Namaste and Welcome to Kathmandu

Book of Abstracts

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Abstracts

Principal Speakers

PR1 **Dongho Chae**, *Challenging mathematical problems in fluid mechanics*, Chung-Ang University, South Korea

Abstract: The motion of the fluids and gases are governed by systems of partial differential equations. In many cases these equations pose difficult problems to mathematicians, which are unsolved over long periods. Typical examples are the Euler equations, the Navier-Stokes equations, and the other related equations such as the quasi-geostrophic equations and the Boussinesq equations. In this talk we introduce some of these problems, and discuss partial progresses achieved in the last decades.

PR2 **Gerhard Pfister**, *Algebraic Geometry in Applications*, TU Kaiserslautern, Germany

Abstract: The aim of the talk is to show that algebraic geometry can be applied in many different areas. In my talk I will report on applications in Coding Theory, Geometric Theorem Proving, Kinematics, Integer Programming, Cryptology and Algebraic Statistics. This includes applications in Biology, Electronics and Computer Vision. As an example we will see how algebraic geometry and computer algebra helps your camera to produce sharp pictures. At the end it is shown (just for the fun of it) that algebraic geometry and computer algebra can be used to solve a sudoku.

PR3 **Ratnasingham Shivaji**, *Semipositone Problems*, University of North Carolina at Greensboro, USA

Abstract: In this lecture, semipositone problems and some methods to solve them will be discussed. Also, recent results and open problems will be presented.

PR4 **Lindi Wahl**, *Predicting the fate of rare mutations in microbial populations*, Western University, Canada

Abstract: Due to large population sizes and short generation times, microbes such as bacteria and viruses can evolve very rapidly. The first step in this adaptive process is the appearance of mutations that increase the fitness of the microbe, such as a mutation that confers resistance to antibiotics, or allows a virus to infect a different host species. We use stochastic models of microbial life history to estimate the probability that such new mutations emerge and spread in the microbial population. Recent results for both bacteria and viruses predict the traits most likely to evolve rapidly in these pathogens.

PR5 **Jiahong Wu**, *The two-dimensional Boussinesq equations with partial dissipation*, Oklahoma State University, USA

Abstract: The Boussinesq equations concerned here model geophysical flows such as atmospheric fronts and ocean circulations. Mathematically the 2D Boussinesq equations serve as a lower-dimensional model of the 3D hydrodynamics equations. In fact, the 2D Boussinesq equations retain some key features of the 3D Euler and the Navier-Stokes equations such as the vortex stretching mechanism. The global regularity problem on the 2D Boussinesq equations with partial or fractional dissipation has attracted considerable attention in the last few years. This talk presents recent developments in this direction. In particular, we detail the global regularity result on the 2D Boussinesq equations with vertical dissipation as well as the result for the 2D Boussinesq equations with general critical dissipation.

Plenary/Special Invited Speakers

PS1 **Maya Chhetri**, *Global bifurcation of positive solutions for a class of superlinear elliptic systems*, University of North Carolina at Greensboro, USA

Abstract: We consider a coupled system of Elliptic equations satisfying Dirichlet boundary conditions. The reaction terms are assumed to be positive with superlinear growth at infinity. We use bifurcation theory, combined with an approximation scheme, to establish the existence of an

unbounded branch of positive solutions emanating from the origin which is bounded in positive direction of the bifurcation parameter. If in addition, the reaction terms are continuously differentiable and satisfy some appropriate subcritical condition, we show that the branch must bifurcate from infinity when the bifurcation parameter is zero.

PS2 **M. Stanca Ciupe**, *A bi-stable switch in virus dynamics can explain the differences in disease outcome following SIV infections in rhesus macaques,* Virginia Tech, USA

Coauthors: Christopher Miller, Jonathan Forde

Abstract: Experimental studies have shown that size and infectious-stage of viral inoculum influence disease outcomes in rhesus macaques infected with simian immunodeficiency virus. The possible contribution to disease outcome of antibody developed after transmission and/or present in the inoculum in free or bound form is not understood. In this study, we develop a mathematical model of virus-antibody immune complexes formation and use it to predict their role in transmission and protection. The model exhibits bi-stable dynamics between cleared and persistent states. We fitted it to temporal virus data and estimated parameter values for free virus infectivity rate and antibody's carrying capacity for which the model transitions between virus clearance and persistence when the initial conditions (in particular the immune complexes to free virus ratio) vary. We used these results to make predictions on the minimum virus load in the inoculum leading to persistent infection in the presence and absence of protective antibody responses.

PS3 **Wolfram Decker**, *Challenges in the Development of Open Source Computer Algebra Systems*, University of Kaiserslautern, Germany

Abstract: Computer algebra is facing new challenges as mathematicians are inventing new and more abstract tools to answer difficult problems and connect apparently remote fields of mathematics. On the mathematical side, while we wish to provide cutting-edge techniques for application areas such as commutative algebra, algebraic geometry, arithmetic algebraic geometry, singularity theory, and many more, the implementation of an advanced and more abstract computational machinery often depends on a long chain of more specialized algorithms and efficient data structures at various levels. On the software development side, for cross-border approaches to solving mathematical problems, the efficient interaction of systems specializing in different areas is indispensable; handling complex examples or large classes of examples often requires a considerably enhanced performance. Whereas the interaction of systems is based on a systematic software modularization and the design of mutual interfaces, a new level of computational performance is reached via parallelization, which opens up the full power of multi-core computers, or clusters of computers.

In my talk, I will report on the ongoing collaboration of groups of developers of several well-known open source computer algebra systems, including (GAP, which pays particular emphasis to group theory, SINGULAR, a system for applications in algebraic geometry and singularity theory, and POLYMAKE, a software for polyhedral geometry. I will present computational tools relying on this collaboration and some of the mathematical challenges which lead us to develop such tools.

PS4 **Mukesh Dhamala**, *Delayed Neuronal Interactions and Synchronization in the Brain*, Georgia State University, USA

Abstract:"How does the brain work?" is one of the most intriguing question for the 21st century. Progress in this effort has been made by considering the brain as a complex dynamical system with its highly interconnected and functionally organized neurons and neuronal networks. Synchronization of neuronal oscillations is known to be the basis for various perceptual and cognitive functions, including perceptual decision-making, memory processes, and multisensory perception. Synchronized oscillations can occur in neurons from small to extended brain regions. Interactions in networks of spatially distributed neurons involve signal transmission time delays because of finite signal speeds and axonal lengths. Delayed interactions can lead to various interesting dynamical behaviors, such as phase-synchrony, phase-flip transition and cession of oscillations. In this talk, the speaker will discuss his work on time-delay-induced synchronization of bursting chaotic neurons and spectral analysis approach to infer delayed neuronal interactions from experimental data in brain functions and dysfunctions.

PS5 **Tanka Nath Dhamala**, *Impact of Network Flow Solutions in Emergency Planning*, Tribhuvan University, Nepal

Abstract: The dynamic flow optimization problems covering wider spectrum of modeling aspects from diversified field of mathematical sciences play significant roles in dealing with real-life problems caused by natural or human-created disasters in today's complex disastrous world. In addition, the global optimal strategies, like logistic supports in emergencies, location-allocation of facilities, and reversals of road segments in urban transportation and evacuation networks – well established as contraflow optimization techniques have played crucial roles in the research and practice of emergency management. In this presentation, computationally very challenging diversified flow-over-time models, ranging from continuous to discrete approaches will be considered. The focus will also be given to the integrated model variants that are crucial in addressing the transportation problems in emergencies as well as rush hour traffic scenarios. Comprehensive insights and critics on various dynamic flow algorithms and their significant extensions to the contraflow optimization will be presented. The contraflow techniques early dominated by many satisfactory heuristics adopted by most of the software in emergency uses and recently studied analytically do have great potential in improving the solutions quality. The currently extended results in addition already established network flow solutions will be extensively discussed that establishes the impact of network flow solutions in evacuation planning.

PS6 **Narendra M. Dixit**, *Bistability in the interferon signalling network underlies the failure of hepatitis C treatment*, Indian Institute of Science, Bangalore, India

Abstract: Hepatitis C virus (HCV) infects nearly 170 million people worldwide. If left untreated, it can lead to liver damage, cancer and associated mortality. Interferon alpha (IFN) based treatment fails to cure a sizeable fraction of the patients treated. The cause of this treatment failure remains unknown. Through a series of signalling events, IFN triggers the expression of several IFN-stimulated genes (ISGs) which together induce an antiviral state in cells and control infection. HCV, however, can evade IFN activity in several ways, including, in particular, by inducing a block in the production of ISGs. When does HCV win and when IFN? The outcome of this battle has been difficult to predict. Here we develop a detailed mathematical model of the IFN signalling network and show that HCV induces bistability in the network, creating a new steady state where it can persist. Cells that admit the new steady state alone are refractory to interferon. Using a model of viral kinetics, we then show that when the fraction of cells refractory to interferon in a patient exceeds a critical value, treatment fails. New direct-acting antivirals that suppress HCV replication can eliminate the new steady state, restoring interferon sensitivity and improving treatment response. Our study thus presents a new conceptual basis of the failure of HCV treatment and facilitates rational treatment optimization.

PS7 **Jane Heffernan**, Multi-Scale Modelling and Public Health, York University, Canada

Abstract: Transmission dynamic mathematical modelling studies have become key tools to support public health policy planning and decision-making. Recent advances in mathematical modelling, in the development of immuno-epidemiological (IE) models can provide more detailed pictures of infectious disease spread, and thus, can provide augmented support to public health decision makers. However, in the development of IE models, multi-scale considerations must be taken into account, at the level of the host (mathematical immunology), and the population (mathematical epidemiology). In this talk I will provide an introduction to the field of immuno-epidemiology, and discuss specific mathematical immunology and epidemiology studies that lead to the development of an IE framework. Influenza, TB, and HIV will be highlighted.

PS8 **Ying-Hen Hsieh**, *Impact of Catastrophic Events on Spread of Dengue: The Case of 2014 Gas Explosion in Kaohsiung, Taiwan*, China Medical University (Taiwan), Taichung, Taiwan

Abstract: Infectious disease outbreaks often occur in the aftermath of catastrophic events, either natural or man-made ones. Kaohsiung is the center of petrochemical industry in Taiwan with pipelines running underneath city streets. Multiple underground gas explosions occurred in Kaohsiung in the evening of July 31, 2014 due to chemical leaks in the pipelines. The explosions caused 32 deaths (including 5 firefighters and 2 volunteer firefighters) and injured 321 persons. Historically, dengue outbreaks in Taiwan occurred mostly in small numbers of around 2000 cases or less,

except 2002 with over 5000 cases. However, in the months after the gas explosion, the city reported 14528 lab-confirmed dengue cases from August to December. To investigate the possible impact, if any, of the gas explosion on this record-breaking dengue outbreak (among other factors such as warmer weather), we make use of a simple mathematical model to pinpoint the waves of infections that had occurred shortly after the gas explosion in city districts in the surrounding area of the gas explosion site, and to compute the reproduction number for each wave in each district. The results indicate geographical heterogeneity in transmissibility, with comparatively higher transmissibility in waves occurring immediately after the gas explosion for districts with multiple waves.

PS9 **Chaudry Masood Khalique**, *Exact solutions and Conservation laws for a (2+1) dimensional KdV-mKdV equation*, North-West University, South Africa

Abstract: In this talk, we study a (2+1) dimensional KdV-mKdV equation, which has two integral terms in it. This equation arises in various problems in mathematical physics. We transform this equation into a system of two partial differential equations and obtain its exact travelling wave solutions. Furthermore, we derive conservation laws for the system by using the multiplier method. Finally, we revert the results obtained into the original variables of the (2+1) dimensional KdV-mKdV equation.

PS10 **Yijun Lou**, *Impact of biodiversity on Lyme-pathogen transmission*, The Hong Kong Polytechnic University, Hong Kong

Coauthors: Jianhong Wu, Xiaotian Wu

Abstract: Lyme disease imposes increasing global public health challenges. On the flip side, since the ticks, vectors of Lyme disease, can feed on a wide range of host species with variable reservoir competence, Lyme disease poses a good example for addressing the impact of host community biodiversity on disease risk. In this talk, two theoretical models with increasing complexity, integrating the disease transmission between ticks and the host community, will be presented. Of particular focus is on qualitative conditions for successful tick invasion and disease persistence, and analysis how host diversity will dilute or amplify the Lyme disease risk to public health.

PS11 **Stefan C. Mancas**, *Cavitation of spherical bubbles with surface tension and viscosity and connection of RP with FRW cosmological equations*, Embry-Riddle Aeronautical University, FL, USA

Abstract: In this talk an analysis of the Rayleigh-Plesset (RP) equation for a three dimensional vacuous bubble in water is presented. When the effects of surface tension are neglected we find the radius and time of the evolution of the bubble as parametric closed-form solutions in terms of hypergeometric functions. By including capillarity we show the connection between RP equation and Abel's equation, and we present parametric rational Weierstrass periodic solutions for nonzero surface tension. When viscosity is present we present only numeri-cal solutions. We also show the connection between the RP equation and Einstein's field equations for spatially curved Friedman-Robertson- Walker (FRW) cosmology.

PS12 **Saralees Nadarajah**, *A review of copulas*, University of Manchester, UK

Abstract: Copulas are used to specify dependence between two or more random variables. The last few years have seen a surge of developments of parametric models for copulas. I will provide an up-to-date and a comprehensive review of over one hundred known parametric copulas as well as their characterizations, applications and open problems. I will also introduce some new copulas.

PS13 **Mythily Ramaswamy**, *Ingham type inequalities and applications*, T.I.F.R, Centre for Applicable Mathematics, Bangalore, India

Abstract: After Ingham proved some trigonometric type inequalities in 1936, they have been applied in Series expansion, Function theory and also in Control theory. Depending on the PDE and the spectrum of the operator, new extensions of these inequalities have been found. I show one such application to a coupled system of PDE of hyperbolic and parabolic types.

PS14 **Stephen B Robinson**, *Eigencurves for the Steklov-Robin problem,* Wake Forest University, USA

Coauthor: Mauricio Rivas

Abstract: We consider the Steklov-Robin problem

$$\begin{array}{c} -\Delta u = \lambda m_1 u \text{ in } \Omega, \\ \frac{\partial u}{\partial \nu} + bu = \mu m_2 u \text{ on } \partial\Omega \end{array} \tag{1}$$

where Ω is a smooth bounded region in $\mathbb{R}^N$, $(\lambda, \mu) \in \mathbb{R}^2$, the coefficient function b and the weights m_1, m_2 lie in appropriate L^p-spaces, and m_2 is assumed to be positive. Using variational arguments we characterize a countable collection of *eigencurves* $(\lambda, \mu_n(\lambda))$, and prove several theorems describing the properties of these curves.

PS15 **Elissa J. Schwartz**, *Antibody kinetics of equine infectious anemia virus infection of horses*, Washington State University, USA

Coauthors: Seema Nanda, Robert H. Mealey

Abstract: Lentivirus escape from neutralizing antibodies (NAbs) is not well understood. In this work, we quantified antibody escape of a lentivirus, using antibody escape data from horses infected with equine infectious anemia virus. We calculated antibody blocking rates of wild-type virus, fitness costs of mutant virus, and growth rates of both viruses. These quantitative kinetic estimates of antibody escape are important for understanding lentiviral control by antibody neutralization and in developing NAb-eliciting vaccine strategies.

PS16 **Robert Smith?**, *A metapopulation model for spread of MRSA in correctional facilities*, The University of Ottawa, Canada

Abstract: The spread of methicillin-resistant strains of Staphylococcus Aureus (MRSA) in healthcare settings has become increasingly difficult to con- trol and has since been able to spread in the general community. The prevalence of MRSA within the general public has caused outbreaks in groups of people in close quarters such as military barracks, gyms, daycare centers and correctional facilities. Correctional facilities are of particular importance for spreading MRSA as inmates are often in close proximity and have limited access to hygienic products and clean clothing. Although these conditions are ideal for spreading MRSA, a recent study has suggested that recurrent epidemics are caused by the influx of colonized or infected individuals into the correctional facility. In this paper, we further investigate the effects of community dynamics on the spread of MRSA within the correctional facility and determine whether recidivism has a significant effect on disease dynamics. Using a simplified hotspot model ignoring disease dynamics within the correctional facility, as well as two metapopulation models, we demonstrate that outbreaks in correc- tional facilities can be driven by community dynamics even when spread between inmates is restricted. We also show that disease dynamics within the correctional facility and their effect on the outlying community may be ignored due to the smaller size of the incarcerated population. This will allow construction of simpler models which consider the effects of many MRSA hotspots interacting with the general community. It is suspected that the cumulative effects of hotspots for MRSA would have a stronger feedback effect in other community settings.

A. Differential Equations and Nonlinear Analysis

DE1 **Dhruba Adhikari**, *Nontrivial Solutions of Perturbed Maximal Monotone Operator Inclusions,* Kennesaw State University, Georgia, USA

Abstract: Let X be a real reflexive Banach space with its dual X^*.Let $L : X \supset D(L) \to X^*$ be densely defined, linear and maximal monotone. Let $T : X \supset D(T) \to 2^{X^*}$, with $0 \in D(T)$ and $0 \in T(0)$, be strongly quasibounded and maximal monotone, and $C : X \supset D(C) \to X^*$ bounded, demicontinuous and of type (S_+) w.r.t. to $D(L)$. The topological degree theory for mappings of type (S_+) introduced by Skrypnik is used to establish the existence of nonzero solutions of the operator inclusion $Lx + Tx + Cx \ni 0$ in the set $G_1 \setminus G_2$, where $G_2 \subset G_1$ with cl$G_2 \subset G_1$, G_1, G_2 are open sets in X, $0 \in G_2$, and G_1 is bounded.

DE2 **M.K. Ahmad**, *PDE-based nonlinear diffusion model for image denoising,* Aligarh Muslim University, India
Coauthor: Santosh Kumar

Abstract: Image denoising is a fundamental problem in both image processing and computer vision with numerous applications. The total variation models [1, 4, 5] and anisotropic diffusion models [2, 3, 6, 7, 8] have been studied as a useful tool to the problem of image denoising and image reconstruction. These partial differential equation based image enhancement techniques have been able to achieve a good edge preservation. In this paper, we propose a new model for image denoising. Second order partial differential equations have been studied as a useful tool for image denoising. Scale space and edge detection using anisotropic by Parona and Malik [3] has an edge preserving property but sometimes it gives undesirable blurred effect. We prove the existence and uniqueness theorem for our proposed model. The results of our model using explicit numerical schemes are compared with other known image restoration models.

Editor's note: The references are omitted.

DE3 **T.V. Anoop**, *A result on the domain derivative of first eigenvalue of p-Laplacian*, IIT Madras, Chennai, India

Coauthors: Vladimir Bobkov, Sarath Sasi

Abstract: Let B_1 be the ball of radius R_1 in $\mathbb{R}^N$ with center at the origin and let B_0 be a smaller ball of radius R_0 contained inside B_1. We show that the first Dirichlet eigenvalue of p-Laplacian in $B_1 \setminus B_0$ is maximal if and only if the balls are concentric.

DE4 **Kaushik Bal**, *Symmetry Results to a Singular Nonlinear Problem*, IIT Kanpur, India

Abstract: Consider the Problem

$$-\Delta u = \frac{r(x)}{u^\delta} + g(u) \text{ in } \Omega$$
$$u = 0 \text{ on } \partial\Omega, u > 0 \text{ in } \Omega$$

Given g is locally lipchitz continuous and $\delta > 0$ we use moving plane method to show that all classical solutions to this problem actually mimics the geometry of the domain, given some symmetry conditions on Ω. We also provide some apriori estimates using blowup technique due to Gidas-Spruck in the interior and moving plane near the boundary and show the existence of solution.

DE5 **Debendra Banjade**, *Estimates for the Corona Theorem on $H^\infty_{\mathbb{I}}(\mathbb{D})$*, Coastal Carolina University, USA

Abstract: Let $\mathbb{I}$ be a proper ideal of $H^\infty(\mathbb{D})$. We prove the corona theorem for infinitely many generators on the subalgebra $H^\infty_{\mathbb{I}}(\mathbb{D})$, in which the corona theorem for finitely many functions is already known to hold. This settles the conjecture of Ryle. Moreover, we prove a generalized Wolff's Ideal Theorem for this subalgebra.

DE6 **Debraj Chakraborty**, *A multi-agent ODE model for Chaotic Indian Traffic*, Indian Institute of Technology, Bombay, India

Coauthors: Rakesh U. Chavan, Ameer Mulla

Abstract: In this paper, a new model for traffic on Indian roads with multiple lanes is developed, where the vehicles do not adhere to lane discipline. Assuming identical vehicles, the dynamics is split along two independent directions—the Y - axis representing the direction of the traffic and the X-axis representing the lateral or the direction perpendicular to the traffic direction. Different influence graphs are used to model the interaction between the vehicles in these two directions. The instantaneous accelerations of each vehicle, in both X and Y directions, are functions of the measurements from the neighbouring vehicles according to these influence graphs. Under time invariant influence structure, expected e.g. in dense traffic, the collection converges to a layered formation with fixed inter-vehicle distances. In general, the formation is BIBO stable with the velocity and inter vehicle separations oscillating between a finite number of equilibrium points.

DE7 **Rajendra Dahal**, *A monotonicity result for discrete fractional difference operators*, Coastal Carolina University, USA

Coauthor: Chris Goodrich

Abstract: In this note we demonstrate that if $y(t) \geq 0$, for each t in its domain, and if, in addition, $\Delta_0^{\nu} y(t) \geq 0$, for each t in its domain, with $1 < \nu < 2$, then it holds that y is an increasing function of t. This demonstrates that, in some sense, the positivity of the ν-th order fractional difference has a strong connection to the monotonicity of y. We conclude the note by mentioning some implications of this result.

DE8 **Ram Prasad Ghimire**, *Transient Analysis of Markovian Queue with Flexible Servers and Balking*, Kathmandu University, Nepal

Coauthors: Samir Shrestha, Oliver Tse

Abstract: This paper deals with the study of time dependent queueing model with balking. Under the study, initially only one server is provisioned to serve the customer and one after another server join the system to serve customers. Customers arrive to the system in Poisson fashion and are served exponentially. We obtain the numerical results for time-dependent state transition probabilities, the mean number of customers in the system and in queue in time t, the mean time that a customer spent in the system and mean time that a customer has to wait in queue and probability that there are greater than or equal to N customers in the system.

DE9 **Raj Kumar Gupta**, *Head on collision between two shock waves in a dusty gas flow*, Indian Institute of Technology (BHU), India

Coauthor: Triloki Nath L.P. Singh

Abstract: The head on collision between two shock waves in dusty gas has been studied using an approximate analytical method. The analytical expressions for the resultant shock waves are derived and their properties are discussed. The solution profiles after the collision are obtained by using an iteration procedure.

DE10 **Chun-Hsiung Hsia**, *On the long time stability of a temporal discretization scheme for the three dimensional primitive equations*, National Taiwan University, Taiwan

Abstract: In this joint work with Ming-Cheng Shiue, a semi-discretized Euler scheme to solve three dimensional primitive equations is studied. With suitable assumptions on the initial data, the long time stability of the proposed scheme is shown by proving that the H1 norm (in space variables) is bounded.

DE11 **Kanhaiya Jha**, *A Common Fixed Point Theorem for Weakly Compatible Mappings in Banach Space*, Kathmandu University, Nepal

Abstract: The fixed point theory as a part of non-linear analysis since 1060 is the study of function equation in metric or non-metric setting and it provides the necessary tools to have existence theorem in many different non-linear problems. Although Dutch mathematician L.E.J. Brouwer in 1912 proved the first fixed point theorem but the credit of making the concept useful and popular goes to Polish mathematician S. Banach in 1922 who proved the famous Banach contraction mapping principle. This classical principle in metric space is one of the fundamental results which have wide applications in several disciplines. Also, this theorem has a big impact on establishing fixed point results for non-expansive mappings in Banach and Hilbert spaces. The main purpose of this paper is to establish a common fixed point theorem for weakly compatible pairs of self mappings in Banach space.

DE12 **Sushil Chandra Karna**, *The non-linear oscillation of the centre of mass of the system in elliptic orbit*, Tribhuvan University, Nepal

Abstract: The paper is concerned with the effect of air resistance, magnetic force and oblateness of the earth on the non-linear oscillations of the system of two satellites connected by a light, flexible and extensible string in the elliptic orbit of the centre of mass. We emphasis on two dimensional equations of motion of the system.

DE13 **Harihar Khanal**, *Computational Models for Radiative Heat Transfer in Semitransparent Medium*, Department of Mathematics, Embry-Riddle Aeronautical University, FL

Abstract: Radiation transfer in semitransparent medium plays an important role in many industrial applications. For instance, quality of the products in the glass industry depends on the proper control of temperature during the various fabricating processes. The conduction-radiation heat transfer problem is usually formulated with a highly nonlinear integro-differential equation. Here, we present some simplified computational models (described by a coupled system of elliptic-parabolic PDEs) for combined conduction and radiation heat transfer in glass with specularly emitting and reflecting bounding walls. Finally, some numerical simulations (employing a semi-implicit finite volume scheme) are presented.

DE14 **Eunkyung Ko**, *Global $C^{1,\alpha}$ regularity and existence of multiple positive solutions for a singular $p(x)-$Laplacian equation*, Seoul National University Seoul, Seoul, South Korea

Abstract: In this presentation we consider existence of multiple weak solutions of singular $p(x)-$Laplacian problem,

$$\begin{cases} -\mathrm{div}(|\nabla u|^{p(x)-2}\nabla u) = \frac{\lambda}{u^{\beta(x)}} + u^{q(x)}, & \text{in } \Omega, \\ u > 0, & \text{in } \Omega, \\ u = 0, & \text{on } \partial\Omega, \end{cases}$$

where Ω is bounded domain in $\mathbb{R}^N, N \geq 1$, with smooth boundary $\partial\Omega$, $\beta \in C^1(\bar{\Omega})$ with $0 < \beta_- \leq \beta(x) \leq \beta_+ < 1$, $p \in C^1(\bar{\Omega})$ with $p(x) > 1$ for $x \in \bar{\Omega}$, and $p(x) - 1 \leq q(x) < p^*(x) - 1$ where $p^*(x) = \frac{Np(x)}{N-p(x)}$ for $p(x) < N$ and $p^*(x) = \infty$ for $p(x) \geq N$.

DE15 **Lukas Krupicka**, *Mathematical modelling of coupled transport processes in porous media*, Czech Technical University, Czech Republic

Coauthor: Michal Benes

Abstract: This contribution deals with nonlinear parabolic differential equations arising from the heat and water flow through a partially saturated porous media. The existence of a global weak solution of the problem on an arbitrary interval of time is proved by means of discretization in time, deriving suitable a-priori estimates and concluding that the solutions of steady problems converge to the solution of the original problem.

DE16 **S. Sivaprasad Kumar**, *Starlikeness criteria for certain analytic functions*, Delhi Technological University, India

Coauthors: Virendra Kumar, V. Ravichandran

Abstract: Let $\mathcal{S}^*_S$ be defined as the class of normalized analytic functions f such that $zf'(z)/f(z)$ lies in the domain $\varphi(\mathbb{D})$, where $\varphi(z) = 1 + \sin z$ maps the unit disk $\mathbb{D} := \{z \in \mathbb{C} : |z| < 1\}$ onto a domain symmetric with respect to the real axis, which is starlike with respect to $\varphi(0) = 1$. In the present investigation, we derive certain geometric properties for functions in $\mathcal{S}^*_S$. Also we obtain $\mathcal{S}^*_S$-radii for the class of Janowski starlike functions and some other geometrically defined classes.

DE17 **M.K. Mallick**, *Bifurcation and multiplicity results*, IIT Madras, India

Coauthors: R. Shivaji, B. Son, S. Sundar

Abstract: We study positive solutions to the $n \times n$ system:

$$\begin{cases} -\left(\varphi_{p_1}(u_1')\right)' &= \lambda h_1(t)\left(u_1^{p_1-1-\alpha_1} + f_1(u_2)\right) \ ; \ (0,1), \\ -\left(\varphi_{p_2}(u_2')\right)' &= \lambda h_2(t)\left(u_2^{p_2-1-\alpha_2} + f_2(u_3)\right) \ ; \ (0,1), \\ \vdots & = \quad \vdots \\ -\left(\varphi_{p_n}(u_n')\right)' &= \lambda h_n(t)\left(u_n^{p_n-1-\alpha_n} + f_n(u_1)\right) \ ; \ (0,1), \\ u_i(0) &= 0 = u_i(1) \ ; \ i = 1,2,\ldots,n, \end{cases}$$

where λ is a positive parameter, $p_j > 1$, $\varphi_{p_j}(w) = |w|^{p_j-2}w$ and $h_j \in C((0,1),(0,\infty))$ are such that $\int_0^1 s^{\sigma_1}(1-s)^{\sigma_2}h_j(s)ds < \infty$ for some $\sigma_1, \sigma_2 < p_j - 1$ for $j = 1,2,\ldots,n$. Here $f_j : [0,\infty) \to [0,\infty)$ are

nondecreasing continuous functions such that $f_j(0) = 0$ for $j = 1, 2, \ldots, n$ and satisfy a combined sublinear condition at infinity. We will discuss bifurcation, existence and multiplicity results. We establish our results via the method of sub-super solutions.

DE18 **K.B. Manandhar**, *Development of Some Common Fixed Point Theorems in Intuitionistic Fuzzy Metric Space*, Tribhuvan University, Nepal

Coauthor: Kanhaiya Jha

Abstract: In,1975, Kramosil and Michalek introduced the fuzzy metric space as an important generalization of metric space with the help of fuzzy metric space. In 2004,intuitionistic fuzzy metric spaces have been introduced by J.H. Park with the help of continuous t-norm and continuous t-conorm as a generalization of fuzzy metric space. Recently, Manandhar et al. extended compatible mappings of type (K) in intuitionistic fuzzy metric space and established some common fixed point theorems. The purpose of this paper is to study briefly the development of common fixed theorems in intuitionistic fuzzy metric spaces using different types of contractive conditions.

DE19 **Ashok Misra**, *Modeling flow and heat transfer of a particulate suspension*, Centurion University of Technology and Management, Odisha, India

Abstract: The flow of fluid with suspended particulate matter is encountered in many different fields. Typical examples occurring in nature are dust storms, forest-fire smoke and the dispersion of solid pollutants in the atmosphere. Many processes in industry utilize gas particle flows, such as transportation of pulverized materials in pneumatic conveyers, separation and classification of particles in cyclone and other particles in cyclone or other separators, fluidization in chemical reactors, and combustion of powered fuels in combustion chambers. In addition, flow of fluid with suspended solid particles has various applications to MHD generators, solid propellant rockets, laser-Doppler anemometry and blast waves moving over the Earth's surface. Among a few study relating to two-phase flow, so far reported in the literature, no consulted effort has been made to study the particle-particle interaction and heat transfer aspect. The model discussed here is capable of simulating such two-phase flow (Fluid with SPM) phenomena and also able to reveal the details of internal processes viz. incompressible, compressible and turbulent mixing of a particulate suspension. This model has twice the number of differential equations as that for clear fluid model. The particle-fluid, particle-particle interactions lead to stronger non-linear differential equations, which can be solved by utilizing numerical method. The present model has a great potential for further development in the establishment of rational mathematical model for two-phase flow and heat transfer phenomena.

DE20 **Satyananda Panda**, *Thin film flow of a second grade fluid over a non-linear stretching sheet*, National Institute of Technology Calicut, Kerala, India

Coauthor: Kiran Kumar Patra

Abstract: In this paper, we derive an evolution equation of a thin film of a second-grade fluid over an unsteady stretching sheet using long-wave theory. For the numerical investigation of the viscoelasticity effect on the thin film dynamics, a finite volume approach on a uniform grid with implicit flux discretization is applied. The present results are in excellent agreement with available literature results for the Newtonian fluid. It is observed that the effect of viscoelasticity is prominent for the unsteady stretching rate.

DE21 **Umesh Rajopadhyaya**, *On Development of Some Common Fixed Point Theorems in Semi-metric space*, Kathmandu University, Nepal

Coauthor: Kanhaiya Jha

Abstract: Since the establishment of the notion of metric space in 1906 by M. Frechet, Polish mathematician Stephan Banach established famous Banach Contraction Principle in 1922. Since then it has become a milestone to establish new theorems. Also, the Austrian mathematician Karl Menger in 1928 introduced the notion of Semi-metric space as a generalization of metric space. The purpose of this paper is to discuss the development of some common fixed point theorems in semi – metric space under weak contraction condition

DE22 **Lakshmi Sankar**, *An existence result for a superlinear semipositone p Laplacian problem*, National Institute of Science Education and Research, Bhubaneswar, India

Coauthors: M. Chhetri, R. Shivaji, B. Son

Abstract: We discuss the existence of a positive solution of a p- Laplacian problem on an exterior domain, when the reaction term is negative at the origin and satisfies a superlinear growth condition at infinity. Our results also extends to systems of equations. Results are obtained by degree theory and rescaling arguments.

DE23 **Sarath Sasi**, *On the structure of the second eigenfunctions of the p-Laplacian on a ball*, National Institute of Science Education and Research, India

Coauthors: Anoop T.V., Pavel Drabek

Abstract: In this talk, we prove that the second eigenfunctions of the p-Laplacian,$p > 1$, are not radial on the unit ball in R^N , for any $N \geq 2$. Our proof relies on the variational characterization of the second eigenvalue and a variant of the deformation lemma.

DE24 **Shivam Shreevastava**, *New Results on phi-contractions in Partially Ordered Fuzzy Metric Space*, Indian Institute of Technology (BHU), India

Abstract: In this Paper We obtain some coincidence point theorem for phi-contraction in partially ordered fuzzy metric space. The proof of our main Theorem depends on lemma in which we prove two sequences Cauchy simultaneously. Finally we give an example in support of our main result.

DE25 **Ajit Kumar Singh**, *Synchronization between fractional order complex dynamical systems*, Indian Institute of Technology (BHU), Varanasi, India

Coauthor: Vijay Kumar Yadav

Abstract: In this article, the authors have studied synchronization between a pair of fractional order complex systems viz., Lorenz and Lu systems, Lu and T systems, Lorenz and T systems using active control method. The numerical results and simulation show that this method is effective to synchronize the fractional order complex dynamical systems. The main feature of the article is the comparison of time of synchronization when pair of systems approach from integer order to fractional order. The numerical results are carried out using MATLAB.

DE26 **Akhil Kumar Srivastav**, *Mathematical Modelling of Avian Influenza with Multiple Strains and Multiple Species*, VIT University, India

Coauthor: Mini Ghosh

Abstract: Avian influenza is an infectious disease primarily observed in birds. Most of the Avian influenza viruses do not cause infection in human but recently some of the strains of Avian influenza (e.g. H5N1 and H7N9) have caused infections in human. This disease is easily transmitted among birds (Chicken, Turkeys etc.). Transmission of this disease is also possible from bird to pig, birds to human, pig to pig, pig to human, human to pig, and human to human. In this paper a mathematical model is formulated by incorporating all i.e. bird, pig and human populations. The model is analyzed by using qualitative theory of differential equations. The existence and stability of different equilibria of this model are discussed in detail. The basic reproduction number R_0 of the model is computed, and it is found that for $R_0 < 1$, the disease free equilibrium of the model is globally stable. For $R_0 > 1$, we have endemic equilibrium which is locally asymptotically stable under some restriction on parameters. Further, this model is extended to an optimal control problem and is analyzed using Pontryagin's Maximum Principle. This optimal control problem is also solved numerically using MATLAB. It is observed that the optimal control strategy gives better result as it reduces the number of infectives significantly in the desired period of control.

DE27 **Bishnu Hari Subedi**, *On the Partition of Fast Escaping Set of Transcendental Entire Function,* Tribhuvan University, Nepal

Coauthor: Ajaya Singh

Abstract: For a transcendental entire function (TEF) f, the set $I(f) = \{z \in \mathbb{C} : f^n(z) \to \infty \text{ as } n \to \infty\}$ is called an escaping set. The major open question in transcendental dynamics is

the conjecture of Eremenko- which says that for any TEF f, the escaping set $I(f)$ has no bounded component. This conjecture in special cases has been proved by defining the set $A(f)$ which consists of points that move to infinity as fast as possible. Very recent study in the field of transcendental dynamics has been concentrated on the partition of fast escaping set in the form of maximality and non-maximality fast escaping sets. It is well known that fast escaping set has no bounded component but in contrast- there are TEF's for which each of maximality and non-maximality set has uncountably many singleton components. In this presentation, we mainly expose this aspect.

DE28 **Krishna Subedi**, *Positivity of Toeplitz Operators via Berezin Transform*, University of Toledo, USA

Abstract: It is known that positivity of Toeplitz operator on Bergman Space of unit disc implies positivity of Berezin Transform on unit disc of the symbol but converse is not always true. First, I will show Dechao Zeng's example whose Berezin transform is positive every where in disc but we could find small interval where Toeplitz operator is negative. Lastly, I will show my work for finding the conditions for converse to be true.

DE29 **Subhash Subedi**, *Quenching and Blow-up problem with a nonlinear concentrated source on a semi-infinite interval*, University of Louisiana at Lafayette, USA

Abstract: Let α, b, and T be positive numbers, $D = (0, \infty)$, $\overline{D} = [0, \infty)$, and $\Omega = D \times (0, T]$. This article studies the first initial-boundary value problem with a concentrated nonlinear source situated at b:

$$\begin{aligned} u_t - u_{xx} &= \alpha\delta(x-b)f(u(x,t)) \text{ in } \Omega, \\ u(x,0) &= 0 \text{ on } \overline{D}, \\ u_x(0,t) &= 0 = \lim_{x\to\infty} u(x,t) \text{ for } 0 < t \leq T, \end{aligned}$$

where $\delta(x)$ is the Dirac delta function, and f is a given function such that $\lim_{u\to c^-} f(u) = \infty$ for some positive constant c, and $f(u)$ and its derivatives $f'(u)$ and $f''(u)$ are positive for $0 \leq u < c$. It is shown that the solution u always quenches for any α and b. Its corresponding blow-up phenomenon is also discussed.

DE30 **Wojciech Sulisz**, *On the evolution of nonlinear waves and freak waves*, Polish Academy of Sciences, Poland

Coauthor: Maciej Paprota

Abstract: A theoretical approach is applied to predict the propagation of nonlinear water waves in a wave train. The solution is applied to study the evolution of nonlinear waves and the formation of extreme waves. The studies show that the evolution of nonlinear waves in a wave train may lead to the formation of freak waves. The analysis shows that these phenomena cannot be described properly by the nonlinear Schrödinger equation or its modifications. Theoretical results are in a fairly good agreement with experimental data. A reasonable agreement between theoretical results and experimental data is observed also for the formation and evolution of freak waves. ACKNOWLEDGEMENTS: Financial support for this study was provided by the National Science Centre, Poland, and the Institute of Hydroengineering of the Polish Academy of Sciences in Gdańsk, Poland, under the contract No. UMO-2012/05/13/ST8/01833.

DE31 **Dhana Kumari Thapa**, *On the Dynamics of Semiconjugate Entire Functions*, Tribhuvan University, Nepal

Coauthor: Ajaya Singh

Abstract: Let f and g be entire functions and let h be a non-constant continuous function of the complex plane, $\mathbb{C}$ into itself satisfying $(h \circ f)(z) = (g \circ h)(z)$ for every $z \in \mathbb{C}$. Then f and g are said to be semiconjugated by h and h is called a semiconjugacy from f to g. We consider the dynamical properties of semiconjugated entire functions f and g. Several results on semiconjugated entire functions under which the semiconjugacy h carries Fatou set of one into the Fatou set of other entire function will be disscussed. More precisely, for some semiconjugate transcendental entire functions f and $g; h(F(g)) \subset F(f)$ where $F(f)$ denotes the Fatou set of the function f.

DE32 **Vandana Tiwari**, *Some Fixed Point Theorems for phi-contraction in Menger Probabilistic Metric Spaces*, IIT(BHU), Varanasi, India

Coauthor: Tanmoy Som

Abstracr: In the present paper, some fixed point theorems and important corollaries are obtained by using the properties of distribution function and t-norm in complete Menger probabilistic metric spaces. Our results improve and generalize the corresponding existing results in literature given by some authors.

DE33 **Anita Tomar**, *On Continuity of Maps and Existence of Common Fixed Point,* Government P. G. College, Dakpathar (Dehradun), India

Abstract: Continuity of map is essential condition for the existence of fixed point. First weaker form of continuity used in the existence of common fixed point is reciprocal continuity. The purpose of this paper is to discuss various weaker forms of continuity and to obtain coincidence and common fixed point for a non compatible and discontinuous pair of maps without using containment of range space of involved maps. To substantiate the authenticity of our results and to distinguish them from existing ones, some illustrative examples are also furnished.

B. Probability, Statistics and Big Data

ST1 **Gokarna Aryal**, *On Some Generalizations of Laplace Distribution*, Purdue University Calumet, IN, USA

Abstract: The Laplace distribution is one of the earliest distributions introduced in the probability theory. It has been used in several areas including medical science, environmental science, economics, and engineering, among others. In this talk we will review some of the recent generalizations of the Laplace distribution and propose a new generalization based on the genesis of Kumaraswamy distribution. We will provide some mathematical properties of the proposed distribution and its applications to model the consumer price index (CPI) data. Comparisons with other competing generalized distributions will also be presented.

ST2 **R.P. Aryal**, *Variability of Aerosol Optical Properties over AERONET Sites in Nepal and India*, Franklin Pierce University, USA

Coauthors: M. Cappucci, B. Dunleavy, M. Penrod, R.C. Kafle, M.K. Thapa, S. N. Tripathi

Abstract: Aerosol Optical Depth (AOD), Single Scattering Albedo, Absorption AOD, and Aerosol Absorption Angstrom Exponents (AAE) from four AERONET sites of Nepal and India was analyzed by using time series statistical model. These studies include five years of aerosol data from Gandhi College and Kanpur sites of India along with two sites, Pokhara and EVK2CNR, a Himalayan site, of Nepal. The observed diurnal, monthly and seasonal variation of aerosol optical components at different sites were compared . The comparison of long term aerosol optical properties over Himalaya site, mostly unpopulated area, with other regional sites of having rapid growth of industrial activities, increasing fossil fuel will help us to identify the shared common air mass over the these sites. The analysis of AOP suggest with the elevated values of aerosol absorption components in spring and winter than in summer in all sites showing a reduction of aerosol concentration in the summer, a Monsoon season, July to August. It signifies for aerosol loading into the atmosphere is highly affected due to seasonal variation. This developed model will also help us to extrapolate and get the future temporal trend of the aerosol optical characteristics, aerosol components over these sites.

ST3 **Ghanshyam Bhatt**, *Deterministic sampling matrices for compressed sensing,* Tennessee State University, Nashville, TN, USA

Abstract: The recovery of a sparse signal is possible even if the number of measurements is far less than actually required in principle. The traditional sampling techniques use random sampling matrices, which satisfy the requirements with a fairly high probability. However the deterministic sampling are preferred for many applications. The construction of deterministic sampling matrices

require low mutual coherence for applications. We construct finite frames as deterministic sampling matrices, and present a sparse signal recovery. The constructed frames provide low mutual coherence.

ST4 **Mitra Devkota**, *Performance of Geographically Weighted Regression (GWR) and its application*, Shawnee State University, USA

Coauthor: Gary Hatfield

Abstract: Ordinary Least Squares (OLS) regression often doesn't accurately model data with spatial non stationarity. In this talk, we will discuss a relatively new approach, Geographically Weighted Regression (GWR) for the modeling of such data. We will compare the model performance of OLS and GWR in terms of higher R2 and lower AICc (bias corrected version of the Akaike Information Criterion). We will assess the explanatory power of the models by approximate likelihood ratio test. We will also discuss that a serious caution must be exercised in drawing conclusions from such approach, while working with small data in particular. A real data will be used as an application.

ST5 **Sharmistha Ghosh**, *A Relational Database Model based on Neutrosophic Set Theory*, Galgotias University, Uttar Pradesh, India

Coauthor: Jaydev Mishra

Abstract: The data associated in real-life problems are often imprecise or non-deterministic in nature. Imperfect information can be classified as: incompleteness, imprecision, uncertainty, and inconsistency. In order to incorporate such imprecise or fuzzy data, the classical relational data model has been extended by several authors on the mathematical framework of fuzzy set theory which was initially introduced by Zadeh in 1965. Vague set theory, subsequently put forward by Gau and Buehrer in 1993, is considered to be a more efficient tool to treat ambiguous data and it has been successfully applied by the present authors to extend a fuzzy relational database model into a vague data model. A vague set, conceived as a generalization of the concept of fuzzy set, is a set of decision objects, each of which is characterized by a truth-membership function and a false-membership function where , $\square[0,1]$ and . Thus a vague set has more powerful ability to process imprecise information than traditional fuzzy sets which are characterized by a single membership function. Also it has been clearly observed that a vague database model may be more useful in processing uncertain information and queries than its fuzzy counterpart. However, it may be noted that due to the restriction that a membership function $\square[0,1]$ and , a fuzzy set/vague set cannot handle inconsistent information that can exist in many real life applications. For example, in data warehousing problems, inconsistency will appear while trying to integrate the data from many different sources. A neutrosophic set, defined by Smarandache in 1999, further generalizes the concept of vague set and allows a third membership function that describes the indeterminate part. The present work deals with the development of a NEUTROSOPHIC RELATIONAL DATABASE MODEL that is capable of manipulating incomplete as well as inconsistent information. The truth and false membership functions can now satisfy a relation $t_v(u) + f_v(u) \leq 2$. It is also observed through suitable real life examples that imprecise queries involving indeterminacy can be accurately processed using the Neutrosophic data model.

ST6 **C.B. Gupta**, *A Comparative Study of Two Indian States in Regard of First Birth Interval*, BITS, Pilani, Rajasthan, India

Abstract: First birth interval has always been at the forefront of demographers due to its impact on all demographic and non-demographic characteristics of a female. In our present paper we analysed the data from N.F.H.S.-3 for two states viz; Kerala and Rajasthan. We tried to identify the link between various socio-economic and demographic factors with first birth interval of a female. In addition to statistical measures, proportional hazard analysis in combination with life table was applied to investigate the impact of various factors on first birth interval.

ST7 **W.J. Jannidi**, *A Comparative Simulation Study on Estimation of Density Functions for Finite Mixtures and Data Clustering using Nonparametric Kernel Smoothing with EM Algorithm*, University of Ruhuna, Matara, Sri Lanka

Coauthor: M. K. Abeyratne

Abstract: Nowadays the determination of the probability density functions and the classification of data of mixtures are important and challenging issues in case of handling large datasets in variety of applications in medical or biological research as well as in many other fields. Even though a number of techniques are available in the research literature, it is of practically significant to have the knowledge of the nature of those methods such as the efficiency, applicability and drawbacks etc., when applying them to real problems. In this study, we first focused on a comparative simulation study in estimating a probability density function in two different ways for a certain population by using a data sample which may contain a mixture of data drawn from its subpopulations. The density function is first estimated by using the nonparametric kernel smoothing technique. Then a parametric approach is performed to find the density as a combination of two or more probability density functions described as a Gaussian mixture model which consists of a finite number of parameters. These parameters are estimated by implementing the EM algorithm. The estimations of the density function from both techniques are then compared graphically. As the second step of this study, the both nonparametric and parametric approaches are considered for data clustering. A nonparametric kernel smoothing technique is again applied to obtain a superposition of a finite number of density distributions to do data clustering by estimating the latent variables of the mixture model using a modified EM algorithm. In this context, rather than developing a new algorithm, an existing semiparametric mixture model with a modified EM algorithm presented by Laurent Bordes et. al. (2006) and improved by Taniana Benaglia et. al. (2008) is used with three different Kernel functions, namely Epanechikov, Triweight and Gaussian Kernel and various bandwidth selections. As the reference frame for viewing the validity and versatility of the method the widely used model based clustering technique with Gaussian mixtures is implemented. For the comparison, a data set generated as a mixture of three random data samples drawn from known normal distributions is used with both methods for data clustering. In all test examples, the graphical illustrations and quantitative analysis of errors show that the nonparametric approach gives a relatively good approximation when an appropriate bandwidth is chosen. However, the selection of an optimal bandwidth is a challenging issue as it is an inherent nature of all nonparametric kernel smoothing methods. Nevertheless, the nonparametric approach is applicable even for mixtures of data drawn from different distributions for which the mixture models cannot be prespecified as Gaussian mixtures. Through this simulation study, it is observed that the nonparametric approach would be more appropriate in modelling and data clustering at the preliminary stage in handling large and dense data sets, because we do not impose many assumptions and specific features into nonparametric models and the reliable results could be obtained.

ST8 **Sampath Kalluri**, *Statistical Outlier Detection and Treatment for the Breast Cancer Data*, Novartis Healthcare Pvt. Ltd., Hyderabad, India

Coauthor: Venkateswara Rao Mudunuru, Leslaw A. Skrzypek

Abstract: Outliers also known as extreme or influential observations, are the data points which disagrees with the majority of data points by deviating away from them. These glitches can arise due to many reasons including but not limited to measurement errors, data entry errors, sometimes by chance, mechanical faults, systems failure, among others. Not all seemingly problematic observations are potential outliers. In this paper, various simple outlier detection techniques aimed at identifying potential outliers are applied on the tumor sizes of the breast cancer data. The best technique is identified as the one which has the least standard deviation. In conclusion, we provide evidence that different ways of identifying, and handling outliers can have a great influence on research hypothesis.

ST9 **Netra Khanal**, *Modeling Carbon Dioxide Emission Data Using Differential Equation*, The University of Tampa, USA

Abstract: Carbon dioxide (CO2) is one of the major contributors in Global Warming. This study focuses on developing a system of differential equations using time series data of significant contributable variables of carbon dioxide in the atmosphere in the continental United States. We define the differential operator as data smoother and use the penalized least square fitting criteria to smooth the data. The proposed model gives an estimate of the rate of change of carbon dioxide

in the atmosphere. The data set is obtained from the Carbon Dioxide Information Analysis Center (CDIAC), the primary climate-change data and information analysis center of the United States Department of Energy.

ST10 **Siuli Mukhopadhyay**, *Modelling Dengue in Urban India*, Indian Institute of Technology Bombay, India

Abstract: Dengue is one of the most severe health problems faced by urban India even today. It is caused by four distinct dengue virus serotypes (DENV 1-4) transmitted primarily by the female Aedes aegypti mosquito, with Aedes albopictus as a secondary vector. Till date no vaccine or specific medical treatment is yet available for dengue, integrated vector control and surveillance are still the only strategies for disease prevention and control in endemic regions. Identifying the causative factors such as age, sex, social factors, climatic conditions etc. affecting the transmission of the disease is very important for epidemiological research on dengue and its eradication. In this work, the aim is to develop an early warning system for dengue in urban India (starting with Mumbai), which will aid the public health department to predict, prevent, and respond to future disease outbreaks. The main focus will be on successful forecasting of dengue cases in future years by incorporating environmental and epidemiological surveillance data, and other social ecological data in a dynamical model. The fitted model will forecast the disease risks for the future years and also generate seasonal risk maps for dengue. For fitting the model and predicting the number of disease cases, weekly data on number of dengue cases for the last seven years from various regions in Mumbai (one of the metro cities in India) have been collected. Preliminary analyses involving tests for non-stationarity, removal of seasonality will be done prior to model fitting. The response variable (disease counts) is count data in nature and there is a chance of presence of overdispersion. Thus the dynamical model fitted will be non-gaussian and possibly nonlinear in nature. Approximate Kalman filter techniques via mode estimation will be used by taking into account all complexities in the data and fitting a model to the disease data using climatic factors, social factors and epidemiological factors as the covariates.

ST11 **Budhinath Padhy**, *A Comparative Study of Structural Equation Models vs. Alternative Models for Multivariate Longitudinal Data*, University of Hartford, USA

Coauthor: Gemechis Djira

Abstract: In the past few years, there has been a surge of research interest in modeling longitudinal data in a variety of fields including medicine, marketing research, psychology, social and behavioral sciences. As such, number of studies in multivariate longitudinal data is also growing. In this talk, among others, attention is placed on structural equation models (SEM) and linear mixed effect models (LME) because they are popular, flexible, and widely applicable. These models assume that measurements from a single subject share a set of latent or random effects which are used to generate an association structure between repeated measurements. The fact that latent structures generate associations implies that SEM and LME are very convenient for the joint or multivariate analysis of longitudinal data. Our main research objective is to describe these multivariate longitudinal data analysis techniques that are easily accessible to a wider audience and then to compare and contrast the evolution of associations and the association of evolution of the responses of these methodologies by giving a motivating example.

ST12 **K.D. Sen**, *Scaling properties of net information measures and statistical complexity for bound states of spherical model potentials*, University of Hyderabad, Hyderabad, India

Abstract: The quantum mechanical Heisenberg uncertainty product is expressed in terms of the standard deviations involving quantum expectation values. The net information theoretical uncertainty-like measures, derived from the measures due to Shannon, Fisher, and others and computed in the position and momentum space provide interesting representations in terms of electron densities. Using the common dimensional properties of the uncertainty measures in general, we present their scaling characteristics in terms of the the parameters of several standard non-relativistic spherical model potentials, V(r) which generate the electron densities from the wave functions. Significance of the scaling properties with the illustrative numerical tests of the scaling behavior will be presented. A similar study involving the statistical complexity measure corresponding to several of these model potentials will also be discussed. A new measure of the

relative statistical complexity will be introduced and its applications to the electronic structure of atoms will be presented.

ST13 **Subhash Shende**, *Modeling Maternal –Infant HIV Transmission with Lag Time distributions as Exponential , Geometric and Shifted Geometric Distribution*, Fergusson College, Pune, India

Coauthors: Mohan M. Kale, Nikhil Gupte

Abstract: An important public health issue is to determine risk of transmission of perinatal human immunodeficiency virus (HIV) and the pediatric acquired immune deficiency syndrome (AIDS) and when it occurs. Several ongoing HIV prevention trials throughout the developing world are evaluating different methods to reduce perinatal HIV transmission. Perinatal transmission refers to mother to infant HIV transmission occurring before or the time of the birth. It results from fetal exposure to the maternal fluids or infected maternal secretions. We propose a model that simultaneously estimates the risks perinatal transmission together with the sensitivity of the screening tests for HIV infection. The model also allows estimating infectivity through breast feeding during postpartum period. The article aims at the review of latest status of the said problem and presenting a tour of tools and techniques available in statistical literature for analyzing such data sets.A case study of this type will be also demonstrated.

C. Mathematical Biology

MB1 **Saraswati Acharya**, *Mathematical Simulation on Human Males' and Females' Body Thermal Behaviour*, Kathmandu University, Nepal

Coauthor: Dil B. Gurung

Abstract: The human body has to stay tends to its normal temperature because the enzymes that causes reaction in the body functions are best at normal temperature. The study is described one and two dimensional mathematical models for tissue temperature distribution during follicular and luteal phases of females. The study is further carried out for the temperature distribution results of these phases as compared to males temperature distribution. The solution is presented on the basis of variational finite element method for steady and transient cases. Sweating is considered as a heat loss within the body by evaporation of water inside the body. The sweating rate for male is calculated by the relation:

$$E = 8.47 \times 10^{-5}(0.1 \times T_{sk} + 0.9 \times T_b) - 36.6^{\circ}C \ [kg/m^2/sec]$$

where, $T_{sk} = T_0$ (Outer skin surface temperature), $T_b = 37^{\circ}$ (Body core temperature).
The sweat rate in females is less compared to males due to the lower density of sweat gland and hormonal pattern in females. So, coefficient of T_b is considered as 0.7 instead of 0.9 in above relation for females [1, 2].
The analysis sought out that during the luteal phase of females, the tissue temperature is lower as compared to males, when atmospheric temperature T_∞ falls below the body core temperature. Likewise, females luteal phase temperature is slightly higher as compared to males, when T_∞ exceeds the body core temperature. But, females follicular phase temperature is lower as compared to females luteal phase and males body temperature either T_∞ is greater or less than the body core. The above differences of females compared to males under the same atmospheric conditions may be the causes of females hormonal variation during the menstrual cycle phases. In this study, convergence of temperature values is also carried out by varying the mesh element size.

Editor's note: The references are omitted.

MB2 **Mamta Agrawal**, *A mathematical model to study temperature distribution in deep tissues of elliptical shaped human limbs involving tumor*, Maulana Azad National Institute, Bhopal, India

Coauthor: K.R. Pardasani

Abstract: In this study a mathematical model of temperature distribution in deep tissues of elliptical shaped human limb involving tumor has been developed. The region of the limb has been divided into several homogenous layers namely skin, fats, muscles and bones. It has been assumed

that a uniformly perfused tumor is situated in the fat layer. Various physical and physiological parameters like metabolic heat generation, effect of blood mass flow rate, thermal conductivity in the various tissue layers of human limb have been incorporated in this model. The heat loss takes place from outer surface of the limb to the environment by conduction, convection, radiation and evaporation in order to maintain the thermal balance with the environment. Finite element method has been used to solve the mathematical model and obtaining thermal information by discretizing the region into coaxial circular sector elements. The thermal information obtained from such models can be of great useful for biomedical scientists in clinical applications.

MB3 **Gokul K. C.**, *Mathematical model for temperature distribution in Laser in Situ Keratomileusis*, Kathmandu University, Nepal

Coauthor: Dil. B. Gurung

Abstract: Lasers have been widely used in ophthalmology. Refractive errors are some of the most common ophthalmic abnormalities worldwide. Laser refractive surgeries were developed to correct different types of refractive errors. People with refractive errors have irregularities in corneal curvature. Laser in Situ Keratomileusis (LASIK) reshapes the corneal curvature making it flatter or steeper to counterbalance the refractive errors. Two types of laser surgical techniques: lamellar and thermal are available to reshape the corneal curvature. LASIK is a lamellar procedure where ultraviolet (UV) emitting argon fluoride (ArF) excimer laser is used to sculpt the cornea. In this paper, a finite element model is developed to investigate the temperature distribution of cornea in LASIK. Influence of different parameters of laser radiation in human eye tissues is investigated. The results are discussed, compared and validated with experimental results.

MB4 **Attila Dénes**, *Global stability for SIR and SIRS models via Dulac functions*, Bolyai Institute, University of Szeged, Hungary

Coauthor: Gergely Röst

Abstract: We prove the global asymptotic stability of the disease-free and the endemic equilibrium for general SIR and SIRS models with nonlinear incidence. Instead of the popular Volterra-type Lyapunov functions, we use the method of Dulac functions, which allows us to extend the previous global stability results to a wider class of SIR and SIRS systems, including nonlinear (density-dependent) removal terms as well. We show that this method is useful in cases that cannot be covered by Lyapunov functions, such as bistable situations. We completely describe the global attractor even in the scenario of a backward bifurcation, when multiple endemic equilibria coexist.

MB5 **Dil B. Gurung**, *Computational study of heat regulation in human body,* Kathmandu University, Nepal

Abstract: All biological bodies live in a thermal environment, where skin and subcutaneous tissue (SST) is the interface with many functions such as sensory, thermoregulation, host defense etc. Among these roles, the most important one is the regulation of heat in SST region of human body. SST is a complex geometrical structures with many more heterogeneous physical and physiological quantities governing the heat transfer process, and hence, the heat transfer mechanism in human body is different than other materials. The thermal behavior in SST has wide applications in biology, medicine and physiological study, and is a current growing research area due to the development of computational technologies and numerical tools. The present study focuses on the temperature variation in SST region/human eye under various in-vivo tissue conditions and outside conditions.

MB6 **Hem Raj Joshi**, *Optimal Control and Stability Analysis of an Epidemic model with Education Campaign and Treatment,* Xavier University, OH, USA

Coauthors: Sanjukta Hota, Folashade Agusto, Suzanne Lenhart

Abstract: We investigated a SIR epidemic model in which education campaign and treatment are both important for the disease management. Optimal control theory was used on the system of differential equations to achieve the goal of minimizing the infected population and slow down the epidemic outbreak. Stability analysis of the disease free equilibrium of the system was completed. Numerical results with education campaign levels and treatment rates as controls are illustrated.

MB7 **M.A. Khanday**, *Thermal behavior of human eye in relation with change in blood perfusion, porosity, evaporation and ambient temperature,* University of Kashmir, Srinagar, J&K, India
Coauthor: Aasma Rafiq

Abstract: Extreme environmental and physiological conditions present challenges for thermal processes in body tissues including multi-layered human eye. A mathematical model has been formulated in this direction to study the thermal behavior of the human eye in relation with the change in blood perfusion, porosity, evaporation and environmental temperatures. In this study, a comprehensive thermal analysis has been performed on the multi-layered eye using Pennes' bioheat equation with appropriate boundary and interface conditions. The variational finite element method and MATLAB software were used for simulation of the results. The effect due to blood perfusion rate, porosity, ambient temperature and evaporation on the thermal stabil- ity at various regions were illustrated. The main applications of this model are associated with the medical sciences while laser therapy and other thermoregulatory investigation on human eye.

MB8 **Chitaranjan Mahapatra**, *Computational study of Subthalamic nucleus neuron: Role of T-type calcium channel in Parkinson's disease,* Computational Neurophysiology Lab, Indian Institute of Technology, Bombay, India
Coauthor: Rohit Manchanda

Abstract: As emergence of abnormal burst discharge in subthalamic nucleus (STN) cells is a pathological hallmark of the Parkinson's disease, quantitative analysis of firing patterns in STN cells will help to pharmacological assessment. Here our goal is to study the effect of T type $Ca2+$ channel at the level of abnormal bursting patterns in computational model of STN cell with proper validation. The cell membrane is described as an equivalent electrical circuit consisting of a membrane capacitance connected in parallel with a number of variable conductances representing the ion channels. The nine ionic currents are described by differential equations, in terms of maximal conductances, electro chemical gradients, and voltage-dependent activation/inactivation gating variables. The STN cell fires action potentials (AP) in the single spike mode with a resting membrane potential (RMP) of approximately $-50\,mV$. A hyperpolarizing current injection changes to the burst mode of firing when the RMP is approximately $-65\,mV$. The T-type $Ca2+$ currents channels bring the oscillatory pattern into a positive feedback cycle, where the AP plateau built up by $Ca2+$ conductances, until enough slowly activated K+ channels are open to end the burst. Moreover, the same T-type $Ca2+$ channel with zero conductances abolished burst firings in STN model and relatively low conductance abolishes the initial rising phase of the burst plateau and then shortens the burst duration. These studies shed light in proper dosing of T-type calcium channel inhibitors as an effective new non-dopaminergic alternative in parkinsonian patients.

MB9 **Luis Melara**, *Optimal Control of MANF to Prevent Apoptosis in Retinitis Pigmentosa*, Shippensburg University, USA/IIT Bhubaneswar, India

Coauthors: Erika Camacho, Suzanne Lenhart, M. Cristina Villalobos, Stephen Wirkus

Abstract: Protein misfolding is one of the major causes of apoptosis in Retinitis Pigmentosa, where apoptosis is programmed cell death. Mesencephalic-Astrocyte-derived-Neurotrophic Factor (MANF) is a protein that has been shown to correct protein misfolding, thus reducing the death of cells due to "cell suicide." In this talk, we formulate an optimal control problem that incorporates MANF treatment to rescue photoreceptors in the eye. Numerical results are shown and discussed.

MB10 **R.O. Olayiwola**, *Modeling and Analytical Simulation of Microbial Fate and Transport Phenomena in Porous Media,* Federal University of Technology, Minna, Nigeria

Abstract: Concern about pathogen contamination of groundwater and the use of microbial agents in the cleanup of groundwater has highlighted the need for an improved understanding of the fate and transport of microbes in the subsurface. This paper presents an analytical method to describe the physical, chemical and biological processes governing the simultaneous transport of microbes and nutrient in porous media. The governing equations account for the net flux of microbes by convection and dispersion, the decay and growth rates of microbes, the chemotaxis/chemotactic and the deposition of microbes on solid matrix. The decay of microbes is assumed to be a first-order reaction and the growth of microbes is assumed to follow the Monod equation. The existence

and uniqueness of solution was examined. The coupled non-linear partial differential equations describing the phenomenon have been decoupled using parameter-expanding method and solved analytically using eigenfunction expansion technique. It is clear from all the results obtained that chemotaxis and sedimentation play a significant role in the transport of microbial cells through porous media.

MB11 **S.D. Perera**, *Sensitivity and Stability of Dengue Virus Dynamics*, University of Colombo, Sri Lanka

Coauthors: S.S.N. Perera, S. Jayasinghe

Abstract: Dengue continues to be one of the world's fastest growing vector-borne diseases that can be mainly found in tropical and sub-tropical regions around the world. The spectrum of dengue infection ranges from asymptomatic infection to death. There are four distinct closely related viruses designated as serotypes (DEN-1, DEN-2, DEN-3, DEN-4) that cause dengue of varying severity in humans. Though the classic form of the disease known as Dengue Fever causes flu-like symptoms and is non-life-threatening, its more severe forms as dengue hemorrhagic fever and dengue shock syndrome can be fatal if not treated properly. Mathematical models for dynamics of dengue virus within-host have not yet been widely discussed in literature. In this paper we focus on describing the dynamics of dengue virus, using a compartment type model with time delay that occurs during the production of antibodies. We study the dynamics of healthy cells, infected cells, B-cells of the human body, viruses and antibodies where immunity is provided by the activation of B cells into plasma cells and maturation of plasma cells into antibodies (humoral immune response). Stability and sensitivity of the model is discussed with respect to external variables such as production rate of antibodies, the conversion rate of healthy cells into infected cells due to the interaction with virus and virus burst rate. Further, stability regions are identified with respect to the external variables and it is observed as the virus burst rate increases, the stability regions would decrease. In addition results indicate as the conversion rate of healthy cells into infected cells increases, the viral load in the body and the antibody production also increases which agrees with theory presented on humoral immune response and the viral load goes to negligible levels within 7-14 days as observed in dengue infection.

MB12 **Ganga Ram Phaijoo**, *Mathematical study of dengue disease transmission dynamics in patches*, Kathmandu University, Nepal

Coauthor: Dil B. Gurung

Abstract: Dengue disease is a vector borne infectious disease transmitted to humans by female aedes mosquitoes. Dengue viruses have been spreading into new human populations due to traveling of human population from one place to the other. Present paper discusses a multi patch SIR epidemic model to study dengue disease transmission in different patches due to travel of human population. Different disease prevalence in different patches are considered in the paper. Basic reproduction number of the model is calculated and local and global stability of equilibrium point are analyzed to study the dynamics of the disease.

MB13 **BSRV Prasad**, *Dynamics of cannibalistic predator-prey system in presence of additional food to predators*, VIT University, India

Coauthor: K. Durga Prasad

Abstract: Cannibalism is a conspecific lethal interaction, a normal phenomenon in many natural populations, which is used as a "life-boat strategy" to avoid circumstances leading to extinction. But, as observed in many experimental studies, this cannibalistic nature in natural enemies can deter the outcome of biological pest control programs. One of the ways to deviate natural enemies from conspecific lethal interactions is to provide them with additional/alternative food. In this paper, using the theory of dynamical systems, we analyze dynamics of the cannibalistic predator-prey system when predators are provided with additional food. A detailed mathematical analysis carried out to study the permanence, stability and various bifurcations occurring in the system. The system analysis reveals several interesting phenomena. Depending on the choice of quality (characterized by predator's handling time towards additional food) and quantity of additional food, the system can exhibit multiple coexisting equilibria, leading to the emergence of the homoclinic

loop. It is also observed that by varying the quality and quantity of additional food, one can, not only limit and control the pest but also eradicate the predators. In the context of biological control programs, the current theoretical study aids the eco-managers in choosing the appropriate additional food to be supplied to enhance biocontrol efficiency of cannibalistic predators.

MB14 **Maneesha Premaratne**, *Mathematical modeling of immune parameters in the evolution of dengue severity*, University of Colombo, Sri Lanka

Coauthors: S.S.N. Perera, G.N. Malavige, Saroj Jayasinghe

Abstract: Dengue results in significant morbidity and mortality in Sri Lanka. Several inter-related factors contribute to its evolution from asymptomatic infection to severe vascular leakage leading to dengue hemorrhagic fever (DHF) and death. Predicting this path at an early stage in an individual patient will be invaluable in preventing morbidity and mortality. This requires analysis of multiple parameters. For this purpose we use the parameters platelet count, lymphocyte count, NS1 panbio levels and IgG panbio levels. We analyze data for 11 adult patients with dengue fever (DF) and 25 patients with DHF in the Colombo South Teaching Hospital, Sri Lanka. Hierarchical clustering is performed to study the characteristics and interactions of the parameters. Fuzzy logic fundamentals are used to map the risk of developing severe forms of dengue. Membership functions are constructed for each of the individual parameters and the cumulative risk indicated by the parameters are obtained using the Hamacher and the Ordered Weighted Aggregation (OWA) operators. The proposed model has the ability to classify the patients with an accuracy ranging from 53% - 89% during the time period of 96 hours to 120 hours after the onset of fever. The results show a robust mathematical model that explains the evolution from dengue to its serious forms in individual patients. The model allows the medical community to use the limited resources in an optimal manner to treat patients during a dengue outbreak.

MB15 **Eugenio M. Rocha**, *Hybrid nonautonomous SIR-model coming from a simple and reasonable government action police*, University of Aveiro, Portugal

Abstract: Some virus diseases (e.g. Zika, Chikungunya or Dengue) are a strong public concern because of its rapid spread even after a wide government intervention, usually by controlling the disease vectors (e.g. killing mosquitoes). Mathematically, the common model to represent such behavior is the SIR model and its variants. In this work, we show that if we consider a SIR model plus a simple and reasonable government action policy (action strategy), the complete model is a complex structure that no more is a ordinary differential equation (or even a differential inclusion). To understand such structure, we use techniques of Dynamical Systems (e.g. nonautonomous attractors, center manifolds, Bohl exponents), Hybrid Logics (e.g. hybrid automata, transition systems) and First-Order Logics (e.g. delta-complete decision, delta-satisfiability, SMT). Note that the complete model has trajectories that do not appear when studying the SIR model without a action strategy. Additionally, new stability results and 1- dimensional reduction equation are presented for the SIR model. Our mathematical approach, based on hybrid numerical analysis, give clues about the reason why the government action police may be major reason for the periodic behavior of Dengue.

MB16 **Gergely Röst**, *Stability switches induced by waning and boosting of immunity in an SIRS model with discrete and distributed delays*, Bolyai Institute, University of Szeged, Hungary

Coauthors: Maria Vittoria Barbarossa, Mónika Van Leeuwen-Polner

Abstract: First we consider a general class of epidemiological models that includes waning and boosting of immunity. As a special case, by assuming that repeated exposure to the pathogen fully restores immunity, we derive an SIRS-type model with discrete and distributed delays. First we prove usual results, namely that if the basic reproduction number, R0, is less or equal than 1, then the disease free equilibrium is globally asymptotically stable, whereas for R0 ¿ 1 the disease persists in the population. The interesting features of boosting appear with respect to the endemic equilibrium, which can go through multiple stability switches by changing the key model parameters. We construct two parameter stability charts, showing that increasing the delay can stabilize the positive equilibrium. Increasing R0, the endemic equilibrium can experience distinct regions of instability, separated by Hopf-bifurcations, resulting in a complex bifurcation diagram.

Our results show that the dynamics of infectious diseases with boosting of immunity can be more complex than most epidemiological models, and calls for careful mathematical analysis.

MB17 **Adnan Sljoka**, *Probing protein flexibility and function via rigidity theory*, Kyoto University, Japan

Abstract: Deep understanding of protein function requires knowledge about its motions, which is critical in fields such as medicine and drug design. Probing protein motions is a complex task as conformational fluctuations are rapid, transient and result in structures that are spectroscopically indistinguishable from the native-state. Biochemical experiments can provide limited insights but are costly and extremely time consuming. Protein motions can also be modelled with molecular dynamics (MD) simulations, but this approach is mostly impractical as it takes a prohibitive amount of computational power to simulate large-scale motions. Advancements in the field of combinatorial rigidity theory have opened up a number of exciting opportunities for computational predictions of flexibility/rigidity in proteins. Methods like FIRST and various spin-offs, can accurately predict the rigid and flexible regions in proteins in a fraction of a second. Starting with a such a rigid and a flexible region decomposition, Monte Carlo inspired geometric simulations can be applied to simulate the protein motions. In this talk we will review the rigidity theoretical results and fast combinatorial algorithms behind these methods and our applications to understanding several key protein functions. We will highlight our rigidity allostery algorithm and examples on several different classes of proteins, which is used to predict and understand how proteins transmit signals (allostery) across the structure and control their activity. We will also discuss our recent results which provide new experiment and computational insights into the structural and dynamic properties of Tau protein, a key disordered protein involved in Alzheimers's and other tauopothies.

MB18 **S. Srinivas**, *Analysis of blood gold nanofluid in a porous channel with moving/stationary walls in presence of thermal radiation*, VIT University, Vellore, India

Coauthors: A. Vijayalakshmi, A. Subramanyam Reddy

Abstract: The present analysis deals with the blood gold nanofluid flow in a porous channel with moving/stationary walls. The thermal radiation is taken into account. In this study, blood is considered as base fluid which is Newtonian and gold as nanoparticles. The governing flow equations are transformed to ordinary differential equations using similarity transformations. The resulting ODE system is solved analytically by employing homotopy analysis method (HAM). The analytical solutions are validated with the numerical solutions obtained by shooting technique coupled with Runge-Kutta fourth order scheme. The effects of emerging parameters on flow variables have been discussed. It is observed that the velocity decreases towards the upper wall for a given increase in nanoparticles volume fraction, while it increases towards the lower wall. The temperature of nanofluid increases for a given increase in radiation parameter towards the upper wall, while decreases towards the lower wall.

MB19 **Ramesh Chandra Timsina**, *Chemostat Model Analysis for growth of three different microorganism in limiting subtrate*, Tribhuvan University, Nepal

Abstract: There are many types of bioreactors used for producing microorganisms population in commercial, medical and research application. chemostat is an important device used for the growth of population of microorganism.This paper presents a systematic discussion on Monod Model on chemostat for growth rate of three different microorganisms in continuous culture using the limiting substrate.It also presents the discussion on stability analysis of the model for different steady state solutions.

MB20 **Jai Prakash Tripathi**, *A non-autonomous predator-prey model incorporating a prey refuge*, Central University of Rajasthan, India

Abstract: This paper is concerned with a non-autonomous modified Leslie-Gower Lotka-Volterra system with Crowley–Martin type functional response incorporating a prey refuge. Crowley-Martin functional response is similar to the Beddington-DeAngelis functional response but contains an extra term describing mutual interference by predators at high prey density. With the help of continuation theorem based on Gaines and Mawhin's coincidence degree, global existence of a positive periodic solution is established. Permanence, existence, uniqueness and global asymptotic stability of positive periodic solution of the model have been discussed under some sufficient conditions by

applying comparison theorem of differential equations and constructing suitable Lyapunov functional. It is established that the prey reserve leaves no effect on globally attractive positive periodic solution of the concerned model system. Further rates (coefficients of the proposed model system) are also assumed to be almost periodic, which generalizes the concept of periodicity. The analytical results obtained are illustrated with the help of numerical examples.

MB21 **Naveen K. Vaidya**, *Modeling HIV Epidemics affected by Labor Migration and TB Co-infection: Far Western Nepal and Southern India as Case Studies*, University of Missouri - Kansas City, USA

Abstract: Seasonal labor migration and co-infection with TB are two major obstacles to proper management of HIV epidemics. With Far Western Nepal and Southern States of India as case studies, I will present how mathematical models can be beneficial to address these issues. In the first part of my talk, I will present an HIV transmission dynamics model that illustrates how seasonal labor migration to India has fueled HIV epidemics in Far Western Nepal. Using our model, we evaluate the effectiveness of various control strategies to mitigate HIV burden in Nepal. In the second part of the talk, I will present an HIV-TB co-infection dynamics model. We apply our model particularly to address the problems that individuals co-infected with HIV and TB often face with a dilemma of making critical decision on whether to begin treatments for both diseases simultaneously or wait to begin HIV-treatment until the completion of TB-treatment. Using our model and related optimal control problems we identify the treatment strategies that result in the minimum burden from this co-infection.

D. Algebra, Topology and Mathematical Education

TP1 **Deepak Basyal**, *Contents of early mathematics books in Nepal*, University of Wisconsin-Marinette, USA

Abstract: The formal writing of mathematics textbooks in Nepal started not until the dawn of democracy in 1951, however, some mathematics textbooks and teacher manuals were written in the late 19th century and early 20th century. This paper presents a brief account of contents of early mathematics books including Gopal Panday's Vyakta Chandrika (1884), Pahalman Singh Swar's Ankendushekhara (1900) and Tikaram Dhananjaya's Shishubodha Tarangini (1933). I will also briefly discuss the potential benefits of using these contextually rich historical resources in the teaching and learning of mathematics in Nepal.

TP2 **Harish Chandra Bhandari**, *On Development of p-Adic Numbers*, Thames International College, Battisputali, Kathmandu

Coauthor: Kanhaiya Jha

Abstract: The p-adic numbers are one of the important notions of the Algebra and Number Theory whereas the p-adic analysis is a branch of number theory that deals with the mathematical analysis of functions of p-adic numbers. Although the applications of p-adic analysis have mainly been in number theory and algebra, the recent development in this field has shown that the p-adic analysis is linked with different fields together with the classical one. The main objective of this presentation is to discuss briefly the development of p-adic numbers with properties and its connection with fixed point.

TP3 **Kailash Ghimire**, *Cellular Decomposition of Hilbert Cube Manifolds and Finding codimension*, Georgia Southwestern State University, USA

Abstract: Cellular sets in the Hilbert cube are the intersection of nested sequences of normal cubes. One way of getting cellular maps on the Hilbert cube is by decomposing the Hilbert cube into cellular sets and using a quotient map. By using a cellular decomposition of the Hilbert cube, an example of a cellular map is given to show that the image of the Hilbert cube under a cellular map can have complex non manifold part, not be a Hilbert cube manifold, and still be a Hilbert cube manifold factor. The non degenerate decomposition elements are shown to satisfy the cellularity criteria. To measure how far the image is from being a Hilbert cube manifold, the idea of covering codimension in finite dimensions is generalized by using a homological codimension approach.

TP4 **Kaji Prasad Ghimire**, *Learning Styles and Academic Achievement in Mathematics among Higher Secondary Level Science Students*, Tribhuvan University, Nepal

Coauthor: Hari Prasad Upadhyay

Abstract: The study was conducted to determine learning styles and mathematics performance among higher secondary school students. A total of 247 (male 161, female 86) grade eleven science students from Kathmandu were participated in the study. In this survey method, an index of learning styles determined learning style preference with respect to 4 different learning style axes; active/reflective, sensing/intuitive, visual/verbal and sequential/global. Students' learning outcome was based on 50 items mathematics achievement test of 100 marks constructed by the researcher. These instruments were administered at the end of academic year 2012/13. The collected data were analyzed using descriptive and inferential statistics including mean, correlation, and variance of analysis in SPSS software version 20. The tendency of most of the students' learning style preferences were towards active, sensing, visual, and sequential. Furthermore, the majority of students were balanced learners (between 27.9% and 72.5% across four learning style dimensions). The results of this study revealed that there was a significant difference between learning style of active/reflective and sensing/intuitive based on gender. The research has shown that the mean mathematics achievement test score was 42.9 with standard deviation 13.5. In addition, there exists a significant relationship between sensing/intuitive learning style and academic achievement in mathematics. As far as the researchers' knowledge is concerned, this study is believed to be the first one of this kind. These findings have implications for improvement of mathematics education of pre-university students.

TP5 **Pawan Kumar Karn**, *On Standard Sequence*, Tribhuvan University, Nepal

Abstract: This paper discusses about the algebra of limit of sequences. It selects the theory of standard sequences from the nonstandard outlook and proves some theorems of nonstandard analysis. Application of these theorems has also been furnished in case of functional analysis.

TP6 **Narayan Prasad Pahari**, *On 2- Banach Space Valued Paranormed Sequence Space* $l(X, M, ||., .||, \bar{\lambda}, \bar{p})$ *Defined by Orlicz Function*, Tribhuvan University, Nepal

Abstract: The aim of this talk is to introduce and study a new class $l(X, M, ||., .||, \bar{\lambda}, \bar{p})$ of 2-Banach space valued sequences using Orlicz function as a generalization of sequence space $l(X, M, \bar{\lambda}, \bar{p})$, which is the generalization of the familiar sequence space sequence space (p). Besides the investigation of conditions pertaining to the containment relation of the class $l(X, M, ||., .||, \bar{\lambda}, \bar{p})$ in terms of different $\bar{\lambda}$ and $\bar{p}$, our primarily interest is to explore the linear topological structures of the class $l(X, M, ||., .||, \bar{\lambda}, \bar{p})$ when topologized it with suitable natural paranorm.

TP7 **Dinesh Panthi**, *Some Fixed Point Theorems of integral and Meir-Keeler Type in Dislocated Metric Space*, Nepal Sanskrit University, Nepal

Abstract: In 1986, S. G. Matthews introduced the concept of dislocated metric space in the context of domain theory. In 2000, P. Hitzler and A. K. Seda introduced the concept of dislocated topology and provided some variants along with dislocated metric space and established fixed point theorems. Since then, a number of fixed point theorems have been established by several authors in this space. In this paper we establish some fixed point theorems for mappings satisfying contractive condition of integral and Meir- Keeler type in dislocated metric space which generalize and improve some similar results in the literature.

TP8 **Özen ÖZER**, *On Some Results Concerning The Fundamental Units of Certain Real Quadratic Number Fields and Fibonacci Numbers,* Kırklareli University, Turkey

Abstract: Let $k = Q(\sqrt{d})$ be a real quadratic number field where $d > 0$ is a positive square-free integer.$w_d = \sqrt{d}$ and $\ell(d)$ are integral basis element of $Z[\sqrt{d}]$ and the period length in simple continued fraction expansion of algebraic integer

$$w_d = \left[a_0; \overline{a_1, a_2, \ldots, a_{\ell(d)-1}, 2a_0}\ \right].$$

for $d \equiv 2, 3(mod 4)$ respectively. The fundamental unit ϵ_d of real quadratic number field is also denoted by

$$\epsilon_d = \left(t_d + u_d\sqrt{d}\right) \rangle\, 1$$

where $N(\epsilon_d) = (-1)^{\ell(d)}$. In [7], K. Tomita defined several theorems for fundamental unit of certain real quadratic number fields. Although, there are infinitely many values of d having all 1s in the symmetric part of continued fraction expansion of w_d , Tomita has described explicitly one type of the fundamental units of the real quadratic fields by using Fibonacci sequence in Theorem 3 in [7]. The main purpose of this paper is to generalize and provide an improvement of the theorem 3 in [7]. Moreover, the present paper will deal with the new certain formulas for fundamental unit $\epsilon_d = \left(t_d + u_d\sqrt{d}\right) > 1$ and Yokoi d-invariants n_d and m_d for such real quadratic fields. These new formulizations have not been known so far.

Editor's note: The references are omitted.

E. Numerical Analysis, Scientific Computation, and Optimization

NM1 **Ami Raj Adhikari**, *Analysis of $E_2/E_2/1/m$ queueing system with sinusoidal arrival rate function subject to server breakdown*, Tribhuvan University, Nepal

Coauthor: Ram Prasad Ghimire

Abstract: The paper deals with the mathematical model of a finite single–server queuing system with a server subject to breakdown, considering customers inter-arrival times and service times follow the Erlang distribution. Cost analysis and analysis of performance measures on taking inter-arrival times as sinusoidal function are undertaken with respect to different parameters. Further we assume that service of customer is interrupted by the occurrence of busy server failure. Under the study we find various performance indices of the model with the numerical illustrations.

NM2 **Raju Prasad Bhusal**, *Numerical Smoothness on RKDG method for the nonlinear conservation laws*, Bowling Green State University, USA

Abstract: It is well known that numerical stability is necessary For numerical solution of the PDEs of the form $u_t + f(u)_x = 0$. We will discuss the different concept called the "Numerical smoothness". The error analysis using Numerical Smoothness for RKDG method for the case of a smooth solution and the case of a fully developed shock has done by Sun, Rumsey and Fode. We will show our idea to approximate the solution during the formation of a shock. Also, time ratio before the breaking time and after breaking time will be presented.

NM3 **B.S. Chaudhary**, *RS and GIS Applications in Integrated Land and Water Resources Management in parts of North India,* Kurukshetra University, Kurukshetra, India

Abstract: Sustainable development plans for land and water resources of an area mandates pre-requisite information on these resources. The recent techniques of remote sensing and GIS helps in generation of more accurate, efficient and quick base line information on various resources in a scientific manner. This helps in development of land and water resources action plans. Various thematic maps like land use/ land cover, hydrogeomorphology, soil, slope, ground water quality and depth are required for preparing any viable sustainable development plan. The study area covers southern part of Mahendergarh district, Haryana state India which has an area of 650 sq kms. It extends from 270 46' to 280 12' north latitudes and 750 55' to 760 15' east longitudes. It represent dry land topography with the presence of inland streams, sandy plains, sand dunes, dissected upland tracts and often barren, denuded, rocky hill ranges. Dohan and Krishnawati are the only non-perennial rivers in the area. IRS 1B & C satellite data along with other ancillary information have been used for preparing various maps. The maps thus prepared were integrated in GIS environment and suitable action plan for optimal utilization of various land parcels have been prepared. Land Resources development plan includes two major categories- management of agricultural lands and management of wastelands. Various activities like Silvipasture, Agrohorticulture, Agroforestry, Peripheral plantation, Vegetative filter, Plantation, Plantation with soil conservation measures, Afforestation and Afforestation with soil conservation measures has been suggested. The water resources developments plans include suggestion for check dams, earthen dams, subsurface barriers and also areas for further groundwater exploration. The land and water resources action plan thus prepared will help to increase the production of food grains and fruits, increase fodder leading to higher animal produce, save land from degradation, better water conservation and management and will ultimately improve the ecological conditions

NM4 **Basu Dev Ghimire**, *Reliability and availability of machines with two types of failures operated under periodic surveillance test*, Kathmandu University, Nepal

Coauthor: Ram Prasad Ghimire

Abstract: This paper deals with the study of two operating machines subject to two types of failure modes –common cause failure and independent failure under periodic surveillance provision. To improve the reliability and availability of machines the provisions have been made to repair of major and minor failures machines and regular surveillance test. The model is taken as 1-out-of-2 standby system and state diagram constructed so as to obtain the system of steady state equations. The numerical results analyze the reliability and availability with the variations of expected surveillance duration, expected manor and major repair rates, standby rates.

NM5 **Sushil Ghimire**, *Optimization of M/M/R/N Queueing System with Multi-Additional Servers*, Tribhuvan University, Nepal

Coauthors: Gyan Bahadur Thapa, Ram Prasad Ghimire

Abstract: Waiting line with finite capacity is the interest of our study. To carry on our work in this area, we will study the multi server finite capacity M/M/R/N queueing system with additional servers where R servers are available to serve N number of customers describing Poisson arrival (M) with exponential service time distribution (M). One server is permanently available and the second server will start serving only after the given number of customers exceed in the queue. The second server stops serving, if the queue length becomes less than a certain number. In this paper, we will calculate mean queue length and mean number customers in the queue using Steady-State Conditions to study the cost optimization. We will find the optimal number of servers to reduce the queue length as well as system cost with the help of numerical illustrations.

NM6 **Manmohan Dass Goel**, *Optimization and Performance Analysis of Solar Still for Resource Constrained Areas*, CSIR-National Environmental Engineering Research Institute, Nagpur, India

Coauthors: Rohit Dubey, Karishma Kapley, S.S. Rayalu

Abstract: Distillation is the process of water purification by the use of solar radiation, heat or electricity. In case of solar still, solar radiation is used for water purification. The purpose of using solar energy is to increase the quality and purification of drinking water in resource constrained areas and to use the abundant sun power without affecting the environment. Herein, in house developed metal nanoparticles are employed in the form of paint/coating to increase the evaporation rate of the still with an area of 0.5 sq. m. In the present investigation, the efficiency of the commercially available single slope solar still is improved by optimizing the dose of the nanoparticles and observed that output of the distillation is improved by a factor of 2.5. Moreover, the optimized dose results in complete removal of fluoride from the water which is more advantageous in fluoride affected areas.

NM7 **Dadang Amir Hamzah**, *On the numerical solution of Fisher's equation by iterative splitting method*, Bandung Institute of Technology (ITB), Indonesia

Coauthors: J.M. Tuwankotta, Yudi Soeharyadi

Abstract: In this paper, we use the method of iterative splitting method on the Fishers Equation and compered with Strang's splitting method. These method are based on splitting the complex problem into simpler sub-problems while the difference are the iteration used at one step time. In the operator splitting method each sub-equation is combined with iterative schemes and solved with suitable integrators, while in Strang's splitting method at one step time the problem splitted and solved saperately. To achieve stability criteria for the proposed method applied to the Fishers equation we perform Von Neumann analysis. The numerical results obtained by iterative splitting method and the sequential splitting method are compered with the exact solutions and for comparation we also use the Crank-Nicholson scheme. It is seen that the iterative splitting method have the smallest error compered to the other.

NM8 **Milan Hladík**, *Interval convex quadratic programming problems in a general form,* Charles University in Prague, Czech Republic

Coauthors: Michal Černý, Jan Pelikán

Abstract: Many real life problems are subject to uncertainties, and these uncertainties are often in the form of intervals. By interval representation, we can easily model measurement and numerical errors, missing values, errors due to discretization etc. We consider a convex quadratic programming problem with interval data, and the aim is to determine the minimal and the maximal optimal values. The known results concern only particular forms of this class of problems. We will present a unified approach to deal with such interval problems. We discuss not only methods for computing the optimal value range, but also complexity of the problem, approximation of the hard cases and we will illustrate the topic by applications.

NM9 **Jivandhar Jnawali**, *Some Higher Order Convergent Newton Type Iterative Methods*, Tribhuvan University, Nepal

Coauthors: Pankaj Jain, Chet Raj Bhatta

abstract: Newton method is one of the most famous numerical method for solving nonlinear equations. McDaugall and wotherspoon recently modified this method in predictor - corrector form and get a order of convergence $1 + \sqrt{2}$. In this paper, we propose a new Newton type iterative method having order of convergence $(3 + \sqrt{17})/2$. Also we derive a hybrid method combining our own method and the standard secant method.The resulting method turn out to be the order of convergence $2+2\sqrt{2}$. Finally numerical comparisons are implemented to demonstrate the performance of the develop methods.

NM10 **Jeevan Kafle**, *Submarine Landslide and Tsunami Impact on Submarine Obstacles*, Nepal Sanskrit University, Nepal

Coauthors: Parameshwari Kattel, Bhadra Man Tuladhar, Shiva P. Pudasaini

Abstract: Gravitational mass flows like submarine and subaerial landslides, and debris avalanches may generate super tsunami waves as they are triggered and impact water bodies such as ocean, sea, bays, hydraulic reservoirs or mountain lakes. On the one hand, these water bodies may contain icebergs, big boulders, islands, fiber-optics, oil-drilling platforms, oil pipe lines, and wind farms as different obstacles. These objects substantially alter the mass flow dynamics. In response, these objects may be severely damaged by the tsunami and submarine landslide impacts. On the other hand, the devastating effect of a submarine landslide and tsunami can be greatly reduced by submarine obstacles such as wave-breaking barriers installed in bay-mouths. As the tsunami enters the shallow regions the propagation speed decreases, and the amplitude grows drastically. Placing obstacles in the flow path controls the flow dynamics by reducing the destructive wave impact, runup and the resulting damages. Constructing appropriate protective object against tsunamis and submarine landslide is thus an engineering solution to the population and infrastructure. So, in order to substantially mitigate mountain and coastal hazards and integrity of hydraulic power plants it is very important to properly understand submarine landslide and tsunami interactions with submarine obstacles.

Here, we apply a comprehensive and general two-phase, physics-based, mathematical mass flow model (Pudasaini, 2012), and present first-ever three-dimensional, high-resolution novel simulation results for a real two-phase debris mass impacting a fluid reservoir containing obstacles of different shapes, sizes and dimensions, installed at different bathymetric positions. The simulations clearly demonstrate that due to the presence of obstacles in the submarine environment, the intense submarine-flow-obstacle-interaction dramatically reduces the flow momentum resulting in the rapid energy dissipation around the obstacles. This results in completely different tsunami and submarine flow dynamics around the obstacle, and in the flow influence region, tsunami wave impact, and the depositional behaviour of the submarine landslide with obstacles as compared to the reservoirs without obstacles. These novel findings help for the proper understanding of landslide and debris induced tsunamis in fluid reservoirs in high mountain slopes, channels, and reservoirs containing different types of obstacles in submarine environment, the associated dynamics of turbidity currents and highly-concentrated sediment transports, and submarine landslides in abyssal plains. These results may be extended and applied to hazard mitigation, prevention and solving relevant engineering or environmental problems.

Editor's note: The references are omitted.

NM11 **Parameshwari Kattel**, *Interaction of two-phase debris flow with obstacles*, Tribhuvan University, Kathmandu, Nepal

Coauthors: Jeevan Kafle, Bhadra Man Tuladhar, Shiva P. Pudasaini

Abstract: Landslides, debris avalanches and debris flows are common geophysical events in mountainous countries, causing tremendous damages to people and infrastructures. Their dynamics are substantially affected and altered by the obstacles like trees, big boulders and civil structures on their way. Appropriately designed and optimally installed obstacles, including the breaking mounds, catching or deflecting dams, in the flow path can dramatically change the flow dynamics by deflecting, re-directing or arresting the debris mass. Properly engineered obstacles can tremendously reduce the momentum and kinetic energy of the flow so that the events may become much less devastating, or even harmless. So, the proper understanding of the flow-obstacle-interaction is required to construct desired defense structures for prevention and mitigation of such events.

Here, we simulate a two-phase debris flow as a mixture of solid particles and viscous fluid down an inclined plane with integrated obstacles (called Vindhyas) of different dimensions, shapes, sizes, numbers and spacing. This is achieved by employing a sophisticated and physically-based general two-phase mass flow model (Pudasaini, 2012) consisting of a set of highly non-linear and coupled partial differential equations representing mass and momentum conservations for both the solid- and fluid-phases. Simulations are performed with high-resolution and efficient numerical schemes capable of capturing rapid and detailed dynamics, including the strongly re-directed flow with multiple stream lines, mass arrest, strong shock waves and debris-vacuum generation and their pattern formations, as the rapidly cascading mass suddenly encounters the obstacles. Some novel simulation results are presented for the estimation of the impact pressures on the obstacles and the obstacle-induced reduction of kinetic energy with their physical significance. The solid and fluid phases show fundamentally different interactions with obstacles, flow spreading and dispersions, run-out dynamics and deposition morphology. These are novel results for two-phase debris flows past obstacles, their dynamics and depositions. These results are in line with natural debris flows and experimental results. Our understanding of the complex interactions of real two-phase mass flows with the multiple obstacles helps us to construct defense structures and constitute advanced and physics-based engineering solutions for the prevention and mitigation of natural hazards caused by different geophysical mass flows.

Editor's note: The references are omitted.

NM12 **Khim B. Khattri**, *Full two-dimensional and two-phase mass flows down a channel: Mathematical modeling and simulation*, Kathmandu University, Nepal

Coauthors: Puskar R. Pokhrel, Bhadra Man Tuladhar, Shiva P. Pudasaini

Abstract: Following Pudasaini (2012) and Domnik and Pudasaini (2012) we present a new, full-dimensional, physical-mathematical model for two-phase mass flows down channels. The fully coupled model consists of a set of highly non-linear partial differential equations describing the dynamics of rapid flows of two-phase mixtures consisting of solid particles and viscous fluid. The new model includes mass and momentum balances, and pressure-Poisson equations both for solid and fluid phases and describes the flow dynamical quantities and internal dynamical pressures. So, the model can be applied in complex situations when topography changes are large, in the vicinity of the flow obstacle interactions, for strongly converging and diverging flows, and in deposition processes. To solve the model numerically, appropriate boundary conditions are applied, including Coulomb sliding for solid, basal no-slip for fluid, tractionless free surface for both solid and fluid, and Neumann boundary conditions for pressures. We adequately design the dynamical variables, and develop a suitable novel simulation strategy. The new full-dimensional model is discretised by using staggered grid. We use Euler's method for time discretization, central difference for diffusion, and the combination of donor-cell and central difference for convection. This prevents possible pressure oscillations. The model is simulated and visualized by applying suitable high resolution shock capturing schemes, including the marker-and-cell methods. The simulation results describe the evolution of full-dimensional velocities and pressures for both the solid and fluid phases. This substantially contributes to more accurately understanding the very complex dynamics of mixture flows in natural slopes, in the form of landslides and debris flows, and particle-fluid transport in industries.

Editor's note: The references are omitted.

NM13 **Hsing Luh**, *Tiered Security Screening System at Airports*, National Chengchi University, Taipei, Taiwan

Coauthors: George Zhang, Pengkun Huang, Hsing Paul Luh

Abstract: After suffering through terrorist attacks such as one in September 11, 2001 or one in Paris 2015, international community have been under tremendous pressure from terrorism. This puts strict requirements on security departments, especially for security check departments of transportation. However even sophisticated security inspection system, it still faces with the problem of possibly high false alarm rate which causes miserably inconvenience to innocent passengers. Nevertheless, from the perspective of queueing theory, airport security inspection system can be analyzed and optimized by using queueing models which can adjust model parameters in real time based on the number of arrival passengers in order to alleviate the average waiting time. In this paper, we proposed a tiered airport security inspecting system, which the passengers can be divided into three classes based on the historical security records. Accordingly passengers with distinct security levels would be assigned to different queues, namely H-queue, M-queue and L-queue. A two-dimensional Markov process and a Markov Modulated Poisson process were used for building the security inspection queueing system. In the two-dimensional Markov process queue model, M-queue is set to be finite to analyze the waiting time through adjusting the queue size of the H-queue. When the queue size in H-queue is small, some passengers in M-queue were sent to H-queue and receive stricter inspection. Likewise, we gave M-queue a different threshold value, when the queue length in the higher-level was below its threshold, passengers in lower queue were able to go to a higher level. Such a queueing mode allows the system to escalate the security level and can also be appropriate to extenuate the system average waiting time simultaneously.

The security screening system is analyzed by matrix geometric method. After deriving the average waiting time and the average queue length for each class, we use the actual passengers' arrival data which were collected in Taoyuan airport in Taiwan and the other two airports to validate our model. Then an optimum configuration of the model parameters could be determined by simulated annealing method. We also introduce a waiting cost and consider the conditions of objective function of optimization according to cost-benefit analysis. After comparing the optimal solutions in our system with a three independent queues sharing system, we conclude that our tiered security screening system could improve the security level as well as the efficiency significantly.

NM14 **Prashant Kumar Mishra**, *Interaction between interfacial and sub-interfacial cracks in a composite media – Revisited*, Indian Institute of Technology(BHU) , Varanasi, India

Coauthors: S. Das, M. Gupta

Abstract: The plane strain problem of determining stress intensity factors and stress magnification factors for an interfacial Griffith crack situated at the interface of two bonded dissimilar orthotropic media having sub-interfacial Griffith crack is considered. The problem is reduced to the solution of two pair of simultaneous singular integral equations which are finally been solved by using Jacobi polynomials. The propagation of interfacial crack through amplification and shielding factors are shown graphically for different particular cases.

NM15 **Puskar R. Pokhrel**, *A Coupled and Efficient Multiscale Modelling of Two-phase Mass Flows*, Tribhuvan University, Nepal

Coauthors: Khim B. Khattri, Bhadra Man Tuladhar, Shiva P. Pudasaini

Abstract: Landslides, debris flows and flash floods are some widely observed geophysical mass transports which are extremely destructive natural hazards. There is a need for an appropriate description and efficient simulation of these types of flows. To do so, here, by unifying the existing methods (Domnik and Pudasaini, 2012; Pudasaini, 2012; Domnik et al., 2013), we present a new multiscale modeling and simulation of two-phase debris, and mixture mass flows consisting of solid particles and the interstitial viscous fluids down inclined channels. A set of highly non-linear and coupled partial differential equations constitutes the advanced physical-mathematical model. Our innovative technique combines the full-dimensional simulation in the regions where there are large gradients of the field variables, depth-averaged reduced-dimensional models for relatively smooth

flows, and the coupling of these models and their simulations. This special strategy retains most of the basic physics of the flow along with very fast and economic numerical computation. To advance in this direction, here we present some basic and newly constructed model structures for full dimensional two-phase debris flow model, and depth-averaged model for channel flows, their domain-decompositions, appropriate coupling across the interfaces, respective boundary conditions at the interfaces, and boundary conditions for the velocities and pressure at the free and the basal surfaces. The physical, mathematical, numerical, and computational significance of the new strategy and their applications for geophysical and industrial flows are discussed in detail.

Editor's note: The references are omitted.

NM16 **Urmila Pyakurel**, *Efficient Algorithms for Contraflow Reconfiguration in Evacuation Planning,* Tribhuvan University, Nepal

Abstract: Contraflow reconfiguration allows the arc reversal that increases the outbound road capacities. During emergency, the maximum number of evacuees should be moved from the disastrous areas to safe destinations. Contraflow technique is one of the widely accepted mathematical models for the efficient solution of evacuation planning problem. From the analytical point of view, the contraflow model increases the flow value upto double and decreases the time at most half to transship the given flow value. With contraflow reconfiguration, efficient algorithms for the earliest arrival (transshipment) contraflow and the lex-maximum dynamic contraflow problems are presented. Moreover, the maximum dynamic contraflow and the earliest arrival contraflow problems are generalized including an additional constraint loss or gain for each arc of the evacuation network. These problems are solved on two terminal lossy network taking minimum loss path from sources to sinks. We illustrate the contraflow solution for the discrete time setting. However, most of the solutions can be extended on the continuous time setting as well.

NM17 **CR Rajapaksa**, *Implementation of Space Debris Removal Strategies*, University of Colombo, Sri Lanka

Coauthor: J.K. Wijerathna

Abstract: The need for debris mitigation is illustrated in the context of historic launch activates and operational practices in space missions. This has led to the existing space debris environment, with consequent collision flux levels and enormous threat to space activities. Therefore mitigation of space debris has become a major concern for us humans lately. National space agencies have proposed many space debris mitigation measures to reduce and stabilize the predicted long term growth of space object population. In [1] we take a closer look at the mathematical computations of three main mitigation strategies adapted to reduce and stabilize the growth of space debris. In this study we analyze the all tracked objects of size greater than 10 cm3 in the low Earth Orbit(LEO) and identify objects with same inclination and same right ascension. Delta-v, cost and the mission time has been computed for all three strategies described in []for selected derbies. Then optimal mission options are being presented in the priority order.

Editor's note: The references are omitted.

NM18 **Shyam Sundar Sah**, *Reliability evaluation of general series-parallel and sequential series-parallel systems*, Kathmandu University, Nepal

Coauthor: R.P. Ghimire

Abstract: In this study reliability of general series - parallel system and sequential series- parallel system are obtained and are compared. Each subsystem in both types of configurations has k_i components with heterogeneous failure rates $\lambda_(i,j)$ .Both types of systems have N subsystems with the provision of cold standby (sequential) and hot standby (general). The main objective this study is to measure the reliability of each system and minimize the cost of the system so as to compare their effectiveness.

NM19 **Buddhi Prasad Sapkota**, *Some features of Carbon Monoxide distribution pattern inside a kitchen*, Tribhuvan University , Nepal

Coauthors: Kedar Nath Uprety, Prakash Bhave

Abstract: Indoor Air Pollution (IAP) is the presence of one or more contaminants in indoor atmosphere in a sufficient quantity and duration to cause them to be injurious to human health and welfare as well as animal life and to interfere with the enjoyment of life and property. IAP represents the fourth most important health risk factor after malnutrition, unsafe sex and unsafe drinking water and sanitation. Indoor air pollution causes an estimated 1.6 million deaths/year; vast majority of deaths occur from Lower Respiratory Infections in young children under five and 2.7% of the entire global burden of disease is attributable to IAP.

Indoor air distribution pattern determines its level of exposure to the occupant in the room. The concentration of indoor air contaminants in the room is attributed to the ventilation condition of room. This paper explores some of the features about the distribution pattern of the indoor air pollutants including Carbon monoxide measured in a kitchen using MicroAeth, Indoor Air Quality Probe and Aeroset and compare with the simulation results. The concentration of CO in a room with proper ventilation is be less compared to that does not have proper ventilation, the proper position of ventilation could support for good indoor air quality. The wind direction and formation of vortices inside the room leads to trapping of the pollutants and remains inside the room for long time. Other contaminants like Total Suspended Particles, Particulate Matters PM1, PM2.5, PM4, PM10, CO2 and black carbon has similar trends of distribution of measured CO inside the room. The measurement of the concentration has good agreement with the simulation results.

NM20 **Samir Shrestha**, *Thermophoretic Transport of a Janus Particle in a Rarefied Gas,* Kathmandu University, Nepal

Coauthors: Sudarshan Tiwari, Axel Klar

Abstract: Micro/nanostructures have attracted great attention because of their extremely interesting properties and wide range of applications in electronic, magnetic, sensing, optics, and nanomedicine. One of these structures is the Janus particle. The asymmetry associated with Janus particles is the key to realizing many commercial applications, including electrophoretic displays, nanosviscometers, and self-propelling micromachines. Here we introduce a new type of Janus particle that can be manipulated by introducing the thermal field. We demonstrate the ability to control the particle's translational and rotational motions. The particle is suspended in the rarefied gas contained in the micro-scale cuboid or rectangular geometries where two parallel walls are kept at two different temperatures to induce the thermal field. The two faces of the particle are given by two different physical properties such as diffuse and specular reflecting boundary faces. The flow of gas is modeled by the Boltzmann equation, and solved numerically by applying Direct Simulation Monte Carlo (DSMC) procedures to find the force and the torque on the particle. The motion of the particle is computed by using the Newton-Euler equations. We also compute the distribution of the orientation of the Janus particle when only the rotational motion is applied. In this article, we take 2-dimensional domain and simulate a disc like Janus particle.

NM21 **Gurmeet Singh**, *Coefficient inequality for a subclass of starlike functions using nth derivative*, GSSDGS Khalsa College, Patiala, India

Abstract: The motive of this talk is to explore more classes of analytic functions and interrogate into coefficient inequality for functions in these classes and their subclasses. We will discuss about a newly constructed class of analytic functions and its subclasses here, by which coefficient bounds of $|a_3 - \mu a_2^2|$ for the analytic function $f(z) = z + \sum_{n=2}^{\infty} a_n z^n,\ |z| < 1$ belonging to these classes and subclasses, will be obtained.

NM22 **Mohan Thapa**, *The Parametrized Newton-Secant Method for Finding an Eigenpair of the Symmetric Quadratic Eigenvalue Problem in an Interval*, University of Wisconsin-Washington County, USA

Coauthors: Karabi Datta, Yoopyo Hong

Abstract: Solving numerically a large sparse quadratic eigenvalue problem (QEP),

$$Q(\lambda)u = (\lambda^2 M + \lambda C + K)u = 0$$

is a difficult task. Most of the real life applications need to compute only few eigenpairs of the quadratic system. We are interested in obtaining an eigenpair (λ, u) of the QEP where the eigenvalue λ lies in a specified interval $[a, b]$ from an initial pair (α, x) in which $x \in \mathbb{R}^n$ is chosen

arbitrarily. We propose a method, the Parametrized Newton-Secant (PNS) that first transforms the QEP to an approximated linear form which has the same dimension as QEP, by using a secant slope matrix. Then the modified Newton method is applied to the secant linear form to obtain the desired eigenpair in an interval. This method is especially useful to expeditiously obtain a good initial pair. This initial pair can then be utilized in other methods (such as Jacobi-Davidson) that require such a pair to guarantee convergence to a target eigenpair.

NM23 **K.K. Viswanathan**, *Free vibration of cross-ply laminated plates under higher order shear theory using splines*, Universiti Teknologi Malaysia, Malaysia

Coauthors: Saira Javed1, Z.A. Aziz

Abstract: Free vibration of cross-ply laminated plates under higher order shear deformation theory is studied using spline approximation. The coupled differential equations in terms displacement and rotational functions are obtained. These displacement and rotational functions are invariantly approximated using cubic and quantic spline. A generalized eigenvalue problem is obtained and solved numerically for an eigenfrequency parameter and an associated eigenvector of spline coefficients. The material properties of Kevlar-49/epoxy, Graphite/Epoxy and E-glass epoxy are used to analyse the frequency parameter with respect to the aspect ratio, side-to-thickness ratio, stacking sequence, number of lamina and ply orientations on of the plate. The vibrational behavior of laminated plates are analyzed under simply supported boundary conditions. The numerical results are validated and new results are presented in terms of tables and graphs.

F. Poster Presentations

Poster Session Coordinating Team:
Deepak Basyal (Chair)
Mohan Thapa
Urmila Pyakurel

PO1 **Iswar Mani Adhikari**, *Transit Based optimization for Evacuation Planning*, Tribhuvan University, Nepal

Abstract: The population of a city may be in danger due to natural or man-made disasters.To protect the affected population , it is necessary to evacuate the affected area in order to send the evacuees as early as possible out of the evacuation zone into a safe zone.Thus the arising evacuation problem is to determine a set of transit routes in an organized traffic routing along with their time tables from a set of capacitated shelters with minimum network clearance time. In this poster presentation, we highlight the transit-based evacuation planning of urban evacuation network.

PO2 **Phanindra Prasad Bhandari**, *Dynamic network contraflow evacuation planning problem with continuous time model*, Tribhuvan University

Coauthors: Shree Ram Khadka

Abstract: Evacuation planning problem efficiently sends evacuees from a risk zone to a safety zone as quickly as possible. The optimization version of the problem has been formulated with a number of efficient solution procedures based on dynamic network in discrete as well as in continuous time models. The contraflow approach of the model increases the outbound capacities and decreases the clearance time during the evacuation. We present the problem, its model and efficient solution procedures, with contraflow approach in continuous time setting.

PO3 **Gauri Bhuju**, *Temperature Effects on Malaria Disease Dynamics*, Kathmandu University, Nepal

Coauthor: Dil B. Gurung

Abstract: A deterministic differential equation model for malaria involving human and mosquito populations with the effects of temperature changes on the transmission dynamics of disease is analysed. Conditions on the basic reproduction number are derived for the existence of disease free and endemic equilibrium. Numerical results are carried out to exhibit the dynamical behaviour of malaria on the temperature variations.

PO4 **Ram Chandra Dhungana**, *Abstract Flows for Evacuation Planning Problem* Tribhuvan University, Nepal

Coauthor: Tanka Nath Dhamala

Abstract: Due to the different disasters, the challenges of emergency management have been increased day by day. After disasters, efficient evacuation transportation is required for the evacuation planning. We have limited time to evacuate the evacuees from the dangerous state (source) to safe place (sink). Thus, it is necessary to evacuate as many evacuees as possible within the limited time. In abstract flow evacuation model, we have capacitated elements (roads or junctions), and linearly ordered subsets of elements called paths (routes). If two paths share an element (cross), then there exists a path that is a subset of the first path up to the cross, and a subset of the second path after the cross that is known as switching axiom of paths. To get an algorithm in abstract network we assume that we have an oracle whose input is an arbitrary subset of elements, and whose output is either a path contained in that subset, or there is no such path in the network. After that we use complementary slackness to show how to augment any feasible set of path flows to a set with a strictly larger total flow value using a polynomial number of calls to the oracle. This technique yields an overall polynomial algorithm to find maximum abstract flows.

PO5 **Himalaya Ghimire**, *Bessel function solution of queuing model*, Tribhuvan University, Nepal

Abstract: Bessel function is the special function used in the solution of system of ordinary differential equation as well as partial differential equations. In the solution of system of ordinary differential equation. Bessel function approach enable us to obtain analytic solution of the system.We discuss various type of Bessel function such function of first kind, second kind, modified Bessel function and generalized Bessel function.

PO6 **Hari Prasad Gnawali**, *A note on maximal monotone operators*, Tribhuvan University, Nepal

Abstract: This paper deals with maximal monotone operators and their properties in various Banach spaces. In addition, some applications for existence results to partial differential equations are given.

PO7 **Jagdish Gnawali**, *Dynamical System of Nonlinear Model Via Lyapunov Function*, Tribhuvan University, Nepal

Abstract: For the problems which can't be solved analytically we can analyze their qualitative behavior at their critical points.It is better to use the Liapunov function to determine stability of the nonlinear system at nonhyperbolic critical point. We study the qualitative behavior of the nonlinear system by using Liapunov function.

PO8 **Mina Gumanju**, *A mathematical study of Haemodialysis*, Kathmandu University, Nepal

Coauthor: Dil B. Gurung

Abstract: The haemodialysis separates the smaller molecules like urea up to some extent from blood. The present work focuses on the mathematical study of urea concentration distribution in the blood in haemodialysis process based on the partial differential diffusion equation in the diffusion process. The study is carried out for steady state laminar newtonian blood flow .The solution of urea concentration is obtained using Galerkin's approximation method associated with appropriate model boundary conditions.

PO9 **Shiva Prakash Gupta**, *Earliest Arrival of Evacuees with Contraflow Approach*, Tribhuvan University, Nepal

Coauthor: Shree Ram Khadka

Abstract: Earliest arrival flow problem in evacuation planning is one of the important aspects with a given capacities and travel time. The objective of the problem is to send supplies from the source to the sink as quickly as possible. Contraflow approach of the problem increases the outbound capacity of the arcs and decreases the time required for the evacuation. In this paper we discuss the formulation as well as solution procedure developed in the literature.

PO10 **Muhammad Qumrul Hassan**, *Water supply system of the University of Dhaka, Bangladesh*, University of Dhaka, Bangladesh

Abstract: The University of Dhaka (DU) was established in 1921, the oldest University in Bangladesh, is located in the southern-central part of the capital of Bangladesh, covered area is about 256 acres of land. The DU has its own water supply management system. The source of water supply is of groundwater system in 100%, pumped by nine deep tube wells with capacity rate of 1.5 cusec each in the campus, depth ranges from 150 to 300 m from the land surface. Recent study reveals that the campus has a total supply of 7302718 L/day against the demand 6805280 L/day with surplus of 497838 L/day which is approximately 7% of the total production. The physic-chemical parameters for example pH, EC, TDS or substance in groundwater of the campus are within the recommended limit for drinking purposes. The DU water supply system is basically piped water from the source to overhead Tank to house hold on 24 hours in general.

PO11 **Nirmal Marahatta**, *Study of Deterministic and Stochastic Single-Species Population Models and Parameter estimations*, Kathmandu University, Nepal

Coauthor: Samir Shrestha

Abstract: The growth of the population modeled by deterministic equations may not capture the natural phenomenon of the growth. The population dynamic could be affected by the some random environmental noises. Here, we study the very well known single-species Malthusian population growth model and Pearl-Verhulst logistic growth model by introducing in them white-noises. The resulting models are the stochastic differential equations or also known as Itô processes. We also present the procedures to estimate the parameters involved in the deterministic as well as stochastic population growth models. In the deterministic model, we use least square techniques and in the stochastic model, we use non-parametric estimation procedures to estimate the parameters.

PO12 **Hari N. Nath**, *Optimization Models and Algorithms for Evacuation Planning*, Tribhuvan University, Nepal

Abstract: To save human life in different disastrous situations, it is imperative to transport people from disaster-prone areas to safe places as quickly as possible. In such situations, a significant number of persons dependent on the transit vehicles, e.g. buses. In this poster, we illustrate a mixed integer programming formulation to transport the people gathered at specified locations, called pick-up nodes, to safe places with known capacities, called shelter nodes (with total capacity not less than the affected population) via homogeneous buses. An implementation of a heuristic algorithm is presented to find a solution to the problem.

PO13 **Shiv Prasad Neupane**, *Stability analysis of May's prey-predator model for two prey and two predator*, Cosmos College of Management & Technology, Nepal

Abstract: This paper deals dynamical study of May's Prey-Predator Model for the case of two prey and two predators. The local stability analysis of the equilibrium points are studied. The study is further carried out simulating the behavior exhibited by the interaction within same species and different species.

PO14 **Raj Kumar Pradhan**, *Deterministic and stochastic microscopic modeling and simulation of pedestrian flows*, Kathmandu University, Nepal

Coauthor: Samir Shrestha

Abstract: Nowadays, pedestrian flow modeling has become more popular and has attracted the interest of an increasing number of scientist planners, and designers. The modeling for the pedestrian motion especially the modeling of evacuation scenarios has become very important in the last recent years. Due to the unpredictable nature of human decision making, the modeling of pedestrian behavior in a real world environment is a complex problem. We present here the deterministic and stochastic microscopic pedestrian models. Deterministic model is based on Newton's laws of motion whose corresponding Fokker-Planck equation is well known macroscopic Lighthill-Whitham-Richards (LWR) pedestrian flow model and the Stochastic pedestrian model is based on Itô stochastic process whose corresponding Fokker Planck is LWR pedestrian flow model with diffusion. We use Greenshield's model to control the velocity of the pedestrian depending on the

density of the pedestrian. Here, we simulate pedestrian flow in 1-D geometry using microscopic deterministic pedestrian as well as stochastic pedestrian model. We compute the density of pedestrian in the domain in each time step and calculate the evacuation time of the pedestrian. A comparative study is also presented from the results obtained from both the models.

PO15 **Sharmila Shrestha**, *The Temperature Distribution on Breast Tissue With and Without Tumor*, Kathmandu University, Nepal
Coauthor: Dil B. Gurung

Abstract: In this work the temperature distribution on breast with and without tumor is estimated using Pennes bio-heat equation from finite element method. The temperature distribution profile on breast is different due to size and location of tumor. Due to the tumor, the metabolic and blood flow rate play important role to generate temperature in in-vivo tissue, and so the study is carried out depending on these parameters.

PO16 **Shiva H Subedi**, *Effect of humidity on skin temperature*, Tribhuvan University, Nepal

Abstract: The ability of human body to regulate its heat exchange depends on various environmental factors together with its ability to exchange heat in in-vivo tissue. The environmental factor humidity plays a crucial role for heat regulation within human body. The heat regulation within in-vivo tissue constitutes temperature regulation in the layers of dermal part to maintain body core temperature constant. The present paper focuses on the effect of humidity on temperature regulation within the human body.

PO17 **Bharat Bahadur Thapa**, *DDE and SDE in Lotka-Voltera population model*, Kathmandu University, Nepal

Abstract: Ordinary Differential Equations (ODE) models for population growth lack two important factors, the time delay and white noise. Such a time delay can be adjusted by Delay Differential Equation (DDE) and noise by Stochastic Differential Equation (SDE). In the present work, stability analysis of a classical Lotka-Volterra model is performed using DDE and SDE. Simulation results obtained through DDE and SDE are compared with classical Lotka-Volterra results.

PO18 **Chet Nath Tiwari**, *Existence of Weak Solution of Pennes Bio-Heat equation*, Kathmandu University, Nepal

Coauthor: Dhruba Adhikari

Abstract: Existence of classical solutions of partial differential equations may not be possible; however, their weak solutions may exist. In this presentation we discuss the existence of weak solutions of Penn's Bio-heat equation.

PO19 **Anup Tuladhar**, *Dynamical Study of HIV Transmission model*, Kathmandu University, Nepal

Abstract: An HIV/AIDS model incorporating seropositive for the homosexual population in formulated. An equilibrium state and the model is stated, and an stability analysis of the equilibrium point is studied. The model is further carried out for the study of ARv drugs on AIDS patients in the form of life expectancy

PO20 **Janaka Wijesundara**, *Cultural continuity as a vital factor in delivering identity, memory and sense of place: a critical study of urban transformation with special reference to pettah in Colombo*, University of Moratuwa, Sri Lanka

Coauthor: Anoj Pathinayaka

Abstract: Most Asian cities are characterized by rapid urban metamorphosis and mostly the urban changes are based on planning mechanisms through spatial and land use methodologies and supported by globalization. In Colonial-contemporary cities, it is often seen that recent planning and development approaches undermine the cultural representation and memory of the place in their transformation process. The study is scoped within the discussion of morphology, in relation to urban transformation and planning, in the context of urban settings (places) in Pettah, Colombo. It aims to re-examine cultural continuity in relation to the memory of a place in transforming urban settings. Methodologically, urban-cultural morphological study couples with spatial anthropology

for field investigation and data transcoded into urban design planning schemata. Referring the literature on this subject area, certain parameters to measure the appropriate cultural transformation have been identified and the analysis of this situation is supported by the observations and personal communications. The research has identified the socio physical and socio cultural relationships of transforming urban settings which are meant to be regeneration of built masses but, mostly the renovations for irreplaceable urban settings where people celebrate the sense of place.

PO21 **R.N. Yadav**, *On a Lattice Point Problem in the Additive Number Theory*, TU, Nepal

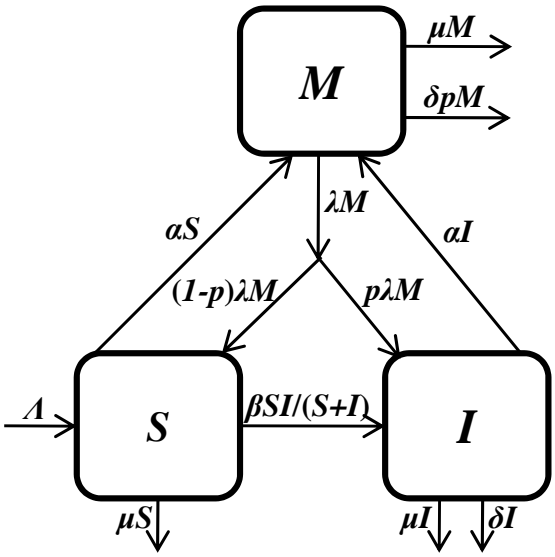
Coauthors: S. R. Pathak, S. K. Chakrabarti

Abstract: In the present paper we focus on the problem of estimating $f(n,d)$ for a fixed dimension d and large n in an attempt to extend the results of Erdos et al (1961) dealing with the cases $d=1$ and $d=2$. Our main result is that for every fixed dimension d, $f(n,d) < c(d)n$ or $f(n,d) = c(d)n$, where $c(d)$ is a constant depending on the dimension d only.

PO22 **Anjana Pokharel**, *Product property of Toeplitz operators in Hardy space and in Bergman space*, Tribhuvan University, Nepal

Coauthor: Chet Raj Bhatta

abstract: Algebraic properties of Toeplitz operator in Hardy space and in Bergman space are discussed.Specifically, Product of two Toeplitz operators T_f and T_g is also Toeplitz operator T_{fg} in Hardy space if and only if f is co-holomorphic or g is holomorphic. But In Bergman space A^2 it is possible only in the bounded harmonic symbols.



Thank you

Conveners:
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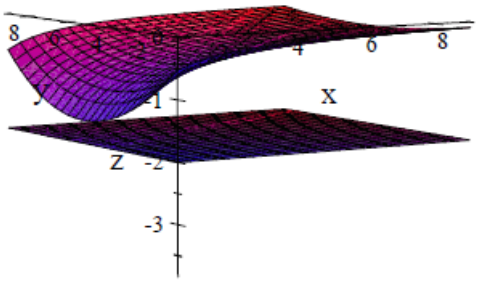

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Electronic Journal of Differential Equations (DEs and Analysis only)
Neural, Parallel, and Scientific Computations (most of the remaining areas)