International Conference in Mathematics and Applications 2016

BOOK OF ABSTRACTS

December 17-19, 2016
The Royal River Hotel
Bang-Plad, Bangkok, Thailand

International Conference in Mathematics and Applications Mahidol University 2016

Book of Abstracts

December 17-19, 2016

Royal River Hotel
Bang-plad, Bangkok, Thailand

Organized by

Centre of Excellence in Mathematics (CEM)
Mahidol University

Co-organized by

National Research Council of Thailand

S&T Postgraduate Education and Research Development Office

Commission on Higher Education
Ministry of Education, Thailand

Published by the Centre of Excellence in Mathematics, Mahidol University

ISBN: 978-616-279-953-2

International Conference in Mathematics and Applications (ICMA-MU 2016)
Book of Abstracts
December 17–19, 2014, Bangkok, Thailand
[organized by the Centre of Excellence in Mathematics (CEM)].
(URL): http://cem.sc.mahidol.ac.th/icma2016/
ISBN: 978-616-279-953-2

International Scientific Committee

Chair	Lenbury, Yongwimon	Mahidol University; Centre of Excellence in Mathematics, Thailand
Members	Agarwal, Ravi P.	Texas A&M University-Kingsville, USA
	Bell, Jonathan	University of Maryland, Baltimore County, USA
	De Gaetana, Andrea	CNR IASI Laboratorio di Biomatematica, Italy
	Inprasitha, Maitree	Khonkaen University; Centre of Excellence in Mathematics, Thailand
	Licht, Chistian	Universit Montpellier 2, France
	Niammanee, Kritsana	Chulalongkorn University; Centre of Excellence in Mathematics, Thailand
	Sinha, Bikas K.	Indian Statistical Institute, India
	Sinha, Bimal K.	University of Maryland Baltimore County, USA
	Wu, Yong Hong	Curtin University of Technology, Australia

Local Scientific Committee

Committee Chair	Sanh, Nguyen Van	Mahidol University, Thailand Centre of Excellence in Mathematics, Thailand
Deputy Chairs	Lenbury, Yongwimon	Mahidol University, Thailand Centre of Excellence in Mathematics, Thailand
	Ananchuen, Nawarat	Silpakorn University, Thailand Centre of Excellence in Mathematics, Thailand
	Rattanakul,Chontita	Mahidol University, Thailand Centre of Excellence in Mathematics, Thailand
.	Tiensuwan, Montip	Mahidol University, Thailand
Assistant Chairs	Maneesawang, Chaiwat	Mahidol University, Thailand
	Orankitjaroen, Somsak	Mahidol University, Thailand
	Tangmanee, Suwon	Centre of Excellence in Mathematics, Thailand

Local Organizing Committee

Chair	Lenbury, Yongwimon	Mahidol University Centre of Excellence in Mathematics
Executive Chair for Academic Affairs	Nguyen, Van Sanh	Mahidol University Centre of Excellence in Mathematics
Executive Chair for Administrative Affairs	Rattanakul, Chontita	Mahidol University Centre of Excellence in Mathematics
Executive Chair for Financial Affairs	Amornsamankul, Somkid	Mahidol University Centre of Excellence in Mathematics
Assistant Chair for Academic Affairs	Orankitjaroen, Somsak	Mahidol University
Assistant Chair for Administrative Affairs	Tangmanee, Suwon	Centre of Excellence in Mathematics
Members	Bannangkoon, Pichkitti	Mahidol University
	Baowan, Duangkamon	Mahidol University
	Bosuwan, Nattapong	Mahidol University
	Bunwong, Kornkanok	Mahidol University
	Chayantrakom, Kittisak	Mahidol University
	Kositwattanarerk, Wittawat	Mahidol University
	Lewchalermvongs, Chanun	Mahidol University
	Muandet, Krikamol	Mahidol University
	Phewchean, Nattakorn	Mahidol University
	Sarika, Warunee	Mahidol University
	Satiracoo, Pairote	Mahidol University
	Sawangtong, Wannika	Mahidol University
	Skulkhu, Ruth J.	Mahidol University
	Suwandechochai, Rawee	Mahidol University
	Tiensuwan, Montip	Mahidol University

Supported by

Contents

Keynote Speaker

Embeddings of Algebras

Efim Zelmanov[1]

[1]University of California, San Diego, USA
efim.zelmanov@gmail.com

Abstract

We will discuss a new construction of matrix wreath product and its applications to embeddings into finitely generated algebras. This is a joint work with A. Alahmadi, H. Alsulami and S. Jain.

Keywords: (n/a)

Plenary Speakers

Combining New Fast Opposite Gradient Search with Ant Colony Optimization for Solving Travelling Salesman Problem

Chidchanok Lursinsup[1]

[1]Department of Mathematics and Computer Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
lchidcha@gmail.com

Abstract

Most of discrete optimization techniques based on evolutionary computing did not deploy and involve the actual geometrical structure of objective function in the process of generating new population. The candidate solutions are selected by considering only a set of high values of objective function which may not lead to the best solutions. A new evolutionary optimization algorithm based on the actual manifold of objective function and fast opposite gradient search was proposed to improve the accuracy and speed of solution finding. The algorithm is divided into two phases. The first phase searches the best candidate solutions by using our fast opposite gradient search on the manifold of objective function. The second phase applies ant colony optimization to improve the candidate solutions. The problem of travelling salesman was experimented and the objective function based on Hopfield and Tank's was adopted. To demonstrate the effectiveness and efficiency of the proposed algorithm, the benchmark problems from TSPLIB were tested and compared with the techniques of Tabu Search, GAs, PSO, ACO, PS- ACO and GA-PSO-ACO. The results showed that our algorithm achieved shorter distances in all cases within fewer generation.

Keywords: (n/a)

Statistical Methods for Cost-Effectiveness Analysis: A Selected Review

Thomas Mathew[1]

[1]Department of Mathematics and Statistics, University of Maryland Baltimore County, Baltimore, Maryland 21250, USA
mathew@umbc.edu

Abstract

Identifying treatments or interventions that are cost-effective (more effective at lower cost) is clearly important in health policy decision making, especially in the allocation of health care resources. Various measures of cost-effectiveness that are informative, intuitive and simple to explain have been suggested in the literature, along with statistical inference concerning them. Popular and widely used measures include the incremental cost-effectiveness ratio (ICER), defined as the ratio between the difference of expected costs and the difference of expected effectiveness in two populations receiving two treatments. Although very easy to interpret as the additional cost per unit of effectiveness gained, being a ratio, the ICER presents difficulties regarding interpretation in certain situations, for example, when the difference in effectiveness is close to zero, and it also presents challenges in the statistical inference. Yet another measure proposed in the literature is the incremental net benefit (INB), which is the difference between the incremental cost and the incremental effectiveness after multiplying the latter with a "willingness-to-pay parameter". Both ICER and INB are functions of population means, and inference concerning them has been widely investigated under a bivariate normal distribution, or under a log-normal/normal distribution for the cost and effectiveness measures. In the talk, we will briefly review these, focusing on recent developments. An alternative probability-based approach will also be introduced, referred to as cost-effectiveness probability (CEP), which is the probability that the first treatment will be less costly and more effective compared to the second one. Inference on the CEP will be discussed. Numerical results and illustrative examples will also be given.

Keywords: cost-effectiveness probability, fiducial method, generalized pivotal quantity, incremental cost-effectiveness ratio, incremental net benefit, U-statistics

It's Not What We Said, It's Not What They Heard, It's What They Said They Heard

Barry D. Nussbaum[1]

[1]President- Elect, American Statistical Association, 7804 Antiopi Street Annandale, VA 22003-1405, USA
StatisticsBarry@gmail.com

Abstract

Statisticians have long known that success in our profession frequently depends on our ability to succinctly explain our results so decision makers may correctly integrate our efforts into their actions. However, this is no longer enough. While we still must make sure that we carefully present results and conclusions, the real difficulty is what the recipient thinks we just said. This presentation will discuss what to do, and what not to do. Examples, including those used in court cases, executive documents, and material presented for the President of the United States will illustrate the principles.

Keywords: (n/a)

Blast from the Past and at a Distance: Applications of Non-Local Calculus

Graeme Wake[1]

[1]Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand
g.c.wake@massey.ac.nz

Abstract

A widely accepted model of coexisting cultures of pasture-growth, such as rye-grass and clover which incorporates delay-mechanisms over an interval of prior time, revealed the existence of naturally occurring periodic solutions, not prevalent in a purely local model formulation. This served to suggest that even a mono-culture (with only one compartment) could also exhibit this largely unexplored phenomenon. Accordingly, here we consider just the Clover biomass which serves to deposit nitrogen in the soil which, in turn, serves as a nutrient for other faster growing grass species like the common rye-grass culture.

In this presentation, we investigate this for the simple and widely used equation: that of the logistic equation, albeit with a distributed-delay mechanism, suggested by the biology, incorporated. The interval $(-T,\ 0)$ of the delay mechanism is, in this model, the life-time of the clover pasture, which is of course simultaneously undergoing a renewal process. It is shown that there is a super-critical Hopf bifurcation, when we use the delay-time T as a distinguished parameter. Hence we have a first order equation which possesses stable periodic solutions The equation is a nonlinear integro-differential equation with constant parameters like the Malthusian growth parameter r and the carrying capacity K.

This illustrates the fact that delays can easily be used to explain unusual experimental outcomes in a relatively straightforward manner. Mathematical knowledge is largely devoid of general results on non-local calculus which is largely neglected in the under-graduate and graduate curricula.

Even more similar startling results occur in current models of cell population models where the cohort of cells are evolving in time, simultaneously growing and undergoing mitosis (division) and which are also structured by cell size (which is commonly taken as the DNA content which is easily measured). This gives rise to a linear first order eigenvalue problem on an unbounded size-interval which is of the famous pantograph-type. The problem has a countable number of eigenvalues, the first of which is the time constant for the evolution to a steady-size-distribution and its sign determines whether the population cohort will grow or decay in time. This is crucial to the treatment of cancer tumours. There are open questions about the completeness of the corresponding set of eigenfunctions.

The key message from this exercise is that it is the non-local nature of the equations that gives rise to the occurrence of these unexpected results, which have successfully explained these complex processes in a relatively simple way.

Keywords: delay equations, population models in agriculture and medicine, limit cycle solutions, action at-a-distance, non-local eigenvalue problems

Invited Speakers

Minimum Average Deviance Estimation for Sufficient Dimension Reduction

Kofi Placid Adragni[1]

[1]Department of Mathematics and Statistics, University of Maryland Baltimore County, 1000 Hilltop Circle, 410 MP Building, Baltimore, MD 21250, USA
kofi@umbc.edu

Abstract

Sufficient dimension reduction reduces the dimensionality of data while preserving relevant regression information. In this article, we develop Minimum Average Deviance Estimation (MADE) methodology for sufficient dimension reduction. It extends the Minimum Average Variance Estimation (MAVE) approach of Xia et al. (2002) from continuous responses to exponential family distributions to include Binomial and Poisson responses. Local likelihood regression is used to learn the form of the regression function from the data. The main parameter of interest is a dimension reduction subspace which projects the covariates to a lower dimension while preserving their relationship with the outcome. To estimate this parameter within its natural space, we consider an iterative algorithm where one step utilizes a Stiefel manifold optimizer. We empirically evaluate the performance of three prediction methods, two that are intrinsic to local likelihood estimation and one that is based on the Nadaraya-Watson estimator. Initial results show that, as expected, MADE can outperform MAVE when there is a departure from the assumption of additive errors.

Keywords: dimension reduction, regression, manifold optimization, local likelihood

Mathematical Modelling in Nanotechnology

Duangkamon Baowan[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok, Thailand
duangkamon.bao@mahidol.ac.th

Abstract

Nanomaterials have inspired much progress in nanomedicine, especially for their use as carriers for targeted drug delivery. Being able to deliver drugs to a targeted cell in the body would certainly enhance the future treatment of patients, especially those suffering from cancer. In such complex physical areas there is often a lack of well-formed conceptual ideas and sophisticated mathematical modelling in the analysis of the fundamental issues involved in the process. Here, we aim to develop a classical mathematical description for the molecular interaction of silica nanoparticles with liposomes, enabling the understanding of the mechanisms for transportation of nanoparticles through cell membranes.

Keywords: (n/a)

Some General Points for the Zero-Truncated Mixture Likelihood with Validation Information

Dankmar Böhning[1]

[1]Southampton Statistical Sciences Research Institute, University of Southampton, Southampton, UK
D.A.Bohning@soton.ac.uk

Abstract

The paper discusses likelihood inference for binomial and Poisson mixtures when zero counts are truncated. This problem occurs frequently in the capture-recapture setting where the count represents the number identifications for each unit of the target population. Two problems are known for the zero-truncated mixture likelihood: one, the population size becomes unidentifiable and, two, a boundary problem occurs leading occasionally to spuriously high population size estimates. These problems will be illustrated in detail here. Furthermore, we show in this paper that these problems disappear when validation information can be included. Here validation information means that an additional sample exists for which zero counts have been observed. These results can be used to design future capture-recapture studies such that a valid mixture likelihood can be used and identified.

Keywords: zero-truncated count data, conditional and unconditional mixture likelihood, EM algorithm, validation sample, composite likelihood

The Dispersion Model and Inverse Problems in the Protection of Atmospheric Environment

Ta Long Bui[1]

[1]Faculty of Fundamental Science, Faculty of Environment and Resources, Hochiminh city of Technology, Hochiminh city, Vietnam
longbt62@hcmut.edu.vn

Abstract

In recent years, a number of models to estimate the spread of air pollution have been made our team found practical application in the problem of environmental protection. Nevertheless, the mathematical model does not pay attention to the interaction between the gas stream and the underlying surface, this will reduce the reliability of the calculated results. In addition, the choice of a model for the inverse problem is an important part of the practice. Previous studies did not meet this requirement. This article is aimed at the creation of mathematical models - information for assessment of proliferation, dry deposition, as well as to solve the inverse problem. The production soft of this article is a version of the EnvimAP software with new features compared to the old version is to assess the degree of influence on the main surface level of air pollution. Software together with the model will be made.

Keywords: (n/a)

On Free Subgroups in Division Rings

Xuan Hai Bui[1]

[1]Faculty of Mathematics and Computer Science, University of Science, VNU-HCM, 227 Nguyen Van Cu Str., Dist. 5, HCM-City, Vietnam
bxhai@hcmus.edu.vn

Abstract

In 1972, J. Tits proved that every finitely generated subgroup of a matrix group over a field is either soluble-by-finite or contains a non-cyclic free subgroup. At the Second International Conference on the Theory of Groups (Canberra, Australia, 1973), S. Bachmuth raised the question of whether Tits' Theorem would remain true if the field was replaced by a division ring. In 1977, Lichtman proved that Tits' theorem fails even for matrices of degree one, i.e. for $D^* = \mathrm{GL}_1(D)$, where D is a division ring. Also, Lichtman remarked that the question of whether the multiplicative group of a division ring contains a non-cyclic free subgroup remains without answer. For discussion purpose, J. Z. Gonçalves and A. Mandel formulate Lichtman's question as the following conjecture:

Conjecture 1. *The multiplicative group of a non-commutative division ring contains a non-cyclic free subgroup.*

Moreover, they posed the following stronger conjecture:

Conjecture 2. *Any non-central subnormal subgroup of the multiplicative group of a non-commutative division ring contains a non-cyclic free subgroup.*

In this talk, we discuss these conjectures and we present some our recent results in this direction of research.

Keywords: division rings, subnormal subgroups, free non-cyclic subgroups

On the Index of Reducibility in Noetherian Modules

Nguyen Tu Cuong[1]

[1]Institute of Mathematics, Vietnam Academy of Science and Technology, Vietnam
ntcuong@math.ac.vn

Abstract

One of the fundamental results in commutative algebra is the irreducible decomposition theorem Satz II and Satz IV proved by Emmy Noether in 1921. In this paper she had showed that any ideal I of a Noetherian ring R can be expressed as a finite intersection of irreducible ideals, and the number of irreducible ideals in such an irredundant irreducible decomposition is independent of the choice of the decomposition. This number is then called the index of reducibility of I and denoted by $\mathrm{ir}_R(I)$. Although irreducible ideals belong to basic objects of commutative algebra, there are not so much papers on the study of irreducible ideals and the index of reducibility. Then the purpose of this talk is to investigate the index of reducibility of submodules of a finitely generated R-module M as well as the behaviour of the function of indices of reducibility $\mathrm{ir}_M(I^nM)$, where I is an ideal of R, and to present applications of the index of reducibility for the studying the structure of the module M. We show that this function is in fact a polynomial for sufficiently large n. Moreover, we can prove that the big height $\mathrm{bight}_M(I) - 1$ is a lower bound and the analytic spread $\ell_M(I) - 1$ is an upper bound for the degree of this polynomial. However, the degree of this polynomial is still mysterious to us. We can only give examples to show that these bounds are optimal. A classical result of Northcott says that the index of reducibility of a parameter ideal in a Cohen-Macaulay local ring is dependent only on the ring and not on the choice of the parameter ideal. We will generalize Northcott's result and get a characterization for Cohen-Macaulayness of a Noetherian module in terms of the index of reducibility of parameter ideals.

Keywords: (n/a)

Algebraic Structure of Repeated-Root Constacyclic Codes of Prime Power Lengths over Finite Commutative Chain Rings

Hai Quang Dinh[1]

[1]Department of Mathematical Sciences, Kent State University, Ohio, USA
hdinh@kent.edu

Abstract

For any given prime p, we study the algebraic structure of repeated-root λ-constacyclic codes of prime power length p^s over a finite commutative chain ring R with maximal ideal $\langle\gamma\rangle$. It is shown that, for any unit λ of the chain ring R, there always exists an element $r \in R$ such that $\lambda - r^{p^s}$ is not invertible, and furthermore, the ambient ring $\frac{R[x]}{\langle x^{p^s}-\lambda\rangle}$ is a local ring with maximal ideal $\langle x-r, \gamma\rangle$. When there is a unit λ_0 such that $\lambda = \lambda_0^{p^s}$, the nilpotency index of $x - \lambda_0$ in the ambient ring $\frac{R[x]}{\langle x^{p^s}-\lambda\rangle}$ is established. When $\lambda = \lambda_0^{p^s} + \gamma w$, for some unit w of R, it is shown that the ambient ring $\frac{R[x]}{\langle x^{p^s}-\lambda\rangle}$ is a chain ring with maximal ideal $\langle x^{p^s} - \lambda_0\rangle$, which in turn provides structure and sizes of all λ-constacyclic codes and their duals. Among others, self-dual constacyclic codes are discussed.

Keywords: (n/a)

The Structure of Weakly V-Rings

Van Huynh Dinh[1]

[1]Department of Mathematics, Ohio University, Ohio, USA
huynh@math.ohiou.edu

Abstract

A ring R is called a right weakly V ring (right WV-ring) if every right simple R-module is injective relative to all proper cyclic right R-modules. All right WV-rings which are not right V are described. Moreover, we discuss an open question on simple V-domains.

Keywords: (n/a)

A Bernstein Type Result for Entire f-Maximal Graphs in the Lorentzian Product $\mathbb{G}^n \times \mathbb{R}_1$

The Hieu Doan[1]

[1]College of Education, Hue University, Hue, Vietnam
dthehieu@yahoo.com

Abstract

In the Lorentzian product $\mathbb{G}^n \times \mathbb{R}_1$, we give a comparison theorem for the f-volume of an entire f-maximal graph and the f-volume of the hyperbolic H_r^+ under the assumption that the gradient of the function defining the graph is bounded away from 1. As a consequence, we obtain a Calabi-Bernstein type theorem for f-maximal graphs in $\mathbb{G}^n \times \mathbb{R}_1$. The gradient assumption comes from an example of non-planar entire f-maximal graph in $\mathbb{G}^2 \times \mathbb{R}_1$.

Keywords: (n/a)

An Invariance Result for Exchangeable Sequences - Application to Stock-Price Model

Alok Goswami[1]

[1]Theoretical Statistics and Mathematics Division, Indian Statistical Institute, Kolkata, India
alok@isical.ac.in

Abstract

In this talk, I describe an interesting Asymptotic Invariance Result for any Exchangeable Sequence of Random Variables. As a special case, I will discuss limiting joint distribution of waiting times between successive hits of extreme values. This theoretical result has consequences in the context of standard models for stock-prices, which will be highlighted. This is based on joint work with Chii-Ruey Hwang and Lo-Bin Chang during my visit to Institute of Mathematics, Academia Sinica, Taipei.

Keywords: exchangeable sequance, waiting times between successive extremes, heirarchical analysis of time series, invariance property, limiting distributions

Leavitt Path Algebras

Roosbeh Hazrat[1]

[1]Department of Mathematics, Western Sydney University, Sydney, Australia
R.Hazrat@westernsydney.edu.au

Abstract

From a directed graph one can generate an algebra which captures the movements along the graph. One such algebras are Leavitt path algebras.

Despite being introduced only 10 years ago, Leavitt path algebras have arisen in a variety of different contexts as diverse as analysis, symbolic dynamics, noncommutative geometry and representation theory. In fact, Leavitt path algebras are algebraic counterpart to graph C*-algebras, a theory which has become an area of intensive research globally. There are strikingly parallel similarities between these two theories. Even more surprisingly, one cannot (yet) obtain the results in one theory as a consequence of the other; the statements look the same, however the techniques to prove them are quite different (as the names suggest, one uses Algebra and other Analysis). These all suggest that there might be a bridge between Algebra and Analysis yet to be uncovered.

In this talk, we introduce Leavitt path algebras and try to classify them by means of (graded) Grothendieck groups. We will ask nice questions!

Keywords: (n/a)

Firing up El Niño

Roger J. Hosking[1]

[1]School of Mathematical Sciences, University of Adelaide, SA 5005, Australia
marjhg@gmail.com

Abstract

The El Niño–Southern Oscillation (ENSO) is a meteorological phenomenon involving anomalously warm sea surface temperature (SST) in the tropical eastern Pacific and high air surface pressure in the western Pacific. ENSO events occur every few years and typically last up to two years, and have been associated with widespread and sometimes severe smoke haze from extensive fires in Indonesia. Significant SST cooling in the region is evident in the early stages of El Niño episodes, and the hypothesis that "local dimming" due to the South East Asian Aerosol Plume (SEAAP) arising from biomass burning initiates these episodes has been examined.

Simple mathematical modelling shows that the rapid development of smoke plumes and the lower direct solar radiation at the Earth's surface due to screening by the consequent SEAAP can produce the observed cooling in a few days at most, reducing the local atmospheric convection and weakening the Walker Circulation as seen in El Niño conditions. A statistical analysis also finds that the aerosols are Grainger causal for the Southern Oscillation Index (SOI) used to define the onset of ENSO events, at a lag of 4 days.

This is joint work demonstrating the role that applied mathematics and statistics can play in understanding our natural environment, in this case with important implications for international social policy.

Keywords: (n/a)

Model Predictive Control of an HBV Model

Hee-Dae Kwon[1]

[1]Department of Mathematics, Inha University, South Korea
hdkwon@inha.ac.rk

Abstract

In this talk, we consider a guideline for efficient drug treatment strategies for hepatitis B virus (HBV) infection. We introduce and analyze a mathematical model that describes the HBV infection during antiviral therapy. The reproduction number R_0 is determined. The local/global stability of virus-free steady state is investigated. We formulate a control problem which minimizes the viral load as well as treatment costs. In order to reflect the status of patients not only at the initial time but also at the follow-up visits, we consider the model predictive control based on ensemble Kalman filter and differential evolution. The ensemble Kalman filter is employed to estimate full information of the state from incomplete observation data. We derive piecewise constant drug schedule applying techniques of differential evolution algorithm. Numerical simulations are performed using various weights in the objective functional to suggest optimal treatment strategies in different situations.

Keywords: feedback control, HBV, model predictive control, ensemble Kalman filter, differential evolution method

Meta-Analysis of Binary Data: One-Step Versus Two-Step Approaches

Guido Knapp[1]

[1]Department of Statistics, TU Dortmund University, 44221 Dortmund, Germany
guido.knapp@tu-dortmund.de

Abstract

Combining results from controlled independent studies with binary outcomes is nowadays a usual task, for instance, in biomedical applications for judging the effect of a treatment versus a control. If the data are available in 2x2-tables, the meta-analyst can choose the effect size for combining the results irrespective of the effect sizes used in the original studies. In a two-step approach, first the estimates of the effect sizes are calculated along with their standard errors in each study and then, in the second step, the study-specific estimates are combined mostly in the random-effects meta-analysis model. However, if the odds ratio is the parameter of interest, the likelihood of conditional models can be maximized. An exact likelihood based on the non-central hypergeometric distribution can be used, when we condition on the number of successes in both groups. The optimization can be difficult and computationally intensive, so an approximate likelihood based on the binomial distribution may be used instead. In this talk, we consider the two approaches using first real data examples for illustration. Then, we report results from Monte Carlo simulation about the properties especially of the confidence intervals on the effect size from the various approaches. We conclude with some recommendations.

Keywords: individual patient data, non-central hypergeometric distribution, odds ratio, conditional model, exact and approximate likelihood

Classification of All Real Solvable Lie Algebras with Derived Ideal Having Small Dimension or Codimension

Anh Vu Le[1]

[1]Department of Economic Mathematics, University of Economics and Law, Vietnam;
Vietnam National University - Ho Chi Minh City, Vietnam
vula@uel.edu.vn

Abstract

Classifying all Lie algebras of dimension less than 4 is an elementary exercise. However, when considering Lie algebras of dimension n ($n \geq 4$), complete classifications are much harder. As it has long been well known, there exist three different types of Lie algebras: the semi-simple, the solvable and those which are neither semi-simple nor solvable. By the Levi-Maltsev Theorem in 1945, any finite-dimensional Lie algebra over a field of characteristic zero can be expressed as a semidirect sum of a semi-simple subalgebra and its maximal solvable ideal. It reduces the task of classifying all finite-dimensional Lie algebras to obtaining the classification of semi-simple and of solvable Lie algebras. The problem of the classification of semi-simple Lie algebras over the complex field has been completely classified by Killing, E. Cartan in 1894, over the real field by F. R. Gantmakher in 1939. Although several classifications of solvable Lie algebras of small dimension are known, but the problem of the complete classification of the (real or complex) solvable Lie algebras is still open up to now. There are two ways of proceeding in the classification of solvable Lie algebras: by dimension or by structure. It seems to be very difficult to proceed by dimension in the classification of Lie algebras of dimension greater than 6. However, it is possible to proceed by structure, i.e. to classify solvable Lie algebras with a specific given property. In this report, we classify by structure, up to an isomorphism, the class consists of all solvable real Lie algebras whose first derived ideals are 2-dimensional.

Keywords: (n/a)

Some Results on Artinian Serial Rings

Duc Thoang Le[1]

[1]Department of Mathematics, Phu Yen University, Tuy Hoa City, Vietnam
leducthoang@pyu.edu.vn

Abstract

A module is called uniserial if the lattice of its submodules is a chain, i.e., the set of all its submodules is linearly ordered by inclusion. A module is called serial if it decomposes into a direct sum of uniserial submodules. A ring is called right (resp. left) serial if it is a right (resp. left) serial module over itself. In this notes, we show that *A ring R is artinian serial if and only if R is left or right perfect, right serial and satisfying $E(eR)$ is uniserial module for all primitive idempotents* and some results on artinian serial rings.

Keywords: (n/a)

Modules Which are Invariant Under Idempotents of Their Envelopes

Le Van Thuyet[1]

[1]Center for International Education, Hue University, Hue, Vietnam
lvthuyet@hueuni.vn

Abstract

In this talk, we will study the class of modules which are invariant under idempotents of their envelopes. We will say that a module M is $\mathcal{X}$-idempotent-invariant if there exists an $\mathcal{X}$-envelope $u : M \to X$ satisfying that for any idempotent $g?End(X)$ there exists an endomorphism $f : M \to M$ such that $uf = gu$. Their properties of this class of modules are obtained. We proved that M is $\mathcal{X}$-idempotent-invariant if and only if for every direct decomposition $X = \sum_I X_i$, then we obtain the direct decomposition $M = \sum_I (u^{-1}(X_i) \cap M)$. Moreover, some generalizations of $\mathcal{X}$-idempotent-invariant modules are considered.

Keywords: (n/a)

Modelling Calcium Signaling by Cellular Automata Simulation Incorporating Endocrine Regulation and Trafficking in Various Types of Receptors

Chontita Rattanakul[1], Yongwimon Lenbury[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
chontita.rat@mahidol.ac.th; yongwimon.len@mahidol.ac.th

Abstract

Calcium signaling plays important physiological roles which range widely that include muscle contraction, neuronal transmission, cellular motility, fertilization, cell growth or proliferation, learning and memory, and secretion of saliva. Calcium also takes an crucial role in biochemical processes such as enzyme activity regulation, ion channels permeability, including activity of ion pumps, and components of the cytoskeleton. Signaling occurs when the cell is stimulated to release calcium ions (Ca^{2+}) from intracellular stores. Many cell surface receptors, including G protein-coupled receptors, stimulate the formation of IP3 that diffuses to the endoplasmic reticulum, binds to its receptor and thus releases Ca^{2+} from the endoplasmic reticulum. Here, we construct a Cellular Automata model of signal transduction pathway mediated by Calcium Sensing receptors. The mechanism of receptor trafficking and dimerization is assumed to exert positive impact on receptor binding affinity. The update equations of cytosolic calcium and extracellular calcium concentrations incorporate endocrine regulation through the parathyroid hormone. Time series of calcium concentrations are obtained to investigate the effects of different fractions of healthy (functional) and defective receptors.

Keywords: Calcium signaling, Cellular Automata model, parathyroid hormone, receptor trafficking, dimerization

*Corresponding author

Various Asymptotic Models for the Dynamics of Two Linearly Elastic Bodies Connected by a Very Thin Viscoelastic Layer

Christian Licht[1]

[1]CNRS, University of Montpellier, Laboratoire de Mécanique et Génie Civil, Cc 048, Place E. Bataillon, 34095 Montpellier Cedex05, France;
Department of Mathematics, Faculty of Science, Mahidol University, Thailand
clicht@univ-montp2.fr

Abstract

Here we present some results devoted to the asymptotic modeling of the dynamics of two linearly elastic bodies connected by a very thin viscoelastic layer. The obtained models depend strongly on the relative behavior of the geometrical and mechanical data considered as parameters when they tend to their natural limits. When the total stiffness of the layers is vanishing, the layer is replaced by a mechanical constraint between the two adherents; whereas in the other cases, the layer is replaced by a viscoelastic material surface to which the adherents are bonded! When the total mass of the layer is vanishing, no dynamic term enter the limit constitutive equation; whereas in the other cases, a dynamic term is involved! These results, easy to guess, can be easily established by considering sequences with bounded total mechanical energies. This key point being understood, it suffices to formulate the problem in terms of (non)linear evolution equations in Hilbert spaces of possible states with finite energy and to use a suitable nonlinear extension of Trotter theory of convergence of semi-groups of operators acting on variable Hilbert spaces.

Keywords: (n/a)

A Spline Growth Model for Multivariate Data

Tapio Nummi[1]

[1]School of Information Sciences, University of Tampere, 33014, Finland
Tapio.Nummi@uta.fi

Abstract

A spline growth model and its multivariate version are presented. The talk focuses on estimation and hypothesis testing. The introduced methods are based on penalized log likelihood and on a spline approximation with an F-test. The methods are illustrated using a real data set.

Keywords: covariance structures, cubic smoothing splines, roughness penalty, singular-value decomposition

Optimum Designs for Parameter Estimation in a Mixture Experiment with Two Correlated Responses

Manisha Pal[1]*,Nripes Kumar Mandal[1]

[1]Department of Mathematics, University of Calcutta, 35 Ballygunge Circular Road, Kolkata - 700 019, West Bengal, India
manishapal2@gmail.com; (no e-mail)

Abstract

In this presentation we discuss a mixture experiment with two responses of interest, which are functions of the mixing proportions, and are correlated. We obtain D- and A- optimal designs for estimating the parameters of the response functions, when none or some of the regression coefficients of the two functions are same. It is shown that when no prior knowledge about the regression coefficients is available, the D-optimal design is independent of the dispersion matrix of the responses, while the A-optimal design depends on it. On the other hand, when some of the regression coefficients are known to be same for both the functions, the D-optimal design depends on the dispersion matrix in the case where the two response functions are not of the same order.

Keywords: correlated responses, linear and quadratic mixture models, D-optimality criterion, A-optimality criterion, optimum designs

*Invited speaker

Analysis of Non-Negative Observations Subject to Two Factors Using Gamma Models

Nuong Thu Thuy Tran[1],Nabendu Pal[1,2]

[1]Faculty of Mathematics and Statistics, Ton Duc Thang University, Ho Chi Minh City, Vietnam
tttnuong@itam.edu.vn

[2]Department of Mathematics, University of Louisiana at Lafayette, Lafayette, Louisiana, USA
nxp3695@louisiana.edu

Abstract

A two-factor analysis of variance (ANOVA) is widely used in design of experiments when experimental units are subjected to two factors (i.e., potential sources of variations). However, such an analysis, which uses the F-tests, is dependent on three critical assumptions, - (i) all the main and interaction effects as well as the unexplained error term are additive to explain the response variable; (ii) the errors are all independent and follow a normal distribution; and (iii) the error variances, though unknown, are all equal (i.e., the errors are homoscedastic). In many engineering and biological studies, where the observations are non-negative to begin with, it is often found that one or more of the above assumptions is/are not tenable. Further, the observations tend to exhibit positively skewed distributions as seen from sample histograms. In such situations, the standard operating procedure (SOP) of the two-factor ANOVA calls for a suitable (Box-Cox type) transformation, so that the transformed observations can follow the aforementioned model assumptions. There are two practical difficulties faced by the researchers with the transformed observations: (a) the transformed observations lose their relevance to the original problem, and the resultant unit(s) of the transformed observations can be meaningless, and (b) it becomes a subjective call to come up with the most appropriate transformation of the data, i.e., one transformation can make the data adhere to one assumption while another transformation can make the data follow another assumption closely. Faced with such a dilemma we offer a completely new paradigm where the non-negative observations, influenced by two factors, are modeled by gamma distributions with unknown shape and scale parameters which are dependent on the corresponding factor levels. We then proceed with testing the main effects (whether the main effects of a factor are all equal or not) and interaction effects (whether the interactions exist or not). To test a null hypothesis against a suitable alternative, we first derive the likelihood ratio test (LRT) based on its asymptotic Chi-square distribution. But since the asymptotic LRT (henceforth called 'ALRT') may not work well for small to moderate sample sizes we then propose a parametric bootstrap (PB) test based on the LRT statistic which does not use the Chi-square distribution, rather finds its critical value automatically through simulation. The PB test using LRT statistic (henceforth called 'PBLRT') appears to work very well in terms of maintaining the nominal level as seen from our comprehensive simulation study. Further, we present some real-life datasets to buttress the applicability of our proposed PBLRT over the classical ALRT, and to show how the inferences may differ from the ones based on traditional ANOVA.

Keywords: hypothesis testing, size of a test, power of a test, parametric bootstrap, likelihood ratio test

On Semiprime Right Goldie Rings

Dan Phan[1]

[1]University of Finance, Ho Chi Minh city, Vietnam
mrphandan@yahoo.com

Abstract

It is shown that a ring R is semiprime right Goldie if and only if R is right nonsingular and every nonsingular right R-module M has a direct decomposition $M = I \oplus N$, where I is injective and N is a reduced module such that N does not contain any extending submodule of infinite Goldie dimension.

Keywords: injective, quasi-injective, extending, nonsingular, reduced, Goldie dimension, and semisimple right Goldie rings

On the Projectivity over Hopf Subalgebras of Hopf Algebras over Dedekind Rings

Ho Hai Phung[1]

[1]Department of Algebra, Hanoi Institute of Mathematics, Hanoi, Vietnam
phung@math.ac.vn

Abstract

We study the projectivity of Hopf algebras, defined over a Dedekind ring, over their Hopf subalgebras. We give a criterion for the faithful flatness and use it to show the faithful flatness of an arbitrary flat Hopf algebra upon its finite normal Hopf subalgebras. For the projectivity over Hopf subalgebras of a Hopf algebra we need some finiteness conditions in terms of the module of integrals. In particular we show that the module of integrals is projective of rank one.

Keywords: (n/a)

A Biological Control of the Spread of Cassava Mealybugs in a Cassava Field Using a Mix of *Anagyrus lopezi* and Green Lacewings: A Simulation Study

Chontita Rattanakul[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Commission on Higher Education, Bangkok 10400, Thailand
chontita.rat@mahidol.ac.th

Abstract

In this study, a cellular automata model is developed and Monte Carlo simulation technique is employed in order to investigate a biological control of the spread of cassava mealybugs in a cassava field when a mix of *Anagyrus lopezi* and green lacewings is utilized. Different manners of the release of *Anagyrus lopezi* and green lacewings are investigated numerically so that an efficient control of the spread of cassava mealybugs is suggested.

Keywords: Anagyrus lopezi, cassava, cassava mealybug, cellular automata, green lacewings

Effect of Magnetic Field on Mixed Convection Flow in a Rectangular Cavity Filled with Porous Medium

Najahulfazliah Zainuddin[1],Rozaini Roslan[1*],Arash Karimipour[2], Maselan Ali[1]

[1]Department of Mathematics and Statistics, Faculty of Science, Technology and Human Development, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, Malaysia
najahulfazliah@gmail.com; rozaini@uthm.edu.my; maselan@uthm.edu.my
[2]Department of Mechanical Engineering, Najafabad Branch, Islamic Azad University, Najafabad, Iran
arashkarimipour@gmail.com

Abstract

The effect of magnetic field on unsteady mixed convection flow in a lid-driven rectangular cavity filled with a porous medium is investigated numerically. The bottom wall is uniformly heated while, the two vertical walls are insulated. The top wall is uniformly cooled and moving at a constant speed from left to right. The finite volume method with semi-implicit for pressure linked equations (SIMPLE) algorithm is employed to solve the dimensionless governing equations of the problem. Comparisons with previous works on special case of the related problem are in good agreement. Effects of the Darcy number, Da and Hartmann number, Ha on the flow and heat transfer are obtained and shown graphically in the cavity. The average Nusselt number, Nu along the top and bottom walls have different results show the dominance of conduction with an increase of Ha and the dominance of convection with an increase of Da. The stream function and isotherm show that there has significant influence with the presence of porous medium and magnetic field. The presence of magnetic field cause the velocity of the fluid and flow intensity decrease due to an inhibition effect on the heat transfer.

Keywords: magnetic field, mixed convection, porous medium, heat generation, finite volume method

*Corresponding author

Coverage Probability and Exact Inference

Bikas K. Sinha[1],Gauranga Chatterjee[2]

[1]Indian Statistical Institute, Kolkata, Kolkata 700108, India
bikassinha1946@gmail.com
[2]Department of Statistics, Calcutta University, Kolkata 700019, India
gcdhstat@gmail.com

Abstract

With reference to 'point estimation' of a real-valued parameter θ involved in the distribution of a real-valued random variable X, we consider a sample size n and an underlying unbiased estimator $\hat{\theta}_n$ for every $n = k, k+1, k+2, \ldots$ where k is the minimum sample size for existence of an unbiased estimator of θ. We wish to investigate exact small sample properties of the sequence of estimators considered here. This we study by considering what is termed as 'Coverage Probability (CP)' and defined as $CP(n, c) = P[-c < \hat{\theta}_n - \theta < c]$. It is desired that the sequence $[CP(n, c); n = k, k+1, k+2, \ldots]$ behaves like an increasing sequence for every $c > 0$. We may note that we are asking for a property beyond 'consistency' of a sequence of estimators. In this talk we will discuss several interesting features of the behaviors of the CP.

Keywords: (n/a)

On Estimation and Prediction for Bivariate Extreme Value Distributions

Nader Tajvidi[1]

[1]Centre for Mathematical Sciences, Lund University of Technology, Box 118 SE-22100 Lund, Sweden
nader@maths.lth.se

Abstract

The last couple of decades have brought several new challenging problems to the attention of scientists including the widely discussed question regarding the climate change and the ongoing financial crisis. Both issues have attracted lots of attention not only from academic world but also from the main stream media. The multivariate extreme value theory and the corresponding multivariate peaks over thresholds models have been developed with the promise of providing a reasonable and sound mathematical model to tackle such new problems.

In this talk we give an introduction to the multivariate extreme value theory and discuss the bivariate case in further details. There are at least two equivalent characterizations of bivariate extreme value distributions based on either the so called spectral measure or a function which has been named dependence function. We discuss the relationship between these two characterizations and show how it can be used for statistical inference. We give also a review of the existing estimation and prediction methods for bivariate extremes.

Keywords: bivariate extreme value distribution, bootstrap, calibration, dependence function, marginal distribution, nonparametric curve estimation

On the Volume and the Number of Lattice Points of Some Semialgebraic Sets

Gia Loc Tran[1]

[1]Teacher Training College of Dalat, 29 Yersin road, Dalat, Vietnam
gialoc@gmail.com

Abstract

Let $f = (f_1, \ldots, f_m) : \mathbb{R}^n \longrightarrow \mathbb{R}^m$ be a polynomial map; $G^f(r) = \{x \in \mathbb{R}^n : |f_i(x)| \leq r,\ i = 1, \ldots, m\}$. We show that if f satisfies the Mikhailov-Gindikin condition then

(i) Volume $G^f(r) \asymp r^{\theta}(\ln r)^k$

(ii) Card $\left(G^f(r) \cap \overset{o}{\mathbb{Z}}{}^n\right) \asymp r^{\theta'}(\ln r)^{k'}$, as $r \to \infty$,

where the exponents $\theta,\ k,\ \theta',\ k'$ are determined explicitly in terms of the Newton polyhedra of f.

Moreover, the polynomial maps satisfy the Mikhailov-Gindikin condition form an open subset of the set of polynomial maps having the same Newton polyhedron.

Keywords: (n/a)

On the Number of Difference-Free Subsets of Integers

Nam Dung Tran[1]

[1]Ho Chi Minh City University of Science, Ho Chi Minh city, Vietnam
trannamdung@yahoo.com

Abstract

For a set A of positive integers, we define $A \setminus A = \{aa' \mid a, a' \in A\}$. Let $[N] = \{1, 2, \ldots, N\}$ and F be a fixed subset of $[N-1]$. A subset A of $[N]$ is called F *difference-free* if $(A \setminus A) \cap F = \varnothing$. In this talk we consider the problem of counting number $S(F, N)$ of all F difference-free subsets of $[N]$. Recurrent formula and asymptotic estimation for $S(F, N)$ are derived for some special classes of F. We propose an algorithm of finding recurrent formula for $S(F, N)$ and prove main theorem on degree of recurrent formula.

Keywords: (n/a)

On X-Continuous Modules

Cong Quynh Truong[1]

[1]The University of Da Nang, Danang, Vietnam;
Da Nang University of Education
tcquynh@live.com

Abstract

In this talk, we continue studying $\mathcal{X}$-idempotent-invariant modules under some conditions. A right R-module M is called $\mathcal{X}$ -idempotent-invariant if there exists an $\mathcal{X}$ -envelope $u : M \to X$ satisfying that for any idempotent $g \in End(X)$there exists an endomorphism $f :\to M$ such that $uf = gu$. Several properties of $\mathcal{X}$ - idempotent-invariant modules are provided and used to describe some well-known classes of rings. For example, it is shown that the endomorphism ring of an $\mathcal{X}$-continuous module is semiregular.

Keywords: (n/a)

Mathematics-in-Industry Initiatives in the Asia-Pacific Region

Graeme Wake[1]

[1]Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand
g.c.wake@massey.ac.nz

Abstract

Programs to enable Mathematics to better address Industrial and Community needs are spreading across the Asia-Pacific region. An isolationist attitude that existed a generation ago is changing. Initiatives are flourishing in many countries near Thailand: notably in Japan, South Korea. China, Malaysia, Australia (since 1984) and. New Zealand (NZ). I have been involved to some degree in all these initiatives. Most of these, but not all, are modifications of the tried and tested approach of week-long Mathematics-in-Industry Study Groups, which were introduced at Oxford in the 1960s, which has now spread world-wide. The distinct feature of this approach is that here the work starts and (it may) stops with the Industry problem as posed by the Problem Challenge provider, and the week is largely taken up in small groups working with the Industry-based people to address the problem **as stated**, not as you want it to be.

Our NZ experience suggests that this works best if it is seen as a whole nation initiative which means that it is run by a group rather than just one institution, which may be fostered by a professional grouping, from government, a professional society, or even a nation-wide grouping formed just for this specific purpose. Or it could be a blend of all three. We have succeeded with this, forming a grouping called **Mathematics-in-Industry for NZ (MINZ)** which is administrated by a national consortium (called KiwiNet) of Industry and Universities formed largely to bring clever science to address Industry problems.

These initiatives are not easy. Industry does not always believe this will be useful and mathematicians often do not see the need to get out to where the problems are. These issues will be discussed,. Across the Asia-Pacific region these activities are linked through a consortium called the APCMfI (=Asia-Pacific Consortium of Mathematics for Industry).

The NZ initiative was initially in partnership with Australia, which was formalised in 1993 under the then (1993) new two-country grouping ANZIAM (=Australian and NZ Industrial and Applied Mathematics) group. After the following two decades this worked well, but the meetings were mostly in Australia, and both Industry and our Mathematical Scientists often were only getting together there, rather than in our own country. So gradually the national need for this to happen regularly **in and for** NZ became clearer. So in 2015 we launched the MINZ initiative which will be described, with the help of a short video, see

https://www.youtube.com/channel/UCBdlFHZ1WA4kiy3WQABUGjA

This type of initiative could work for Thailand.

Keywords: uses of mathematics, problem-solving study groups, national effort

Mathematical Modelling of a Robust Claim Interpretation and Claim Construction for an ETCI, - Advanced Steps of a "Mathematical Theory of Innovation"

Bernd Wegner[1]

[1]Department of Mathematics, Technical University of Berlin, Str. des 17. Juni 136, 10623 Berlin, Germany
zblwegner@googlemail.com

Abstract

Any claimed intervention (CI) embodies technically creative steps not limited to dealing with tangible subject matter, but comprising any allegedly new technical teaching disclosed in an enabling way by a patent, the technical teaching being non-obvious over pertinent ordinary skill(s) and prior art. The latter is represented by a finite reference set of additional documents, each disclosing its technical teaching, which jointly potentially anticipate the given technical teaching. The development of a claim interpretation, being as precise as possible, and a claim construction, satisfying the fundamental concerns of Substantive Patent Law (SPL), represented by 35 USC 101, 102/103, 112, and the relevant precedents like the Mayo and Myriad decisions among others, is essential for supporting a rational decision on the patent eligibility and the patentability of a CI. In accordance with the precedents involved this analysis is of big importance for emerging technology claimed inventions (ETCI).

The aim of the paper is to demonstrate the kind of mathematical modelling, which seems to be most appropriate to set up rational claim interpretations and claim constructions satisfying SPL. This method is not restricted to US law. It is capable to integrate any other SPL. Among others, it provides the mathematical tools for modelling the technical teaching embodied by an ETCI over its prior art and determining its creative height over a given reference set. This includes the refinement of the technical teaching of the ETCI by a corresponding sequence of transformations of knowledge representations on different levels of precision and the development of a scope of the ETCI enabling to decide on its violation by other ETCIs. These axiomatically defined mathematical tools are based on several important Highest Courts patent precedents.

The talk only will concentrate on the mathematical structures involved, though there are a lot of arguments why they are considered as appropriate to model relevant parts of the juridical background. The latter had been written down in a long series of papers mainly addressed to professionals from the law side. There are several other disciplines involved like semantics, semiotics or logics. The set up for the interpretation of the ETCI also will involve a human factor, represented by an inventor, analyst or posc (person of ordinary skill and creativity). Hence we are not in the same situation like sending a rocket to the moon. The important message is that mathematics can do a lot to help to solve the problems involved.

This is a report on a joint project directed by Professor Sigram Schindler at TU Berlin.

Keywords: (n/a)

Contributed Speakers

A Study on Rational Metric Energy of a Graph

Raghavendra A[1]*,Sooryanarayana B[2],Raksha Y. Poojary[1]

[1]Department of Mathematics, Poornaprajna College, Udupi, Karnataka, India
raghavendra_ppc@rediffmail.com; rakshayogeesh@gmail.com
[2]Department of Mathematical and Computational Sciences, Dr Ambedkar Institute of Technology, Bengaluru, Karnataka, India
dr_bsnrao@hotmail.com

Abstract

The concept of energy of a graph plays an important role in different fields of science and engineering. We consider simple, finite and undirected graphs throughout this paper. The energy, $E(G)$, of a simple graph G is defined to be the sum of the absolute values of the eige values of G. For any two vertices $u, v \in V(G)$, $d(u/v)$ the rational distance from u to v is given by $d(u/v) = \frac{\sum\limits_{u_i \in N(u)} d(u_i,u)}{\deg(u)+1}$. The rational distance matrix $M_R(G) = [a_{ij}]$ of a graph G is a square matrix of order n, where

$$a_{ij} = \begin{cases} 0, & i = j; \\ d(v_i/v_j), & i \neq j. \end{cases}$$

If $\lambda_1, \lambda_2, \ldots, \lambda_n$ are the eigenvalues of the rational distance matrix then $\sum\limits_{i=1}^{n} |\lambda_i|$ is called the Rational Metric Energy of the graph G and is denoted by $E_{MR}(G)$.
In this paper we obtain the rational metric energy of some family of graphs and compare the results with the usual energies of graphs.

Keywords: graph, rational distance, rational metric, rational distance matrix

*Corresponding author

Modeling Application of Queue Manual Method and Road Capacity in Indonesia to Increase Intersection Capacity

Sobri Abusini[1]

[1]Department of Mathematics, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang 65145, Indonesia
sobri@ub.ac.id

Abstract

According to Asri (2000), a queue is people or goods in a row that are waiting before being served. Queuing theory is the science of waiting in various models. Queuing system is a set of customers, services and the rules governing the arrival of customers. Intersection is the location of the meeting or intersection of two or more roads. The queue of vehicles at the intersection can cause congestion problems. One purpose of this study was to determine the level of service of the intersections of the highways with queuing models and methods of the Highway Capacity Manual Indonesia (HCMI) to increase the capacity of the intersection. According to Morlok (1988), service level of intersection is a measurement used to determine the quality of an intersection in serving the traffic flow through it. Based on HCMI, the level of intersection service depends on the major obstacles that are encountered, because the larger or the longer the bottlenecks a queue arises anyway.

Keywords: queues, interchange, congestion, traffic

Enhancement of Heat Transfer in a U-loop Circular Tube with Axial Perforated Inserts

Simul Acherjee[1],Md. Moniruzzaman Bhuyan[2],M. Shahriar[3], Ujjwal Kumar Deb[4]

[1]Narangiri Govt. High School, kaptai, Rangamati, Bangladesh
acherjeesimul@gmail.com
[2]Department of Electrical and Electronics Engineering, Southern University Bangladesh, Chittagong 4000, Bangladesh
mmbhuyan87@southern.edu.bd
[3]Department of Mechanical Engineering, Chittagong University of Engineering and Technology, Chittagong 4349, Bangladesh
tanim0907@gmail.com
[4]Department of Mathematics, Chittagong University of Engineering and Technology, Chittagong 4349, Bangladesh
ukdeb03@gmail.com

Abstract

In practical applications inserts of various geometrical shape are used to enhance the heat transfer. So many experiments have been carried out for a circular tube using various types of inserts. In our investigation, we have used perforated axial inserts in the straight part of a U-loop circular pipe. The non-isothermal laminar flow is considered as the physics for fluid flow inside the tube. A copper pipe with 3425 mm long, 70 mm diameter and 5 mm thickness is taken for our simulation. Two 1600 mm $\times$ 70 mm $\times$ 2 mm rectangular copper plates with perforated are used as inserts inside the tube fitted in perpendicular to the fluid flow. For our simulation, we have used a uniform heat-flux around the U-loop circular tube. The variations of temperature and pressure drops are examined for with inserts and without insert. Finally we compare the results for a without perforated inserts tube. We found a significant difference between both results where the perforated inserts tube enhanced the amount of heat transfer than the without perforated inserts for a fluid flow. It is also noted that when the surface temperature is higher , it follows lower heat transfer rate.

Keywords: heat transfer, perforated inserts, u-loop pipe, laminar flow, simulation

A Simulation Study of a Biological Control of the Spread of Cassava Mealybugs in a Cassava Field Using *Anagyrus lopezi* as a Biological Control Agent

Supassorn Aekthong[1],Chontita Rattanakul[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Commission on Higher Education, Bangkok 10400, Thailand
llittlesorn@gmail.com; chontita.rat@mahidol.ac.th

Abstract

In this work, the use of *Anagyrus lopezi* as a biological control agent for controlling the spread of cassava mealybugs in a cassava field is investigated. A cellular automata model is constructed based upon farmer's usual practices of cassava's planting in Thailand. The effect of increased global temperatures on the life cycle of *Anagyrus lopezi* is also taken into account. Computer simulations at different temperatures with different manners of biological control are carried out so that guidelines for controlling of the spread of cassava mealybugs with *Anagyrus lopezi* at different temperatures are obtained.

Keywords: Anagyrus lopezi, cassava, cassava mealybug, cellular automata

*Corresponding author

A Relationship Between Synchronization and Allee Effect in von Bertalanffy's Models

Sandra M. Aleixo[1],Acilina Caneco[2]

[1]Department of Mathematics, ISEL Instituto Superior de Engenharia de Lisboa, Rua Conselheiro Emidio Navarro, 1, 1959-007 Lisbon, Portugal, Portugal;
CEAUL, Lisbon, Portugal
sandra.aleixo@adm.isel.pt

[2]Department of Mathematics, ISEL Instituto Superior de Engenharia de Lisboa, Rua Conselheiro Emidio Navarro, 1, 1959-007 Lisbon, Portugal, Portugal;
CIMA, Evora, Portugal
acilina@adm.isel.pt

Abstract

The Allee effect corresponds to a positive relationship between population size and individual performance. There is a critical population size, the Allee point, below which the population becomes extinct. It has been repeatedly reported by some biologists that there is a positive influence of the Allee effect on the cooperation, or synchronism of populations. In this work, we use Bertalanffys models in which were introduced Allee effect factors and, the evolution study of the synchronizability when the Allee point increases, was carried out. In fact, our numerical results show that, when the Allee effect gets stronger, the synchronization improves. We observed that the synchronization begin at a lower value of the coupling parameter and the amplitude of the synchronization interval becomes larger. These results confirm the experimental observations of biologists.

Keywords: Allee effect, synchronization, von Bertalanffy's models

Sharp Estimates of Oscillatory Singular Integrals with Rough Kernels

Hussain M. Al-Qassem[1],Leslie Cheng[2],Yibiao Pan[3]

[1]Department of Mathematics, Statistics and Physics, Qatar University, Doha, Qatar
husseink@qu.edu.qa
[2]Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA 19010, U.S.A.
lcheng@brynmawr.edu
[3]Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260, U.S.A.
yibiao@pitt.edu

Abstract

In this paper we establish sharp bounds for oscillatory singular integrals with an arbitrary real polynomial phase P. Our kernels are allowed to be rough both on the unit sphere and in the radial direction. We show that the bounds grow no faster than $\log(\deg(P))$, which is optimal and was first obtained by Parissis and Papadimitrakis for kernels without any radial roughness. Among key ingredients of our methods are an $L^1 \to L^2$ estimate and extrapolation.

Keywords: oscillatory singular integral, rough kernel, singular integral, Orlicz spaces, block spaces, extrapolation, L^p boundedness

Algae Based Shore Protection Model: Wave Energy Absorption Aspect

Busayamas Pimpunchat[1],Achara Sornnery[1],Pacharin Henchote[1],
Somkid Amornsamankul[2*],Wannapong Triampo[3]

[1]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
knbusaya@kmitl.ac.th; achara.sorn@hotmail.com; patcharin.he@kmitl.ac.th
[2]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
somkid.amo@mahidol.ac.th
[3]Department of Physics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
wannapong.tri@mahidol.ac.th

Abstract

Many pieces of research work on problems of coastal erosion in Thailand were published in various cases. Natural protections and engineering structure methods are designed for shore protection. This research aims to study shoreline protection by using the designed algae feeding model. This model can explain the movement of the wave through algae and MATLAB GUI toolbox was utilized to calculate the wave energy.

Keywords: algae, mathematical modeling, shore protection, wave energy

*Corresponding author

Modeling Fibrous Cap Formation in Atherosclerotic Plaque Development: Stability and Oscillatory Behavior

Yongwimon Lenbury[1], Wanwarat Anlamlert[2*], Jonathan Bell[3]

[1]Department of Mathematics, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
yongwimon.len@mahidol.ac.th, scylb@yahoo.com
[2]Department of Mathematics and Statistics, Thammasat University, Rangsit Center, Pathum Thani 12121, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
wannarat@mathstat.sci.tu.ac.th
[3]Department of Mathematics and Statistics, University of Maryland, Baltimore County, Baltimore, MD 21250, United States
jbell@umbc.edu

Abstract

Atherosclerotic plaque formation and growth in arteries are complex processes hemodynamically and mechanically. Some plaques remain stable throughout one's life, or they become unstable and can grow to such a size that they pose a health risk from stenosis, which is a partial blockage of the artery, leading to disruption. The rupture of these vulnerable plaques is thought to culminate in many life threatening illnesses, such as coronary heart disease, cardiovascular diseases, myocardial infraction and stroke, responsible for most fatalities. According to Davies (1992) almost 73% of deaths from myocardial infarction (heart attack) are caused by plaque rupture. A mathematical model of the essential chemical processes associated with atherosclerotic plaque development is constructed, considering the concentrations of LDLs, oxidized LDLs, foam cells, oxidized LDL derived chemoattractant and macrophage derived chemoattractant, the density of macrophages, smooth muscle cells (SMCs), and extracellular matrix (ECM). Only the saturation effect is incorporated in the rate equations for the smooth muscle cell density and macrophage-derived chemo attractant. The positive invariant set is found and local stability is established. Oscillatory behavior of the model solutions is also investigated in the form of Hopf bifurcation.

Keywords: atherosclerosis, atherosclerotic plaque development, local stability, oscillatory behavior

*Corresponding author

Option Pricing Under GARCH Models Applied to the SET Index of Thailand

Somphorn Arunsingkarat[1],Renato Costa[1],Nattakorn Phewchean[2]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
F.Somphorn@gmail.com; costarenato81@gmail.com
[2]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, CHE 328 Si Ayutthaya Road, Bangkok Thailand
nattakorn.phe@mahidol.ac.th

Abstract

In the real world, variance does change over time and depend on past data and past variance; as a result, it is useful to use a GARCH process to model it. In this paper, we use the notion of conditional Esscher transform introduced by Buhlmann et al.(1996) and applied by Siu Tong and Yang (2004) to GARCH models, to find the GARCH, EGARCH and GJR risk-neutral models. Subsequently, we apply them to obtain option prices for options on the SET and SET50 index of Thailand.

Keywords: GARCH, EGARCH and GJR risk-neutral models, option pricing, conditional Esscher transform

Simulation of Heat Transfer in a Tubular Pipe Using Different Length Twisted Tape Inserts

Md. Moniruzzaman Bhuyan[1],Simul Acherjee[2],M. Shahriar[3], Ujjwal Kumar Deb[4]

[1]Department of Electrical and Electronics Engineering, Southern University Bangladesh, Chittagong 4000, Bangladesh
mmbhuyan87@southern.edu.bd
[2] Narangiri Govt. High School, kaptai, Rangamati, Bangladesh
acherjeesimul@gmail.com
[3]Department of Mechanical Engineering, Chittagong University of Engineering and Technology, Chittagong 4349, Bangladesh
tanim0907@gmail.com
[4]Department of Mathematics, Chittagong University of Engineering and Technology, Chittagong 4349, Bangladesh
ukdeb03@gmail.com

Abstract

This paper presents simulation studies of the heat transfer phenomena in a tubular U-loop pipe. We have investigated the enhancement of heat transfer with mass flow in a pipe without insert, with full length and short length twisted tape inserts. The length of the pipe is approximately 2391.24mm long with 25mm inner and 30mm outer diameter. A constant heat flux is taken which generated the boundary layer of the pipe close to the flowing fluid around the boundary layer. The simulations are considered for stationary and time dependent module for 240 seconds with different length of inserts and comparison is made among the results. We observed that the transfer of heat is enhanced significantly with the increase of the length of inserts inside the computational domain. We also found that full length twisted tape inserts are more effective compared to the short length inserts and without insert.

Keywords: heat transfer, non-isothermal flow, tubular pipe, twisted tape insert, simulation

Comparing the Spread of TB in the HIV-Infected Populations

Natdanai Boonsri[1],Kornkanok Bunwong[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
natdanai.boo@student.mahidol.ac.th; kornkanok.bun@mahidol.ac.th

Abstract

From WHO's observation, tuberculosis (TB) incidence has increased as a result of the human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) epidemic since HIV weakens the immune system. TB is also the most common opportunistic infection and a leading cause of death among people living with HIV. In this paper, the transmission dynamics of TB and HIV co-infection is considered. The compartmental structure of the model combines four states for HIV dynamics (HIV susceptible individuals, HIV infected individuals, AIDS infected individuals and infected individuals under ARV treatment) with three states for TB dynamics (TB susceptible individuals, latent TB individuals and TB infected individuals). The basic reproduction numbers are calculated by using the next generation matrix in order to compare the spread of TB through the epidemiological subgroups of HIV/AIDS.

Keywords: basic reproduction numbers, epidemic model, TB and HIV co-infection, transmission dynamics

*Corresponding author.

Determining System Poles Using Row Sequences of Simultaneous Padé-Faber Approximants

Nattapong Bosuwan[1],Guillermo L. Lagomasino[2]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Rama VI Road, Ratchathewi District, 10400, Bangkok, Thailand;
Centre of Excellence in Mathematics, CHE, Si Ayutthaya Road, 10400, Bangkok, Thailand
nattapong.bos@mahidol.ac.th
[2]Department of Mathematics, Universidad Carlos III de Madrid, Avenida de la Universidad, 30, CP-28911, Leganés, Madrid, Spain
lago@math.uc3m.es

Abstract

We introduce a new definition of simultaneous Padé-Faber approximants. We study a relation of the convergence of poles of row sequences of simultaneous Padé-Faber approximants and the system poles of a vector of approximated functions. We give necessary and sufficient conditions for the convergence with geometric rate of the common denominators of simultaneous Padé-Faber approximants. Thereby, we obtain an analogue of Montessus de Ballore-Gonchar theorem for row sequences of simultaneous Padé-Faber approximants.

Keywords: Montessus de Ballore's theorem, inverse problems, simultaneous Padé-Faber approximants, Faber polynomials, Hermite-Padé approximants, Padé-Faber approximants

Chaotic Synchronization of von Bertalanffys Systems

Acilina Caneco[1],Sandra M. Aleixo[2],Leonel Rocha[2]

[1]Department of Mathematics, ISEL Instituto Superior de Engenharia de Lisboa, Rua Conselheiro Emidio Navarro, 1, 1959-007 Lisbon, Portugal, Portugal;
CIMA, Evora, Portugal
acilina@adm.isel.pt

[2]Department of Mathematics, ISEL Instituto Superior de Engenharia de Lisboa, Rua Conselheiro Emidio Navarro, 1, 1959-007 Lisbon, Portugal, Portugal;
CEAUL, Lisbon, Portugal
sandra.aleixo@adm.isel.pt; jrocha@adm.isel.pt

Abstract

The logistic, the Gompertz and von Bertalanffys growth models are often used to describe the growth of several dynamic populations such as marine mammals, invertebrates and reptiles, seabirds, sea turtles and fishes. In this work, we study a dynamical approach of a generalized family of von Bertalanffys maps. The system complexity is measured using Lyapunov exponents, which depend on two biological parameters: von Bertalanffys growth rate constant and the asymptotic weight.

Synchronization is a fundamental nonlinear phenomenon which can be observed in many systems modelling real life. In population dynamics synchronization occurs on the level of single cells and even on the level of large populations.

In this work, we consider networks having in each node a von Bertalanffys model and we study the chaotic synchronization interval of these networks, as a function of those two biological parameters. Numerical simulations are also presented to support our approaches.

Keywords: von Bertalanffys models, synchronization, Lyapunov exponents

Optimal Control of Zika Virus Infection by Vector Elimination, Vector-to-Human and Human-to-Vector Contact Reduction

Nonthamon Chaikham[1], Wannika Sawantong[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
nonthamon.chi@mahidol.ac.th; wannika.saw@mahidol.ac.th

Abstract

The recent outbreak of mosquito-borne Zika virus (ZIKV) in Brazil, with estimated cases surpassing 1.5 million, has gained attention due to its rapid spread and neurological complications associated with the infection such as microcephaly and Guillain-Barré syndrome. Populated in tropical regions, the predominant vector of Zika virus, *Aedes aegypt* Mosquito, is also the transmission vector of other arboviruses such as dengue and chikungunya. The epidemiological patterns of these viruses suggest that Zika virus could cause other outbreaks, particularly in other areas of high vector concentration. There is a possibility for an outbreak in Thailand, considering that it is located in a tropical region populated with the vector like in Brazil. In order to plan and prepare for counter-control measure, it is important to study the previous cases. Hence, the people epidemic model using a susceptible-exposed-infectious-treatment-removed ($S_hE_hI_hT_hR_h$) framework and mosquito epidemic model using susceptible-exposed-infectious ($S_vE_vI_v$) framework are developed from the model of French Polynesia outbreak. Several parameters are estimated from the available data in Brazil outbreak. Regarding control measure, the control functions for these strategies; vector elimination, vector-to-human contact reduction, and human-to-vector contact reduction are introduced into the system. The optimal control model is proposed using optimal control theory, and optimality system is solved by the fourth order Rung-Kutta scheme. Consequently, the numerical results with control and without control models are shown and discussed.

Keywords: Zika virus, epidemic model, parameter estimation, optimal control, pontryagin's maximum principle, numerical simulation

*Corresponding author

An Impulsive Mathematical Model of Bone Formation and Resorption: Effects of Prolactin and Parathyroid Hormone Supplement

Inthira Chaiya[1],Chontita Rattanakul[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Commission on Higher Education, Bangkok 10400, Thailand
aonseni@gmail.com; chontita.rat@mahidol.ac.th

Abstract

In this paper, an impulsive mathematical model accounted for the effects of prolactin and the impulsive treatment of parathyroid hormone on the number of active osteoclasts (bone resorbing cells) and the number of active osteoblasts (bone forming cells) is developed. The model is then analyzed in terms of its stability and permanence both theoretically and numerically. Conditions on the system parameters are then derived so that the stability and permanence of the system are assured.

Keywords: bone resorption, bone formation, prolactin, parathyroid hormone, impulsive treatment, mathematical model

*Corresponding author

Modelling of Bone Remodeling Process: Effects of Parathyroid Hormone, Calcitonin and Impulsive Estrogen Supplement

Inthira Chaiya[1],Chontita Rattanakul[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Commission on Higher Education, Bangkok 10400, Thailand
inthira.cha@student.mahidol.ac.th; chontita.rat@mahidol.ac.th

Abstract

In this paper, we propose an impulsive mathematical model accounting for the number of active osteoclastic cells and the number of active osteoblastic cells based on the effects of parathyroid hormone and calcitonin with impulsive estrogen supplement. The model is then analyzed theoretically in terms of its stability and permanence. Numerical simulations are also carried out in order to support our theoretical predictions.

Keywords: bone remodeling process, calcitonin, parathyroid hormone, estrogen, impulsive treatment, mathematical model.

*Corresponding author

A Study of a Mathematical Model for Commodities

Nattiya Chaiyapo[1],Nattakorn Phewchean[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
nattiya.chi@student.mahidol.ac.th, nattiya.art@gmail.com; nattakorn.phe@mahidol.ac.th

Abstract

In commodity modelling, mean reversing process is widely seen and Ornstein Uhlenbeck process is the most popular to use in modelling. We focus on commodity market in Thailand since Thailand is an outstanding agricultural country and a major exporter in the world. This study derives an Ornstein Uhlenbeck process to evaluate commodity convenience yield. We discuss the estimation of parameters in various techniques subject to difficulty of estimating the speed of mean reversion parameter in the model. We derive the most appropriate parameter for the model suitable in the Thai commodity market.

Keywords: commodity, Ornstein Uhlenbeck process, mean revering process, parameter estimation, stochastic process, time series analysis

*Corresponding author

Modeling the Spread of Capripoxviruses in Goats and Sheep

Farida Chamchod[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, CHE, Bangkok 10400, Thailand
farida.cha@mahidol.ac.th

Abstract

Capripox is an important transboundary animal disease that is endemic across Africa, the Middle East, and many parts of Asia. The disease is highly infectious and considered to be a major obstacle causing significant economic loses to many agriculture areas. In this study, I present a mathematical model that describes the transmission dynamics of capripoxviruses among a ruminant population based on two transmission modes, direct contact and insect bites. The overall goals here are to identify important predictors for the enzootic maintenance and to find the optimal ways to control the disease spread via vaccination when seasonal forcing is taken into account. The presented model covers the compartmental model, seasonal term for the vector population, scenario-based results, and optimal control.

Keywords: capripoxviruses, livestock disease, optimal control, seasonal forcing

*Corresponding author

Numerical Simulation of Particle Mixing in Vertical Silo Using Finite Element Method

Akapak Charoenloedmongkhon[1], Wannika Sawangtong[1*], Nathnarong Khajohnsaksumeth[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand; Centre of Excellence in Mathematics, Bangkok 10400, Thailand
akapak.math@gmail.com; wannika.saw@mahidol.ac.th; Nathnarong.kha@mahidol.ac.th

Abstract

Many productive industries such as pharmaceutical, paper, plastics, ceramics and rubber industries involve many granular processes including mixing, filling and discharging of granular material in silos. A number of mathematical models have been proposed to study the flow behavior of granular material in these processes and the results obtained from these models give the basic understanding of silo design and flow pattern of granular material in silo. Today, productive industries are looking for their silo design so as to achieve operational efficiency and to reduce downtime as well as the energy consumption. In this paper, we study the flow behavior of granular mixing on the silo with internal insert. Numerical simulation based on Finite Element Method is utilized to deal with optimization design of silo and determine the quality of granular mixing.

Keywords: granular material, silo, mixing process, mathematical model, finite element method

*Corresponding author

Conditional Linearization of the Quintic Nonlinear Beam Equation

Nuntawan Sripana[1], Waraporn Chatanin[2]

[1]Faculty of Liberal Arts, Rajamangala University of Technology Tawan-Ok : Chakrabongse Bhuvanarth Campus, Bangkok 10400, Thailand
n.sripana@gmail.com
[2]Department of Mathematics, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
waraporn.chat@kmutt.ac.th

Abstract

In this paper, the linearization of the third order ordinary differential equations which are the transformed equations of the quintic nonlinear beam equation is presented. First of all, the third order ordinary differential equations can be linearized if its coefficients satisfied the conditions of the linearization theorem. So, the conditions for linearization are investigated. After that, the linearizing transformation is defined and finally the linear third-order equations are obtained. Moreover, after calculating the solutions of linear third-order equations and substituting the original variables to the solutions, the exact solutions of the equations of motion are obtained.

Keywords: conditional linearization, quintic nonlinear beam equation, nonlinear ordinary differential equations

Red Blood Cell Counting by Using Video Processing with OpenCV

Parin Sungkata[1], Meechoke Choodoung[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
meechoke.chu@mahidol.ac.th

Abstract

The traditional method of red blood cell counting involves counting observed red blood cells slide under the microscope manually. The result of this method depends on the laboratory technician's experience. In this paper, we develop the automated red blood cell counting prototype software by using video processing based on the algorithms and commands in open-source OpenCV. The output of this project shows that the developed software can be used to detect red blood cells effectively not only in a single image from a slide, but also in real time videos.

Keywords: red blood cell, opencv, image processing, video processing, C++, open source, circle detection

*Corresponding author

Characterization of Clustering Coefficient for Signed Weighted Gene Co-Expression Network

Chidchanok Chornkrathok[1], Apichat Suratanee[2], Teerapong Buaboocha[3], Supachitra Chadchawan[4], Kitiporn Plaimas[1*]

[1]Department of Mathematics and Computer Science, Chulalongkorn University, Bangkok 10330, Thailand
chonkrathhok chid@hotmail.com; kitiporn.p@chula.ac.th
[2]Department of Mathematics, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, 10800, Thailand
apichat.s@sci.kmutnb.ac.th
[3]Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
teerapong.b@chula.ac.th
[4]Department of Botany, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
s_chadchawan@hotmail.com

Abstract

Clustering coefficient is a measure of node local density in network topology analysis by computing a proportion of existing edges and all possible edges connecting among neighbors of a certain node. High value of clustering coefficient of a node means that this node is located in a densely connected network of its neighbors. Clustering coefficient of a simple graph has been applied in many network applications, including both social networks and biological networks. However, in general, a real-world network captured a lot of information that signs and weights can be included into the analysis. Calculating this measure with this condition is under consideration in interpreting the meaning of signed weights, based on the applied problems. Recently, a formula of this measure for signed weighted network has been proposed to combine all positive and negative edges into the calculation. Thus, here the characteristics and the properties of this measure were applied to analyze gene expression data set with two stages of the expression changes. Gene co-expression networks were constructed based on the expression level correlation with having either positive or negative values. The results showed that the comparison of this measure to the other established clustering coefficients gave high correlations and the efficiency in distinguishing two stages of the expression levels. This methodology can be used to predict a set of crucial genes in the specific treatment condition.

Keywords: clustering coefficient, signed weighted network, gene expression

*Corresponding author

Detection of Multiple and Partially Occluded Humans Based on Adaptive Background Subtraction and Improved Histogram of Oriented Gradients

Shayhan A. Chowdhury[1],Kaushik Deb[1*]

[1]Department of CSE, Chittagong University of Engineering & Technology (CUET), Chittagong 4349, Bangladesh
shayhan@yahoo.com; debkaushik99@cuet.ac.bd

Abstract

Human detection in a video surveillance system has vast application areas including suspicious event detection and human activity recognition. In the current environment of our society suspicious event detection is a burning issue. For that reason, this paper proposes a framework for detecting humans in different appearances and poses by generating a human feature vector. Initially, every pixel of a frame is represented as an incorporation of several Gaussians and use a probabilistic method to refurbish the representation. These Gaussian representations are then estimated to classify the background pixels from foreground pixels. Shadow regions are eliminated from foreground by utilizing a Hue-Intensity disparity value between background and current frame. Then morphological operation is used to remove discontinuities in the foreground extracted from the shadow elimination process. Image correlogram is used to label objects within a group. After that, the framework generates ROIs by determining which of the foregrounds represent human by considering conditions related to human body. Finally, features are extracted from ROI for classification. A feature descriptor, improved histogram of oriented gradients (ImHOG) is proposed to alleviate the limitation of Histogram of Oriented Gradients (HOG).Various videos containing moving humans are utilized to test the proposed framework and acquired an over 94% human object detection rate. The proposed framework detected humans from continuous frame sequences with higher adaptability and precision.

Keywords: background subtraction, histogram of oriented gradients, human detection, occlusion handling, shadow elimination

*Corresponding author

Mathematical Modeling of Porcine Reproductive and Respiratory Syndrome Incorporating Decaying Infectiousness and Periodic Inoculation

Nattawan Chuchalerm[1], Yongwimon Lenbury[1*], Puttida Matkhao[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
nattawanc13@gmail.com; scylb@yahoo.com ; puttida_m@outlook.co.th

Abstract

The porcine reproductive and respiratory syndrome (PRRS) is a well-known epidemic disease, causing large economic losses in the swine industry. High rates of morbidity from this infectious disease in swine farms could cause severe financial crisis to the countries with swine industries as a whole. It is therefore crucial that all efforts are brought to bear to discover as much as possible about the disease, to predict its progress as well as discover optimal prevention and control strategies. In this endeavor, mathematical models of the disease are needed to study the behavior of the disease and control strategies. Here, we construct a mathematical model which incorporates decaying infectiousness and the effect of periodic inoculation to prevent the spread of the disease. We investigate the dynamic behavior of the model system and carry out a stability analysis. Our theoretical results are able to shed some light onto the effect of periodically inoculated on the management and control of the spread of the disease in the swine population.

Keywords: porcine reproductive and respiratory syndrome, periodic inoculation, stability, impulsive differential equations

*Corresponding author

Combined Pressure-Driven Electroosmotic Flow Through an Elliptic Cylindrical Microchannel

Pearanat Chuchard[1],Somsak Orankitjaroen[2],
Benchawan Wiwatanapataphee[3]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
pearanat.chu@student.mahidol.ac.th
[2]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
somsak.ora@mahidol.ac.th
[3]Department of Mathematics and Statistics, Faculty of Science and Engineering, Curtin University, Perth,
WA 6845, Australia
b.wiwatanapataphee@curtin.edu.au

Abstract

Combined pressure-driven electroosmotic flow induced by time-periodic pressure gradient and external electric field on an electrolyte fluid through an elliptic cylindrical microchannel under the Navier slip condition is considered. The incompressible Navier-Stokes equations coupled with the electroosmotic body force are solved analytically in the elliptic cylindrical coordinate system in terms of Mathieu function. We further present the effect of the electrical double layer, the slip length, and the external electric field on the flow pattern. This study will advance the understanding of combined pressure-driven electroosmotic flow which helps in the development of microfluidic devices such as lab-on-a-chip, micromixer, and drug delivery system.

Keywords: electroosmotic flow, time periodic pressure gradient, Navier slip condition, elliptic cylindrical channel, microchannel

Approximate Solution of Variable-Order Linear Cable Equations with Shifted Third Kind Chebyshev Polynomials

Mehrdad Dadkhah Tirani[1],Leili Masoudi[2],Majid Tavassoli Kajani[2]

[1]Department of Accountancy, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
mdadkhah@khuisf.ac.ir

[2]Department of Mathematics, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
leili.massoudi92@gmail.com; mtavassoli@khuisf.ac.ir, tavassoli_k@yahoo.com

Abstract

In this paper, we apply third kind Chebyshev polynomials to solve variable-order linear cable equations. First, we convert third kind Chebyshev polynomials on the interval $[-1, 1]$ into $[0, R]$. Then we reduce variable-order linear cable equation to a set of algebraic equations by using third kind shifted Chebyshev polynomials and collocation method. To obtain an approximate solution of the linear cable equation, we should solve this algebraic system. The results demonstrate that the proposed method has high accuracy and effectiveness for solving the variable-order linear cable equations. The validity and effectiveness of the method are demonstrated by solving several numerical examples.

Keywords: collocation, third kind Chebyshev polynomials, variable-order linear cable equations

Stability and Sensitivity Analysis of a Time-Delay HIV/AIDS Epidemic Model with Treatment

Rachadawan Darlai[1],Elvin J. Moore[2]

[1]Faculty of Science, Energy and Environment, King Mongkut's University of Technology North Bangkok (Rayong Campus), Rayong 21120, Thailand
rachadawan.d@sciee.kmutnb.ac.th
[2]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400,Thailand
elvinmoo@gmail.com

Abstract

A mathematical model of the HIV/AIDS epidemic is studied that separates the total population into five compartments: a susceptible population, an HIV+ population, a population with AIDS that is not receiving ARV treatment, a population with AIDS that is receiving treatment and a population that is effectively immune from infection because of their lifestyle. The model includes a time delay between an individual becoming HIV+ and becoming infectious. The stability of the disease-free and endemic equilibria are analyzed and formulas are derived for the sensitivity of the equilibria with respect to changes in parameter values. Numerical simulations are carried out to support the analytical results.

Keywords: HIV/AIDS model, ARV treatment, basic reproductive number, stability, sensitivity analysis

The Effect of Irradiance Related Temperature on Microalgae Growth in a Tubular Photobioreactor

Ujjwal K. Deb[1],M Shahriar[2]

[1]Department of Mathematics, Chittagong University of Engineering and University, Chittagong 4349, Bangladesh;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
ukdeb03@gmail.com
[2]Department of Mechanical Engineering, Chittagong University of Engineering and University, Chittagong 4349, Bangladesh
tanim0907@gmail.com

Abstract

In microalgae based biofuel technology, the light is one of the important factors for the proper growth of microalgae cells as microalgae is a photosynthetic microorganism. For a large scale outdoor culture the irradiance of sunlight and associated temperature are also needed to be considered. In this study our aims to present computational model of microalgae growth taking into account the effect of solar irradiance and corresponding temperature in a tubular photobioreactor for an outdoor culture system. We consider the transient behaviour of temperature inside the photobioreactor for a microalgae culture. The optimum range of temperature for outdoor cultivation of microalgae is about 22-27^{0}c and out of this range the microalgae cell growth inhibited. Many correlations have already been established to investigate the heat transfer phenomena inside a tubular PBR. However, none of them are validated yet numerically by using a user defined function in a simulated model. A horizontal tubular PBR of length 20.5m with radius 0.05m has been taken into account to investigate the temperature effect for the growth of microalgae cells. As the solar irradiance varies at any geographic latitude for a year so an empirical relation is established between irradiance and temperature to simulate the effect. We observed some significant effects of temperature on the growth of microalgae. Moreover, for the maximum growth of the cells we should control the surrounding temperature as well.

Keywords: microalgae, biofuel, photobioreactor, solar irradiance, temperature, simulation

On Derived Category of U-Complexes

Gustina Elfiyanti[1]*,Intan Muchtadi-Alamsyah[1]

[1]Department of Mathematics, Institut Teknolog Bandung, Ganesha 40132, Indonesia;
Algebra Mathematics Research Group, Department of Mathematics, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung (ITB), Bandung, Indonesia
gustina.elfiyanti@uinjkt.ac.id; ntan@math.itb.ac.id

Abstract

One of a generalization of chain complexes of modules is chain U-complexes which subtitute kernel with any submodules U. This notion was introduced by Davvaz and Shabani-Solt in 2002 to make some generalizations in homological algebra. Using their results, we defined the category of U-complexes and homotopy category of U-complexes. In this paper, we introduce the derived category of U-complexes and we show that this category is a triangulated category.

Keywords: chain U-complexes, derived category of U-complexes, triangulated category

*Corresponding author

Extreme Value Distributions Class and Applications in Hydrological Analysis and Risk Management

Duong Ton Dam[1],Huynh To Uyen[2],Duong Ton Thai Duong[3]

[1]Department of Mathematics, Information Technology University, Vietnam National University, Ho Chi Minh City, VietNam
damdt@uit.edu.vn

[2]Department of Economic Mathematics, Economics and Law University, Vietnam National University, Ho Chi Minh City, VietNam
uyenht@uel.edu.vn

[3]Department of Academic Affairs, Vietnam National University, Ho Chi Minh City, VietNam
dttduong@vnuhcm.edu.vn

Abstract

Extreme Value distributions is an important distribution class in probability theory, so many researchers concern about its characteristics especially the domain of attraction and the correlation with other random distribution classes. Based on the definition of slowly varying function, this paper aims at giving the necessary and sufficient conditions for a random distribution to belong to the domain attraction of Extreme Value distribution–subclass of a stable distribution. This research illustrates the applications of Extreme Value distribution in analysis, forecasting hydrology such as peak salinity in Ca Mau Peninsula–Viet Nam; and risk management in finances and economics.

Keywords: extreme value distributions, stable distribution, slowly varying function, domain of attraction, peak salinity, risk management

Guaranteed Cost Control of Exponential Synchronization of Delayed Complex Dynamical Networks with Hybrid Uncertainties Asymmetric Coupling Delay

Prem Junsawang[1],Thongchai Botmart[1]

[1]Department of statistics, Khon Kaen University, Khon Kaen, 40002, Thailand
prem@kku.ac.th; thongbo@kku.ac.th

Abstract

In this paper, the problem of guaranteed cost control for exponential synchronization for delayed complex dynamical network with mixed time-varying uncertainties asymmetric coupling delays, which is composed of constant coupling, discrete time-varying delay coupling and distributed time-varying delay coupling is considered. The constraint on the derivative of the time-varying delay is not required which allows the time-delay to be a fast time-varying function. For this problem, a decentralized guaranteed cost hybrid feedback controller is designed to achieve exponential synchronization of delayed complex dynamical network. Based on the construction of improved Lyapunov-Krasovskii functional is combined with Leibniz-Newtons formula and the technique of dealing with some integral terms by Wirtinger's inequality. New synchronization criteria is given in terms of LMIs which can be solved efficiently by standard convex optimization algorithms. A numerical example is also given to illustrate the effectiveness of the proposed method.

Keywords: exponential synchronization, delayed complex dynamical network, uncertainties asymmetric coupling, hybrid feedback control

Forbidden Subgraphs for Graphs of Given Metric Dimension

Shreedhar K[1*],Sooryanarayana B[2]

[1]Department of Mathematics, KVG College of Engineering, Kurunjibagh, Sullia, India
shreedharkvgce@gmail.com
[2]Department of Mathematical and Computational Sciences, Dr Ambedkar Institute of Technology, Bengaluru, Karnataka, India
dr_bsnrao@hotmail.com

Abstract

It is necessary to determine a collection of vertices in a given graph at which the detection device can be placed so that if there is any object at any vertex in the graph, it can be detected and its position is uniquely identified. This concept motivated for the investigation of the graph invariant called metric dimension. A set of vertices S of a graph G resolves the graph if every vertex is uniquely determined by its vector of distances to the vertices in S. The metric dimension of G is the minimum cardinality of a resolving set of G. A resolving set with the minimum cardinality is called a metric basis. The vertices of a metric basis are called land marks. In this paper we obtain forbidden subgraphs for graphs of given metric dimension and Khuller type results on metric dimensions.

Keywords: metric dimension, landmarks, graph, subgraph, resolving set

*Corresponding author

A Numerical Investigation on Adaptive Shape Parameter Schemes in a Meshfree Method Applied to Convection-Diffusion Problems

Sayan Kaennakham[1],Nissaya Chuathong[1]

[1]School of Mathematics, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
sayan-kk@g.sut.ac.th; c.nissaya@gmail.com

Abstract

It is known that all RBF-based meshfree methods suffer from a lack of reliable judgement on the choice of shape parameter, appearing in most of the RBFs. Several attempts have been proposed and tested with specific classes of PDEs and their effectiveness has been widely documented. Nevertheless, it has not well been agreed on which choice remains optimal. Therefore, it is pretty much up to and very often down to the 'ad-hoc' decision of the user. Our main task in this work is to numerically investigate the quality of each adaptive RBF-shape parameter approach by applying them to the same type of problem, convection-diffusion class. The classical RBF-collocation Kansa meshless method is modified as well as the solutions quality is carefully monitored in different aspects; matrix condition number, the rate of convergence, and CPU-time spent. The information gathered and presented in this work shall be useful for the future users in making decision as well as will provide useful guide to further invent another potential shape adaptive approaches.

Keywords: RBF-collocation methods, adaptive shape parameter, convection-diffusion problems

Computational Fluid Dynamics of Abrasive Water Jet Design

Mongkol Kaewbumrung[1],Panumas Arundachawat[2],Thitiwat Suebsuwong[2]

[1]Department of Mechanical Engineering, Pathumthani University, Pathumthani 12000, Thailand
mongkol.kaewbumrung@gmail.com
[2]Department of Aerospace Engineering, Kasetsart University, 50 Phaholyothin Rd., Ladyao, Jatujak, Bangkok, 10900, Thailand
fengpma@ku.ac.th; fengttw@ku.ac.th

Abstract

The aim of this study is to investigate relationships between a Wall Shear Stress (WSS) and the flow field interacting between the water jet surrounded by air. The nozzle dimensions, water mass flow rate, its height from surface and inclined angle are the observed variables. This fluid flow problem is considered as two-dimensional multiphase turbulence incompressible flow at a steady and unsteady state conditions. The set of governing equations of multiphase fluid include Navies-Stoke Equation, the Continuity equation, the Momentum equation and the k-ω SST Transport equations of two phase turbulent flows are carried out based on Finite Volume Method (FVM). The computational results showed that the inlet pressure and the height of nozzle from surface are effect to wall shear stress The relationship between the nozzle angle and the maximum wall shear stress is proportional correlated each other at the interacted position.

The results of this study will complete the database which is useful for developing equipment or machines required WSS. As a result, this study is the crucial activity in an industrial product development life cycle.

Keywords: multiphase flow, water jet, finite volume,wall shear stress

Hematocrit Changes due to Dengue Infection in Blood Flow Model

Meta Kallista[1],Nuning Nuraini[1],Agus Y. Gunawan[1],Edy Soewono[1]

[1]Industrial and Financial Mathematics Group, Department of Mathematics, Institut Teknologi Bandung, Bandung 40132, Indonesia

meta.kallista@gmail.com; nuraini@math.itb.ac.id; aygunawan@math.itb.ac.id; esoewono@math.itb.ac.id

Abstract

Dengue virus infection can end in fatality if the infected human are not treated properly and quickly. One of the parameters that can detect the stage of fatality from dengue infection is the hematocrit value. In dengue infection cases, hematocrit value changes because of many factors. For example, virus can disturb platelet production in the bone marrow, the vessel wall is damaged because of the immune response to control the viral infection leading to exudation of blood plasma, and so on. In this paper, a mathematical model for hematocrit changes in dengue virus is shown. Using the relation between hematocrit and viscosity, we implement the viscosity changes due to Dengue Fever infection to the blood flow model. The interesting part is to understand blood velocity profile because of viscosity changes due to dengue infection.

Keywords: blood flow, dengue fever, hematocrit, model, viscosity

The Impact of Climate Cycle (El Nino and La Nina) in Rice Production in Thailand

Jittranuch Kitkla[1],Phatcharee T. Thongrattana[1],Puntip Toghaw[2*]

[1]Department of Industrial Engineering , Kasetsart University, Bangkok 10900, Thailand
jittranuchkit@gmail.com; fengprt@ku.ac.th
[2]Department of Mathematics, Kasetsart University, Bangkok 10900, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
fsciptt@ku.ac.th

Abstract

A climate cycle in this research is El Nino and La Nina phenomenon (El Nino/Southern Oscillation: ENSO) in the Pacific Ocean with a global impact on weather patterns. During El Nino phenomenon, some parts in world such as Southeast Asia are experiencing severe droughts unusually, while some parts in the world such as India Peninsular are facing more frequent rain than normal year. Although, a variety of tools and techniques are used to monitor and forecast ENSO and its impact on weather patterns, in last decade, climate change and global warming influence ENSO has been happened more frequently and stronger effect. Climate directly and indirectly affects most agricultural and socio-economic systems, including land-use planning, level of agricultural yield, consistency in yield and agricultural infrastructure. Especially in Thailand, the rice production is primarily dependent on rainfall and highly vulnerable to climate uncertainty. El Nino phenomenon leads to drought year in Thailand and may cause to decrease rice yield. La Nina can bring a wet year to Thailand and increase rice yield when there are a plenty of rainfall during rice cultivation. However, flooding can happen and damage rice acreage. Thus, this research is to study the impact of El Nino and La Nina phenomenon measured in term of the Oceanic Nino Index (ONI) to rice output and rice acreage in Thailand including central, north, northeast and south area. The main and second rice crops are considered in this study. The result shows that the level of ENSO affect rice output and rice acreage of both main and second rice crop in north and northeast area. Meanwhile, central and south area do not significantly effect to those rice.

Keywords: El Nino and La Nina, climate change, Thai rice yield

*Corresponding author

Characterizing Network Topology of Disorder Proteins in Protein Interaction Networks

Satanat Kitsiranuwat[1],Kitiporn Plaimas[1],Apichat Suratanee[2]

[1]AVIC research center, Department of Mathematics and Computer Science, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
Satanat.K@student.chula.ac.th, kit.satanat@gmail.com; kitiporn.p@chula.ac.th
[2]Department of Mathematics, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
apichat.s@sci.kmutnb.ac.th

Abstract

Protein-protein interaction (PPI) network provides fundamental information for understanding complex biological processes. By analyzing topological structures of the PPI networks, several studies have revealed several important structural features. One of the most commonly studied structures is a scale-free structure. By definition, a scale-free network is a network whose degree distribution follows the power law distribution. Thus, it is characterized by the presence of small numbers of hubs. In the PPI, it had been known that intrinsic structural disorder of proteins is a distinctive and common characteristic of hub proteins. However, the relationship between disorder proteins and hub proteins in the network is still unclear. In this work, we first investigated the role of disorder proteins in term of network topological features and structures. The PPI network was constructed by using a curated database with high confident interaction scores. After that, network properties, such as centrality measures, clustering coefficient and node degrees, of disorder proteins and non-disorder proteins were compared. The test of a scale-free structure by discarding a protein was then performed. Finally, the result shows that the disorder proteins affect topological properties of the PPI networks as expected. Moreover, most of the disorder proteins were related with crucial diseases such as cancer and cardiovascular disease.

Keywords: protein-protein interaction (PPI) network, disorder protein, scale-free network

Numerical Treatment of a Three-Dimensional Multi-Sources Air Pollutant Dispersion Model in an Industrial Area with Various Atmospheric Stability Classes

Sureerat A. Konglok[1],Nopparat Pochai[2]

[1]Department of Mathematics, Sukhothai Thammathirat Open University, Nonthaburi , Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
sureerat.kon@stou.ac.th, sakonglok@yahoo.com
[2]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
konoppar@kmitl.ac.th

Abstract

The air pollutants emitted from industrial plants are considered one of the major causes of the typical air pollution problem. A mathematical model for describing the dispersion of the air pollutants released from the source into the atmosphere is examined. A numerical approximation using the three dimensional fractional step method is applied based on the discretization of the time dependent atmospheric advection-diffusion equation. The diffusion coefficients are supplied by the meteorological station. The concentration of the pollutants at the source is assumed to be a δ-function, which gives rise to a steady emission rate of pollutants. The resulting model is solved for the test problem with the range of parameters in the Pasquill's stability classes. The fractional step method is used to solve the dispersion model. This paper proposes a fractional step method so as to make the model simpler without any significant loss of computational efficiency. The results obtained indicate that the proposed experimental variations of the atmospheric stability classes and wind velocities do affect the air quality around the industrial areas.

Keywords: finite differences, atmospheric diffusion equations, air-quality model, fractional step method

Analysis of a Three-Compartment Model for the Signal Transduction Pathway under Signal Amplification Delay

Jutarat Kongson[1],Somkid Amornsamankul[2],Yongwimon Lenbury[2]

[1]Department of Mathematics, Burapha University, Chonburi 20130, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
jutarat.kongson@gmail.com
[2]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
somkid.amo@mahidol.ac.th; scylb@yahoo.com

Abstract

The signal transduction pathway is the important process of communication of the cells. It is the dynamical interaction between the ligand-receptor complexes and an inhibitor protein in second messenger synthesis. The signaling molecules are detected and bound by receptors, typically G-Protein receptors, across the cell membrane and that in turns alerts intracellular molecules to stimulate a response or a desired consequence in the target cells.

In this research, we consider a model of the signal transduction process consisting of a system of three differential equations which involve the dynamic interaction between an inhibitor protein and the ligand-receptor complexes in the second messenger synthesis. We will incorporate a delay τ in the time needed before the signal amplification process can take effect on the production of the ligand-receptor complex.

Letting $R(t)$ be the density of the ligand bound receptor, $C(t)$ the concentration of the second messenger or cAMP and $I(t)$ the density of inhibitor protein, the system model can be written in the following form.

$$\frac{dR}{dt} = -b_1 R - \frac{a_1 R}{a_2 + R} + a_3 C, \tag{1}$$

$$\frac{dC}{dt} = -b_2 C + \frac{a_4 R^2(t-\tau)}{(a_5 R(t-\tau) + I)^2} + a_6, \tag{2}$$

$$\frac{dI}{dt} = -b_3 I + a_7 R \tag{3}$$

where the first term of eq.(1)-(3) are the removal rates of the corresponding state variables. The second term of eq.(1) is the rate that R is internalized through the cell membrane. The third term of eq.(1) is the signal amplification arising from the synthesis of cAMP. The second term of eq.(2) is the amplification effect on the production of the ligand-receptor complexes due to the secondary hormone with a delay τ. The third term of eq.(2) is the zero order production rate and the second term of eq.(3) is the production rate of the inhibiting protein in response to the increase in the ligand-receptor complexes.

In this study, we investigate persistence and stability of the system. It is shown that the system allows positive solutions and the positive equilibrium is locally asymptotically stable under suitable conditions on the system parameters.

Keywords: signal transduction pathway, persistence, locally asymptotically stable, ligand-receptor, inhibitor protein, second mesenger

Model Predictive Control of an HBV Model

Hee-Dae Kwon[1]

[1]Department of Mathematics, Inha University, South Korea
hdkwon@inha.ac.rk

Abstract

In this talk, we consider a guideline for efficient drug treatment strategies for hepatitis B virus (HBV) infection. We introduce and analyze a mathematical model that describes the HBV infection during antiviral therapy. The reproduction number R_0 is determined. The local/global stability of virus-free steady state is investigated. We formulate a control problem which minimizes the viral load as well as treatment costs. In order to reflect the status of patients not only at the initial time but also at the follow-up visits, we consider the model predictive control based on ensemble Kalman filter and differential evolution. The ensemble Kalman filter is employed to estimate full information of the state from incomplete observation data. We derive piecewise constant drug schedule applying techniques of differential evolution algorithm. Numerical simulations are performed using various weights in the objective functional to suggest optimal treatment strategies in different situations.

Keywords: feedback control, HBV, model predictive control, ensemble Kalman filter, differential evolution method

Role and Scope of the National Research Council: Past, Present and Future

Yongwimon Lenbury[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
yongwimon.len@mahidol.ac.th

Abstract

The role of the National Research Council in its support of research and development in Thailand will be briefly reviewed both in the past and the present. Its possible role in the future while facing the organizational changes and upheavals will also be discussed.

Keywords: (n/a)

Indigenous Mathematical Methods for Learning Success

Michael Little Crow[1]

[1]Department of Mathematics, Scottsdale Community College, Scottsdale Community College, United States of America;
OPEN Global Village, Original Peoples' Education Network, Inc., Phoenix, AZ, USA
michael.little.crow@scottsdalecc.edu

Abstract

This presentation will explore indigenous mathematical methods of learning used in various original societies. Activities which have brought about learning success by incorporating the languages and cultures of Native American peoples will be presented and explored through an interactive, hands-on presentation.

Learning Outcomes Activities which build and develop cultural competence will be explored which includes: building a understanding of the rationale for cultural awareness and competence when teaching native students; historical and cultural norms within Indigenous societies; and methods of enhancing math instruction for Native students, including alternative instruction methods such as kinesthetic activities which connect learning to tribal norms and create a supportive learning environment.

Focus on Math Participants will review and work through various lesson activities which will allow them to experience alternative methods of instruction which have been developed through decades of work which integrates Oral Traditions, Indigenous Knowledge Systems, community based consensus building, Local Wisdom, and Western Models of Academic research

Keywords: indigenous math, vedic math, math education, local wisdom

New Log-Likelihood Estimation Function

Inpong Luanglath[1]

[1]Bangkok University International College (BUIC), Rama 4, Klong Toey, Bangkok 10110, Thailand
Lecturepedia@gmail.com

Abstract

The objective of this paper is to provide a New Log-Likelihood Estimator (NLLE) function as a tool for value approximation. The current Maximum Likelihood Estimation (MLE) function lacks precision. We modified log MLE in two steps in order to reduce the inaccuracy between the arithmetic mean and the expected value. The proposed NLLE consists of two steps: (i) determine the log likelihood of a random variable X, and (ii) adjust the estimate by a factor of 1/(n-1)(ln L(X). In-Sample testing was accomplished by using daily indices over a period of 6 months from 10 major stock markets: NASDAQ, DOW, SP500, CAC40, FTSE, DAX, Heng Seng, Shanghai, KOSPI and Nikkei. Out-of-sample data were used for confirmatory verification; out-of-sample data came from another six months of daily indices of the same markets. Relevant tests used to compare the results of the proposed NLLE include Cramer-Rao Lower Bound (CRLB), Likelihood Ratio Test, Wald statistic, and Lagrange Multiplier (Score Statistic). It was found that NLLE is more efficient than the conventional MLE. The proposed NLLE function could achieve as high as 99% accuracy in estimating the expected value for a random variable. This novel approach is a contribution to the field. It gives practitioners a better tool for value estimation. The proposed NLLE function has practical applications in many fields of natural and social sciences.

Keywords: Cramer-Rao Lower Bound (CRLB), maximum likelihood estimator (MLE), Monte Carlo, Lagrange multiplier (Score Statistic), likelihood ratio test, log likelihood estimator (LLE), Wald statistic

Exploring Teachers' Mathematical Knowledge in Teaching about Fractions in the Context of Lesson Study and Open Approach

Chompoo Lunsak[1],Narumon Changsri[1],Maitree Inprasitha[1]

[1]Department of Mathematics Education, Khon Kaen University, Khon Kaen 40002, Thailand;
Centre for Research in Mathematics Education, Khon Kaen 40002, Thailand
chompoo_lunsak@hotmail.com; changsri_crme@kku.ac.th; inprasitha_crme@kku.ac.th

Abstract

This study aimed to explore teachers' mathematical knowledge in teaching about fractions in the context of lesson study and open approach. A translated and adapted version of mathematical knowledge for teaching about fractions test was used to gather data on teachers' mathematical knowledge in teaching about fractions collected from 64 fourth-grade mathematics teachers from 50 project schools of lesson study and open approach. Descriptive statistics analysis on teachers' mathematical knowledge in teaching about fractions revealed that the lowest, average, and highest scores were 2, 7.05, and 11.5 respectively from the total score of 18 points. The majority of the participants (68.5 percent) gave correct answers about Knowledge of Content and Teaching (KCT) which described students' idea to represent 1/3 and most of their incorrect answers (95.7 percent) were about Specialized Content Knowledge (SCK) that asked for the meaning of unit fraction and identification the unit fraction.

Keywords: mathematical knowledge for teaching, fraction, lesson study and open approach

On Size Multipartite Ramsey Numbers for P_3 Versus Star Forests

Anie Lusiani[1],Edy Tri Baskoro[1],Suhadi Wido Saputro[1*]

[1]Combinatorial Mathematics Research Group, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Bandung, Indonesia
anielusiani@students.itb.ac.id; ebaskoro@math.itb.ac.id; suhadi@math.itb.ac.id

Abstract

For simple graphs G and H, the size multipartite Ramsey number $m_j(G, H)$ is the smallest natural number t such that any arbitrary red-blue coloring on the edges of $K_{l\times t}$ contains a red G or a blue H as a subgraph. There have been studied about $m_j(G, H)$ if G is a star or a homogeneous star forest and H is a path. In this paper, we determine the size multipartite Ramsey numbers $m_j(P_3, G)$ if G is a heterogeneous star forest, for $j = 2$ or 3 and P_3 is a path of order 3.

Keywords: path, size multipartite Ramsey number, star

*Corresponding author

An Upper Curve Length Estimate Given Total Curvature and Circumradius

Mantana Chudtong[1],Chaiwat Maneesawarng[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand; Centre of Excellence in Mathematics, Commission on Higher Education, Si Ayutthaya Rd., Bangkok 10400, Thailand
mchudtong@gmail.com; chaiwat.man@mahidol.ac.th

Abstract

With the use of Reshetnyak's fan construction technique, a sharp upper bound of the length of a curve in terms of its total curvature and the radius of a closed ball containing it is extended from the Euclidean space to CAT(K) spaces. The configurations of curves that render the maximum length, which exist in standard spaces of constant curvature, are completely identified for a given pair of total curvature and circumradius. It is interesting that in spaces of negative constant curvature, maximizers for large total curvatures and large circumballs are polysegments, which are maximizing configurations that have never been seen.

Keywords: CAT(K) space, length estimate, total curvature

*Corresponding author

Modeling Porcine Reproductive and Respiratory Syndrome Incorporating Decaying Infectiousness and Delayed Infection Incidences

Puttida Matkhao[1], Yongwimon Lenbury[1*], Nattawan Chuchalerm[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
puttida_m@outlook.co.th; scylb@yahoo.com ; nattawanc13@gmail.com

Abstract

There are many epidemic diseases in the swine population such as swine fever disease, foot and mouth disease and Aujesky's disease. One of the most important diseases in the swine industry is porcine reproductive and respiratory syndrome (PRRS). Mathematical models of the disease are needed to study its behavior effective and control strategies. Various research works on this subject cannot find out how to control the disease effectively. In this work, we study a mathematical model of PRRS infection with a time-delay incorporating infectiousness decay. We carry out a stability analysis to discover the effect of time delay on the dynamic behavior of the model. Our work is expected to form a basis for further investigation, building upon our basic model, to test the potential effectiveness of employing various intervention strategies for disease containment, such as vaccination and isolation.

Keywords: porcine reproductive and respiratory syndrome, time-delay, stability, decaying infectiousness

*Corresponding author

Statistical Modelling for Wind Direction and Velocity in Amritsar

Marzukee Mayeng[1],Prashanth Gururaja[1], Nittaya McNeil[2]

[1]Department of Mathematics and Computer Science, Faculty of Science and Technology, Prince of Songkla University, Pattani 94000, Thailand
yee0007@gmail.com; pzml@yahoo.com
[2]Department of Mathematics and Computer Science, Faculty of Science and Technology, Prince of Songkla University, Pattani 94000, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
nchirtki@gmail.com

Abstract

Wind movement on the Earths surface is both a threat that can cause enormous damage and an important renewable energy resource that can be productively harnessed on wind farms. It is thus important to understand how to analyze characteristics of winds using available data from meteorological stations. These characteristics include wind speed and direction and their variation over location and time. In this preliminary study we focus on hourly data collected over a five-year period from 2004 to 2008 at Amritsar, one of nine stations in India from which similar data are available. We use graphical displays and models to handle time-series autocorrelation, non-normality, and speed-direction association. Conclusions suggest that applying logistic regression to time-series averages in four-hourly periods for different speed-direction sectors provides an appropriate methodology, and areas under ROC curves are useful for comparing goodness-of-fit of models.

Keywords: wind movement, time-series autocorrelation, ROC curves

Mathematical Modeling of Infectious Disease Transmission in Macroalgae

Charin Modchang[1],Artorn Nokkaew[2],Somkid Amornsamankul[3], Yongwimon Lenbury[3],Busayamas Pimpunchat[4],Wannapong Triampo[1]

[1]Department of Physics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand; Centre of Excellence in Mathematics, CHE, 328, Si Ayutthaya Road, Bangkok 10400, Thailand
charin.mod@mahidol.edu; wtriampo@gmail.com
[2]Institute for Innovative Learning, Mahidol University, Nakorn Pathom 73170, Thailand
anokkaew@gmail.com
[3]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand; Centre of Excellence in Mathematics, CHE, 328, Si Ayutthaya Road, Bangkok 10400, Thailand
somkid.amo@mahidol.ac.th; yongwimon.len@mahidol.ac.th
[4]Industrial Mathematics Research Unit and Department of Mathematics, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
knbusaya@kmitl.ac.th

Abstract

Understanding the infectious diseases outbreak of algae can provide a significant knowledge for disease control and intervention. We consider here a disease caused by highly pathogenic organisms that can result in the death of algae. Even though a great deal of understanding about many diseases in algae has been reached, still the studies concerning effects of the outbreak at the population level are still rare. For this reason, we computationally model the outbreak in the algae reservoir or container systems consisting of several patches or clusters of algae being infected with a contagious infectious disease. We computationally investigate the systems as well as make some predictions via the deterministic SEIR epidemic model. We study the factors that could affect the spread of disease including the number of patches, the size of initial infected population, the distance between patches or spatial range, and the reproductive ratio. The results provide some information that may be beneficial to attempts at disease control, intervention or prevention in algae cultivation. This modeling work is believed to pave the way for more realistic model of algae cultivation.

Keywords: algae, epidemic, infectious disease, SEIR model

Numerical Computing of Preimage Domains of Canonical Slit Domains

Mohamed M. S. Nasser[1]

[1]Department of Mathematics, Statistics and Physics, Qatar University, Doha, Qatar
mms.nasser@qu.edu.qa

Abstract

Several numerical methods have been presented recently for numerical computing of conformal mapping $w = \Phi(z)$ from a given multiply connected domain G in z-plane whose boundaries are Jordan curves to canonical slit domains Ω in the w-plane. For those methods, the domain G is assumed to be known and the numerical methods are used to compute the conformal mapping Φ as well as the canonical slit domain Ω. However, for many applications of conformal mapping (e.g., in fluid dynamics), the canonical slit domain Ω is assumed to be known and the preimage domain G as well as the conformal mapping Φ are unknowns. An iterative numerical method for computing the preimage domain G as well as the conformal mapping Φ will be presented in this paper. Several numerical examples will be presented to demonstrate the efficiency and accuracy of the proposed method.

Keywords: numerical conformal mapping, generalized Neumann kernel, boundary integral equations

Shape Resonances in Radially Inhomogeneous Spheres with Negative Dielectric Functions

Umaporn Nuntaplook[1*],John A. Adam[2],Perathorn Pooksombat[3]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
umaporn.nun@mahidol.ac.th
[2]Department of Mathematics, Old Dominion University, Virginia, USA
jadam@odu.edu
[3]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
ppeeez.pp@gmail.com

Abstract

The theory of morphology-dependent resonances (MDR's) of a radially inhomogeneous sphere with negative dielectric functions is developed. MDR's can be interpreted as shape resonances. Exact analytic formulas for predicting the shape resonances are provided.

Keywords: refractive index, computational results, shape resonances, negative dielectric functions

*Corresponding author

Application of Box-Jenkins Models to the Tourist Inflow in Bhutan

Dorji Om[1],Chompunooch Thamanukornsri[1],Montip Tiensuwan[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
om_dorji@yahoo.com; chompunooch.tha@student.mahidol.ac.th; montip.tie@mahidol.ac.th

Abstract

Bhutan has now increasingly become a popular destination for many international tourists. Tourism in Bhutan is considered as one of the largest foreign earning industries. The number of tourist inflow in the country is increasing year by year. Forecasting is very necessary for administration and tourist agent for creating awareness and planning for the future development. It can also predict the future trends as accurately as possible and helps in staying one step ahead of the competition. This study aims to apply mathematical model for forecasting monthly tourist inflow from Malaysia, Singapore, China, USA, England, France, Germany, Thailand, Australia and Japan to Bhutan. The Box-Jenkins model is used to identify the parameters of autoregressive integrated moving average (ARIMA) model of monthly tourist visited data of above mentioned countries in the period 2011-2015 obtained from Tourism Council of Bhutan. An Akaike's information criterion, Schwartz's Bayesian criterion and estimate variance of white noise are used throughout to test for the identification of best fit model. Further, the periodogram analysis was used to confirm the seasonal period of the model. The results showed ARIMA model for Thai, Chinese, Malaysian and Japanese, while seasonal ARIMA for American, Australian, British, French, Singaporean and German. Further, seasonal ARIMA model was obtained as the best fit model for the overall data. These models are illustrated and could possibly forecast the monthly tourist inflow of one year ahead with acceptable accuracy.

Keywords: Akaike's information criterion, Box-Jenkins model, Schwartz's Bayesian criterion, variance of white noise

*Corresponding author

Solution Techniques for Structural Optimization Problems

Svetozara I. Petrova[1]

[1]Department of Engineering Science and Mathematics, University of Applied Sciences, Bielefeld 33619, Germany
svetozara.petrova@fh-bielefeld.de

Abstract

The problem of optimizing the structural design of technological devices and systems arises in many industrial applications. Especially shape and topology optimization problems are fields of advanced research in the recent years due to the increasing industrial demands concerning performance, design and cost effectiveness of structures. The optimization criteria typically occur as nonlinear objective functions which depend on the state parameters coming from the physical model and the design parameters describing the geometrical details. The constraints are governed by partial differential equations (PDE) as equalities and additional inequalities coming from the technological restrictions. We focus on the primal–dual solution techniques for the resulting constrained nonlinear optimization problem and development of efficient multiscale numerical algorithms which are challenging tools in reducing the computational complexity. As applications in materials science we consider the optimal shape design of composite materials with heterogeneous microstructures and microfluidic biochips.

Keywords: structural optimization, PDE constraints, state and design parameters, primal-dual approach, KKT conditions

Optimal Buffer Size of a Hospital's Queueing Network in Thailand

Kedchuda Phienukrochon[1],Rawee Suwandechochai[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
applymathked@gmail.com; rawee.suw@mahidol.ac.th

Abstract

The number of patients in Thailand hospitals increases every year which leads to the congestion of patients in waiting areas. When the spaces of these areas are too small, some patients may not be willing to wait and go to another hospital. On the other hand, when the waiting areas are too large, the hospital is not using the space efficiently. In this paper, we determine the optimal size of waiting area, called buffer size in the queueing network, for a department in Thailand hospital while maximizing throughput rate. We also investigate other performance measurements which are total time in the hospital's department queueing network, the waiting time of the patients in queue for each point of services and the number of patients in the system.

Keywords: buffer size, throughput rate

*Corresponding author

Numerical Solutions for Fractional Differential Equations for Lévy Jump Models in Finance: An Application to Pricing of Call and Put Options

Worawimuit Pienplairrattana[1],Elvin J. Moore[2]

[1]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
flukeacctu@hotmail.com
[2]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400,Thailand
elvinmoo@gmail.com

Abstract

In this research, we study Lévy processes (a KoBol process) and how to incorporate them into a financial model for pricing American call and put options. A fractional partial differential equation (FPDE) model is derived for the boundary value problems associated with these options. Numerical solutions of the boundary value problems are obtained using a Crank-Nicolson scheme combined with a successive overrelaxation method. Reasonable information-relevant prices are obtained for these financial instruments.

Keywords: financial options, fractional diffusion model, Kobol process, Crank-Nicolson scheme, successive overrelaxation

Parameters Estimation for One-Factor CIR Term Structure Model Using Kalman Filter: Empirical Evidences from Thailand Bond Market

Worawimuit Pienplairrattana[1],Chanin Srisuwannapa[1]

[1]Department of Statistics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
flukeacctu@hotmail.com; Chaninsri@yahoo.com

Abstract

In this research, we study the technique called, Kalman filter, to extract the information from the unobservable instantaneous interest rate. By employing the Differential Evolution Algorithm to minimize the sum squares error to estimate the parameters in the one-factor CIR Term Structure Model. These combined two techniques are capable of capturing the pre-set parameters in the simulation data. We apply these two techniques to the panel set of zero coupon yield obtained from Thai Bond Market Association (ThaiBMA) from 2011 to 2016.

Keywords: zero coupon yield, one-factor CIR model, Kalman filter, differential evolution algorithm

The Design of Discrete Time Random Number Generator Based on SHA-256 and One-Dimension Chaotic System as Control Parameters

Magfirawaty [1*], Suryadi M.T.[2], Kalamullah Ramli[1]

[1]Departement Electrical of Engineering, Faculty of Engineering, Universitas Indonesia, Depok 16424, Indonesia.
magfirawaty@ui.ac.id; k.ramli@ee.ui.ac.id
[2]Departement of Mathemathics, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Depok 16424, Indonesia.
yadi.mt@sci.ui.ac.id

Abstract

Key is a series of unpredictable random numbers. In a crypto system, key has a very big role to determine the strength of the cryptosystem. The randomness of key sequences has to pass several statistical tests, e.g. NIST 800-22 test suite, TestU01 or Diehard. A series of key generation processes can be done by the random number generator (RNG). Non-Deterministic random number generator is one method of generating random numbers, which falls into two subclasses: physical TRNGs (PTRNGs) and non-physical TRNGs (NPTRNGs). In this paper a new design of NPTRNG using LFSR, SHA-256 and chaotic system is proposed. We use system time as random number source. LSFR and SHA-256 are used to generate random numbers. To produce random numbers with high entropy, one-dimensional chaotic system is used to produce control parameters of SHA-256. NIST 800-22 is applied to perform statistical test to verify the randomness of NPTRNGs output. The result shows the proposed design generates random number sequences that pass all NIST 800-22 statistical tests.

Keywords: randomness, random number generators, chaos, SHA, entropy source, chaotic system.

*Corresponding author.

A Numerical Simulation of a Three-Dimensional Air Quality Model in an Area Under a Bangkok Sky Train Platform Using an Explicit Finite Difference Scheme

Kewalee Suebyat[1],Nopparat Pochai[2]

[1]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
kew26_tan@hotmail.com
[2]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand;
Centre of Excellence in Mathematics, CHE, Si Ayutthaya Rd., Bangkok 10400, Thailand
nop_math@yahoo.com

Abstract

One air pollution problem in areas under Bangkok sky train platforms caused by the pollutant coming from the entrance to the tunnel, which increases the concentration of pollutant. In this research, the governing equation of the air quality model in an area considered is a three-dimensional advection-diffusion equation which is time dependent. The air flow velocity along an area considered is assumed to be an interpolated function. A finite difference technique is employed to approximate the solution of the governing equation. The model is solved by using an explicit forward difference in time and backward difference in space (FTCS). The result of model is satisfactory, and will be implemented on a problem of air pollution control in a more complicated tunnel.

Keywords: air quality, advection-diffusion equation, finite difference method, FTCS, Bangkok sky train, tunnel

Numerical Simulation of a Two-Dimensional Air Pollution Model in an Urban Street Canyon

Hasakarn Thongzunhor [1],Nopparat Pochai[2]

[1]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
ampipe_love@hotmail.co.th
[2]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
nop_math@yahoo.com

Abstract

Permeability and building density are important parameters for precisely modeling urban air pollution and influencing regulatory requirements for building planning. An air pollution model is proposed to investigate the dispersion of air pollution in an urban street canyon. This model describes the wind flow that effected to the air pollutant concentration. To investigate the level of air pollution in an urban street canyon, the spatial distribution of pollutant concentration level is modeled using a two-dimensional advection-diffusion equation. The numerical results are calculated by using an explicit finite difference scheme with variable wind velocity fields. The calculated numerical results were compared with different boundary conditions and with different wind velocity functions.

Keywords: air pollution, urban street canyon, dispersion model, advection-diffusion equation, explicit method

Unconditional Stable Numerical Techniques for a Water-Quality Model in a Nonuniform Flow Stream

Nopparat Pochai[1]

[1]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
nopparat.po@kmitl.ac.th

Abstract

A couple of two mathematical models is used to simulate water quality in a non-uniform flow stream. The first is the hydrodynamic model that provides the velocity field and elevation of water. The second is the dispersion model that provides the pollutant concentration field. Both models are formulated in one-dimensional in space equations. The unconditional stable Crank-Nicolson method is also used in the hydrodynamic model. At each step, the flow velocity fields calculated from the hydrodynamic model will be the input to the second model as the field data on the similarly grid spacing. An unconditional stable finite difference techniques are subsequently employed in the second model. This research proposes a simply remarkable alteration to the Saulyev method so as to make it more accurate without any significant loss of computational efficiency. The results obtained indicate that the proposed Saulyev scheme does improve the prediction accuracy and flexibility compared to that of the traditional methods.

Keywords: water-quality model, hydrodynamic model, dispersion model, advection-diffusion-reaction equation, Crank-Nicolson method, Saulyev method

Orthogonal Polynomials with Their Weight Functions

Maitree Podisuk[1]

[1]Kasem Bundit University, 1761 Pattanakarn Street, Suan Luang, Bangkok 10250, Thailand
maitree.pod@kbu.ac.th

Abstract

The orthogonal polynomials are used very often in applied mathematics. M. Podisuk and his colleague presented some kinds of orthogonal polynomials in I, II, III and IV. In this paper, the orthogonal polynomials in the closed interval [0,1] with the weight functions of the form will be illustrated.

Keywords: (n/a)

Application of Integral Equations in Numerical Solution of Initial Value Problem

Witichai Pongprasert[1],Boriboon Novaprateep[1],Khomsan Neamprem[2]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
witichai.pon@student.mahidol.ac.th; boriboon.nov@mahidol.ac.th
[2]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
khomsann@kmutnb.ac.th

Abstract

In this paper, we consider the numerical solution of Initial Value Problem (IVP) between the numerical solution from Integral Equation (IE) and the numerical solution from Ordinary Differential Equation (ODE).

Keywords: initial value problem, system of integral equation, volterra integral equation, runge-kutta method

Vaccine Coverage and the Cost Effectiveness of Dengue Vaccine in Thailand

Sittisede Polwiang[1]

[1]Department of Mathematics, Faculty of Science, Silpakorn University, Nakhon Pathom, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
polwiang_s@su.ac.th

Abstract

Background: Dengue fever is a major mosquito-borne disease, nearly 100,000 reported cases in Thailand. The first commercial dengue vaccine, Dengvaxia, was recently approved in Mexico, Brazil and the Philippines. The target of the vaccine is persons aged between 9-45 years old. The objective of this study was to estimate the effectiveness of a vaccine to dengue transmission and the cost-effectiveness of the vaccine.
Methods: The simulation and analysis were carried out using a mathematical model for dengue transmission with age structure. The vaccine was given to a certain part of population in the community and the number of dengue infections and incidences was then calculated. The cost effective price of the vaccine was measured in disability adjusted life years (DALYs) averted, and the incremental cost-effectiveness ratio (ICER) of the vaccination was expressed in 2015 US dollars per DALY.
Results: The number of dengue incidences declines with increased vaccine coverage in the community. If a vaccination program would be implemented in Thailand, the cost effective price of the vaccine per person should be 25-28 US dollars.
Conclusions: Our results describe the effects of the dengue vaccination to infections and incidences. The cost effective price of dengue vaccine for use in Thailand has been calculated.

Keywords: dengue, mathematical model, vaccine, simulation

Novel Delay-Dependent Exponential Stabilization Criteria of Nonlinear System with Mixed Time-Varying Delay via Intermittent Hybrid Feedback Control

Patarawadee Prasertsang[1], Thongchai Botmart[2]

[1]Department of General Science, Kasetsart University, Chalermprakiat Sakon Nakhon Province Campus, Sakon Nakhon, 10400, Thailand
patarawadee.s@ku.th
[2]Department of Mathematics, Khon Kaen University, Khon Kaen, 40002, Thailand
thongbo@kku.ac.th

Abstract

In this paper, we shall investigate the problem of exponential stabilization criteria for nonlinear system with mixed time-varying delay, which is composed of discrete intervals and distributed time-varying delay, not both of which are necessarily differentiable. The exponential stabilization criteria of nonlinear system are proposed via either hybrid feedback control or intermittent hybrid feedback control. Based on the constructing of improved Lyapunov-Krasovskii functionals, properties of nonlinear functions, Leibniz-Newton's formula, Jensens inequality, some zero equations and using the reciprocal convex combination technique, novel delay-dependent sufficient conditions of exponential stabilization criteria is derived in terms of linear matrix inequalities (LMIs) without introducing any free-weighting matrices, which can be efficiently solved via standard numerical software. Two numerical examples are given to demonstrate the effectiveness of the obtained results.

Keywords: exponential stabilization, nonlinear system, mixed time-varying delay, intermittent hybrid feedback control

A Simulation Study of the Spread of Mealybugs in a Cassava Field: Effect of Increased Global Temperature

Jairaj Promrak[1],Chontita Rattanakul[1]*

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Commission on Higher Education, Bangkok 10400, Thailand
jpjairaj@gmail.com; chontita.rat@mahidol.ac.th

Abstract

Even though the effect of release frequency of green lacewings in controlling the spread of mealybugs in a cassava field was investigated by Promrak and Rattanakul in 2015, the effect of increased global temperature was not taken into account. In this work, cellular automata and Monte Carlo simulation are then employed in order to study the effect of increased global temperature on the life cycles of mealybugs and green lacewings which in turn effects the efficacy of the biological control of the spread of mealybugs. Computer simulations are carried out at different temperatures so that an efficient biological control of the spread of mealybugs in a cassava field is obtained.

Keywords: biological control, cassava, cellular automata, green lacewings, mealybugs, Monte Carlo simulation

*Corresponding author

Application of Discrete Optimal Control to Feeding of Farm Animals

Sathaporn Puengpo[1],Chanakarn Kiataramkul[1],Elvin J. Moore[1]

[1]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
s.puengpo@hotmail.com; chanakarn.k@sci.kmutnb.ac.th; elvinmoo@gmail.com

Abstract

An important problem in farm management is to feed animals in an optimal manner to achieve maximum food production subject to constraints, for example, to feed swine or beef cattle to achieve an optimal weight at time of sale. The objective of this research is to apply discrete optimal control to solve these types of optimization problems for actual data obtained either from the Ministry of Agriculture and Cooperatives of the Royal Thai government or from Agricultural Research Stations in Thailand. Numerical solutions of these types of discrete optimal control problem are obtained and discussed.

Keywords: discrete optimal control, feeding of farm animals

Upper Bounds of the Connected Size Ramsey Number for P_5 and nK_2

Budi Rahadjeng[1],Edy Tri Baskoro[1],Hilda Assiyatun[1]

[1]Combinatorial Mathematics Research Group, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Indonesia
budi.rahadjeng@students.itb.ac.id; ebaskoro@math.itb.ac.id; hilda@math.itb.ac.id

Abstract

For graphs F, G, and H, we write $F \to (G, H)$ to mean that if the edges of F are colored with two colors, say red and blue, then the red subgraph of F contains a copy of G or the blue subgraph of F contains a copy of H. The connected size Ramsey number $\hat{r}_c(G, H)$ is the minimum size of graph F such that $F \to (G, H)$ and F is connected. In this paper, we derive an upper bound for the connected size Ramsey number for P_5 and nK_2.

Keywords: connected size Ramsey number, matching, path

Some Infinite Classes of Unicyclic Graphs in $\mathcal{R}(P_3, P_n)$, for $n \geq 6$

Desi Rahmadani[1*],Edy Tri. Baskoro[1],Hilda Assiyatun[1]

[1]Department of Mathematics, Institut Teknologi Bandung, Ganesha 40132, Indonesia;
Combinatorial Mathematics Research Group, Department of Mathematics, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung (ITB), Bandung, Indonesia
desi.rahmadani33@students.itb.ac.id; ebaskoro@math.itb.ac.id; hilda@math.itb.ac.id

Abstract

Let F, G and H be any graphs. The notation $F \to (G, H)$ means that for every 2-coloring (red and blue) of the edges of F will create either a red subgraph isomorphic to G or a blue subgraph isomorphic to H. The graph F is a *Ramsey* (G, H)*-minimal graph* if $F \to (G, H)$ but $F - e \nrightarrow (G, H)$ for every $e \in E(F)$. The class of all Ramsey (G, H)-minimal graphs (up to isomorphism) is denoted by $\mathcal{R}(G, H)$. The pair (G, H) will be called *Ramsey-finite* or *Ramsey-infinite* depending upon whether $\mathcal{R}(G, H)$ is finite or infinite. The pair (P_3, P_n), for $n \geq 6$ is Ramsey-infinite, it means that there is an infinite set of graphs that are in $\mathcal{R}(P_3, P_n)$, for $n \geq 6$. In this paper, we construct some infinite classes of unicyclic graphs that belong to $\mathcal{R}(P_3, P_n)$, for $n \geq 6$. We also give an algorithm to construct these graphs.

Keywords: Ramsey minimal graph, coloring, Ramsey infinite, unicyclic graph

*Corresponding author

Asymptotic Stability of Neutral-Type Neural Networks

Thaned Rojsiraphisal[1]

[1]Department of Mathematics, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
thaned.r@cmu.ac.th

Abstract

Practical systems are often formed in the singular neutral-type neural networks. In this paper we proposed a delay-dependent asymptotically stable condition of the singular neutral-type neural networks with bounded neural activation functions. The purpose criterion is in the form of LMI and derived based on Lyapunov-Krasovskii functional with an integral inequality containing the derivative of state vector. Two numerical examples are given to show the effectiveness of the proposed condition.

Keywords: descriptor system, singular system, neutral-type, neural networks, stability, Lyapunov

Harvest Induced Evolution in Life-history Traits: Age at First Reproduction

Kornkanok Bunwong[1], Wichuta Sae-jie[2*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
kornkanok.bun@mahidol.ac.th

[2]Department of Applied Mathematics and Informatics, Faculty of Science and Industrial Technology,
Prince of Songkla University, Surat Thani Campus, Surat Thani 84000, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
wichuta.sa@psu.ac.th

Abstract

The aim of this paper is to investigate the adaptive change of age at first reproduction to harvested single-species fish population. Throughout this work, individuals are grouped into discrete time intervals. Thus an age-structured population dynamics in terms of difference equations is developed. It is composed of four age classes, i.e., 0-year-olds (newborns), 1-year-olds (juveniles), 2-year-olds (small adults), and individuals aged 3 years or older (large adults). There are also two alternative life histories since female fish can start to reproduce when they have reached either small adults (for $\gamma = 1$) or large adults (for $\gamma = 0$). Based on the fact that the female fish can generally produce a million of eggs whereas about 90 percent of them die in the first few weeks, the age-specific growth, fecundity, and survival probability are also taken into account. Moreover, we let the survival probability from newborns to age one be density-dependent. After finding the invasion fitness, we obtain that the first reproduction can occur earlier due to age selective harvesting of older. In addition, the well-known growth model such as von Bertalanffy growth curve can estimate the size (length or weight) of a fish as a function of its age. Therefore, the size at first reproduction can be calculated.

Keywords: age at first reproduction, age structured model, density dependent survival, harvesting, invasion fitness, life history evolution

*Corresponding author

Some Applications of G_2

Sarawut Saenkarun[1]

[1]Department of Mathematics, Ubonrachathani University, Ubonrachathani 34190, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
sarawut.s@ubu.ac.th

Abstract

We realized all finite-dimensional irreducible representations of the Lie group of class G_2 in spaces of complex-valued polynomials of six variables. The realization is applied to the problem of restriction of representations of a Lie group of class G_2 to a Lie subgroup of class A_2 and a study of solutions of some systems of partial differential equations.

Keywords: representations, Lie algebra of class G_2, Lie group of class G_2

Numerical Solution of Integral Equation of the Second Kind with Monomial Kernels

Worawut Saetang[1],Boriboon Novaprateep[1],Narongpol Wichailukkana[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand; PERDO, Centre of Excellence in Mathematics, Commission on higher Education, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
worawut.sae@student.mahidol.ac.th; boriboon.nov@mahidol.ac.th; narongpol.wic@student.mahidol.ac.th

Abstract

To solve numerical solution of the integral equations, we are asked to solve the numerical solution of system of linear equations $AX = B$. Each element a_{ij} of the coefficient matrix $A = [a_{ij}]$ is in the integral form which must be calculated. In this paper, we apply exact integration of $\int_a^b x^p dx$ to get a more accurate solution.

Keywords: exact integration, Fredholm integral equation, Galerkin method, Legendre wavelet, Legendre polynomial, Gauss-Legendre quadrature

A Fractional Differential Equation Model for Continuous Glucose Monitoring Data

Sasikarn Sakulrang[1],Elvin J. Moore[1],Surattana Sungnul[1],
Andrea De Gaetano[2]

[1]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400,Thailand
eve_kmutnb@hotmail.com; elvinmoo@gmail.com; ssj@kmutnb.ac.th
[2]Laboratorio di Biomatematica, CNR IASI, Viale Pinturicchio, 34-00196 Roma, Italy
andrea.degaetano@cnr.it

Abstract

In this research, continuous glucose monitoring (CGM) data from subjects with type I diabetes was analyzed by three mathematical models, namely, a deterministic first-order differential equation model, a stochastic first-order differential equation model with Brownian motion, and a deterministic fractional-order model. CGM data was analyzed to find optimal values of parameters by using ordinary least squares fitting or maximum likelihood estimation using a kernel-density approximation. R-Programs have been developed for each model to find optimal values of parameters to fit observed data and to test the usefulness of each model.

Keywords: type 1 diabetes, CGM data, fractional differential equation, Brownian motion, R programs

A Mathematical Modelling of Gastrointestinal Tract: An Effect of Randomness in Gastric Emptying

Rattana Sangngam[1], Yongwimon Lenbury[1], Chontita Rattanakul[1],
Pairote Satiracoo[1*], Andrea De Gaetano[2], Simona Panunzi[2]

[1]Department of Mathematics, Mahidol University, Bangkok 10400, Thailand;
Center of Excellence in Mathematics, Bangkok 10400, Thailand
rattana.sag@student.mahidol.ac.th; yongwimon.len@mahidol.ac.th; chontita.rat@mahidol.ac.th;
pairote.sat@mahidol.ac.th
[2]Institute of System Analysis and Informatics (IASI) "A. Ruberti", National Research Council (CNR),
Rome, Italy
andrea.degaetano@gmx.net; simona.panunzi@biomatematica.it

Abstract

The digestive system consists of the gastrointestinal (GI) tract and organs of digestion. It has a function to digest and absorb nutrients, which can be converted into usable energy for human body. Glucose is an important source of energy and the maintenance of blood glucose homeostasis is essential for life. Hypoglycemia is a condition in which the plasma glucose decreases to below normal levels. In contrast, hyperglycemia is a condition characterized by abnormally high level of plasma glucose, which causes a major medical problem for people with diabetes. An inverse relationship between plasma glucose concentration and the rate of gastric emptying has been clinically observed in previous studies. Gastric emptying (GE) is the process by which the stomach delivers chyme into the small intestine until it is empty. Several deterministic models have been used to describe GE, which assume the GE mechanism to be a continuous and smooth process in time. However, GE is physiologically characterized by a random sequence of spurts, which varies in size and time. Therefore, the aim of this paper is to develop a mathematical model of GI tract by incorporating a stochastic model of GE into an existing model of GI tract. The proposed model takes into consideration the irregular decrements of gastric contents after a meal, and should be able to explain the inverse relationship between the plasma glucose concentration and the rate of gastric emptying.

Keywords: euglycaemia, gastric emptying, gastrointestinal tract, hyperglycaemia, hypoglycaemia, stochastic model

*Corresponding author.

An Exploration of Sixth-Grade Students'Mathematical Proficiency in Fractions

Solun Say[1],Narumon Changsri[2],Maitree Inprasitha[2]

[1]Centre of Excellence in Mathematics, CHE, Si Ayutthaya RD., Bangkok 10400, Thailand
saysolun@gmail.com
[2]Department of Mathematics Education, Khon Kaen University, Khon Kaen 40002, Thailand;
Centre for Research in Mathematics Education, Khon Kaen 40002, Thailand
changsri_crme@kku.ac.th; inprasitha_crme@kku.ac.th

Abstract

This study aimed to investigate students' mathematical proficiency in fractions. The research employed a quantitative-method research design that explored students' mathematical proficiency in fractions, using twenty- question mathematics (fractions) test. The component of the research involved 194 sixth-graders randomly selected from three primary schools in Phnom Penh, Cambodia, and their solutions on the test were analyzed in terms of five strands of mathematical proficiency. The findings revealed that the participants were still not mathematically proficient, that is, they did not understand the concepts well, were not fluent in performing operations, exercise a selection of strategic knowledge, reason clearly and maintain a positive outlook towards mathematics. In particular, the majority of these students did not show adaptive reasoning and productive disposition. It also provided insight into mathematical proficiency held by the students the majority of which did not perform well on learning about fractions.

Keywords: mathematical proficiency, learning fractions, Phnom Penh, Cambodia

Vaccination and Fumigation Design by Using Input-Output Linearization Method in Host Vector Model

Edwin S. Nugraha[1],Janson Naiborhu[1],Nuning Nuraini[1]

[1]Department of Mathematics, Bandung Institute of Technology, Bandung, Indonesia
edwin.setiawan@students.itb.ac.id; janson@math.itb.ac.id; nuning@math.itb.ac.id

Abstract

In this work, we explore the Host-Vector Model and develop a design of vaccination and fumigation to control infectious population by using feedback control, especially the input-output linearization method. Host population is divided into three compartments, namely susceptible, infectious and recovered populations, whereas the vector population is divided into two compartments, namely susceptible and infectious populations. In this method, vaccination and fumigation are the input and infectious population is the output. The objective of the design is to stabilize of the output asymptotically.

Keywords: vaccination, fumigation, host-vector model, feedback control, liniearization

A Model for Porcine Reproductive and Respiratory Syndrome with Time Dependent Infection Rate: Travelling Wave Solution

Jeerawan Suksamran[1], Yongwimon Lenbury[1*], Pairote Satiracoo[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
jeerawan.tangmo@gmail.com; yongwimon.len@mahidol.ac.th; pairote.sat@mahidol.ac.th

Abstract

Porcine Reproductive and Respiratory Syndrome (PRRS) gives rise to reproductive disorders in sows and problems with respiratory system in piglets and young pigs. This disease creates serious economic losses to major pork producing countries such as Vietnam and China, among others. Its rapid spread necessitates extensive use of antibiotics to control bacterial secondary infections in pig production. However, not much is known about the spatial transmission of PRRSV in growing pigs. In previous models, infection rate has been assumed to be constant with time. Experimental studies on specific cases of this viral infection with prolonged viral shedding suggest that this assumption might not hold. A structured model for the spread of PRRSV has therefore been constructed, incorporating time and spatial dimensions as well as the decline of infection rate with time. Using the travelling wave coordinate and the hyperbolic tangent method, we derive analytical solutions to the model system. Stability and phase plane analyses are also carried out in order to gain insights into the spatial spread of PRRS as time progresses.

Keywords: Porcine Reproductive and Respiratory Syndrome, time-dependent infection rate, travelling wave coordinate, tanh method, stability analysis

*Corresponding author

Optimal Time for Sugarcane Harvesting for Sugar Factories in Thailand

Surattana Sungnul[1],Santipong Prasarttong[2],Wisanlaya Pornprakun[1], Chanasak Baitiang[2]

[1]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
surattana.s@sci.kmutnb.ac.th; wisanlaya514066203@hotmail.com
[2]Department of Mathematics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
santipong.p@sci.kmutnb.ac.th; cbt@kmutnb.ac.th

Abstract

In this research, we aim to find the optimal harvesting time of sugarcane to factory in order to maximize the revenue and to minimize the cost. We generated a mathematical model in multi-objective optimization under the office of the Cane and Sugar Board (OCSB) conditions. The price of sugarcane depends on its quality (the sweetness) and weight. Generally, the level of sweetness will increase with time whereas the weight will decrease with time. The ε-constraints method which is an optimization technique is applied to solve the mathematical model. We then obtained the optimal harvest time in each region (Northern, Central, Eastern and North-Eastern Thailand). The results between the years 2012/13 and 2013/14 are presented for comparison.

Keywords: sugarcane, ε-constraints method, optimal harvest time

Numerical Integral Equation Method of Average Run Length on EWMA Control Chart for Long-Memory Process with ARFIMA Model

Rapin Sunthornwat[1*], Yupaporn Areepong[1], Saowanit Sukparungsee[1]

[1]Department of Applied Statistics, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand

valentineandlove@gmail.com; yupaporn.a@sci.kmutnb.ac.th; saowanit.s@sci.kmutnb.ac.th

Abstract

In this paper, a numerical integral equation (NIE) method with Gauss-Legendre Quadrature rule technique for evaluating Average Run Length (ARL) of long-memory ARFIMA process with exponential distribution white noise on EWMA chart is approximated and proposed. In addition, comparison based on the Absolute Percentage Relative Errors (APRE) between approximated ARL and analytical ARL is demonstrated. The results indicate that APREs are decreasing when sizes of shift are also increasing. It is important that the approximated ARL take computational CPU time more than analytical ARL. To sum up, the NIE method for ARL is an alternative to measure the efficiency of EWMA control chart.

Keywords: ARFIMA process, average run length, EWMA control chart, numerical integral equation method

*Corresponding author

Rainbow 2-Connectivity of Strong Product of a k-Connected Graph and a Path

Bety H. Susanti[1*],AN M. Salman[1],Rinovia M.G. Simanjuntak[1]

[1]Combinatorial Mathematics Research Group, Department of Mathematics, Institut Teknologi Bandung, Jl. Ganesa 10, Bandung, 40132, Indonesia;
Sekolah Tinggi Sandi Negara
bety.hayat@s.itb.ac.id, bety.hayat@stsn-nci.ac.id; msalman@math.itb.ac.id; rino@math.itb.ac.id

Abstract

An edge-colored graph G is called $rainbow\ k\text{-}connected$, if for any two different vertices of G, there are k internally disjoint rainbow paths, i.e., all edges of each path have distinct colors. The minimum number of colors needed for which there exists a rainbow k-connected coloring for G, denoted by $rc_k(G)$, is the $rainbow\ k\text{-}connection\ number$ of G. In this paper, we are able to find sharp lower and upper bounds for rainbow 2-connectivity of strong product of arbitrary k-connected graph and a path. We also determine the rainbow 2-connectivity of strong product of a path and some graphs, i.e. complete graphs, wheel graphs, and cycle graphs.

Keywords: k-connected graph, path, rainbow k-connectivity, rainbow path, strong product

*Corresponding author

A Mathematical Model of Oil Production with Intermittent Gas Lift Method

Tasmi [1],Silvya Dewi Rahmawati[2],Pudjo Sukarno[2],Edy Soewono[1]

[1]Department of Mathematics, Institut Teknologi Bandung, Ganesha 40132, Indonesia
tasmi@students.itb.ac.id; esoewono@math.itb.ac.id
[2]Drilling and Production Engineering and Oil and Gas Management Group, Institut Teknologi Bandung, Ganesha 40132, Indonesia
sdr@tm.itb.ac.id; psukarno@tm.itb.ac.id

Abstract

In oil industry, it is very important to increase the volume of oil production. However, many mature wells are not capable of being drained of oil from reservoir to the surface. Mature wells need artificial lift to help dredging of oil to the surface. One of the artificial methods is intermittent gas lift. Intermittent gas lift uses gas injection in wells. Gas is used to propel oil to the surface. A mathematical model is developed to study intermittent gas lift. The model is based on momentum and mass conservation giving rise to a system of ordinary differential equations. This paper analyzes and simulates the model with Runge Kutta method. Moreover, the dynamics of some variables is studied. The success of oil production is affected by some variables such as pressure of gas injection, velocity of gas, velocity of oil, and film thickness. The pressure of injected gas can be controlled, so that production of oil is optimal. The results can be used to design wells with intermittent gas lift method.

Keywords: mature wells, intermittent gas lift, mathematical model, mass and momentum conservation, Runge Kutta method, dynamic of variable

On the Shifted Fourth Kind Chebyshev Collocation Method for the Solution of Variable-Order Linear Cable Equations

Majid Tavassoli Kajani[1]

[1]Department of Mathematics, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
mtavassoli@khuisf.ac.ir, tavassoli_k@yahoo.com

Abstract

In this paper, we introduce a new numerical technique to solve variable-order linear cable equations on a $[0, R]$ interval. The approach is based on a fourth kind Chebyshev collocation method. First, we convert fourth kind Chebyshev polynomials on the interval $[-1, 1]$ into $[0, R]$. Then we reduce variable-order linear cable equation to a set of algebraic equations by using fourth kind shifted Chebyshev polynomials and collocation method. To obtain an approximate solution of the linear cable equation, we should solve this algebraic system. Present method is utilized to reduce the solution of this physical problems to the solution of systems of algebraic equations. The method is easy to implement and yields very accurate results.

Keywords: collocation, fourth kind Chebyshev polynomials, variable-order linear cable equations

Introduction of Ramsey Orderly Algebras as Localized Versions of Ramsey Algebras

Wen Chean Teh[1]

[1]School of Mathematical Sciences, Universiti Sains Malaysia, 11800 USM, Malaysia
dasmenteh@usm.my

Abstract

Topological Ramsey spaces introduced by Carlson are generalizations of Ellentuck's space and Milliken's space. In particular, the existence of certain topological Ramsey space of variable words, attributed as Carlson's theorem by Hindman, has profound Ramsey theoretic implications. The underlying algebra of variable words satisfies some property analogous to that possessed by the semigroup of natural numbers with addition as exhibited in Hindman's theorem. Ramsey algebras are generalizations of these structures. Every semigroup is a Ramsey algebra. However, the characterization of Ramsey algebras is still wide open.

We propose a new type of structures, called orderly algebras, motivated by the study of Ramsey algebras. Essentially, Ramsey orderly algebras are the localized versions of Ramsey algebras. In this talk we present our initial findings on Ramsey orderly algebras and highlight this notion as a feasible approach for further study on Ramsey algebras. Specifically, certain generation of new Ramsey algebras will be analyzed using this approach.

Keywords: Ramsey algebra, topological Ramsey space, orderly algebra, orderly term, Hindman's theorem, semigroup

An Analytical Solution of a Hydrodynamic Model in an Opened Uniform Reservoir

Kaboon M. Thongtha[1],Jaipong Kasemsuwan[2]

[1]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
kaboon.t@gmail.com
[2]Department of Mathematics, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
kwjaipon@kmitl.ac.th

Abstract

A hydrodynamic model in a reservoir provides the velocity and the elevation of water. The water current can be used to investigate the water-quality level and the sediment transport. The purpose of this research is to propose an analytical solution of a hydrodynamic model in an opened uniform reservoir. The wave maker channel by outer reservoir is added into the system. The water elevations as a function of positions and times are proposed as the result of the developed analytical solution technique.

Keywords: hydrodynamic model, opened uniform reservoir, water elevation, analytical solution

A Heuristic Method for the Location-Routing Problem: Coin Circulation in Thailand

Salinee Thumronglaohapun[1],Rawee Suwandechochai[1]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
maenina@gmail.com; rawee.suw@mahidol.ac.th

Abstract

In this paper, we study a supply chain problem of coin circulation in Thailand. Coins are distributed from a production plant, located near Bangkok, to main facilities in each region across the country. Meanwhile customers, both people and traders, visit the facilities to exchange and return coins. Nowadays, only one or two facilities provide the services for each region. Customers from other provinces need to travel to get the services. Due to the long distance, some customers may not travel to the facilities for exchanging coins. Although people can exchange coins at banks or private providers in their provinces, fees have been charged for coin exchange. However, these providers cannot cover massive demands of the traders. This may lead to coin shortage in some areas and coin overflow in other areas. Therefore, we propose to open intermediate facilities to make coin circulation more effective. Our problem consists of 1) to determine locations of intermediate facilities, 2) to assign coverage area of the facilities, and 3) to construct routes from the main facilities to the new ones to minimize the total cost. A mixed integer programming for solving this problem is formulated. This problem is a large-scale problem and it is not practical to find optimality. We propose a heuristic method to improve solutions by moving the locations of opened facilities and exchanging the visited orders of places in the routes. Our results obtained from the heuristic method are practical and good enough compared with the optimal solution obtained from LINGO 13.0.

Keywords: coin circulation, supply chain, location-routing, heuristic method

Three-Dimensional Simulation of the Molar Tooth While Chewing Using Finite Element Method

Kamonchat Trachoo[1], Wannika Sawangtong[1], Nathnarong Khajohnsaksumeth[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
kamonchat.tra@gmail.com; wannika.saw@mahidol.ac.th; nathnarong.kha@mahidol.ac.th

Abstract

In this research, a mathematical model of the three-dimensional tooth is established and simulated. The stress equilibrium equation with a chewing force in various directions of chewing force is applied to a realistic domain developed from CT scan data. With the use of numerical techniques based on finite element method using the Comsol multiphysics package, this study aims to investigate the effect of static load boundary condition on the total displacement and von mises stress on a tooth.

Keywords: finite element method, total displacement, three-dimensional simulation, mathematical modeling, three-dimensional tooth

*Corresponding author

Undergraduate Students Perceptions About Pursuing Master's Education and Enrolling into a Master's Program: A Case Study from the University of Economics, Ho Chi Minh City, Vietnam

Quyen H. Tran[1]*,Nabendu Pal[2]

[1]Department of Mathematics and Statistics, University of Economics Ho Chi Minh City, Ho Chi Minh City 70000, Vietnam
haquyen0106@gmail.com, quyentran@ueh.edu.vn
[2]Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA 70504-1010, The US
nabendupal@gmail.com, nxp3695@louisiana.edu

Abstract

This work is based on a recent survey on undergraduate students attending a large prestigious university in Vietnam to study their opinions about the leading factors affecting their intention in enrolling into a Master program. The Theory of Planned Behavior has been adopted to this study to examine the students' intention. This study has tremendous implications not only for the universities in a rapidly developing country like Vietnam, but also for the entire South-East Asian region since this area tends to have more or less homogeneous cultural and socio-economic background. The study sheds some light on the dominant factors influencing the students' attitude toward the Master program they intend to enroll after graduation.

Keywords: student intention, The Theory of Planned Behavior TPB, pursue master program

*Corresponding author.

Monte Carlo Modelling of Waste Water Treatment by Algae

Somkid Amornsamankul[1],Wannapong Triampo[2*]

[1]Department of Mathematics, Mahidol University, Bangkok 10400, Thailand;
Centrr of Excellence in Mathematics, Bangkok 10400, Thailand
somkid.amo@mahidol.ac.th
[2]Department of Physics, Mahidol University, Bangkok 10400, Thailand;
Centrr of Excellence in Mathematics, Bangkok 10400, Thailand
wannapong.tri@mahidol.ac.th

Abstract

Waste water treatment has been a long standing problem for communities and environment conservationists. Various methods have been applied for both research and development purposes. We thus have performed Monte Carlo simulations to investigate and describe a system of waste water treatment by algae. It was found that the waste absorption treatment dynamics is stochastic by nature as expected. Some analytic results have been presented and compared. The connection between the model and the real world system has been done.

Keywords: Monte Carlo, waste water treatment, algae, stochastic, modelling

*Corresponding author

Modelling the Effect of Pollutants on Bivalve Population

Pichaya Voottipruex[1],Kornkanok Bunwong[1*]

[1]Department of Mathematics, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, Bangkok 10400, Thailand
ipichy.v@gmail.com; kornkanok.bun@mahidol.ac.th

Abstract

The food and drug administration (FDA) is issuing a policy statement on the safety of domestic and foreign foods. The risks associated with chemical contaminants, natural toxins, metals are protected. Of cause, importing and exporting seafood is included. In this paper, a nonlinear mathematical model is proposed in order to study the effect of toxicant on bivalve population. The model is composed of bivalve population, the toxicant in the environment and the toxicant in bivalve population. The dynamical behavior is analyzed through a singular perturbation analysis including the existence of limit cycle.

Keywords: singular pertubation, limit cycle, ecotoxicology

*Corresponding author

Distribution of Average Length of Stay of Tourists in Bhutan

Cheki Wangmo[1],Suntaree Unhapipat[1],Montip Tiensuwan[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
pelden08@gmail.com; suntaree.unh@mahidol.ac.th; montip.tie@mahidol.ac.th

Abstract

This study aims to find the distribution of an average length of stay of tourists using the data set obtained from Tourism Council of Bhutan. We consider its histogram in order to find out the distributions of this variable for 20 provinces during 2011-2015. The Kolmogorov-Smirnov and chi-square tests are used to find the distribution and a goodness of fit with a level of significance 0.05. The results show that one province has normal distribution, one province has an exponential distribution, and two provinces have gamma distributions. While all provinces for each year the results show that the average length of stay of tourists has log normal distribution for five years. Furthermore, properties of these distributions such as mean and variance are illustrated.

Keywords: average length of stay of tourists, chi-square, exponential distribution, gamma distribution, Kolmogorov-Smirnov

*Corresponding author

Application of Log-Linear Models to Cancer Patients: A Case Study of Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) in Bhutan

Kuenga Wangmo[1],Montip Tiensuwan[1*]

[1]Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
skuenga@gmail.com; montip.tie@mahidol.ac.th

Abstract

Cancer is a non-communicable disease caused by an abnormal growth of cells which tends to proliferate in an uncontrolled way that leads to the death of the host. Cancer has become an emerging issue and biggest concern worldwide. Bhutan has been initiating and promoting programs to create awareness on the disease aimed at reducing the number of deaths from cancer. The purpose of this study is to find the association among personal and clinical variables. The subjects of this study were 4,122 cancer patients who were treated between 2005 and 2015 at Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) in Bhutan. A test of independence was conducted for all cancer patients and individual gender to identify the association between any two variables using chi-square test and Cramer's V statistic. The variables which produced maximum Cramer's V value were formulated using two-dimensional log-linear models to obtain estimate parameters, expected frequencies and standardized residuals. Three-dimensional log-linear models were applied to test the association among any three variables. The best model was obtained by analysis of deviance. A test of independence showed that most paired variables were significantly related at p-value less than 0.01. For all data, the site of cancer was highly related to ward, age, and gender. Moreover, the status of last contact had an association with ward, number of visit and length of stay. The best model either saturated or maximal model are illustrated.

Keywords: cancer, chi-square, Cramer's V, log-linear models

*Corresponding author

Dynamical Analysis of Zika Virus Transmission Model

Heni Widayani[1],Nuning Nuraini[1]

[1]Department of Mathematics, Institut Teknologi Bandung, West Java, Indonesia
heni.w@students.itb.ac.id,heniwidayani@gmail.com; nuning@math.itb.ac.id

Abstract

The Zika virus is one of vector-borne diseases which become a major global public health emergency. While Zika virus is transmitted from human to human by bites of Aedes spp mosquitoes, recent evidence indicates that zika virus can also transmitted via sexual contact with cases of sexually transmitted Zika virus. A mathematical model for the transmission of Zika viruses through mosquitoe bites and sexual transmission is proposes and analyzed. An epidemiological model was used to shown the dynamics of Zika viruses at the population level. Furthermore, qualitative dynamics of the model is determine by the basic reproduction number, R_0. If the threshold parameter, $R_0 < 1$, then the solution converges to the disease free equilibrium point. On the other hand, if $R_0 > 1$ the convergences is to the endemic equilibrium point. Local and global stability properties is shown. Finally, numerical simulations of the model ilustrate several different dynamics depending on the threshold parameter R_0 and show the importance of this parameter.

Keywords: vector-borne, Zika, analysis dynamic, basic reproduction ratio

A Mathematical Model of Zika Virus Disease Transmission

Chaiwat Wilasang[1],Charin Modchang[2]

[1]Department of Physics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
wilasang.c@gmail.com
[2]Department of Physics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics, CHE, 328, Si Ayutthaya Road, Bangkok 10400, Thailand
charin.mod@mahidol.edu

Abstract

Zika virus disease is a vector borne disease caused by the Zika virus. It is rapidly spreading by infected mosquitoes namely *Aedes aegypti* which is also a vector of Dengue and Chikungunya. The symptoms include fever, headache, rash, conjunctivitis, or joint pain. The major health concern of Zika virus is infection in pregnant women. The infection may lead to brain defects of baby which cause baby's head being smaller than usual called microcephaly. The current situation of Zika virus is that the disease has spread through South America, especially in Brazil, where there are estimated 1.5 million cases of Zika virus infection and epidemiological evidence suggests that Zika virus infection of pregnant women in Brazil might be associated with microcephaly as well. In this research, we studied the transmission dynamics of Zika virus disease in French Polynesia by using a compartmental model. We also used the 2013-2014 outbreak data in French Polynesia to fit our model. The results indicate that the results from the compartmental model are consistent with epidemiological data in French Polynesia. These results may be useful to epidemiologists in trying to understand the transmission dynamics of Zika virus disease.

Keywords: Zika virus disease, compartmental model, French Polynesia

A Numerical Investigation of Radial Basis Function Collocation Methods for Poisson Equation with Nonlinear Source Term and Diffusion Equations with Extended Precision Floating Point Arithmetic

Suranon Yensiri[1],Ruth J. Skulkhu[2*]

[1]Department of Mathematics, Mahidol University, Bangkok 10400, Thailand
suranonmath@gmail.com
[2]Department of Mathematics, Mahidol University, Bangkok 10400, Thailand;
Centre of Excellence in Mathematics
ruthj.sku@mahidol.ac.th

Abstract

During the last few decades, Radial Basis Function (RBF) methods have been developed as the important tool for scattered data interpolation and solving numerical solution of Partial Differential Equations within complexly shaped domains. Additionally, various numerical evidences from collocation method that applies infinitely differentiable basis functions can detect and provide the yield of spectral accuracy in the case of elliptic PDEs. Theoretically, the most accuracy is obtained when the linear systems associated with the methods are in extremely poor condition. In this study, some nonlinear elliptic and time dependent PDEs are investigated. Collocation method is implemented for solving PDEs, and iterative method is used in the cases of nonlinear PDEs. We also examine the efficiency of extended precision strategy, which allow us to evaluate the solution in the ill-conditioned region.

Keywords: radial basis function, collocation method, extended precision floating point arithmetic, numerical partial differential equation

*Corresponding author

Kernel Weighted Spatial Matrix in Generalized STAR Model

Yundari [1*],Udjianna S. Pasaribu[1],Utriweni Mukhaiyar[1],
Mohamad N. Heriawan[2]

[1]Department of Mathematics, Institut Teknologi Bandung, Ganesha 40132, Indonesia;
Statistics Research Group, Department of Mathematics, Faculty of Mathematics and Natural Sciences,
Institut Teknologi Bandung (ITB), Bandung, Indonesia
yuendha@yahoo.com; udjianna@math.itb.ac.id; utriweni@math.itb.ac.id
[2]Mining of Department, Institut Teknologi Bandung, Ganesha 40132, Indonesia
heriawan@mining.itb.ac.id

Abstract

In this paper, we consider the problem of determining the spatial weighted of matrix space time series, modelled by the GSTAR (1;1) process. Commonly, the spatial weighted matrix was determined based on the Euclidean distance, but not based on data. In this work, we use kernel function approach and sequence kernel weighted determination based on observations at each locations. In addition, we also study the influence of this weighted matrix to stationary condition of GSTAR (1;1) model. We used inverse of auto-covariance matrices or IAcM for checking stationarity. The results showed that the kernel weighted matrix approach still being met influence on stationary of this model.

Keywords: kernel weighted matrix, generalized STAR, space-time model, auto-covariance matrices

*Corresponding author

Speaker Index

Organized by

Centre of Excellence in Mathematic(CEM)
PERDO,Commission on Higher Education (CHE)
http://cem.sc.mahidol.ac.th

Sponsored by

Department of Mathematics, Faculty of Science
Mahidol University
http://www.sc.mahidol.ac.th/scma

National Research Council of Thailand
http://nrct.go.th/