the Extension of Γ_1-Nonderanged Permutation Group

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Abstract

A Γ_1-non deranged permutation group $\mathcal{G}_p^{\Gamma_1}$ ($p \geq 5$ and $p = prime$) is a permutation group such that $\mathcal{G}_p^{\Gamma_1} = \{\omega_i | 1 \leq i \leq p-1\}$ where $\omega_i = \big((1)(1+i)_{mP}$ $(1+2i)_{mP} \ldots (1+(p-1)i)_{mP}\big)$. In this paper, an extension of $\mathcal{G}_p^{\Gamma_1}$ denoted by $\mathbb{G}_p^{\Gamma_1}$ is given in such a way that $\omega_p \in \mathcal{G}_p^{\Gamma_1}$ and an operation of addition '+' and multiplication '$\cdot$' is define on the extended version $\mathbb{G}_p^{\Gamma_1}$ to show that $\mathbb{G}_p^{\Gamma_1}$ together with either addition '+' or multiplication '$\cdot$' is an Abelian group. Also, the extended version ($\mathbb{G}_p^{\Gamma_1}$, '+', '$\cdot$') is both a commutative ring with identity and a vector space.

Keywords: Group, permutation group, nonderanged permutation group, commutative ring, vector space.

References

1. A. A. Ibrahim, O. Ejima, & K. O. Aremu, "On the Representations of Γ_1-Non deranged Permutation Group", Advances in Pure Mathematics **6** (2016) 608.

2. A. I. Garba, O. Ejima, K. O. Aremu, & H. Usman, "Non standard Young Tableaux of Γ_1 Non deranged Permutation Group", Global Journal of Mathematical Analysis **5** (2017) 21.

3. A. I. Garba, A. Yusuf, & A. Hassan, "Some Topological Properties of a Constructed Algebraic Structure", Journal of the Nigerian Association of Mathematical Physics **45** (2018) 21.

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3.5 On the Uniform Stability and Ultimate Boundedness of Solutions to a Class of Second-order Neutral Functional Differential Equations with Delay

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Abstract

This paper presents criteria for the asymptotic stability of the zero forcing term and, for a nonzero forcing term, boundedness of solutions to a class of neutral functional differential equations of order two using the direct method of Lyapunov. The equation is first reduced to a system of first-order differential equations, and then an appropriate Lyapunov's functional is obtained. This functional is used to establish conditions that ensure stability, uniform asymptotic stability of the zero solutions, and, for the nonzero forcing term, uniform boundedness and uniform ultimate boundedness of solutions for the discussed nonlinear neutral differential equation with delay. Special cases are provided to demonstrate the credibility and dependability of these results.

Keywords: Uniform stability, boundedness, second-order, neutral differential equation, Lyapunov functional.

References

1. A. T. Ademola, S. O. Akindeinde, B. S. Ogundare, M. O. Ogundiran, O. A. Adesina, On the stability and boundedness of solutions to certain second order nonlinear stochastic delay differential equations, *Journal of the Nigerian Mathematical Society,* **38**(2), (2019) 185 - 209.

2. A. T. Ademola, S. Moyo, B. S. Ogundare, M. O. Ogundiran and O. A. Adesina, Stability and boundedness of solutions to a certain second order non autonomous stochastic differential equation, *International Journal of Analysis,* **2016,** Article ID 2012315, (2016) 11 pages.

3. A. T. Ademola, B. S. Ogundare, M. O. Ogundiran and O. A. Adesina, Periodicity, stability, and boundedness of solutions to certain second order delay differential equations, *International Journal of Differential Equations,* **2016,** Article ID2843709, (2016) 10 pages.

4. O. A. Adesina, A. T. Ademola, M. O. Ogundiran, B. S. Ogundare, Stability, boundedness and unique global solutions to certain second order nonlinear stochastic delay differential equations with multiple deviating arguments, *Nonlinear Studies* **26**(1), (2019) 71 - 94.

5. S. M. Afonso, A. L. Furtado, Antiperiodic solutions for $nth-$order functional differential equations with infinite delay, *Electronic Journal of Differential Equations,* **2016**(44), (2016) 1 - 8.

6. A. R. Aftabizadela, S. Aizicovici, N. H. Pavel, On a class of second-order anti-periodic boundary value problems, *J. Math, Anal.,* **171,** (1992) 301 - 320.

7. A. R. Aftabizadeh, S. Aizicovici, N. H. Pavel, Anti-periodic boundary value problems for higher order differential equations in Hilbert spaces, *Nonlinear Anal.,* **18,** (1992) 253 - 267.

8. S. Aizicovici, N. H. Pavel, Anti-periodic solutions to a class of nonlinear evolution equations in Hilbert spaces, *J. Funct. Anal,* **99,** (1991) 387-408.

9. M. Bohner, S. R. Grace, I. Jadlovská, Oscillation criteria for second-order neutral delay differential equations, *Electronic Journal of Qualitative Theory of Differential Equations,* **2017**(60), (2017) 1 - 12; doi: 10.14232/ejqtde.2017.1.60.

10. A. Bouakkaz, A. Ardjouni, A. Djoudi, Existence of anti-periodic solutions for a second order neutral functional differential equation via Leary-Schauder's fixed point theorem, *Dynamics of Continuous, Discrete and Impulsive Systems Series A: Mathematical Analysis* **27,** (2020) 47 - 67.

11. B. Cahlon, D. Schmidt, Stability criteria for certain second order neutral delay differential equations, *Dynamic Systems and Applications,* **19,** (2010) 353-374.

12. G. Chen, O. Gaans, S. V. Lunel, Asymptotic behavior and stability of second order neutral delay differential equations, *Mathematical Institute, Leiden University, Leiden,* The Netherlands Report **MI-2013**-06, (2013) 1 - 18.

13. Y. Chen, J. J. Nieto, D. O'Regan, Anti-periodic solutions for fully nonlinear first-order differential equations, *Math. Comput. Modelling,* **46,** (2007) 1183 - 1190.

14. N. Ding, Anti-periodic solutions for a class of second order differential equations, *Applied Mathematical Sciences,* **7**(16), (2013) 791 - 798.

15. Q. Y. Fan, W. T. Wang, X. J. Yi, Anti-periodic solutions for a class of nonlinear $nth-$order differential equations with delays, *Journal of Computational and Applied Mathematics,* **230,** (2009) 762 - 769.

16. B. Liu, Anti-periodic solutions for forced Rayleigh-type equations, *Nonlinear Anal.,* **10,** (2009) 2850 - 2856.

17. B. S. Ogundare, A. T. Ademola, M. O. Ogundiran, O. A. Adesina, On the qualitative behaviour of solutions to certain second-order nonlinear differential equation with delay, *Ann Univ Ferrara,* (2016) 1 - 21. DOI 10.1007/s11565-016-0262-y.

18. S. Panigrahi, R. Basu Oscillation criteria for a forced second order neutral delay differential equation, *Functional Differential Equations,* **24**(1-2), (2017) 27 - 44.

19. Ch. G. Philos, I. K. Purnaras, An asymptotic result for second order linear nonautonomous neutral delay differential equations, *Hiroshima Math. J.* **40,** (2010) 47-63.

20. S. Ruan, Oscillations of second order neutral differential equations, *Canad. Math. Bull.* **36**(4), (1993) 485 - 496.

21. X. Tang, Existence and uniqueness of anti-periodic solutions for nonlinear higher order differential equations with two deviating arguments, *Advances in Dynamical Systems and Applications,* **7**(1), (2012) 129 - 143.

22. A. K. Tripathy, B. Panda, A. K. Sethi, On oscillatory nonlinear second order neutral delay differential equations, *Differential Equations & Applications,* **8**(2), (2016) 247 - 258 doi:10.7153/dea-08-12.

23. C. Tunç, A note on the stability and boundedness of nonautonomous differential equations of second order with a variable deviating argument, *Afrika Matematika,* **25**(2), (2014) 417 - 425.

24. C. Tunç, A note on the bounded solutions to $x''+c(t,x,x')+q(t)b(x) = f(t)$, *Applied Mathematics & Information Sciences,* **8**(1), (2014) 393 - 399.

25. C. Tunç, Boundedness analysis for certain two-dimensional differential systems via a Lyapunov approach, *Bulletin Mathematique de la Societe des Sciences Mathematiques de Roumanie,* **53**(1), (2010), 61 - 68.

26. C. Tunç, New results on the existence of periodic solutions for Rayleigh equation with state-dependent delay, *Journal of Mathematical and Fundamental Sciences,* **45**(2), (2013), 154 - 162.

27. C. Tunç, Stability and boundedness of solutions of nonautonomous differential equations of second order, *Journal of Computational Analysis and Applications,* **13**(6), (2011), 1067 - 1074.

28. C. Tunç, Uniformly stability and boundedness of solutions of second order nonlinear delay differential equations, *Applied and Computational Mathematics,* **10**(3), (2011) 449 - 462.

29. X. Wang, F. Meng, Oscillation criteria of second-order quasi-linear neutral delay differential equations, *Mathematical and Computer Modelling* **46,** (2007) 415-421.

30. A. F. Yeniçerioğlu, B. Demir, On the stability of second order neutral delay differential equation, *Beykent University Journal of Science and Engineering,* **5**(1-2), (2012) 109-129.

31. J. Zhang, Z. Jin, T. Su, J. Wang, Z. Zhang, J. Yan, On the nonoscillation of second order neutral delay differential equation with forcing term, *Discrete Dynamics in Nature and Society,* **2008,** Article ID 150163, 9 pages doi:10.1155/2008/150163.

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3.6 On Distributional Henstock-Kurzweil-Stieltjes-◊-Integral for Inner Product space-valued functions on Time scales

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Abstract

In this paper, the concept of time scales calculus is introduced in the study of distributional Henstock-Kurzweil-Stietljes integral in inner product space. Some of the basic properties of the distributional Henstock-Kurzweil-Stieltjes-◊-integral for inner product space-valued functions on time scales are stated and proved. Applications of fixed point theorems and Volterra integral equation are studied on time scales.

Keywords: Distributional, Henstock integral, Kurzweil integral, Stieltjes integral, inner product space, time scales.

References

1. D. A. Afariogun and A. A. Mogbademu, *Henstock-Kurzweil-Stieltjes-◊-Double integral for Gronwall-Bellman's Type Lemma on time scales*, Int. J. Nonlinear Anal. Appl. 14 (2023) 1, 833-841.
2. D. A. Afariogun, A. A. Mogbademu and B. O. Fagbemigun, *On l_p-Valued Functions for Henstock-Kurzweil-Stieltjes-⋄-Double Integrals on Time Scales*, Ajayi Crowther J. Pure Appl. Sci. (2023), 2(2), pp. 79-86.
3. S. Avsec, B. Bannish, B. Johnson, and S. Meckler, *The Henstock-Kurzweil delta integral on unbounded time scales*, Panamer. Math. J. No. 3, 16 (2006), 77-98.
4. A. Ben Amar, *Some fixed point theorems and existence of weak solutions of Volterra integral equation under Henstock-Kurzweil-Pettis integrability*, Comment. Math. Univ. Carolin., 52(2011), 177-190.
5. M. Bohner and A. Peterson, *Dynamic equations on time scales*, Birkhauser Boston, MA.(2001).
6. M. Federson and R. Bianconi, *Linear Volterra-Stieltjes integral equations in the sense of the Kurzweil-Henstock integral*, Arch. Math. (Brno), 37(2001), 307-328.
7. R. Henstock, *Theory of Integration.* Butterworths, London, (1968).
8. S. Hilger, *Ein MaB kettenkalkul mit Anwendung auf Zentrumannigfahigkeiten*, Ph.D. Thesis, Universtat Wurzburg, (1988).
9. J. Kurzweil, *Henstock-Kurzweil integration: its relation to topological vector space*, Series in Real Analysis, World Scientific Publishing Co., Inc., River Edge, NJ, (2000). 1.
10. W. Liu, G. Ye and D. Zhao, *The distributional Henstock-Kurzweil integral and applications II*, J. Nonlinear Sci. Appl., 10(2017), 290-298.
11. A. Peterson and B. Thompson, *Henstock-Kurzweil delta and nabla integrals*, J. Math. Anal. Appl., No. 1, 323 (2006), 162-178.
12. B. Satco, *Volterra integral inclusions via Henstock-Kurzweil-Pettis integral*, Discuss. Math. Differ. Inc. Control Optim., 26(2006), 87-101.
13. P. M. Soardi, *Existence of fixed points of nonexpansive mappings in certain Banach lattices*, Proc. Amer. Math. Soc. 73(1979), 25-29.
14. E. Talvila, *The distributional Denjoy integral*, Real Anal. Exchange, 33(2008), 51-82.

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3.7 On the Characterization of Some Variants of Inverse Properties in Conjugate Loop

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Abstract

A conjugate loop is a two-sided loop that obeys the identity $x(yx^{-1}) = (xy)x^{-1}$. In this work, necessary and sufficient(s) conditions for conjugate loop to possess variants of inverse property (left, right, weak, cross, automorphic, anti-automorphic) were established.

Keywords: Left, right, weak, cross, automorphic, anti-automorphic inverse properties, conjugate loop

References

1. Adéníran J. O. and Jaiyéọlá T. G. (2007), *On central loops and the central square property*, Quasigroups And Related Systems 14(2), 191–200.

2. Batool A, Shaheen A and Ali A. (2013), *An Introduction to Conjugate loops*, Internationa Mathematical Forum 8(5), 223–228.

3. Shumaila A. and Asif A. (2014), *On Multiplicative Conjugate loops*, Quasigroups and related Systems 22(2), 1–8.

4. Jaiyeola T. G. (2009), *A study of new concepts in smarandache quasigroups and loops*, ProQuest Information and Learning(ILQ), Ann Arbor, USA, 127pp.

5. Solarin A. R. T., Adeniran J. O., T. G. Jaiyéọlá, A. O. Isere and Y. T. Oyebo. *Some Varieties of Loops (Bol-Moufang and Non-Bol-Moufang Types).* In: Hounkonnou, M.N., Mitrovi, M., Abbas, M., Khan, M. (eds) Algebra without Borders ? Classical and Constructive Nonassociative Algebraic Structures. STEAM-H: Science, Technology, Engineering, Agriculture, Mathematics & Health. Springer, Cham. 2023. https://doi.org/10.1007/978-3-031-39334-1_3

3.8 On Semi-symmetric (α, β, γ)-inverse Quasigroup

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Abstract

A quasigroup $(Q, \cdot)$ will be called an (α, β, γ)-inverse quasigroup, if there exist fixed permutations α, β and γ of Q, such that $(x \cdot y)\alpha \cdot x\beta = y\gamma \ \forall \ (x, y) \in Q \times Q$. Examples were given to illustrate that a quasigroup can have more than one (α, β, γ)-inverse property. Consequently, for a set Δ_Q of such triples, it was shown that if the semi-symmetry law holds in $(Q, \cdot)$, it induces a binary operation on Δ_Q for which Δ_Q is a group. Interestingly, this leads to an isomorphism between Δ_Q and the autotopism group of $(Q, \cdot)$.

Keywords: Weak, cross, m-, (r, s, t)-, (α, β, γ)-, inverse properties, semi-symmetric.

References

1. Ilemobade, R., George, O. and Jaiyeola, T. G., *On the universality and isotopy-isomorphy of (r, s, t)-inverse quasigroups and loops with applications to cryptography.* Quasigroup and Related Systems **31**(2023), 53-64.

2. Jaiyéọlá, T. G., *A study of new concepts in smarandache quasigroups and loops*, ProQuest Information and Learning(ILQ), Ann Arbor, USA, 2009.

3. Keedwell, A. D. and Shcherbacov, V. A., *Quasigroups with an inverse property and generalized parastrophic identities*, Quasigroups and Related Systems **13**(2005), 109 − 124.

4. Pflugfelder, H. O., *Quasigroups and loops: Introduction,* Sigma Series in Pure Math. **7,** Heldermann Verlag, Berlin. 1990.

5. Shcherbacov, V. A., *Elements of quasigroup theory and applications.* Monographs and Research Notes in Mathematics. CRC Press, Boca Raton, FL, 2017.

6. Solarin, A. R. T., Adeniran, J. O., Jaiyéọlá, T. G., Isere, A. O. and Oyebo, Y. T., *Some Varieties of Loops (Bol-Moufang and Non-Bol-Moufang Types)*. In: Hounkonnou, M. N., Mitrovi, M., Abbas, M., Khan, M. (eds) Algebra without Borders Classical and Constructive Nonassociative Algebraic Structures. STEAM-H: Science, Technology, Engineering, Agriculture, Mathematics & Health. Springer, Cham. 2023. https://doi.org/10.1007/978-3-031-39334-1_3

3.9 Partial Differential Formulation of Covid-19

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Abstract

Inspired by the second Fick's law in physics and following Fisher's equation, we formulate a reaction-Diffusion Partial Differential Equations(PDE) Model to predict the Spatio-Temporal spread of the Covid-19 epidemic. The formulated seird model has the condition that the susceptible class is subject to logistic growth in the absence of the disease and on introduction of a time-delay from the susceptible class s to the infective class i, seird is transformed to an sird model which is then analyzed. First we prove the existence and boundedness of solutions and investigated their long-time behaviour, and show that the trivial equilibrium E_0 is always unstable, also that for $R_0 < 1$ and $R_0 \leq 1$ that the disease free equilibrium E_f is locally and globally stable asymptotically stable respectively, finally for $1 < R_0 \leq 3$ and $R_0 > 1$ that the endemic equilibrium is locally and globally asymptotically stable respectively.

Keywords: Susceptible class, infective class, long-time behaviour, equilibrium.

3.10 On the Operator Fourier Transform of the Harish-Chandra Scwartz Algebra

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Abstract

We establish a $K-$type decomposition of the Harish-Chandra Schwartz algebra $\mathcal{C}^p(G)$, for any real-rank 1 reductive group G with a maximal compact subgroup K and $0 < p \leq 2$. This decomposition is then used to give an infinite-matrix-realization of the operator Fourier image $\mathfrak{F} : \mathcal{C}^p(G) \to \mathcal{C}^p(\hat{G})$ of $\mathcal{C}^p(G)$ as a Frechet multiplication algebra in which every member of $\mathcal{C}^p(\hat{G})$ consists of a countable block-matrices of the form

$$((\mathfrak{F}_B(\vec{\alpha})_{(\gamma,m)}(\Lambda) \otimes \mathfrak{F}_H(\vec{\alpha})_{(\gamma,l)}(Q : \chi : \nu))_{\gamma \in F,(l,m)\in\mathbb{Z}^2})_{F\subset\hat{K},|F|<\infty}$$

for every $\alpha \in \mathcal{C}^p(G)$. This proves Trombi's conjecture for G of real rank 1 and the technique leads to a proof of the fundamental theorem of harmonic analysis for any arbitrary real-rank reductive group G..

Keywords: Reductive groups, Harish-Chandra Schwartz algebra, operator Fourier transform, $K-$type decomposition.

References

1. Arthur, J. G., *Harmonic analysis of tempered distributions on semisimple Lie groups of real rank one,* Ph.D. Dissertation, Yale University, 1970.

2. Arthur, J. G., *Harmonic analysis of the Schwartz space of a reductive Lie group,* I. II. (preprint, 1973).

3. Barker, W. H., The spherical Bochner theorem on semisimple Lie groups, *J. Funct. Anal.,* vol. **20** (1975), pp. 179 – 207.

4. Barker, W. H., Positive definite distributions on unimodular Lie groups, *Duke Mathematical Journal,* vol. **43** No. **1**,, (1976), pp. 71 – 79.

5. Barker, W. H., Tempered invariant, positive-definite distributions on $SU(1,1)/\{\pm 1\}$, *Illinois J. Maths*, vol. **28**, no. 1, (1984), pp. 83 – 102.

6. Dixmier, J., Opérateurs de rang fini dans les représentations unitaires, *Publ. math. de l' Inst. Hautes Études Scient.,* tome **6** (1960), pp. 13 – 25.

7. Godement, R. A., A theory of spherical functions, *I. Trans. Amer. Math. Soc.,* vol. **73** (1952), pp. 496 – 556.

8. Godement, R. A., Introduction aux travaux de A. Selberg, *Séminaire Bourbaki* No. **144** Paris (1957).

9. Helgason, S., *"Differential Geometry, Lie Groups and Symmetric Spaces,"* Academic Press, New York, 1978.

10. Helgason, S., *"Groups and Geometric Analysis; Integral Geometry, Invariant Differential Operators, and Spherical Functions,"* Academic Press, New York, 1984.

11. Helgason, S. and Johnson, K., The bounded spherical functions on symmetric spaces, *Advances in Math,* **3** (1969), pp. 586-593.

12. Kahane J.-P., Sur un théorème de Wiener-Lévy, *C.R. Acad. Sc., Paris,* t. **246**, (1958), pp. 1949 – 1951.

13. Oyadare, O. O., Non-spherical Harish-Chandra Fourier transforms on real reductive groups, *J. Fourier Anal. Appl.* **28**, 15 (2022) http://doi.org/10.1007/s00041-09906-w

14. Trombi, P. C. and Varadarajan, V. S., Spherical transforms on semisimple Lie groups, *Ann. of Math.,* **94** (1971), pp. 246 – 303.

15. Varadarajan, V. S., The theory of characters and the discrete series for semisimple Lie groups, in *Harmonic Analysis on Homogeneous Spaces,* (C.C. Moore (ed.)) *Proc. of Symposia in Pure Maths.,* vol. **26** (1973), pp. 45 – 99.

16. Varadarajan, V. S., *"An introduction to harmonic analysis on semisimple Lie groups,"* Cambridge University Press, Cambridge, 1989.

3.11 Existence of Fixed Points via C^*-Algebra-Valued Simulation Functions

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Abstract

In this paper, the ideas of C^*-algebra-valued simulation functions and some corresponding fixed point results are discussed. It is noted that the notions studied in this work unify, complement and generalize a handful of related concepts in the literature.

Keywords: C^*-algebra, C^*-algebra-valued metric space, C^*-algebra-valued simulation function, fixed point.

References

1. Browder, F .E., Petrysyn, W. V. (1966). The solution by iteration of nonlinear functional equation in Banach spaces. Bulletin of American Mathematical Society, 72,571-576.

2. Chatterjea, S. K. (1972). Fixed-point theorems. Dokladi na Bolgarskata Akademiya na Naukite, 25(6), 727-735.

3. Congcong S., Lining J. and Zhenhua M. (2018). C^*-algebra-valued G-metric spaces and related fixed-point theorems. Journal of Function Spaces, Volume 2018, Article ID 3257189, 8 pages.

4. Khojasteh, F., Shukla, S., and Radenovic, S. (2015). A new approach to the study of fixed point theory for simulation functions. Filomat, 29(6), 1189-1194.

5. Ma, Z. H., Jiang, L. N. and Sun, H. K (2014). C^*-algebras-valued metric spaces and related fixed point theorems. Fixed Point Theory and Applications, 2014:206.

6. Ma, Z. H., and Jiang, L. N. (2015). C^*-algebras-valued $b-$metric spaces and related fixed point theorems. Fixed Point Theory and Applications, 2015:222.

7. Murphy, G. J. (1990). C^*- algebras and operator theory. Academic Press, Inc., Boston, MA x.

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3.12 On Fixed Point Results of Hybrid $F-$contractive Operators

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Abstract

The survey of available literature shows that most fixed point results in generalized metric spaces correspond with their equivalent ones in metric or quasi-metric spaces. To provide an interesting research in these spaces, this paper employs a recent method for analysing fixed point findings in $G-$metric space to introduce a novel concept called Jaggi-type hybrid $(\phi - F)-$contraction and establish some fixed point results for this class of contractions in the framework of generalized metric space. Some special cases of the results obtained herein with respect to the corresponding literature are highlighted and discussed.

Keywords: $F-$contraction, $G-$metric, fixed point, hybrid contraction.

References

1. Alghamdi, M. and Karapinar, E. (2013). $(G-\beta-\psi)$-contractive Type Mappings in G-Metric Spaces. Journal of Applied Analysis and Computation, 11(1), 101-112.

2. Chen, J., Zhu, C. and Zhu, L. (2021). A Note on Some Fixed Point Theorems on G-Metric Spaces. Journal of Applied Analysis and Computation, 11(1), 101-112.

3. Dhage, B.C. (1992). Generalized metric space and mapping with fixed point. Bulletin of Calcutta Mathematical Society, 84, 329-336.

4. Fabiano, N., Kadelburg, Z., Mirkov, N., Čavič, V. S and Radenović, S. (2022). On $F-$Contractions: A Survey. Contemporary Mathematics, 327-342.

5. Jiddah, J. A., Mohammed, S. S., Alansari, M., Mohamed, S. K. and Bakery, A. (2022). Fixed Point Results of Jaggi-Type Hybrid Contraction in Generalized Metric Space. Journal of Function Spaces, vol 2022, Article ID 2205423.

6. Jiddah, J. A., Mohammed, S. S. S. and Imam, A. T. (2023). Advancements in fixed point results of generalized metric spaces: A Survey. Sohag Journal of Sciences, 8(2), 165-198.

7. Jleli, M. and Samet, B. (2012). Remarks on G-metric Spaces and Fixed Point Theorems. Fixed Point Theory and Applications, 2012:210.

8. Joshi, V. and Jain, S. (2021). G-Metric Spaces: From the Perspective of F-contractions and best proximity points. In Metric Structures and Fixed Point Theory (pp. 103-148). Chapman and Hall/CRC.

9. Karapinar, E. and Fulga, A. (2019). A Hybrid Contraction that Involves Jaggi Type. Symmetry, 11(715).

10. Mustafa, Z. and Sims, B. (2006). A New Approach to Generalized Metric Spaces. Journal of Nonlinear and Convex Analysis, 7(2), 289-297.

11. Mustafa, Z., Obiedat, H. and Awawdeh, F. (2008). Some Fixed Point Theorem for Mapping on Complete G-metric Spaces. Fixed Point Theory and Applications, vol. 2008, Article ID 189870, 12 Pages, DOI: 10.1155/2008/189870.

12. Mustafa, Z.; Khandaqji, M. and Shatanawi, W. (2011). Fixed point results on complete G-Metric spaces. Studia Science Mathematica Hungaria, 48, 304-319.

13. Ogbumba, R. O., Shagari, M. S., Alansari, M., Khalid, T. A., Mohamed, E. A. and Bakery, A. A. (2023). Advancements in Hybrid Fixed Point Results and F-Contractive Operators. Symmetry, 15(6), 1253.

14. Piri, H. and Kumam, P. (2014). Some Fixed Point Theorems Concerning F-contraction in Complete Metric Spaces. Fixed Point Theory and Applications, 2014(1), 210.

15. Samet, B., Vetro, C. and Vetro, F. (2013). Remarks on G-Metric Spaces. International Journal of Analysis, vol 2013, Article ID: 917158.

16. Singh, D., Joshi, V., Singh, N. and Kumam, P. (2017). Fixed Point Results for Generalized F-contractive and Roger Hardy type F-contractive Mappings in G-metric Spaces.

17. Shatanawi, W. (2010). Fixed Point Theory for Contractive Mappings Satisfying Φ-Maps in G-Metric Spaces. Fixed Point Theory and Applications, Volume 2010, Article ID 181650, 9 pages, DOI:10.1155/2010/181650.

18. Wardowski, D. (2012). Fixed Points of a New Type of Contractive Mappings in Complete Metric Spaces. Fixed Point Theory and Applications, 2012(1), 94.

3.13 On Fixed Point of Quasi Contraction With Application to Integral Equation

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Abstract

It is observed from the surveyed literature that there is no sufficient study of quasi-weakly contractive operators in the context of $b-$metric-like spaces. From this background information, this paper introduces a new unified notion of quasi-weakly contractive operator in $b-$metric-like space and examines the existence and uniqueness of invariant points of such operators. The idea put forward herewith subsumes a few known results in the literature. A few corollaries which reduce our findings to other famous ideas are presented and discussed.

Keywords: Fixed point, $b-$metric-like, integral equation.

References

1. Y. Aber, D. S. Guerre, Principles of weakly contractive maps in Hilbert spaces, I Lyubich, Yu(eds), Oper. Theory Adv. Appl., 98, (2011) pp. 7-12.

2. A. Aghaiani, M. Abbas and J. R. Roshan, Common fixed point of generalized weak contractive mappings in partially ordered $b-$metric spaces, Math. Slovaca, 2014 (2014), pp. 941-960.

3. M. A. Alghamdi, N. Hussain and P. Salimi, Fixed point and coupled fixed point theorem on $b-$metric-like spaces, J. Inequal. Appl., 2013 (2013).

4. A. Amini-Harandi, Metric-like spaces, partial metric spaces and fixed points, Fixed Point Theory Appl., 2012 (2012).

5. I. Bakhtin, The contraction mapping principle in quasi metric spaces, Funct. Anal. Appl., 30 (1989), pp. 26-37.

6. K. P. Chi, E. Karapinar, T. D. Thanh, On the fixed point theorems for generalized weakly contractive mappings on partial metric spaces, Bull. Iranian Math. Soc., 39(2) (2013), pp. 369-381.

7. S. Cho, Fixed point theorems for generalized weakly contractive mappings in metric spaces with application, Fixed Point Theory Appl., 2018(3) (2012).

8. L. B. Ciri´c, A generalization of Banach's contraction principle, Proc. Amer. Math. Soc., 45(2) (1994), pp. 267-273.

9. S. Czerwik, Contraction mappings in $b-$metric spaces, Acta Math. Univ. Ostrav., 1(1) (1993), pp. 5-11.

10. S. Gähler, $2-$metrische Räume und ihre topologische Struktur, Math. Nachr., 26(1-4) (1963), pp. 115-148.

11. R. George, M. Houas, M. Ghaderi, S. Rezapour and S. K. Elagan, On a coupled system of pantograph problem with three sequential fractional derivatives by using positive contraction-type inequalities, Results in Phys., 39 (2022), pp. 105-687.

12. R. George, F. Al-shammari, M. Ghaderi and S. Rezapour, On the boundedness of the solution set for the $\psi-$Caputo fractional pantograph equation with a measure of non-compactness via simulation analysis, AIMS Math., 8(9) (2023), pp. 20125-20142.

13. Z. Heydarpour, M. N. Parizi, R. Ghorbnian, M. Ghaderi, S. Rezapour and A. Mosavi, A study on a special case of the Sturm-Liouville equation using the Mittag Leffler function and a new type of contraction. AIMS Math., 7(10) (2022), pp. 18253-18279.

14. Y. Hoa and H. Guan, On some common fixed point results for weakly contraction mappings with application, J. Funct. Spaces, 2021 (2021), pp. 14.

15. L. G. Huang and X. Zhang, Cone metric spaces and fixed point theorems of contractive mappings, J. Math. Anal. Appl., 332(2) (2007), pp. 1468-1476.

16. N. Hussain, J. R. Roshan, V. Parvaneh, and Z. Kadelburg, Fixed points of contractive mappings in $b-$metric-like spaces, Sci. World J., (2014), pp. 15.

17. G. Jungck, Compartible mappings and common fixed points, Int. J. Math. Sci., 9, (1986), pp. 771-779.

18. S. G. Matthews, Partial metric topology, Annals New York Acad. Sci., 728 (1994), pp. 183-197.

19. Z. Mustaf and B. Sims, A New Approach to Generalized Metric Spaces, J. Nonlinear Convex Anal., 7(2) (2006), pp. 289-297.

20. M. Noorwali and M. S. Shagari, On two-point boundary value problems and fractional differential equations via new quasi-contractions, Math., 11(1) (2023), pp. 2477.

21. E. Karap?nar, T. Abdeljawad and F. Jarad, Applying new fixed point theorems on fractional and ordinary differential equations, Adv.Differ Equ., 2019(1) (2019), pp. 1-25.

22. S. Shukla, Partial $b-$metric spaces and fixed point theorems, Mediterr. J. Math., (2013).

23. R. Chiroma, M. S. Shagari and J. A. Jiddah, On fixed point of quasi contraction with application to integral equation, Sahand Communications in Mathematical Analysis, (Accepted)

24. W. A. Wilson, On quasi-metric spaces, Amer. J. Math., 53 (1931), pp. 675-684

3.14 Fixed Point Results of Hardy-Rogers-Type Contraction in Generalized Metric Space via Interpolation

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Abstract

In this manuscript, a new concept of interpolative contraction, namely interpolative Hardy-Rogers-type (G-μ)-contraction is introduced and some fixed point results in generalized metric space that are not deducible from their akin in metric space are obtained. The preeminence of this class of contractions is that it complements and subsumes a few corresponding notions in the literature. Consequently, substantial examples are constructed to validate the assumptions of our obtained theorems and to show their distinction from corresponding results.

Keywords: G-metric, fixed point, Hardy-Rogers contraction, interpolation.

References

1. Abbas, M., Khan, S. H. and Nazir, T. (2011). Common fixed points of R-weakly commuting maps in generalized metric spaces. Fixed Point Theory and Applications, Volume 2011, Article ID 41(2011), 11 pages, DOI:10.1186/1687-1812-2011-41.

2. Chen, J., Zhu, C. and Zhu, L. (2021). A Note on Some Fixed Point Theorems on G-Metric Spaces. Journal of Applied Analysis and Computation, 11(1), 101-112.

3. Jiddah, A. J., Alansari, M., Mohamed, O. S. K., Shagari, M. S. and Bakery, A. A. (2022). Fixed Point Results of Jaggi-Type Hybrid Contraction in Generalized Metric Space. Journal of Function Spaces, vol. 2022, Article ID: 2205423, DOI: 10.1155/2022/2205423.

4. Jiddah, A. J., Noorwali, M., Shagari, M. S., Rashid, S. and Jarad, F. (2022). Fixed Point Results of a New Family of Hybrid Contractions in Generalized Metric Space with Applications. AIMS Mathematics, 7(10), 17894-17912, DOI: 10.3934/math.2022986

5. Jleli, M. and Samet, B. (2012). Remarks on G-metric Spaces and Fixed Point Theorems. Fixed Point Theory and Applications, 2012:210.

6. Karapınar, E. and Agarwal, R. P. (2013). Further Fixed Point Results on G-metric Space. Fixed Point Theory and Applications, 2013:154.

7. Karapınar, E., Alqahtani, O. and Aydi, H. (2018). On Interpolative Hardy-Rogers Type Contractions. Symmetry, 11(8), 7 pages.

8. Manro, S., Bhatia, S. S. and Kumar, S. (2010). Expansion Mapping Theoremsin G?Metric Spaces. International Journal of Contemporary Mathematical Sciences, 5(51), 2529 - 2535.

9. Mustafa, Z. (2005). A New Structure For Generalized Metric Spaces - With Applications To Fixed Point Theory, PhD Thesis, The University of Newcastle, Australia, 2005.

10. Mustafa, Z. and Sims, B. (2006). A New Approach to Generalized Metric Spaces. Journal of Nonlinear and Convex Analysis, 7(2), 289-297.

11. Mustafa, Z., Obiedat, H. and Awawdeh, F. (2008). Some Fixed Point Theorem for Mapping on Complete G-metric Spaces. Fixed Point Theory and Applications, vol. 2008, Article ID 189870, 12 Pages, DOI: 10.1155/2008/189870

12. Samet, B., Vetro, C. and Vetro, F. (2013). Remarks on G-Metric Spaces. International Journal of Analysis, Volume 2013, Article ID: 917158, 6 pages.

13. Noorwali, M. (2018). Common Fixed Point for Kannan Type Contractions via Interpolation. Journal of Mathematical Analysis, 9(6), 92-94.

14. Shagari, M. S., Rashid, S., Jarad, F. and Mohamed, M. S. (2022). Interpolative Contractions and Intuitionistic Fuzzy Set-Valued Maps with Applications. AIMS Mathematics, 7(6), 10744-10758.

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3.15 On Stability, Controllability and Feedback Control of Nonlinear Autonomous Systems

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Abstract

We review the Lyapunov - Razumihkin method employed in the theory of Stability and Controllability of Nonlinear autonomous systems. The results of the stability analysis were obtained using the Lyapunov indirect approach to examine the local stability of the equilibrium point using Jacobian linearization.

Keywords: Controllability, feedback control, Lyapunov indirect method.

References

1. Cotterell S. T., Davies I. and Abraham L. C. (2020) : Stability and controllability of nonlinear systems, Asian Research Journal of Mathematics, Vol. 16, No. 2, pp. 51-60.

2. Cotterell S. T., Davies I. and Abraham L. C., Amadi E. H. (2020): Stability and feedback control of nonlinear systems, International
Journal of Control Science and Engineering 2020, 10(1), pp. 11-15

3. Davies I. (2006): Euclidean Null Controllability of Infinite Neutral Differential Systems, Anziam Journal 48, pp. 285-294.

4. Davies I. and Oliver H. (2015): Null Controllability of Neutral System with Infinite Delay, European journal of control systems, vol. 26,
pp. 28-34.

5. Dikko D. A. (2017), MAT 256: Modeling Lecture Note, Department of Mathematics, University of Ibadan.

6. Hale J., Verduyn Lunel M.S. (1993): Introduction to functional differential equations.

7. Jerzy Zabczyk (2010) : Mathematical Control Theory: An Introduction (Systems & Control: Foundations & Applications) 2nd Edition.

8. J. Klamka (2000): Schauder's fixed-point theorem in nonlinear controllability problems, Control and Cybernetics, vol. 29 No. 1.

9. Karl J. Astrom, Richard M. Murray (2006): Feedback Systems: An Introduction for Scientists and Engineers.

10. Khalil H.K. (2002): Nonlinear systems 3rd Edition, Prentice Hall, Upper Saddle River.

11. Liu W-C., Zhang S-G. (2017): Variable Gradient Approach to Construct Lyapunov Function for Judging Stability of Non-Linear Systems.

12. Pukdeboon C.(2011): A Review of Fundamentals of Lyapunov theory, The Journal of Applied Science, vol. 10, no. 2, pp. 55-61.

13. R. M. Murray, Z. Li and S. S. Sastry (1994) : A Mathematical Introduction to Robotic Manipulation."

14. Robert D. Gahl (1978) : Controllability of Nonlinear Systems of Neutral type Journal of Optimization Theory and Applications 63, pp. 33-42.

15. Richard C. Dorf, Robert H. Bishop (2018): Modern Control Systems Thirteenth Edition.

16. Seyed K. Y. N. (2012): Nonlinear systems stability analysis; Lyapunov based approach.

17. Slottine J-J. E. and Weiping Li (1991): Applied Nonlinear Control.

18. Sontag E. D (1998): Mathematical Control Theory: Deterministic Finite Dimensional Systems.

19. Trevor M. F. (2007): Linear Time Invariant System and Control Theory.

20. Vidyasagar M. (1978): Nonlinear System Analysis Second Edition, Prentice Hall, Englewood Cliffs.

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3.16 On the Full Scalar-Valued Bochner Theorem on Real Reductive Groups

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Abstract

The major results of Barker leading to the spherical Bochner theorem and its (spherical) extension, were possible through the spherical transform theory of Trombi-Varadarajan and were greatly restricted by the non-availability of the full (non-spherical) Harish-Chandra Fourier transform theory on a general connected semisimple Lie group, G. Sequel to the recently announced results of Oyadare where the full image of the Schwartz-type algebras, $\mathcal{C}^p(G)$, under the full scalar-valued Fourier transform is computed as $\mathcal{C}^p(\widehat{G}) := \{(\widehat{\xi_1})^{-1} \cdot h \cdot (\widehat{\xi_1})^{-1} : h \in \bar{\mathcal{Z}}(\mathfrak{F}^\epsilon)\}$ with $\bar{\mathcal{Z}}(\mathfrak{F}^\epsilon)$ given as the Trombi-Varadarajan image of $\mathcal{C}^p(G//K)$ $(0 < p \leq 2)$, the present paper gives the full scalar-valued Bochner theorem for G by lifting the earlier results of Barker to full non-spherical status. An extension of the Bochner theorem to all of $\mathcal{C}^p(G)$, $1 \leq p \leq 2$, is then established. It is also conjectured that every positive-definite distribution T on G which corresponds to a Bochner measure μ on $\mathfrak{F}^\epsilon$ extends uniquely to an element of $\mathcal{C}^p(G)'$ if and only if T can be expressed as a finite sum of derivatives of a class of functions exclusively parameterized by members of $\mathfrak{F}^\epsilon$ and $supp\ (\mu) \subset \mathfrak{F}^\epsilon$ (with $\epsilon = (\frac{2}{p}) - 1$ for $1 \leq p \leq 2$). This gives the non-spherical abstract version of the extension theorem for any positive-definite distribution on G. Our results confirm the one-to-one correspondence between tempered invariant positive-definite distributions and the Bochner measures of the case $SU(1,1)/\{\pm 1\}$ (as

earlier computed by Barker) for all G.

Keywords: Spherical Bochner theorem, Tempered invariant distributions, Harish-Chandra's Schwartz algebras.

References

1. Arthur, J. G., *Harmonic analysis of tempered distributions on semisimple Lie groups of real rank one,* Ph.D. Dissertation, Yale University, 1970.

2. Arthur, J. G., *Harmonic analysis of the Schwartz space of a reductive Lie group,* I. II. (preprint, 1973).

3. Barker, W. H., The spherical Bochner theorem on semisimple Lie groups, *J. Funct. Anal.,* vol. **20** (1975), pp. 179 – 207.

4. Barker, W. H., Positive definite distributions on unimodular Lie groups, *Duke Mathematical Journal,* vol. **43** No. **1**,, (1976), pp. 71 – 79.

5. Barker, W. H., Tempered invariant, positive-definite distributions on $SU(1,1)/\{\pm 1\}$, *Illinois J. Maths*, vol. **28**, no. 1, (1984), pp. 83 – 102.

6. Dixmier, J., Opérateurs de rang fini dans les représentations unitaires, *Publ. math. de l' Inst. Hautes Études Scient.,* tome **6** (1960), pp. 13 – 25.

7. Godement, R. A., A theory of spherical functions, *I. Trans. Amer. Math. Soc.,* vol. **73** (1952), pp. 496 – 556.

8. Godement, R. A., Introduction aux travaux de A. Selberg, *Séminaire Bourbaki* No. **144** Paris (1957).

9. Helgason, S., *"Differential Geometry, Lie Groups and Symmetric Spaces,"* Academic Press, New York, 1978.

10. Helgason, S., *"Groups and Geometric Analysis; Integral Geometry, Invariant Differential Operators, and Spherical Functions,"* Academic Press, New York, 1984.

11. Helgason, S. and Johnson, K., The bounded spherical functions on symmetric spaces, *Advances in Math,* **3** (1969), pp. 586-593.

12. Kahane J.-P., Sur un théorème de Wiener-Lévy, *C.R. Acad. Sc., Paris,* t. **246**, (1958), pp. 1949 – 1951.

13. Oyadare, O. O., Non-spherical Harish-Chandra Fourier transforms on real reductive groups, *J. Fourier Anal. Appl.* **28**, 15 (2022) http://doi.org/10.1007/s00041-09906-w

14. Trombi, P. C. and Varadarajan, V. S., Spherical transforms on semisimple Lie groups, *Ann. of Math.,* **94** (1971), pp. 246 – 303.

15. Varadarajan, V. S., The theory of characters and the discrete series for semisimple Lie groups, in *Harmonic Analysis on Homogeneous Spaces,* (C.C. Moore (ed.)) *Proc. of Symposia in Pure Maths.,* vol. **26** (1973), pp. 45 – 99.

16. Varadarajan, V. S., *"An introduction to harmonic analysis on semisimple Lie groups,"* Cambridge University Press, Cambridge, 1989.

3.17 Fourier Transform of Schwartz Algebras on Groups in the Harish-Chandra Class

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Abstract

It is well-known that the Harish-Chandra transform, $f \to Hf$, is a topological isomorphism of the spherical (Schwartz) convolution algebra $\mathcal{C}^p(G//K)$ (where K is a maximal compact subgroup of any arbitrarily chosen group G in the Harish-Chandra class and $0 < p \leq 2$) onto the (Schwartz) multiplication algebra $\bar{\mathcal{Z}}(\mathcal{F}_\epsilon)$ (of $\mathfrak{w}$-invariant members of $\mathcal{Z}(\mathcal{F}_\epsilon)$, with $\epsilon = (2/p) - 1$). This is the Trombi and Varadarajan theorem. Also the full Harish-Chandra Plancherel formula on G is known for all of $\mathcal{C}^2(G) =: C(G)$. In order to then understand the structure of Harish-Chandra transform more clearly and to compute the image of $\mathcal{C}^p(G)$ under it (without any restriction) we derive an absolutely convergent series expansion (in terms of known functions) for the Harish-Chandra transform by an application of the full Plancherel formula on G. This leads to a computation of the image of $\mathcal{C}(G)$ under the Harish-Chandra transform which is seen as a concrete realization of Arthur's result and is easily extended to all of $\mathcal{C}^p(G)$ in much the same way as it is known in the work of Trombi and Varadarajan.

Keywords: Spherical Bochner theorem, tempered invariant distributions, Harish-Chandra's Schwartz algebras.

References

1. Arthur, J. G., *Harmonic analysis of tempered distributions on semisimple Lie groups of real rank one,* Ph.D. Dissertation, Yale University, 1970.

2. Arthur, J. G., *Harmonic analysis of the Schwartz space of a reductive Lie group,* I. II. (preprint, 1973).

3. Barker, W. H., The spherical Bochner theorem on semisimple Lie groups, *J. Funct. Anal.,* vol. **20** (1975), pp. 179 – 207.

4. Barker, W. H., Positive definite distributions on unimodular Lie groups, *Duke Mathematical Journal,* vol. **43** No. **1**,, (1976), pp. 71 – 79.

5. Barker, W. H., Tempered invariant, positive-definite distributions on $SU(1,1)/\{\pm 1\}$, *Illinois J. Maths*, vol. **28**, no. 1, (1984), pp. 83 – 102.

6. Dixmier, J., Opérateurs de rang fini dans les représentations unitaires, *Publ. math. de l' Inst. Hautes Études Scient.,* tome **6** (1960), pp. 13 – 25.

7. Godement, R. A., A theory of spherical functions, *I. Trans. Amer. Math. Soc.,* vol. **73** (1952), pp. 496 – 556.

8. Godement, R. A., Introduction aux travaux de A. Selberg, *Séminaire Bourbaki* No. **144** Paris (1957).

9. Helgason, S., *"Differential Geometry, Lie Groups and Symmetric Spaces,"* Academic Press, New York, 1978.

10. Helgason, S., *"Groups and Geometric Analysis; Integral Geometry, Invariant Differential Operators, and Spherical Functions,"* Academic Press, New York, 1984.

11. Helgason, S. and Johnson, K., The bounded spherical functions on symmetric spaces, *Advances in Math,* **3** (1969), pp. 586-593.

12. Kahane J.-P., Sur un théorème de Wiener-Lévy, *C.R. Acad. Sc., Paris,* t. **246**, (1958), pp. 1949 – 1951.

13. Oyadare, O. O., Non-spherical Harish-Chandra Fourier transforms on real reductive groups, *J. Fourier Anal. Appl.* **28**, 15 (2022) http://doi.org/10.1007/s00041-09906-w

14. Trombi, P. C. and Varadarajan, V. S., Spherical transforms on semisimple Lie groups, *Ann. of Math.,* **94** (1971), pp. 246 – 303.

15. Varadarajan, V. S., The theory of characters and the discrete series for semisimple Lie groups, in *Harmonic Analysis on Homogeneous Spaces,* (C.C. Moore (ed.)) *Proc. of Symposia in Pure Maths.,* vol. **26** (1973), pp. 45 – 99.

16. Varadarajan, V. S., *"An introduction to harmonic analysis on semisimple Lie groups,"* Cambridge University Press, Cambridge, 1989.

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3.18 A Fixed Point Theorem of Quasi-Contraction in C^*-Algebra-Valued Metric

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Abstract

The concept of C^*-algebra is of great importance in quantum theory and statistical mechanics. A lot of work has been done in efforts to refine the well known Banach contraction principle in C^*-algebra valued metric space. However, none of these investigations has attempted to establish Quasi contraction in aforementioned notions. In the present paper, we propose this idea in C^*-algebra valued metric space and prove a fixed point theorem in such space. The result obtained in this work extends a few corresponding ones in the corresponding literature.

Keywords: Metric spaces, C^*-algebra valued metric spaces, fixed point, quasi contraction.

References

1. Batul S. and Kamran T. (2015). C^*-valued contractive type mappings. J. Fixed point theory and appl., 142.

2. Ciric L. B. (1974). A generalization of banach?s contraction principle. Proc. Amer. Math. Soc.,45:267-273.

3. Douglas R. G. (1998). Banach algebra techniques in operator theory. Spring. Berlin.

4. Dung N. V. and Hang V. T. (2016). On relaxations of contraction constants and caristi?s theorem in b-metric spaces. J. Fixed Point Theory Appl.

5. Kari A., Rossafi M., and Massati H. (2021). Some fixed point theorems on C^*-algebra valued rectangular quasi-metric spaces. J. Math. Comput. Sci., 11(6):7459-7475.

6. Ma Z., Jiang L. and Sun H. (2014) C^*-algebra valued metric spaces and related fixed point theorems. J. Fixed point theory and appl, 206:1-11.

7. Massit H. and Rossafi M. (2021). Fixed point theorem for (ϕ, f)-contraction on C^*-algebra valued metric spaces. Eur. J. Math. Appl.

8. Murphy G. J.(1990). C^*-Algebras and Operator Theory. Academic Press, London.

9. Sakai C. (1971) C^*-algebras and W^*-algebras. Springer-Verlag Berlin Heidelberg, New York.

10. Umudu J.C., Olaleru J. O. and Mogbademu A. A. (2020). Fixed point results for Geraghty quasi-contraction type mappings in dislocated quasi-metric spaces. J. Fixed point theory and appl, 16(2020).

11. Zamfirescu T.(1972). Fixed point theorems in metric spaces. Arch. Math. (Basel), 298:292-298.

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3.19 Common Fixed Points of Enriched Contractions in Banach Spaces

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Abstract

This paper presents comprehensive study on the existence and uniqueness of fixed point and common fixed points for general class of enriched contractions in Banach spaces. We prove some fixed point theorems as well as common fixed point theorems for these general class of enriched contraction definitions, using Jungck-Schaefer and other iterative techniques. Having in mind, the wide range of applicability of Banach contraction principle and some of its generalizations and extensions, this paper gives a more robust contraction conditions, in respect of V. Berinde *et al.* [6]. Our results generalize and extend results of Banach [2], Jungck [8], Akram *et al.* [1], Olatinwo *et al.* [13], Berinde *et al.* [6], and many other related results in the literature.

Keywords: Enriched Akram-Jungck contraction, Jungck-Schaefer iteration, positively homogeneous function, common fixed point and Banach spaces.

References

1. Akram, M., Zafar, A. A. and Siddiqui, A. A. (2008); A general class of contractions; A-contractions, Novi Sad J. Math., 38. No1, 25-33.

2. Banach, S. (1922); Sur les Operations dans les Ensembles Abstraits et leur Application aux quations intrales, Fundamenta Mathematicae 3, 133-181.

3. Berinde, V. (2007); Iterative approximation of fixed points, Editura Efemeride.

4. Berinde, V. (2018); Weak and strong convergence theorems for the Krasnoselskij iterative algorithm in the class of enriched strictly pseudocontractive operators, An. Univ. Vest Timis. Ser. Mat-Inform., 56, No. 2, 13-27.

5. Berinde, V. (2019); Approximating fixed points of enriched nonexpansive mappings in Banach spaces by using a retraction-displacement condition. Carpathian J. Math., 36, No. 1, 27-34.

6. Berinde, V. and Pacurar, M. (2020); Approximating fixed points of enriched contractions in Banach spaces, J. Fixed Point Theory Appl., (22) No 2, Paper 38, 10 pp.

7. Chatterjea, S. K. (1972); Fixed-point theorems, C. R. Acad. Bulgare, Sci., 10, 727-730.

8. Jungck, G. (1976); Commuting mappings and fixed points, Amer. Math. Monthly, 83, 261-263.

9. Jungck, G. (1986); Compatible mappings and common fixed points, Int. J. Math. and Math Sci., 9 771 - 773.

10. Kannan, R. (1968); Some results on fixed points. Bull Calcutta Math. Soc. 10, 71-76.

11. Maia, M. G. (1968); Un'osservazione sulle contrazioni metriche, Rend. Sem. Mat. Univ. Padova, 40, 139 - 143.

12. Olatinwo, M. O. (2012); Convergence results for Jungck-type iterative processes in convex metric spaces, Acta Univ. Palacki. Olomuc., Fac. rer. nat., mathematica 51, 1(2012) 79-87.

13. Olatinwo, M. O. and Omidire, O. J. (2016); Fixed point theorems of Akram-Banach type, Nonlinear analysis forum 21(2), pp. 55-64.

14. Olatinwo, M. O. and Omidire, O. J. (2020); Convergence results for Kirk-Ishikawa and some other iterative algorithms in arbitrary Banach space setting, Transactions on Mathematical Programming and Applications, Vol 8, No. 1, 01-11.

15. Olatinwo, M. O. and Omidire, O. J. (2021); Convergence of Jungck-Schaefer and Jungck-Kirk-Mann iterations to the unique common fixed point of Jungck generalized pseudo-contractive and Lipschitzian type mappings, Journal of Advanced Math. Stud. 14(1).

16. Olatinwo, M. O. and Omidire, O. J. (2022); Some new convergence and stability results for Jungck generalized pseudo-contractive and Lipschitzian type operators using hybrid iterative techniques in the Hilbert spaces. Springer Journals; Rendiconti del Circolo Matematico di Palermo Series 2.

17. Rajeev K. (2016);On convergence of Jungck Type iteration for certain contractive conditions,International Journal of Engineering and Science. 6, No 4, 102-105.

18. Rakotch, E. (1962); A note on contractive mappings, Proc. Amer Math. Soc. 13, 459-465.

19. Singh, S. L., Bhatnagar, C., Mishra, S. N. (2005); Stability of Jungck-type iterative procedures. International J. Math. Math. Sci. 19, 3035-3043.

20. Singh, S. L.,Hematulin, A. and Pant, R. (2009); New coincidence and common fixed point theorems. Applied General Topology (c) Universidad Politecnica de Valencia, Vol. 10, No. 1, pp. 121 - 130.

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3.20 On Continuous Dependence of the Fixed Point for Modified Kirk-Mann Iterative Process in Banach Spaces

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Abstract

Let E be a Banach space and T be a self map defined on E satisfying certain contractive conditions. In 2008 Olatinwo introduced a Kirk-Mann type iterative process and employed it to obtain some results on continuous dependence of the fixed point of T. For $x_0 \in E$, define the sequence $\{x_n\}_{n=0}^{\infty}$ by

$$x_{n+1} = \sum_{i=0}^{k} \alpha_{n,i} T^i x_n, \quad n = 0, 1, 2, \cdots, \ \sum_{i=0}^{k} \alpha_{n,i} = 1$$

$\alpha_{n,i} \geq 0$, $\alpha_{n,0} \neq 0$, $\alpha_{n,i} \in [0,1]$, where k is a fixed integer.
In this paper, we introduce and employed a more general Kirk-Mann type iterative process to obtain some results on continuous dependence of fixed point, and also remove the constraint that $\sum_{i=0}^{k} \alpha_{n,i} = 1$.

Keywords: Kirk-Mann type iterative process, continuous dependence, fixed point.

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