KAMPALA INTERNATIONAL UNIVERSITY

EXPLORING THE HEIGHTS

1ST WORKSHOP AND INTERNATIONAL CONFERENCE ON COMPUTATIONAL FLUID DYNAMICS AND MATHEMATICAL MODELLING (WICCOMM)

SCHOOL OF MATHEMATICS AND COMPUTING, KAMPALA INTERNATIONAL UNIVERSITY, KAMPALA, UGANDA

6th -7th February, 2023

Book of Abstracts

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Programme and Abstracts

Hon. John Chrysestom Muyingo
Minister for State Education

Prof. Mouhamad Mpezamihigo
Vice Chancellor

Theme:

Mathematical Integration of Scientific Research, Innovation, and Technology for Sustainable Development

- *The Chief Guest, the Honourable Minister for State Education, Hon. Dr. J.C. Muyingo*
- *Chairman, Board of Trustees*
- *DVCs*
- *Dean, School of Mathematics and Computing*
- *Other Deans, and Principals*
- *Heads of Departments*
- *Keynote and Guest Speakers*

- *Chairman, Local Organizing Committee*
- *Representatives from sister universities present.*
- *Members of the conference, Local Organizing Committee*
- *Distinguished participants*
- *Ladies and Gentlemen*

Welcome to Kampala International University, Uganda and our 1st workshop and international conference on computational fluid dynamics and mathematical modelling. This is an extraordinary opportunity for us to collaborate and affect the direction of sustainable development through computation and mathematical modelling.

I want to express my gratitude to the organizers of the 1st Workshop and International Conference on Computational Fluid Dynamics and Mathematical Modeling (WICCOMM 2023) for inviting me to speak and serve as the conference's Chief Host. This conference offers an avenue for interacting with academics, postgraduate students, mathematicians, industry and members of the general public.

As many of you may know, the conference's theme is "Computational Fluid Dynamics Advances and Applications," Let me hope that the discussions will focus on how best to leverage on scientific research, innovation, and technology. and to learn about new developments in this sphere of knowledge. Maximize your networks in this conference through paper presentations, , connection for potential future partnerships and collaborations. Please socialize as much as you can and fee at home at KIU.

Maths and relevance

Mathematics is a vital tool for advancing science, technology, and innovation. Formulation, computation, and calculation are three crucial approaches frequently used in science and technology to produce the necessary outcomes supporting advancements in these fields. It is also true that without scientific and technological advancements, no nation can significantly increase its citizens' standard of living. Mathematics plays a considerable role in our daily life.

For example, it aids in development in several various ways. Basically, Math is used often in everyday life, and graphs and other mathematical symbols are frequently used to illustrate information. Advanced mathematics is extensively utilized in specialized industries like architecture, computing, and engineering. In contrast, elementary mathematics has applications in our

daily lives, including time management, budgeting, and planning and one needs to be numerate and computer literate to function successfully and efficiently in these fields in today's worldwide society.

The process of industrialization greatly benefits from mathematics. This position is evident, but as we advance into the future, it has to be valued much more. However, it is essential to remember that the creation of novel mathematical models to address a range of social and economic issues will always go hand in hand with advancing cutting-edge computer systems and technology. Pure mathematicians should keep this in mind when they create their theories. In the coming decades, I anticipate a period in which math will be used to simulate and predict various economic development processes.

I take this opportunity to warmly welcome all our guests to the leading private University in Uganda and in the East Africa Region. Enjoy the best of Kampala and Uganda in general. I wish you a successful conference.

Prof M. Mpezamihigo

Vice-Chancellor

Key Note Speaker

Professor O. D. Makinde

(MFR, FAAS, FIAPS)

Oluwole Daniel Makinde is a distinguished Professor of Applied & Computational Mathematics at the Faculty of Military Science, Stellenbosch University, South Africa. He is also a visiting distinguished Professor to several other Universities within and outside African continent. Before joining Faculty of Military Science, Stellenbosch University, Professor Makinde already worked as a Senior Professor and Chair of Postgraduate Studies and the founding Director of the Institute for Advanced Research in Mathematical Modelling and Computations at the Cape Peninsula University of Technology, South Africa (2008–2013) and Full Professor and Head of the Applied Mathematics Department at the University of Limpopo, South Africa (1998–2008).

Professor Makinde is the recipient of the 2014 Nigerian National Honour Award titled the Member of the Order of the Federal Republic (MFR) for his outstanding contribution to basic science, technology and innovation by His Excellency the President of Nigeria. He is the winner of the prestigious 2011/2012 African Union Kwame Nkrumah Continental Scientific Award from African Heads of State for outstanding contributions to basic science, technology and innovation in Africa; the winner of the South African National Science and Technology Forum and the National Research Foundation (NRF) 2009/2010 T.W.

MY Research Website with Scientific Metrics	
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Kambule Senior Researcher Award for outstanding contributions to science, engineering, technology and innovation in South Africa; the winner of the Best Senior Research Scientist Award at the University of Limpopo (1999–2007); the winner of the Best Senior Research Scientist Award at the Cape Peninsula University of Technology (2008–2012); the winner of the 2014 and 2015 Highly Commendable Published Papers Award from Emerald Group Publishing (UK); the winner of the 2015 most outstanding reviewer award from Emerald Group Publishing (UK); the winner of the Research Scientist Award at the Faculty of Military Science, Stellenbosch University (2016–2021); the winner of Stellenbosch University 2019 Chancellor Award for outstanding research excellence, the winner of 2021 Obada Prize for Distinguished International Researcher Award and winner of 2022 African Mathematical Union and Pan African Congress of Mathematician Award for outstanding research contributions to mathematics, its applications and mentorship.

He also won several distinctions, scholarships, fellowships, prizes, grants and awards. Professor Makinde received a prestigious Fellow of the African Academy of Sciences (FAAS) for outstanding contributions to science, innovation and technology in Africa (2012).

He was also awarded a Fellow of the International Academy of Physical Sciences (FIAPS) for his outstanding contributions to the field of mathematical sciences (2018) and a Fellow of the Papua New Guinea Mathematical Society for outreach contributions (2013) to the development of mathematical sciences research in Papua New Guinea. Professor Makinde is on the editorial board of several reputable academic journals such as the *Journal of Applied Mathematics*, *Afrika Matematika*, *Journal of Nanofluids*, *Journal of the Nigerian Mathematical Society*, *The Open Chemical Engineering Journal*, *Physica Scripta*, *Revue des Composites et des Matériaux Avancés, Advanced in Mechanical Engineering*, *PLOS ONE, etc.,* and also served as a reviewer for many reputable international academic journals worldwide and for the South African National Research Foundation. He is the lead guest editor of two special issues, titled "New developments in fluid mechanics and its engineering applications" published in the journal *Mathematical Problems in Engineering* (2013) and "Nonlinear fluid flow and heat transfer" published in the journal *Advances in Mathematical Physics* (2014).

In 2017, Professor Makinde edited two research books titled "*Advances in Nonlinear Heat Transfer in Fluids and Solids*" (*Diffusion foundations* Vol. 11) and *"New Development for Heat Transfer*

in Solids and Fluid Flow" (*Defect and diffusion forum* Vol. 377), published by Trans Tech Publications, Switzerland. In 2018 and 2020, he also edited research books titled *"Fluid Mechanics and Heat Transfer in Applied Engineering"*(*Diffusion Foundations* Vol. 16, and Vol. 26) and "*Computational Analysis of Heat Transfer in Fluids and solids I and II*" (*Defect and Diffusion Forum* Vol. 387 and Vol. 401) published by Trans Tech Publications, Switzerland. Recently in 2021, Prof Makinde edited another research textbooks titled *"Engineering Fluid Flows and Heat Transfer Analysis"* (*Defect and Diffusion Forum* Vol. 409). In addition, Prof. Makinde authored four University Applied Mathematics textbooks and monographs and published over 600 high impact research papers in several reputable international journals.

His present scientific metrics (http://scholar.google.co.za/citations?user=00NF_EwAAAAJ&hl=en**) according to Google Scholar research database** shows **H-Index = 70, Citations Index = 21660, i10-index = 418**. These bibliometric statistics still continue to increase due to the global impact of his outstanding research work.

Prof. Makinde is listed globally as one of the year 2022 (https://research.com/u/oluwole-daniel-makinde) top engineering and technology scientists. He organised several conferences, workshops and symposia within and outside the African continent and delivered keynote research papers at several national and international conferences and workshops worldwide. He has an extensive record of research and academic collaboration with several faculties and universities in countries such as Kenya, Ethiopia, Ghana, South Africa, Zimbabwe, Tanzania, Namibia, Nigeria, Botswana, India, Algeria, Iran, Pakistan, Germany, the United Kingdom, the USA, Saudi Arabia, Egypt, Bangladesh, Papua New Guinea and China.

His research covers a broad range of topics, including fluid mechanics, nanofluid dynamics, heat and mass transfer, hydrodynamic stability, dynamical systems, thermal science, combustion theory, bio-mathematics and epidemiological modelling, computational mathematics and improved perturbation techniques.

His research in the area of computational mathematics has generated a new approach to tackling nonlinear problems that model real systems. The main objective of his research is to use mathematical theories and methodologies to gain insights into the dynamics of various engineering and biological systems that are of

industrial, environmental, medical and social interest. Professor Makinde's research has contributed immensely to the upliftment of many scholars in the field of mathematical science research and postgraduate training. He has taught, supervised and mentored several students at undergraduate, postgraduate and postdoctoral levels.

He has supervised over 42 PhDs, 73 MSc and 200 BSc (Hons) candidates in the field of Applied Mathematics and Computations across the African continent and served in several high-level academic management and administrative positions. He also served as an external examiner for many universities within and outside the African continent.

He is a member of the International Association of Engineers (http://www.iaeng.org/membership.html). Professor Makinde is presently the Vice-President African Mathematical Union for Southern Africa region (2022–2026). He served as the Secretary General of the African Mathematical Union (2009–2017), the vice-president and general secretary of the Southern African Mathematical Sciences Association (2002–2006), a founding academic advisory board member of the African Institute for Mathematical Sciences (2003–2005), an associate member of the International Centre for Theoretical Physics (2000–2005) and an associate member of the National Institute of Theoretical and Computational Sciences (NITheCS) in South Africa.

Plenary Speakers

Prof Abba B. Gumel (F-AMS, F-SIAM, F-ASI, F-AAS, F-NAS)

The Michael and Eugenia Brin Endowed E-Nnovate Chair in Mathematics Department of Mathematics, University of Maryland,

Professor O.M. Bamigbola

Professor O.M. Bamigbola is a faculty member at the University of Ilorin, Ilorin, Nigeria. His research Interest is in the broad area of computational mathematics, encompassing optimization, numerical analysis, and analysis, modeling, and computing He has taken part in collaborative research at home and abroad. On the Google Scholar Web, his research effort is credited with 230 citations and an h-index of 8 and an i-index of 7. He received the International Mathematical Union Commission Award. For the Developing Countries Volunteer Lecturer Program at Kampala International University, Kampala, Uganda (2020), Scholarship Award, International Congress of Industrial and Applied Mathematicians, Valencia, Spain (2019), and European Mathematical Society—Simons for Africa Grant for collaborative research visit to the University of Kansas, Lawrence, USA (2018) He has successfully supervised 17 PhD theses and 31 master's dissertations. Professor Bamigbola is on the Board of Trustees of Crawford University, Igbesa, Ogun State, Nigeria. He is happily married with children.

PETER, PhD **Chairman, LOC** B. A.

Professor, TWAS-UNESCO Associates
Chairman, Local Organizing CommitteeWICCOMM, Kampala International University, Uganda

(Mathematics & Computational) benjamin.aina@kiu.ac.ug

Prof Peter is an academic lecturer passionate about teaching and has 11 years of expertise managing instruction and classroom procedures independently and with department, faculty and leaders. Laying the groundwork for the future of academia and the workforce is a professor who values his students and is skilled in differential equations, modelling, and computational techniques.

AWARDS

- TWAS Fellowship for Research & Advanced Training in conjunction with the Department of Mechanical Engineering, DUT, South Africa, 2021.
- TWAS-UNESCO Associateship Scheme 2022 in collaboration with the Department of Mathematics, University of Ilorin.
- International Mathematical Union (IMU) and the Commission for Developing Countries (CDC) project grant 2022
- I was awarded a Chebyshev grant from ICM to St. Petersburg, Russia, for ICM 2022, July 5 to July 15, 2022.
- I was selected for the African Mathematical Union grant from ICTP to Brazzaville for PACOM August 1-7, 2022..

Scientific Committee

- Prof O.D. Makinde, Faculty of Military Science, Stellenbosch University, South Africa
- Prof Abba B. Gumel, Department of Mathematics, University of Maryland, USA
- Prof O.M. Bamigbola, Department of Mathematics, University of Ilorin, Nigeria
- Associate Prof B.A. Peter,

Kampala International University, Uganda

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- Dr Abullahi Ibrahim
- Dr. Mohammed Baba Abdullahi
- Dr. Ibrahim Abdullahi
- Dr Kimuli

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3.5 A Modified Meningitis Transmission Model and Its Dynamics

3.6 Fuzzy Fractional Mathematical Model of Monkeypox Disease Considering Fomite Transmission

Arrivals	5th February, 2023	LOC, Secretariat
Day One	**6th February, 2023**	
Time	-Activity Chair: Dr. Kayero, Kawiso, Dr. Ibrahim Babangida and Dr Balagadde	
08:00-09:00	Registration	Secretariat
08:30-09:00	Health Break	All
09:00-10:30	Opening Ceremony	Library 5th floor
09:00-09:05	Welcome remarks by the Host	Chairman, LOC
09:05-09:10	Welcome remarks by SOMAC	HOD, Mathematics & Statistics
09:10-09:20	Remarks by Directorate of Research and Innovation	DVC RICE
09:20-09:30	Remarks by Directorate of Academic Affairs	DVC AA
09:30-09:40	Remarks by Directorate of Finance and Administration	DVC F&A
09:40-09:50	Remarks by Kampala International University	Vice Chancellor
09:50-10:00	Official Opening by Guest of Honor	State Minister for Education
10:00-10:30	Group photo	All
	Venue A: Senate Board Room	Chair: Assoc. Prof B.A. Peter
10:30-11:30	Keynote Speaker	Prof O.D. Makinde
11:30-12:30	Plenary Speaker	Prof O.M. Bamigbola
	Venue A: Senate Board Room	Venue B: Library 5th floor

	Chair: Prof Julius Mugisha	Chair: Prof Mango
12:30-12:50	R. L. Monaledi	
12:50-13.10	E. O. Sangotayo	
13:10-13:30	E. O. Adeyefa	
13:30-14:00	Lunch	All
	Venue A: Senate Board Room	Venue B: Library 5th floor
	Chair: Prof Hamisu Musa	Chair: Prof
14:00-14:20	D. O. Adams	Mohammed B. Abdullahi
14:20-14:40	S.K. Amhmad	J. A. Akingbade
14:40-15:00	Bashiru Abdullahi	Mohammed B. Abdullahi
15:00-16:00	Plenary Speaker	Prof Abal B.Gumel
16:20-16:40	B. A. Peter and S.A. Idowu	U. Ojimadu
16:40-17:00	Hamza Shuaibu	Free slot
Day Two	**7th February, 2023**	
	Venue A: Chair: Prof O.D. Makinde	Venue B: Chair: Prof
09:00-10:00	Computational Fluid Dynamics	Prof B.A.Peter
10:00-10:20	B. B. Abubakar	Aminu T. F.
10:20-11:00	Health Break	All
11:00-11:20	Mohammed S. Lawal	Mohammed B. Abdullahi
11:20-11:40	Abdullahi Ahmed	Mohammed B. Abdullahi
11:40-12:00	B. A. Peter and S.A. Idowu	Free slot
12:00-12:20	Abdulsalam Shuaibu	Free slot
12:20-12:40	Hamisu Musa	Free slot
12:40-13:00	Abubakar Isah	Free slot
13:00-14:00	Lunch	All
	Venue A: Chair: Associate Prof B.A. Peter	
14:00-15:00	Mathematical Software	Prof O.D. Makinde
15:00-16:00	Questions and answer	
16:00-16:20	Questions	
16:20-17:00	Closing Ceremony	LOC
17:00-18:00	Conference Dinner	LOC

Venue A

2.1 Computational Modelling of Unsteady Nanofluid Convection in a Heated Porous Microchannel: An Exploitation of Method of Lines

Professor Oluwole Daniel Makinde

Abstract

In various engineering and industrial processes, finding effective solutions to heat transfer problems in fluid flow has become a crucial part of new product development, reliability and effective operation of the system. Therefore, efficient thermal management is very obligatory in order to avoid overheating and achieve functional success. The advent of nanofluids ensuing from nanotechnology has provided a major improvement in engineering heat transfer processes and cooling technologies. In this talk, a computational modelling and analysis of unsteady variable viscosity nanofluid convection in microchannel with heat and mass transfer characteristics is presented. The nonlinear model partial differential equations are obtained and tackled numerically via method of lines. This method refers to the numerical analysis for partial differential equations that proceeds by first discretizing the spatial derivatives only and leaving the time variable continuous. This leads to a system of ordinary differential equations to which a numerical method for initial value ordinary equations such as Runge-Kutta-Fehlberg integration scheme is applied. The effects of various emerging thermophysical parameters on the nanofluid velocity, temperature and concentration profiles, including skin friction, Nusselt number and Sherwood number are presented graphically and quantitatively discussed.

Keywords: Unsteady flow; Porous microchannel; Nanofluid; Heat and mass transfer; Method of lines; Runge-Kutta-Fehlberg integration scheme

2.2: Modelling of Power Flow on Electric Transmission Lines

O.M. Bamigbola

Department of Mathematics, University of Ilorin, Ilorin

Abstract

Many phenomena and processes in real-life that affect human existence and well-being are usually studied with the use of mathematical models. In electrical

engineering, mathematical modelling plays prominent roles in knowledge generation and application. It also aids formulation of sound policies in electric power system. By treating a transmission line as a collection of infinitesimal lumped closed circuits and applying relevant laws, the flow of power on electric transmission lines evolved in the form of as one-dimensional hyperbolic partial differential equations. The models were simulated using data obtained from a typical transmission station to predict power losses on different transmission lines. Eventually, the strategies to apply to keep power losses to the minimum on transmission lines were revealed on application of the classical optimization technique.

2.3 Thermal Decomposition of Variable Viscosity Couette Flow of Nanofluids in a Microchannel - A Mathematical Model

R. L. Monaledi* and O. D. Makinde

Faculty of Military Science, Stellenbosch University, Private Bag X2, Saldanha 7395, South Africa.

Abstract

Couette flow of nanofluid refers to the laminar flow of disperse nanometer-sized metallic or non-metallic particles in the base fluid between two parallel plates, one of which is moving relative to the other. Flow of this nature is extremely important to the field of tribology in understanding the underlying complex dynamics that occurs during hydrodynamic lubrication process as well as coolant dynamics in engineering systems. In this paper, a computational model for Couette flow and heat transfer capability of a variable viscosity water based nanofluid containing Copper nanoparticles is examined. The nonlinear single-phase nanofluid model is tackled numerically using shooting method with Runge-Kutta-Fehlberg integration scheme. Effects of various emerging thermophysical parameters on the overall flow structure with heat transfer and inherent irreversibility are displayed graphically and discussed.

Keywords: Couette flow; Water; Copper nanoparticles; Variable viscosity; Radiative heat; Entropy analysis

2.4 Determination of the influence of the Prandtl number on Flow and Heat Transfer in a Cylinder Filled with Cu-Water Nanofluid

[1]E. O. Sangotayo*, [2]B. A. Peter, [3]J.O. Ogidiga

[1,3]Department of Mechanical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.[1]eosangotayo@lautech.edu.ng, & [3]joel.ogidiga@yahoo.com

[2]Department of Mathematics and Statistics, Kampala International University, Uganda

benjamin.aina@kiu.ac.ug (corresponding author)

Abstract

Nanoparticles improve the performance of convective heat transfer in the boundary layer flow zone. The Prandtl number is crucial for regulating the momentum and thermal boundary layers. This study focuses on analyzing the effects of the Prandtl number on flow and heat transfer in a cylinder containing Cu-Water nanofluid with varying concentrations of nanoparticles. Using the finite difference method, continuity and Navier Stoke fields were discretized and simulated in the C++ computer language. The Prandtl number varied between 6.0 and 12, and the concentration of Cu nanoparticles varied between 1% and 10%; the results are displayed as Nusselt number, vorticity, and stream function profiles. The results indicate that the highest Prandtl value is 9.56 at a nanoparticle volume of 0.04, resulting in a considerable increase in the convective heat transfer rate with a maximum Grashof number of 2.76 x 10^6 and a reduction in the Prandtl number as the nanoparticle volume increases. In addition, when the Prandtl number increases, the Nusselt number in the nanofluid decreases exponentially and the local drag coefficient rises. The fluid's stream function, rotation, and circulation increase as its Prandtl number increases. Therefore, fluids with a Prandtl number in the lower spectrum have strong thermal conductivity and are free-flowing, and the medium with a lower Prandtl value is suitable for a heat-conducting liquid.

Keywords: Nanofluid; Cylinder; Numerical; simulation; finite-difference-method; Prandtl-number

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2.5 An Improved Model for Direct Integration of System Higher Order Initial Value Problems

[1]Adeyefa E. O. and [2*]Olanegan O. O.

[1]Department of Mathematics, Federal University Oye-Ekiti, Ekiti State, Nigeria

[2*]Department of Statistics, Federal Polytechnic Ile-Oluji, Ondo State, Nigeria

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Abstract

This article focuses on the development of a numerical method that can be used to numerically approximate higher-order differential equations with initial value problems (IVPs). The proposed 2-point implicit method constructed by collocation and interpolation procedure was used to integrate system of third, and fourth differential equations directly with a substantial enhancement in proficiency. The proposed method derived in a block mode to simultaneously estimate three kind of differential equations through the incorporation of the first and second derivatives of the discrete method to improve the accuracy and rate of convergence in problem evaluations. The basic characteristics, including order, zero-stability, and convergence of the proposed method was established. The proposed method was used to solve some systems of equations for third and fourth-order as numerical experiments to check the favorable performance of the method in comparison to some existing method

Keywords: Block Method, Collocation, Convergence, Higher-order ODE, Interpolation,

AMS Classification: 65L05, 65L06

2.6 Boundedness Results for Solutions of Certain Second Order Non-Autonomous Ordinary Differential Equations

Daniel Oluwasegun Adams

Department of Mathematics, Federal University of Agriculture, Abeokuta, Nigeria

Abstract

We shall consider the second order non-autonomous nonlinear ordinary differential equations: a(t)x 00 + b(t)f(x, x0) + c(t)[g(x 0) + m(x)]h(x 0) = p(t, x, x0) and (a(t)x 0) 0 + b(t)f(x, x0) + c(t)[g(x 0) + m(x)]h(x 0) = p(t, x, x0), where a, b, c, f, g, m, h and p are real valued functions which depend at the most on the argument displayed explicitly. In this research, different forms of integral inequalities and two forms of mean value theorem for integrals will be used to investigate the boundedness of all solutions and their derivatives. Mathematics Subject Classification 2010: 34C11 Key Words and Phrases: boundedness; nonlinear; second order; integral inequalities;

differential equations

2.7 MHD Free-Convective Couette flow in a Vertical Porous Microchannel Using Non- Linear Boussinesq Approximation

[1]Samaila K. Amhmad, [2]Basant k. Jha, [2,3]Ayyub M. Hussaini, [2,4]Muhammad M. Altine

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Abstract

An analytical solution for free convection flow of an electrically conducting fluid in a vertical micro-porous-channel, in the existence of transversely applied magnetic-field and nonlinear Boussinesq approximation is carried out in this article. The governing equations representing stated objective are obtained and solved analytically using method of undetermiend coefficients and direct integration. Pictorial and tabularlar representions of solutions obtained are carried out, so as to ascertain the role of various governing parameters entering flow formation. During the course of numerical simulation of results, it is found that the volumetric flow rate increases with increase in Couette flow parameter, asymmetric heating parameter and suction/injection parameter but decreases with increase in nonlinear Boussinesq approximation parameter.

Key-words: Free convection; Microchannel; MHD; nonlinear Boussinesq approximation parameter; Couette flow; Porous channel; Vertical channel.

2.8 Convective Boundary Condition; A Tool For Heat Transfer Control in MHD Flow Within Radiative Porous Channels

[1]Bashiru Abdullahi, [2]Isah Bala Yabo, [3]Ibrahim Saidu

[1] Department of Mathematics Abdu Gusau Polytechnic Talata Mafara Zamfara State, Nigeria

[2] Department of Mathematics Usmanu Danfodiyo University Sokoto, Nigeria

[3] Department of Information Technology Usmanu Danfodiyo University Sokoto, Nigeria

Corresponding email: malbashmaf@yahoo.com

Abstract

In this research, the steady and transient MHD heat transfer within a radiative porous channel due to convective boundary conditions are considered. The solution of the steady-state and that of the transient version were conveyed by Perturbation and Finite difference methods respectively. The results established were discussed with the help of a line graph. In the research, the heat transfer mechanism ascertains the influence of Biot number), magnetizing parameter, radiation parameter, temperature difference (,), suction/injection, Grashof number , and time on velocity , temperature, skin friction, and Nusselt number . The research shows that the steady-state solution was in perfect agreement with the transient version for a significant value of time t and the heat transfer rate within the channel is significantly been influenced by the convective (Biot number) parameter. It is also found that an upturn in M leads to a decline in velocity and skin friction while an upsurge in R and leads to an increase in velocity, temperature, and skin friction. In addition, the outcomes are in agreement with the existing literature by direct appraisal.

Keywords: convective boundary condition, heat transfer, thermal radiation, porous channel, steady, and transient

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2.9 Electro-Kinetic Flow of Third Grade Tangent Hyperbolic Fluid with Radiative Heat through a Porous Medium

B. A. PETER[1], S.A. IDOWU[2]

[1] Department of Mathematics and Statistics, Kampala International University, Uganda

[2] Olabisi Onabanjo University, Ago-Iwoye, Nigeria

Abstract

This current paper investigates third grade tangent hyperbolic fluid with radiative heat, variable viscosity and variable thermal conductivity through a porous medium. The fluid viscosity and thermal conductivity are temperature-dependent. The differential equations governing the fluid flow are derived and tackled numerically by employing Maple 18 Software package, Finite Difference technique, C++ programming language and Garlekin weighted residue technique. Increase in the values of Electro-Kinetic parameter, activation energy parameter, radiation parameter and third grade material parameter consequently increase the local Nusselt number and skin friction coefficient. The effects of Electro-Kinetic parameter, activation energy parameter, radiation parameter and third grade material parameter on the fluid temperature and velocity distributions are explained in detail.

Keywords: Porous media, Non-Newtonian fluids, Viscosity, Thermal conductivity, Radiant energy, Reactive flows, Petroleum, Thermodynamic states and processes.

2.10 Insight into the Fluid Flow of Sensitized Chemical Kinetic Exponent in a Vertical Channel Under Newtonian Heating

Abdulsalam Shuaibu*, Audu O. Umar, Lawal. Shehu .F. and Godwin Ojemeri
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Abstract

In the current work, we examine free convective slip flow between two vertical walls caused by convective heating of the left wall in steady and unsteady state magnetohydrodynamics with chemical kinetic exponent. After transforming the governing equation from dimensional form to dimensionless form homotopy perturbation method (HMP) were employed to solve the steady state governing

equation. While the implicit finite difference strategy is used in a numerical approach to solve the time-dependent governing equation. Line graphs were used to discuss the consequences of different flow characteristics that entered the problem, such as the Hartmann number, Navier slip parameter, reaction parameter, chemical kinetic exponent, local Biot number. The results showed that, when the Hartman number is changed, a small rise in the Hartman number triggers the Lorentz force, which streamlines the momentum boundary layer, slowing the flow .Additionally, it was discovered that the chemical kinetic exponent (m) considerably improves the temperature and velocity gradients in the situation of sensitize (-2), where the fluid velocity and temperature are larger. Additionally, a comparison of the steady state and the unsteady solution has been done, and the results indicate great agreement

2.11 **Numerical Solution for Second Order Linear Integro Diferential Equations using Polynomial Collocation Method**

B. B. Abubakar , A. O. Adesanya, O. R. Odekunle, and H. U. Waniyos

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Abstract

In this study, an operational matrix is used to find an approximate solution to second order linear integro-differential equations under mixed conditions using polynomial basis function. The methods convert the integro differential equations in to systems of linear algebraic equations with unknown coefficients. Combining these matrix equations and solving the systems of equations gives the coefficient of the solution function. Uniqueness and convergence of the method is established, numerical examples were solved and compared with different approaches considered in literature to test accuracy and efficiency of the method in handling integro differential equations with high degree of accuracy in errors obtained.

Keywords: Integro-diferential equations, Operational matrix, Collocation

method, Polynomials.

2.12 **Unsteady CFD Simulation of Hydrogen Leakage and Dispersion Under Forced Ventilation Condition**

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Abstract

This study simulates hydrogen leakage and dispersion under forced ventilation condition of the homogenous charged compression ignition engine (HCCI) laboratory, Mechanical Engineering Department, University College London. The 3-D modeling employed the STAR-CD CFD code to simulate hydrogen gas leaks and subsequent dispersion based on airflow configuration of the test laboratory. The approach was first to obtain steady state solution, and then run unsteady simulation to investigate the time dependent nature of the problem. Additionally, unsteady simulation was employed to model gradual shut down of the leak source after detection. Consistent results were obtained with the standard and Reynolds Stress turbulence models (RSM). However, only results from the unsteady simulation resolved in more detail, the buoyant characteristic of hydrogen gas rising upward towards the ceiling, confirming the time dependent nature of the problem. Also, the unsteady results provide reasonable prediction of gradual reduction in hydrogen concentration in the test room, at lower leak velocity. Similar to the results obtained from the steady-state solution, the unsteady simulation predicted a restricted region with hydrogen concentration above the LFL – around the leak source. Therefore, results from the simulation indicate, under the forced ventilation condition in the laboratory, risk of fire due to hydrogen leakage from small orifice investigated in this study is localized

in the region of leak source.

Keywords: RANS, unsteady, turbulence model, hydrogen leak, dispersion.

2.13 Mixed convection slip flow with thermal radiation in a convectively heated vertical plate saturated with Darcy porous

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Abstract

The fully developed steady mixed convection slip flow with thermal radiation in a convectively heated vertical plate saturated with Darcy porous material has been studied. The non-dimensional governing equations of the velocity, temperature, skin friction and Nusselt number are analytically solved by a set of imposed initial and boundary conditions using perturbation technique. The solution obtained is graphically represented and the effect of various controlling parameters such as mixed convection ($\frac{Gr}{\mathrm{Re}}$ = Gre), thermal radiation (R), thermal Boit number (Br), Darcy number (Da), Navier slip condition (L) are discussed. During the course of the analytical computations, it is found out that, the velocity of the fluid is higher for increasing values of Gre, Da and L while increase in Br and R improves both the temperature and velocity flow profiles respectively. Furthermore, it is interesting to reveal that, skin friction as well as rate of heat transfer is strongly dependent on Gre, Da and Br.

Keywords: Mixed convection, thermal radiation, Navier slip condition, Newtonian heating, Porous material

2.14 Reactive Flow of Unsteady Eyring-Powell Hyperbolic Fluid with Thermocapillary Convective Boundary Conditions, Variable Thermal Conductivity and Radiant Heat through a Porous Medium

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Abstract

In this study, thermal conductivity is studied for an unsteady Eyring-Powell hyperbolic fluid with saturated porous media, thermocapillary convective boundary conditions, and variable thermal conductivity. The thermal conductivity and fluid viscosity are temperature-dependent properties. The Maple 18 Software package, the Spectral element approach, the C++ programming language, and the Garlekin weighted residue technique are used to generate and solve the differential equations governing the fluid flow numerically. Skin friction coefficient and the local Nusselt number rise when the values of the Marangon convective parameter, Biot number, stretching parameter, and Eyring-Powell material parameters increase. The fluctuations of the physical factors on the distributions of fluid temperature and velocity are shown graphically and quantitatively discussed in depth.

Keywords: Porous media, Non-Newtonian fluids, Thermal conductivity, Radiant energy, Reactive flows, Petroleum, Thermodynamic states and processes.

2.15 Insight into the Fluid Flow of Sensitized Chemical Kinetic Exponent in a Vertical Channel under Newtonian Heating

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Abstract:

In the current work, we examine free convective slip flow between two vertical walls caused by convective heating of the left wall in steady and unsteady state magnetohydrodynamics with chemical kinetic exponent. After transforming the governing equation from dimensional form to dimensionless form homotopy perturbation method (HMP) were employed to solve the steady state governing equation. While the implicit finite difference strategy is used in a numerical approach to solve the time-dependent governing equation. Line graphs were used to discuss the consequences of different flow characteristics that entered the problem, such as the Hartmann number, Navier slip parameter, reaction parameter, chemical kinetic exponent, local Biot number. The results showed that, when the Hartman number is changed, a small rise in the Hartman number triggers the Lorentz force, which streamlines the momentum boundary layer, slowing the flow .Additionally, it was discovered that the chemical kinetic exponent (m) considerably improves the temperature and velocity gradients in the situation of sensitize (-2), where the fluid velocity and temperature are larger. Additionally, a comparison of the steady state and the unsteady solution has been done, and the results indicate great agreement

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2.16 **Two–Point Diagonally Implicit Extended Super Class of Block Backward Differentiation Formula for Stiff Initial Value Problems**

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Abstract

In this paper, a diagonal form of the extended super class of block backward differentiation formula is derived. The method is fully implicit and approximates two solution values at a time. By varying a parameter (–1,1) in the formula, different sets of formulae can be generated. Analysis of the method indicated that the method is both zero and A – stable, hence, suitable for the solution of stiff initial value problems.

Comparison of the method with some existing algorithms showed its advantage in terms of accuracy over some methods.

Key words: Initial Value Problems, Stiff, zero stability, A – Stability, diagonally implicit method.

Venue B

3.1 Ebola Virus Outbreak in Uganda: Fractional Order Mathematical Model

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Abstract

Uganda has earlier had four outbreaks of Sudan Ebola virus; one outbreak in 2000 and 2011 and two outbreaks in 2012, in addition to an outbreak of Bundibugyo virus disease in 2007 and an Ebola virus disease outbreak in 2019. Ongoing outbreak of the Sudan Ebola virus causes Ebola, in the Western Region and Central Region of the country. In this paper fractional order model of Ebola virus was developed. Laplace–Adomian Decomposition Method is applied to calculate an estimated solution of the system of nonlinear fractional differential equations. The solutions of fractional differential equations is obtained in the form of infinite series. The proposed series solution of the model converges swiftly to its precise value. The acquired results are related with the standard case.

Key words: Fractional Order, Ebola virus, Mathematical model, Outbreak

3.2 Dynamical Analysis of a Deterministic Human-Bird Avian Influenza Model

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Abstract

In this paper, a deterministic model for the transmission and control of Avian Influenza is presented. In order to analyze the effectiveness of this viral disease, that do occur from animal to human, vaccine, treatment and quarantine were used as intervention strategies. The human population was divided into seven classes and the bird, into four. The model dynamics were studied to understand the epidemic phenomenon for its control. The qualitative properties of the model were examined with appropriate techniques using the Jacobian determinant, and the effective and basic reproductive ratios were computed using the next generation matrix. The trace and determinant of the matrix were employed to discuss the stability of the disease-free equilibrium of the model. The results of the local stability showed that the diseasefree equilibrium which is locally asymptotically stable if the effective reproduction number Rh,b c < 1 for tr(JE+) < 0 and det(JE+) > 0. The model, when simulated on different sets of parameter values, demonstrates that using the three controls together reduces the infection better than using either one or a pair of the controls. Keywords: Avian influenza, deterministic model, basic reproductive number, equilibrium, asymptotic stability

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3.3 **Analysis of Lassa Fever Mathematical Model With Taylor Matrix Method**

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Abstract:

Lassa fever is an acute viral hemorrhagic infectivity triggered by the Lassa virus. It is mainly spread to humans either via direct interaction with disease-ridden *Masto mys* rodents, or via food or domestic stuffs contaminated with the urine or faeces of disease-ridden rodents. In this paper, a deterministic mathematical model is developed. The time dependent rate of transmission of the disease is calculated. The Taylor matrix and collocation method is applied. Using this method, we focus on the evolution of Lassa fever. Numerical simulations are show the estimates with the help

of graphics.

Keywords: Analysis, Lassa fever, Mathematical Model, Taylor Matrix Method

3.4 Mathematical Modelling of Climatic Variables and Its Effect on Flooding in Coastal Regions

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Abstract

The implications of climatic change have been predicted to havedevastating effects on society particularly lives and properties within acoastal environs.Daily climatic data obtained from Nigerian Meteorological Agency was used as the in put data to give a realistic simulation of the Nigerian coastal climate. Also, the study presented the mathematical modelling ofc limate variables and its effect on the coastal regions of Nigeria. Six equations were used which includes; two momentum equations,Thermodynamic equation, Equation for Specific Humidity, Continuity equation, Hydrostatic equation and the equation of state. The equation adopted is the climate equation which was derived from the Russian Academy of Science. The method used to analyse these equations was the Regression Analysis. This method describes the relationship between temperature change and rainfall.The method is appropriate because it described the measurement of flooding in Lagos state, Nigeria in the year 2020. The result showed that rainfall and temperature pattern were significantly high as rainfall distributions reach its peak in June (312.2mm); while temperature distribution was high throughout the year (<28.046^{o}C);The analys is of the method suggests a very high relationship, since the regression coefficient is 0.8252.The study concluded that society have been negatively impacted by flooding. Hazards associated to climate change intensify infrequency and severity; hence, adaptation strategies that proved successful in the past phase are limited.However,the mathematic modelling has predicted the progressive impacts attributed to climate-induced flooding.The study recommends robust adaptation strategies to climate change impact in recent times. This study reveals the potential impacts of flooding in other riparian corridors and coastal regions of Nigeria and West Africa which are prone to flooding as predicted by the study.

3.5 A Modified Meningitis Transmission Model and Its Dynamics

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Abstract

A deterministic mathematical model for the dynamical transmission of meningitis has been formulated in this paper. The model is presented and the equilibrium states depicted. The epidemiological and biological features of meningitis with control such as vaccination and educational campaigns. The theoretical study of the model was provided, the equilibrium states were shown. The reproduction number R0, that determines the extinction or persistence of the disease was computed. It was also shown that there exist a globally asymptotically stability when R0 < 1. The numerical simulations were carried out and the outcomes further suggest the control of the epidemic of Meningitis is achievable through a combination of vaccination and educational campaigns. Keywords: Meningitis, Reproduction Number, Stability, Dynamics, Asymptotic, Mo

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3.6 Fractal-Fractional Modeling and Mathematical Analysis of Cryptosporidiosis Transmission Dynamics

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Abstract

Cryptosporidiosis is caused by cryptosporidium protozoan and constitutes a large number of gastrointestinal disease. It's linked with aquatic transmission mechanism via the faecal–oral path in numerous recreational water facilities. In this study, fractal fractional operator was applied to develop the cryptosporidium mathematical model. The derivative is defined in the sense of Caputo. The stability of the model was considered. The numerical solution of the model computed using fractional Adams-Bashforth method. The proposed scheme is used to simulate the available data for some the compartments of the model equations. Numerous graphical presentations are given to understand the dynamics of the model at various fractional

orders.

Keywords: Fractal-Fractional, Cryptosporidiosis, Transmission, Dynamics, Mathematical Analysis

3.7 Fuzzy Fractional Mathematical Model of Monkeypox Disease onsidering Fomite Transmission

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Abstract

Monkeypox is a zoonotic viral infectivity that is caused by the monkeypox virus, a genus of Orthopoxvirus in the Pox family of viruses. There is a current outbreak of the disease that was confirmed in May 2022, which was found in the United Kingdom. The case detected in London was traced to a traveler from Nigeria. In this paper, a fuzzy fractional mathematical model of the dynamics of disease is developed in Caputo's sense. The stability analysis of the scheme carried out and non-negative unique solution within the domain and boundeness were verified. The basic reproductive number of the model calculated. The existence and uniqueness of the solution of the considered model was computed. The approximate solution of the proposed model was computed using the fuzzy hybrid Laplace method. The results obtained are presented graphically to show the behavior of each compartments.

Key words: Fuzzy Fractional, Mathematical Model, Monkeypox Disease, Fomite Transmission

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