4. 中山

西灣應數研討會
Sizihwan Workshop on Applied Mathematics

時間: **109年11月14日星期六**
上午9:30～下午5:05
地點: **國立中山大學理學院**
國際會議廳 理 SC1005

欣逢中山大學成立40週年，我們應數系系所也踏進第34個年頭。40年是一個里程碑，我們想藉著這次校慶的機會，舉辦這個研討會，邀請我們優秀的系友和朋友們，齊聚一堂，一起分享他們的研究成果。

國立中山大學
National Sun Yat-sen University

應 用 數 學 系
Department of Applied Mathematics

中山 40 西灣應數研討會

欣逢中山大學成立 40 週年，我們應數系系所也踏進第 34 個年頭。40 年是一個里程碑，我們想藉著這次校慶的機會，舉辦這個研討會，邀請我們優秀的系友和朋友們，齊聚一堂，一起分享他們的研究成果。歡迎踴躍參加!

日期: 109 年 11 月 14 日星期六
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演講者:

王惟權 國立金門大學土木與工程管理學系副教授

林良靖 國立成功大學統計學系副教授

林耿慧 中央研究院物理研究所副研究員

洪芷漪 國立政治大學應用數學系助理教授

張書瑋 長庚大學臨床資訊與醫學統計中心助理教授

莊智升 國立嘉義大學應用數學系助理教授

陳瑞彬 國立成功大學統計學系教授兼系主任暨數據科學研究所所長

黃士峰 國立高雄大學應用數學系教授兼理學院院長

黃宏財 義守大學財務與計算數學系教授

歐陽振森 義守大學資訊工程學系副教授

蔡政江 中央研究院數學研究所助研究員

鄭彥修 國立臺北教育大學數理暨資訊系副教授

主辦單位: 國立中山大學應用數學系

主辦人: 羅春光

研討會網址

議程:

109 年 11 月 14 日 (理 SC1005)

9:30-10:00	開幕式: 吳明忠院長、羅夢娜、羅春光
場次一	主持人: 郭美惠
10:00-10:25	陳瑞彬 統計 vs 最佳化
10:25-10:45	林良靖 那些年，我們一起做的研究 -- From high frequency data analysis to symbolic interval-valued data analysis
10:45-11:10	茶會
場次二	主持人: 張中
11:10-11:35	黃士峰 中山 40 西灣應數 33 分之 28
11:35-11:55	張書瑋 Genome-wide association analysis in host genetic characteristics of progression to high-grade cervical intraepithelial neoplasia or higher for women with human papillomavirus infection and normal cytology
11:55-12:15	歐陽振森 Artificial intelligence-based quantitative electroencephalogram for smart healthcare
12:15-14:00	午餐
場次三	主持人: 呂宗澤
14:00-14:25	黃宏財 A study on the method of fundamental solutions
14:25-14:45	洪芷漪 Some limit theorems in branching random walks
14:45-15:05	莊智升 Self-adaptive algorithms for the split variational inclusion problems in real Hilbert spaces
15:05-15:25	茶會
場次四	主持人: 黃毅青
15:25-15:45	林耿慧 表皮組織中發現的新幾何形狀: 盾片狀
15:45-16:05	蔡政江 About the Langlands program
16:05-16:25	茶會
場次五	主持人: 張福春
16:25-16:45	鄭彥修 A note on the non-Newtonian fluids
16:45-17:05	王惟權 Some generalized trigonometric functions and their applications
17:05	閉幕式

議程:

中山 40 西灣應數研討會摘要集

統計 vs 最佳化

陳瑞彬

[大學部 83 級, 碩士班 85 級]
國立成功大學統計學系暨數據科學研究所

摘要

最佳化方法一直是統計分析中的重要工具。過往常見的是以最大概似估計法 (maximum likelihood estimation, MLE)來估計模型的參數。乃至現今在機器學習演算法中，最佳化方法亦扮演了重要的角色，如以座標下降(coordinate descent)法來找出支援向量機(support vector machine, SVM)中的間隔超平面，及在特徵選擇(feature selection)中的 LASSO 解法。而我自身的研究中，亦有探討如何使用啟發式演算法(metaheuristic algorithm)找出在不同準則下的最適設計(optimal design)，其中甚至涵蓋了多層次的巢狀最佳化(nested optimization)問題。除了以最佳化方法來解決統計問題，反過來說，統計亦可協助設計最佳化的演算法。早先在 50 年代的反應曲面法(response surface methodology, RSM)，至 90 年代的高效全局優化法(efficient global optimization, EGO)及近幾年在資工領域的貝氏優化法(Bayesian optimization)，均是以統計建模(statistical modeling)及序列設計(sequential design)作為其中的核心技術所發展起來的最佳化方法。在這演講中，我將以本身的研究成果分別呈現這兩個面像。

那些年，我們一起做的研究 -- From high frequency data analysis to symbolic interval-valued data analysis

林良靖

[碩士班 96 級, 博士班 102 級]
國立成功大學統計學系

摘要

In this talk, I will briefly introduce the research topics when I studied in National Sun Yat-sen University. They include the high frequency data analysis and innovative goodness-of-fit test for stochastic volatility model. There are also studies on the symbolic interval-valued data analysis. Further, I combine the concepts of the high frequency data analysis and the symbolic interval-valued data analysis to construct a new model for daily maximum and minimum prices of stock prices.

中山 40 西灣應數 33 分之 28

黃士峰

[大學部 85 級, 碩士班 87 級, 博士班 97 級]
國立高雄大學應用數學系

摘要

我自 1992 年 10 月就讀中山應數系大學部起,與中山應數結緣至今已 28 個年頭,期間受系上栽培於 1996、1999 與 2008 年分別取得學士、碩士與博士學位,畢業至今一直在學術界服務,並持續與系上保持密切的交流。本演講主要簡述我這幾年在衍生性商品定價、風險管理、統計方法與數據科學等領域的研究成果,並針對其中幾篇與中山應數老師們合作的成果進行較深入的介紹。

Genome-wide association analysis in host genetic characteristics of progression to high-grade cervical intraepithelial neoplasia or higher for women with human papillomavirus infection and normal cytology

張書瑋

[大學部 89 級]

長庚大學臨床資訊與醫學統計中心

摘要

Background: Human papillomavirus (HPV) testing is widely used for cervical cancer screening. The hazard ratio of developing cervical intraepithelial neoplasia grade 2 or higher (CIN2+) in HPV-positive/ normal cytology women is 20–34 fold as compared to those with HPV-negative/normal cytology. HPV-positivity would cause substantial anxiety. Apart from viral factors such as high-risk (hr) types, it is important to identify host characteristics for predicting outcome. Methods: An initial genome-wide association study (GWAS) of single nucleotide polymorphisms (SNPs) by Affymetrix Axiom™ Genome-Wide Human Arrays was conducted on 505 cases with histological diagnosis of CIN2+ (group D1) versus 3235 female controls. The identified 19 CIN2+ -associated SNPs from GWAS ($p < 5 \times 10^{-6}$) were verified in an independent cohort (group D2 [n = 306] versus group N [n = 600]). Group N were HPV-negative/normal cytology women from a population-based cervical cytology and HPV co-test study. A cohort with HPV-positive/normal cytology (group P, n = 755) underwent follow-up and was served as the prediction set. The predictive validity was analyzed by logistic regression and receiver operating characteristic (ROC) curve analysis. Results: Thirty-three individuals of the group P progressed to CIN2+ (median follow-up: 23.7 months, range 4.0–122.1). A risk-predictive panel of 8 SNPs rs3097662, rs35979982, rs7763822, rs4282438, rs3128927, rs7759943, rs213194, rs17835649 which were significant in the replication ($p < 0.05$) was used to train models for disease risk prediction using the combination of GWAS and verification sets. Two prediction models were finalized and determined using 7 SNPs for hr- and low-risk (lr) HPV groups respectively (sensitivity 0.72 and 0.75, specificity 0.651 and 0.884, area under the ROC curve 0.703 and 0.701). Among group P with hr-HPV, those carried < 6 risk-alleles had significantly decreased hazard (log-rank $p < 0.001$) of progression to CIN2+ than those with ≧6 risk-alleles, while among group P with lr-HPV, those with predictive probability of ≥ 0.095 had a cumulative risk of progression of 10% at 3 years. Conclusions: Two risk-predictive SNP panels including 7 SNPs with hr- or lr-HPV groups can assist risk stratification among HPV-positive/ normal cytology women. These panels could be further tested in other ethnic populations.

Artificial intelligence-based quantitative electroencephalogram for smart healthcare

歐陽振森

[大學部 87 級]

義守大學資訊工程學系

摘要

近年來，人工智慧技術的突破性發展，使其在各領域的應用獲得許多關注與成果，特別是在智慧醫療領域。腦電波圖是神經疾病醫療常見的檢查之一，其腦電波訊號乃具有多頻道、非穩態、多雜訊、高時間解析等特性，故傳統上透過醫師以人工方式判讀顯得費力、耗時且難以察覺其中細微變化。透過數位化腦電波訊號的量化處理與分析，使得其於時域、頻域、空域等特徵得以量化、視覺化，並可進一步建立偵測/預測模型，藉以提供診斷、治療、預後、預防等健康醫療照護之精準決策支援。本一系列研究針對小兒癲癇疾病的診斷、治療與預後，提出多種基於人工智慧的量化腦電波預測模型學習，其預測結果可以輔助醫師提高對於小兒癲癇疾病診斷、治療、預後等決策精準度與成功率。

A study on the method of fundamental solutions

黃宏財

[碩士班 85 級, 博士班 92 級]

義守大學財務與計算數學系

摘要

From the boundary integral equations (BIE), the fundamental solutions (FS) satisfy the governing equations in the solution domain S, and they are the functions of distance $|\overline{PQ}|$, where P and Q are the source nodes. For Laplace's equations, the FS are known as $\ln|\overline{PQ}|$ in 2D and $\frac{1}{\overline{PQ}}$ in 3D. When the source nodes Q_i are located outside of S, $|\overline{PQ_\iota}| > 0$, no singularity exists for the FS, distinctly to the case of the boundary element method (BEM). To solve the boundary value problems of homogeneous partial differential equations (PDE), their linear combinations, such as $\sum_i \ln|\overline{PQ_\iota}|$ or $\sum_i \frac{1}{|\overline{PQ_\iota}|}$, are chosen to satisfy the exterior and the interior boundary conditions only. This method is called the method of fundamental solutions (MFS). The MFS was first used in V.D. Kupradze, *Potential methods in elasticity*, in J.N. Sneddon and R. Hill (Eds), Progress in Solid Mechanics, Vol.III, Amsterdam, pp.1-259, 1963. Since 1963, there have appeared numerous reports of the MFS for computation, but there exist only a few papers for analysis. In this book, the numerical algorithms are introduced, and their characteristics are addressed. The main efforts are paid to establish the theoretical analysis in errors and stability. For wide application of the MFS, reader may refer monographs by Chen, Karageorghis, and Smyrlis (Eds.), **The Method of Fundamental Solutions - A Meshless Method**, Dynamic Publishers, Inc. USA, 2008, and Kolodziej and Zielinski, **Boundary Collocation Techniques and their Application in Engineering**, WIT Press, Southamption, Boston, 2009. More applications of the MFS are reported in *International Workshops on the method of fundamental solutions* in Ayia Napa, Cyprus, June 11-13, 2007, National Sun Yat-sen University, Taiwan, March 15-18, 2011, HangZhou, China, October 11-13, 2015, Poznan, Poland, July 4-9, 2017, and Lisbon, Portugal, July 29-31, 2019. Since 2011, they hold and join together with *International Workshops on the method of Trefftz method*. How to balance the accuracy and instability is important issue for the MFS in real computations, which is related to the choices of source nodes Q_i. How to better choose Q_i is explored in Chapters 6 and 9. The new " *grid-like*" source nodes are proposed in Chapter 14. For Helmholtz equations, the spurious eigenvalues and their removals are imperative to the exterior problems. The new modified MFS is proposed in Chapter 9, to eliminate all spurious eigenvalues. The strict analysis of error and stability (as well as the important computational issues) in this book has provided the solid theoretical basis of the MFS, to grant it to become the effective numerical method for partial differential equations (PDE). This book is essential and important to the MFS.

Some limit theorems in explosive branching random walks

洪芷漪

[大學部 90 級, 碩士班 92 級]
國立政治大學應用數學系

摘要

A branching random walk is a stochastic process that generalizes both the concept of a random walk and of a branching process. In this talk, we will focus on the class of branching random walks with infinite offspring mean, which is often called the explosive case, and investigate the behavior of the distributions of the individuals' positions.

Self-adaptive algorithms for the split variational inclusion problems in real Hilbert spaces

莊智升

[大學部 90 級]

國立嘉義大學應用數學系

摘要

In this paper, we present new algorithms and related initial type algorithms for the split variational inclusion problems in Hilbert spaces. Further, we prove that the proposed algorithms converge weakly to an element of the solution set of the considered problem under suitable conditions.

表皮組織中發現的新幾何形狀: 盾片狀

林耿慧

[高中資優班 81 級]
中央研究院物理所副研究員

摘要

上皮細胞是位於皮膚或腔道表層的細胞,是生命發生時胚胎出現的第一種細胞。胚胎發育的過程中,上皮細胞有劇烈的形狀變化,但又如此巧妙的精準的移到該移到的位置,並且配合形狀的變化,變成該有的功能與型態。整個過程吸引著發育生物學家與物理學家想要能解釋上皮細胞為什麼會有這些形狀。細胞的形狀與細胞之間的拉力是息息相關的,而上皮細胞之間最重要的一種拉力就是沿著邊邊的表面張力,常被稱作錢包線(purse string model)模型。2018 年一群西班牙裔的科學家發現長在如腔體曲面上的上皮細胞之間的作用力是錢包線,為了降低整體上皮細胞的能量,上皮細胞會改變成一種叫做盾片狀的形狀,這種形狀在幾何學教課書從來沒有過,但這群西班牙裔科學家的模型並沒有預測在平面上會看到盾片狀。在我的研究,我們發現在平面上,上皮細胞也會呈現盾片狀,我們經由一系列研究發現上皮細胞之間還有一種新的作用力,就是沿著在頂面平面上的內聚力。我們的研究對於上皮細胞的形態學會帶來新的視野來重新解釋過去許多研究。

About the Langlands program

蔡政江

[高中資優班 90 級]
中央研究院數學研究所

摘要

The Langlands program is the arguably most important program in number theory as well as geometric representation theory. In a nutshell, it associates to each monodromy (number theoretic or geometric objects) a representation theoretic datum. In this presentation, we aim to briefly motivate the Langlands program and talk about some joint progress in the p-adic field setting.

A note on the non-Newtonian fluids

鄭彥修

[大學部 87 級, 碩士班 89 級, 博士班 94 級]
國立臺北教育大學數理暨資訊系

摘要

In this talk, we will introduce the Non-Newtonian flow by playing a video on youtube. Then we will show some eigenvalue properties of the p-Laplacian string equation and how to reconstruct the density in the string equation by using the nodal data.

Some generalized trigonometric functions and their applications
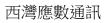
王惟權

[博士班 99 級]
國立金門大學土木與工程管理學系

摘要

Some generalized trigonometric functions (GTF) and their associated properties will be reviewed. Owing to such known results, we will represent some applications related to GTF.

中山 40 應數系校慶慶祝活動

日期	時間	活動內容
109 年 11 月		出版「西灣應數通訊」
11 月 13 日　星期五	16:00-18:00	系友座談會
	09:30-17:00	碩博生研究海報展
11 月 14 日　星期六	09:30-17:00	碩博生研究海報展
	09:30-17:05	中山 40 西灣應數研討會
	12:30-14:00	「系友回娘家」自助午餐
	13:00-14:00	系友會大會
	14:00-15:30	數學電影欣賞：「學數學的女孩」
	15:30-17:00	校園探索
	17:30-	校慶晚宴

西灣應數通訊

更多校慶活動 https://40th.nsysu.edu.tw/

ANNIVERSARY

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