2019 中華民國數學年會

TMS Annual Meeting

大會手冊

Abstract Book

主辦單位

中華民國數學會

協辦單位

科技部自然司數學研究推動中心

國立中興大學

國立交通大學丘成桐中心

(按筆劃排序)

承辦單位

國立中興大學應用數學系暨統計學研究所

2019 年 中華民國數學年會

2019 Taiwan Mathematical Society Annual Meeting

會議時間：2019 年 12 月 7 日(星期六)至 2019 年 12 月 8 日(星期日)
會議地點：國立中興大學資訊科學大樓、理學大樓
主辦單位：中華民國數學會
承辦單位：國立中興大學應用數學系暨統計學研究所
協辦單位：科技部自然司數學究推動中心、國立中興大學、國立交通大學丘成桐中心

學術委員會 Scientific Committee

淡江大學數學學系	郭忠勝(召集人)
國立臺灣大學數學系	王偉仲
國立中央大學數學系	洪盟凱
國立清華大學數學系	蔡志強
國立政治大學應用數學系	陳隆奇
國立中興大學應用數學系	陳鵬文(108 年主辦學校)
國立中興大學應用數學系	施因澤

承辦單位籌備人員 Organizing Committee（依筆劃順序排列）

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國立中興大學應用數學系	陳宏賓
國立中興大學應用數學系	彭冠舉
國立中興大學應用數學系	蔡亞倫
國立中興大學應用數學系	謝博文

2019 中華民國數學年會

2019 Taiwan Mathematical Society Annual Meeting

2019 年 12 月 7 日(星期六)

Sessions	偏微分方程	數論與代數	離散數學	計算數學	統計	最佳化	分析	機率	動態系統與生物數學	微分幾何與代數幾何	數學科普
Room	U301 資訊科學大樓	S104 理學大樓	S1A01 理學大樓	U414 資訊科學大樓	U502 資訊科學大樓	S106 理學大樓	S102 理學大樓	U517 資訊科學大樓	U302 資訊科學大樓	S113 理學大樓	S101 理學大樓
08:30 - 09:30	報到註冊										
09:30 - 10:00	年會開幕式 主持人: 郭忠勝理事長										S1A03 理學大樓
10:00 - 10:50	大會演講 Yousef Saad 教授 主持人: 林文偉教授										S1A03 理學大樓
10:50 - 11:05	團體照										
11:05 - 11:20	茶會										
11:20 - 12:05	主持人:黃信元 演講者:**洪盟凱**	主持人:郭容妙 演講者:**楊一帆**	主持人:符麥克 演講者:**黃顯貴**	主持人:施因澤 演講者:Qin Sheng	主持人:沈宗荏 演講者:**温啟仲**	主持人:陳鵬文 演講者:**陸行**	主持人:王雅書 演講者:**黃毅青**	主持人:許元春 演講者:**黃皓瑋**	主持人:謝世峰 演講者:Hayato Chiba	主持人:宋瓊珠 演講者:**鄭日新**	***
12:05 - 13:30	午餐 Lunch										

13:30 - 13:55	主持人:張覺心 演講者:**陳逸昆**	主持人:楊一帆 演講者:**李秋坤**	主持人:李渭天 演講者:**韓永楷**	主持人:謝博文 演講者:**黃楓南**	主持人:沈宗荏 演講者:**蔡旻曉**	主持人:陳鵬文 演講者:**陳界山**	13:30-14:15 主持人:黃毅青 演講者: Norisuke Ioku	13:30-14:15 主持人:許順吉 演講者: Seiichiro Kusuoka	13:30-14:15 主持人:謝世峰 演講者: Tomoki Kawahira	13:30-14:15 主持人:鄭日新 演講者:**宋瓊珠**	***
13:55 - 14:20	主持人:張覺心 演講者:**郭鴻文**	主持人:楊一帆 演講者:**陳志瑋**	主持人:李渭天 演講者:**張惠蘭**	主持人:胡偉帆 演講者:**朱家杰**	主持人:沈宗荏 演講者:**高竹嵐**	主持人:陳鵬文 演講者:**郭岳承**					***
14:25 - 14:50	主持人:黃博峙 演講者:**謝天長**	主持人:楊一帆 演講者: Ryotaro Harada	主持人:李渭天 演講者:**余冠儒**	主持人:胡偉帆 演講者:**黃韋強**	主持人:沈宗荏 演講者: Takeshi Emura	主持人:陳鵬文 演講者:**莊智升**	主持人:黃毅青 演講者:**陳中川**	主持人:許順吉 演講者: Yuki Chino	主持人:陳賢修 演講者:**梁育豪**	主持人:邱鴻麟 演講者:**李國瑋**	***
14:50 - 15:15	主持人:黃博峙 演講者:**林奕亘**	主持人:楊一帆 演講者: David C. Ni	主持人:李渭天 演講者: Ariel R. Paningbatan	***	***	***	***	主持人:許順吉 演講者: Yu-Ting Chen	主持人:陳賢修 演講者:**張志鴻**	主持人:邱鴻麟 演講者:**張瑞恩**	***
15:15 - 15:40	茶會										
15:40 - 16:30	大會演講 謝銘倫教授 主持人: 程舜仁教授										S1A03 理學大樓
16:30 - 17:50	會員大會暨頒獎典禮										
18:30 -	晚宴										

2019 中華民國數學年會

2019 Taiwan Mathematical Society Annual Meeting

2019 年 12 月 8 日(星期日)

Sessions	偏微分方程	數論與代數	離散數學	計算數學	統計	最佳化	分析	機率	動態系統與生物數學	微分幾何與代數幾何	數學科普
Room	U301 資訊科學大樓	S104 理學大樓	S1A01 理學大樓	U414 資訊科學大樓	U502 資訊科學大樓	S106 理學大樓	S102 理學大樓	U517 資訊科學大樓	U302 資訊科學大樓	S113 理學大樓	S101 理學大樓
08:30 - 09:00	報到註冊										
09:00 - 09:50	大會演講 Gordon Slade 教授 主持人：陳隆奇教授										S1A03 理學大樓
09:50 - 10:10	茶會										
10:10 - 10:55	主持人:李俊璋 演講者:**陳志有**	主持人:郭容妙 演講者:**林正洪**	主持人:傅東山 演講者:**游森棚**	主持人:謝博文 演講者:**洪子倫**	主持人:沈宗荏 演講者:**陳春樹**	主持人:陳鵬文 演講者:**許瑞麟**	主持人:王雅書 演講者: Naohito Tomita	主持人:許元春 演講者:**黃啟瑞**	主持人:謝世峰 演講者:**王烽彬**	***	***
11:00 - 11:25	主持人:李俊璋 演講者:**謝佳佑**	主持人:林正洪 演講者:**郭家瑋**	主持人:余冠儒 演講者:**徐祥峻**	主持人:謝博文 演講者:**樂美亨**	主持人:沈宗荏 演講者:**林長鋆**	主持人:陳鵬文 演講者:**林仁彥**	11:00-11:45 主持人:王雅書 演講者:**沈俊嚴**	11:00-11:45 主持人:黃啟瑞 演講者: Ryoki Fukushima	主持人:李信儀 演講者:**李俊憲**	主持人:邱鴻麟 演講者:**祝偉霞**	主持人:陳宏賓 演講者:**高欣欣**
11:25 - 11:50	主持人:吳昌鴻 演講者:**洪立昌**	主持人:林正洪 演講者:**陳昱宇**	主持人:余冠儒 演講者:**劉家安**	***	主持人:沈宗荏 演講者:**劉維中**	主持人:陳鵬文 演講者:**林來居**			主持人:李俊憲 演講者:**林惠娥**	***	主持人:陳宏賓 演講者:**林家妤**

11:50 - 12:15	主持人:吳昌鴻 演講者:**王冠祥**	***	主持人:余冠儒 演講者:**羅元勳**	***	主持人:沈宗荏 演講者:**鍾冬川**	主持人:陳鵬文 演講者:**黃建豪**	主持人:王雅書 演講者:**蔡明誠**	11:45-12:10 主持人:黃啟瑞 演講者:**陳定立** 12:10-12:35 主持人:黃啟瑞 演講者:**劉聚仁**	主持人:李俊憲 演講者:**李信儀**	主持人:邱鴻麟 演講者:**何忠益**	主持人:陳宏賓 演講者:**嚴志弘**
12:15 - 13:30	午餐										
13:30 - 13:55	***	***	***	***	***	***	主持人:王雅書 演講者:**黃同瑤**	***	13:30-14:15 主持人:謝世峰 演講者: **陳賢修**	***	13:30-15:10 主持人:陳宏賓 演講者:**嚴志弘**
13:55 - 14:20	***	***	***	***	***	***	主持人:王雅書 演講者:**陳宏益**	***		***	
14:20 - 14:45	***	***	***	***	***	***	***	***	14:25-14:50 主持人:謝世峰 演講者:**張正陽**	***	
14:45 - 15:10	***	***	***	***	***	***	***	***	14:50-15:15 主持人:謝世峰 演講者:**陳俊英**	***	
15:10 - 15:35	***	***	***	***	***	***	***	***	***	***	***
15:35 -	賦歸										

2019 Taiwan Mathematical Society Annual Meeting

7 Dec. 2018(Saturday)

Sessions	**Partial Differential Equations**	**Number Theory and Algebra**	**Discrete Mathematics**	**Computational Mathematics**	**Statistics**	**Optimization**	**Analysis**	**Probability**	**Dynamical Systems and Biomathematics**	**Differential and Algebraic Geometry**	**Mathematics Out-reaching**
Room	U301 Information Science Building	S104 Science College Building	S1A01 Science College Building	U414 Information Science Building	U502 Information Science Building	S106 Science College Building	S102 Science College Building	U517 Information Science Building	U302 Information Science Building	S113 Science College Building	S101 Science College Building
08:30 | 09:30	Registration										
09:30 | 10:00	Opening Ceremony Chair：President Jong-Shenq Guo										S1A03 Science College Building
10:00 | 10:50	Plenary Lecture by Professor Yousef Saad Chair：Professor Wenwei Lin										S1A03 Science College Building
10:50 | 11:05	Group Photo										
11:05 | 11:20	Coffee Break										
11:20 | 12:05	Chair: Hsin-Yuan Huang Speaker: Meng-Kai Hong	Chair: Jung-Miao Kuo Speaker: Yifan Yang	Chair: Michael Fuchs Speaker: Hsien-Kuei Hwang	Chair: Jerry Y.-T. Shih Speaker: Qin Sheng	Chair: Tsung-Jen Shen Speaker: Chi-Chung Wen	Chair: Peng-Wen Chen Speaker: Hsing Luh	Chair: Ya-Shu Wang Speaker: Ngai-Ching Wong	Chair: Yuan-Chung Sheu Speaker: Hao-Wei Huang	Chair: Shih-Feng Shieh Speaker: Hayato Chiba	Chair: Chiung-Jue Anna Sung Speaker: Jih-Hsin Cheng	***
12:05 | 13:30	Lunch										

13:30 I 13:55	Chair: Chueh-Hsin Chang Speaker: I-Kun Chen	Chair: Yifan Yang Speaker: Tsiu-Kwen Lee	Chair: Wei-Tian Li Speaker: Wing-Kai Hon	Chair: Po-Wen Hsieh Speaker: Feng-Nan Hwang	Chair: Tsung-Jen Shen Speaker: Min-Hsiao Tsai	Chair: Peng-Wen Chen Speaker: Jein-Shan Chen	13:30-14:15 Chair: Ngai-Ching Wong Speaker: Norisuke Ioku	13:30-14:15 Chair: Shuenn-Jyi Sheu Speaker: Seiichiro Kusuoka	13:30-14:15 Chair: Shih-Feng Shieh Speaker: Tomoki Kawahira	13:30-14:15 Chair: Jih-Hsin Cheng Speaker: Chiung-Jue Anna Sung	***
13:55 I 14:20	Chair: Chueh-Hsin Chang Speaker: Hung-Wen Kuo	Chair: Yifan Yang Speaker: Chih-Whi Chen	Chair: Wei-Tian Li Speaker: Huilan Chang	Chair: Wei-Fan Hu Speaker: Chia-Chieh Chu	Chair: Tsung-Jen Shen Speaker: Chu-Lan Kao	Chair: Peng-Wen Chen Speaker: Yueh-Cheng Kuo					***
14:25 I 14:50	Chair: Bo-Chih Huang Speaker: Tien-Tsan Shieh	Chair: Yifan Yang Speaker: Ryotaro Harada	Chair: Wei-Tian Li Speaker: Guan-Ru Yu	Chair: Wei-Fan Hu Speaker: Wei-Qiang Huang	Chair: Tsung-Jen Shen Speaker: Takeshi Emura	Chair: Peng-Wen Chen Speaker: Chih-Sheng Chuang	Chair: Ngai-Ching Wong Speaker: Chung-Chuan Chen	Chair: Shuenn-Jyi Sheu Speaker: Yuki Chino	Chair: Shyan-Shiou Chen Speaker: Yu-Hao Liang	Chair: Hung-Lin Chiu Speaker: Kuo-Wei Lee	***
14:50 I 15:15	Chair: Bo-Chih Huang Speaker: Yi-Hsuan Lin	Chair: Yifan Yang Speaker: David C. Ni	Chair: Wei-Tian Li Speaker: Ariel R.Paningbatan	***	***	***	***	Chair: Shuenn-Jyi Sheu Speaker: Yu-Ting Chen	Chair: Shyan-Shiou Chen Speaker: Chih-Hung Chang	Chair: Hung-Lin Chiu Speaker: Jui-En Chang	***
15:15 I 15:40	Coffee Break										
15:40 I 16:30	Plenary Lecture by Professor Ming-Lun Hsieh Chair：Professor Shun-Jen Cheng									S1A03 Science College Building	
16:30 I 17:50	TMS Meeting & Award Ceremony										
18:30 I	Banquet										

2019 Taiwan Mathematical Society Annual Meeting

8 Dec. 2019(Sunday)

Sessions	Partial Differential Equations	Number Theory and Algebra	Discrete Mathematics	Computational Mathematics	Statistics	Optimization	Analysis	Probability	Dynamical Systems and Biomathematics	Differential and Algebraic Geometry	Mathematics Out-reaching
Room	U301 Information Science Building	S104 Science College Building	S1A01 Science College Building	U414 Information Science Building	U502 Information Science Building	S106 Science College Building	S102 Science College Building	U517 Information Science Building	U302 Information Science Building	S113 Science College Building	S101 Science College Building
08:30 | 09:00	Registration										
09: 00 | 09:50	Plenary Lecture by Professor Gordon Slade Chair：Professor Lung-Chi Chen										S1A03 Science College Building
09:50 | 10:10	Coffee Break										
10:10 | 10:55	Chair: Chiun-Chang Lee Speaker: Zhi-You Chen	Chair: Jung-Miao Kuo Speaker: Ching-Hung Lam	Chair: Tung-Shan Fu Speaker: Sen-Peng Eu	Chair: Po-Wen Hsieh Speaker: Tzyy-Leng Horng	Chair: Tsung-Jen Shen Speaker: Chun-Shu Chen	Chair: Peng-Wen Chen Speaker: Ruey-Lin Sheu	Chair: Ya-Shu Wang Speaker: Naohito Tomita	Chair: Yuan-Chung Sheu Speaker: Chii-Ruey Hwang	Chair: Shih-Feng Shieh Speaker: Feng-Bin Wang	***	***
11:00 | 11:25	Chair: Chiun-Chang Lee Speaker: Chia-Yu Hsieh	Chair: Ching-Hung Lam Speaker: Jia-Wei Guo	Chair: Guan-Ru Yu Speaker: Hsiang-Chun Hsu	Chair: Po-Wen Hsieh Speaker: Mei-Heng Yueh	Chair: Tsung-Jen Shen Speaker: Chang-Yun Lin	Chair: Peng-Wen Chen Speaker: Jen-Yen Lin	11:00-11:45 Chair: Ya-Shu Wang Speaker: Chun-Yen Shen	11:00-11:45 Chair: Chii-Ruey Hwang Speaker: Ryoki Fukushima	Chair: Hsin-Yi Lee Speaker: Chun-Hsien Li	Chair: Hung-Lin Chiu Speaker: Weixia Zhu	Chair: Hong-Bin Chen Speaker: Shin-Shin Kao
11:25 | 11:50	Chair: Chang-Hong Wu Speaker: Li-Chang Hung	Chair: Ching-Hung Lam Speaker: Shih-Yu Chen	Chair: Guan-Ru Yu Speaker: Chia-An Liu	***	Chair: Tsung-Jen Shen Speaker: Wei-Chung Liu	Chair: Peng-Wen Chen Speaker: Lai-Jiu Lin		11:45-12:10 Chair: Chii-Ruey Hwang Speaker: Ting-Li Chen	Chair: Chun-Hsien Li Speaker: Huey-Er Lin	***	Chair: Hong-Bin Chen Speaker: Shark Lin

11:50 I 12:15	Chair: Chang-Hong Wu Speaker: Kuan-Hsiang Wang	***	Chair: Guan-Ru Yu Speaker: Yuan-Hsun Lo	***	Chair: Tsung-Jen Shen Speaker: Tony Jhwueng	Chair: Peng-Wen Chen Speaker: Chien-Hao Huang	Chair: Ya-Shu Wang Speaker: Ming-Cheng Tsai	12:10-12:35 Chair: Chii-Ruey Hwang Speaker: Gi-Ren Liu	Chair: Chun-Hsien Li Speaker: Hsin-Yi Lee	Chair: Hung-Lin Chiu Speaker: Chung-I Ho	Chair: Hong-Bin Chen Speaker: Chih-Hung Yen
12:15 I 13:30	Launch										
13:30 I 13:55	***	***	***	***	***	***	Chair: Ya-Shu Wang Speaker: Tone-Yau Huang	***	13:30-14:25 Chair: Shih-Feng Shieh Speaker: Shyan-Shiou Chen	***	13:30-15:10 Chair: Hong-Bin Chen Speaker: Chih-Hung Yen
13:55 I 14:20	***	***	***	***	***	***	Chair: Ya-Shu Wang Speaker: Hong-Yi Chen	***		***	
14:20 I 14:45	***	***	***	***	***	***	***	***	14:25-14:50 Chair: Shih-Feng Shieh Speaker: Zhengyang Zhang	***	
14:45 I 15:10	***	***	***	***	***	***	***	***	14:50-15:15 Chair: Shih-Feng Shieh Speaker: Chun-Ying Chen	***	
15:10 I 15:35	***	***	***	***	***	***	***	***	***	***	***
15:35 I	Closing										

目錄

Plenary Speech

Yousef Saad

CSE Distinguished Professor, Department of Computer Science,
University of Minnesota
Email: saad@cs.umn.edu

Filtering techniques for eigenvalue problems

The solution of large symmetric eigenvalue problems is central to applications ranging from electronic structure calculations to the study of vibrations in mechanical systems. A few of these applications require the computation of a large number of eigenvalues and associated eigenvectors. For example, when dealing with excited states in quantum mechanics, it is not uncommon to seek a few tens of thousands of eigenvalues of matrices of sizes in the tens of millions. In such situations it is imperative to resort to `spectrum slicing' strategies, i.e., strategies that extract slices of the spectrum independently. The presentation will discuss a few techniques in this category, namely those based on a combination of filtering (polynomial, rational) and standard projection methods (Lanczos, subspace iteration). Filtering consists of computing eigenvalues and vectors of a matrix of the form B = f(A), where f is typically a polynomial or rational function. With the mapping f the wanted eigenvalues of the original matrix are transformed in such a way that they become easier to extract. This particular area blends ideas from approximation theory with standard matrix algorithms. The presentation will emphasize polynomial filtering and will discuss some recent work on nonlinear eigenvalue problems.

Yousef Saad is a College of Science and Engineering (CSE) distinguished professor with the department of computer science and engineering at the University of Minnesota. He received the "Doctorat d'Etat" from the university of Grenoble (France) in 1983. He joined the university of Minnesota in 1990 as a Professor of computer science and a Fellow of the Minnesota Supercomputer Institute. He was head of the department of Computer Science and Engineering from January 1997 to June 2000, and became a CSE distinguished professor in 2005. From 1981 to 1990, he held positions at the University of California at Berkeley, Yale, the University of Illinois, and the Research Institute for Advanced Computer Science (RIACS). His current research interests include: numerical linear algebra, sparse matrix computations, iterative methods, parallel computing, numerical methods for electronic structure, and linear algebra methods in data mining. He is the author of two monographs and over 190 journal articles. He is also the developer or co-developer of several software packages for solving sparse linear systems of equations and eigenvalue problems including SPARSKIT, pARMS, ITSOL, and EVSL. Yousef Saad is a SIAM fellow (class of 2010) and a fellow of the AAAS (2011).

Plenary Speech

Gordon Douglas Slade

Professor, Department of Mathematics,
University of British Columbia
Email: slade@math.ubc.ca

Self-avoiding walk, spin systems, and renormalization

The subject of critical phenomena in statistical mechanics is a rich source of interesting and difficult mathematical problems that touch on combinatorics, probability, and mathematical physics. Self-avoiding walks and lattice spin systems provide fundamental examples. This talk will address recent progress in computing critical exponents for these models, using a rigorous version of Wilson's renormalisation group method.

Education:

1984: Ph.D., Mathematics, University of British Columbia.
1979: M.Sc., Mathematics, University of Toronto.
1977: B.A.Sc. (Honours.) Engineering Science (physics option), University of Toronto.

Honours:

2018: Jeffery-Williams Prize of the Canadian Mathematical Society
2017: Fellow of the Royal Society (London)
2017: UBC Killam Teaching Prize
2012: Fellow of the American Mathematical Society
2011: Fellow of the Institute of Mathematical Statistics
2010: Fellow of the Fields Institute
2010: CRM-Fields-PIMS Prize
2009: Institute of Mathematical Statistics Medallion Lecture, Berlin
2004: UBC Killam Research Prize (Senior Science Category)
2003: Prix de l'Institut Henri Poincaré (with Remco van der Hofstad)
2000: Fellow of the Royal Society of Canada
1995: Coxeter-James Prize of the Canadian Mathematical Society
1994: Invited Lecture, International Congress of Mathematicians, Zürich

Plenary Speech

Ming-Lun Hsieh

Research fellow, Academia Sinica, Taiwan
Professor (Joint appointment), Department of Mathematics,
National Taiwan University, Taiwan
Email: mlhsieh@math.sinica.com.tw

Iwasawa theory and elliptic curves

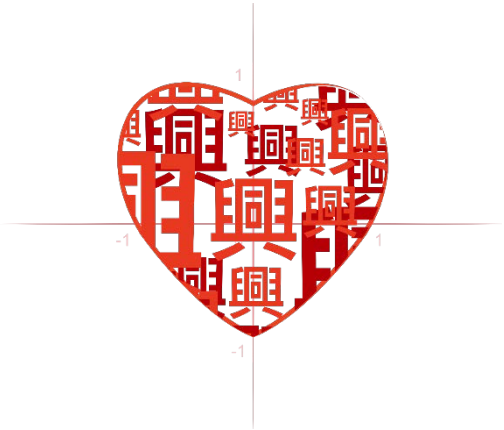
Classical Iwasawa theory studies the mysterious connection between the values of Riemann zeta function at negative integers and the size of ideal class groups for cyclotomic fields. We will talk about its generalization to elliptic curves and review some results on arithmetic of elliptic curves.

Education:

2008: Ph.D., Mathematics , Columbia University, USA
2000: M.S., Mathematics , National Taiwan University, Taiwan
1998: B.A., Mathematics , National Taiwan University, Taiwan

Employment:

Academia Sinica, Taipei, Taiwan
Research fellow August 2016 -present
National Taiwan University, Taipei, Taiwan
Professor (Joint appointment) August 2016 -present
National Taiwan University, Taipei, Taiwan
Associate professor August 2013 -July 2016
National Taiwan University, Taipei, Taiwan
Assistant professor August 2009 -July 2013
Mcmaster University , Hamilton, Ontario, Canada
Post-doctorate fellow August 2008 - June 2009
Mandatory military service , Taoyuan, Taiwan
Second lieutenant, logistic officer July 2000 - March 2002



數論與代數

Number Theory and Algebra

Organizer：郭容妙

地點：理學大樓 S104

2019年12月7日(星期六)		Speaker
11:20-12:05	Modular units and cuspidal divisor classes on $X_0(n^2M)$ with n|24 and M squarefree Chair:郭容妙	楊一帆 Yifan Yang
13:30-13:55	Triplet invariance under generalized inverses Chair:楊一帆	李秋坤 Tsiu-Kwen Lee
13:55-14:20	Tilting modules for the periplectic Lie superalgebra Chair:楊一帆	陳志瑋 Chih-Whi Chen
14:25-14:50	On function field alternating multizeta values Chair:楊一帆	Ryotaro Harada
14:50-15:15	Characterization of Zeta functions in differential equations and dynamical systems Chair:楊一帆	David C. Ni

2019年12月8日(星期日)		Speaker
10:10-10:55	Automorphism groups of holomorphic vertex operator algebras of central charge 24 Chair:郭容妙	林正洪 Ching-Hung Lam
11:00-11:25	Class Number Relations Arising From Intersections Of Shimura Curves And Humbert Surfaces Chair:林正洪	郭家瑋 Jia-Wei Guo
11:25-11:50	On the algebraicity of the symmetric sixth power L-functions of elliptic modular forms Chair:林正洪	陳昱宇 Shih-Yu Chen

Modular units and cuspidal divisor classes on $X_0(n^2M)$ with $n|24$ and M squarefree

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For a positive integer N, let $C(N)$ be the subgroup of $J_0(N)$ generated by all cuspidal divisors of degree 0 and $C(N)(\mathbb{Q}) := C(N) \cap J_0(N)(\mathbb{Q})$ be its $\mathbb{Q}$-rational subgroup. Let also $C_{\mathbb{Q}}(N)$ be the subgroup of $C(N)(\mathbb{Q})$ generated by $\mathbb{Q}$-rational cuspidal divisors. We prove that when $N = n^2M$ for some integer n dividing 24 and some squarefree integer M, the two groups $C(N)(\mathbb{Q})$ and $C_{\mathbb{Q}}(N)$ are equal. To achieve this, we show that all modular units on $X_0(N)$ on such N are products of functions of the form $\eta(m\tau + k/h)$, $mh^2|N$ and $k \in \mathbb{Z}$ and determine the necessary and sufficient conditions for products of such functions to be modular units on $X_0(N)$. This is a joint work with Liuquan Wang.

Triplet invariance under generalized inverses

Tsiu-Kwen Lee and Jheng-Huei Lin

8th November 2019

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Abstract

Given a semiprime ring R, we give a complete characterization of the triplet invariance ba^-c (resp. ba^+c) under all inner inverses a^- (resp. reflexive inverses a^+) of $a \in R$. For the case of outer inverses, given a regular element a in an arbitrary ring, the outer inverses of a are completely determined. It is also proved that if R is a regular ring and $a, b, c \in R$, then the triplet $b\hat{a}c$ is invariant under all outer inverses $\hat{a}$ of a if and only if $\mathrm{E}[b]\mathrm{E}[a]\mathrm{E}[c] = 0$. Here, $\mathrm{E}[x]$ is the smallest idempotent in C, the extended centroid of R, such that $x = \mathrm{E}[x]x$. These answer the questions due to Hartwig and Patrício in 2018.

2010 *Mathematics Subject Classification.* 15A09, 16E50, 16N60.

Key words and phrases: Semiprime (prime, regular) ring, extended centroid, triplet invariance, (unit-) regular element, inner (outer, reflexive) inverse.

Speaker: Tsiu-Kwen Lee

Tilting modules for the periplectic Lie superalgebra

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The periplectic Lie superalgebra $\mathfrak{p}(n)$ is a superanalogue of the orthogonal or symplectic Lie algebra. In this talk, we will introduce a version of Ringel duality of arbitrary parabolic BGG category $\mathcal{O}$ for $\mathfrak{p}(n)$. In particular, this duality provide an approach to the problem of finding character formulae of tilting modules. This talk is based on joint works with Shun-Jen Cheng, Kevin Coulembier and Yung-Ning Peng.

Keywords: Lie superalgebras, tilting modules, character formulae.

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On function field alternating multizeta values

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In the research on number theory, it is known that there are many analogies between number fields and function fields over finite fields $\mathbb{F}_q$ (q is a power of prime number p). For example, the basic analogues are $\mathbb{F}_q[\theta]$, $\mathbb{F}_q(\theta)$, $\mathbb{F}_q((1/\theta))$ and $\mathbb{C}_\infty$ which correspond to $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$ and $\mathbb{C}$ respectively. Finding such analogues is one of fundamental issues in function field number theory. In this result [H19], we introduce the *alternating multizeta values in positive characteristic* (AMZVs in short) which are generalizations of Thakur multizeta values, positive characteristic analogue of multizeta values [T04] and also function field analogues of alternating multizeta values (for the detail of number fields case, see [Z16]). The AMZVs are defined as the following infinite sums ([H19]):

For $\mathfrak{s} = (s_1, \dots, s_r) \in \mathbb{N}^r$ and $\boldsymbol{\epsilon} = (\epsilon_1, \dots, \epsilon_r) \in (\mathbb{F}_q^\times)^r$,

$$\zeta(\mathfrak{s}; \boldsymbol{\epsilon}) = \sum_{\substack{a_1, \dots, a_r \in \mathbb{F}_q[\theta] \\ a_1, \dots, a_r : \text{monic} \\ \deg a_1 > \cdots > \deg a_r \geq 0}} \frac{\epsilon_1^{\deg a_1} \cdots \epsilon_r^{\deg a_r}}{a_1^{s_1} \cdots a_r^{s_r}} \in \mathbb{F}_q((1/\theta)).$$

We call $\mathrm{wt}(\mathfrak{s}) := \sum_{i=1}^r s_i$ the weight and $\mathrm{dep}(\mathfrak{s}) := r$ the depth of the presentation of $\zeta(\mathfrak{s}; \boldsymbol{\epsilon})$. We also show their fundamental properties listed in below.

(A). Non-vanishing ([H19, Theorem 2.1]) For any $\mathfrak{s} = (s_1, \dots, s_r) \in \mathbb{N}^r$ and $\boldsymbol{\epsilon} = (\epsilon_1, \dots, \epsilon_r) \in (\mathbb{F}_q^\times)^r$, $\zeta(\mathfrak{s}; \boldsymbol{\epsilon})$ are non-vanishing.

(B). Sum-shuffle relations ([H19, Theorem 2.6]) For $\mathfrak{a} := (a_1, a_2, \dots, a_r) \in \mathbb{N}^r$, $\mathfrak{b} := (b_1, b_2, \dots, b_s) \in \mathbb{N}^s$, $\boldsymbol{\epsilon} := (\epsilon_1, \epsilon_2, \dots, \epsilon_r) \in (\mathbb{F}_q^\times)^r$ and $\boldsymbol{\lambda} := (\lambda_1, \lambda_2, \dots, \lambda_s) \in (\mathbb{F}_q^\times)^s$, we may express the product $\zeta(\mathfrak{a}; \boldsymbol{\epsilon})\zeta(\mathfrak{b}; \boldsymbol{\lambda})$ as follows:

$$\zeta(\mathfrak{a}; \boldsymbol{\epsilon})\zeta(\mathfrak{b}; \boldsymbol{\lambda}) = \sum_i f_i'' \zeta(c_{i1}, \dots, c_{il_i}; \mu_{i1}, \dots, \mu_{il_i})$$

for some $c_{ij} \in \mathbb{N}$ and $\mu_{ij} \in \mathbb{F}_q^\times$ so that $\sum_{m=1}^r a_m + \sum_{n=1}^s b_n = \sum_{h=1}^{l_i} c_{ih}$, $\prod_{m=1}^r \epsilon_m \prod_{n=1}^s \lambda_n = \prod_{h=1}^{l_i} \mu_{ih}$, $l_i \leq r + s$ and $f_i'' \in \mathbb{F}_p$ for each i.

(C). Period interpretation ([H19, Theorem 3.4]) For $\mathfrak{s} = (s_1, \dots, s_r) \in \mathbb{N}^r$ and $\boldsymbol{\epsilon} = (\epsilon_1, \dots, \epsilon_r) \in (\mathbb{F}_q^\times)^r$, $\zeta(\mathfrak{s}; \boldsymbol{\epsilon})$ are periods of pre-t-motive M defined in [H19] Definition 3.2.

(D). Linear independence ([H19, Theorem 4.7]) Let $w_1, \dots, w_l \in \mathbb{N}$ be distinct. We suppose that V_i is a $\mathbb{F}_q(\theta)$-linearly independent subset of AZ_{w_i} for $i = 1, \dots, l$. Then the following union

$$\{1\} \bigcup_{i=1}^{l} V_i$$

is a linearly independent set over $\overline{\mathbb{F}_q(\theta)}$ (a fixed algebraic closure of $\mathbb{F}_q(\theta)$ in $\mathbb{C}_\infty$), that is, there are no nontrivial $\overline{\mathbb{F}_q(\theta)}$-linear relation among elements of $\{1\} \bigcup_{i=1}^{l} V_i$.

Here we denote AZ_w the set of monomials of AMZVs with total weight w. Further, the total weight is defined for the monomial $\zeta(\mathfrak{s}_1; \boldsymbol{\epsilon}_1)^{m_1} \cdots \zeta(\mathfrak{s}_n; \boldsymbol{\epsilon}_n)^{m_n}$ as

$$\sum_{i=1}^{n} m_i w_i$$

where $m_1, \dots, m_n \in \mathbb{Z}_{\geq 0}$ which are not all zero and $\zeta(\mathfrak{s}_1; \boldsymbol{\epsilon}_1), \dots, \zeta(\mathfrak{s}_n; \boldsymbol{\epsilon}_n)$ be AMZVs of $\mathrm{wt}(\mathfrak{s}_i) = w_i$ $(i = 1, \dots, n)$.

For the property (A), it is immediately obtained by an inequality property of the absolute values of power sums proved by Thakur [T09]. For the property (B), we use Chen's formula [Ch15] and approach the higher depth case by induction method invented by Thakur [T10]. This enable AMZVs to form an $\mathbb{F}_p$-algebra. For the property (C), inspired by [AT09] and Anderson-Thakur polynomials ([AT90]) that can interpolate power sums, we use those polynomials to create suitable power series that their specialization are AMZVs and then we use these series to create suitable pre-t-motives to establish the period interpretation of (C). By this property, we can proceed to the property (D). For the linear independence property of AMZVs (D), we modify the method [C14] by applying Anderson-Brownawell-Papanikolas criterion [ABP04] to establish the alternating analogue of MZ property for AMZVs. By the property (D) ,we can show that there are no $\overline{\mathbb{F}_q(\theta)}$-linear relation between AMZVs of different weights and that each AMZV $\zeta(\mathfrak{s}; \boldsymbol{\epsilon})$ is transcendental over $\overline{\mathbb{F}_q(\theta)}$.

Keywords: multizeta values in positive characteristic, non-vanishing, sum-shuffle relation, pre-t-motive, linear independence

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Characterization of Zeta functions in differential equations and dynamical systems

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Traditional efforts on proving Riemann Hypothesis have been focusing on analytical, algebraic and algebraic geometrical aspects. Recently, computing efforts have extended to assert that ~10^{30} zeta zeros are locating on critical line. Nevertheless, the mathematical communities are still expecting that the continuous studies may also produce impacts on other branches of mathematics as well as promote broad applications in different scientific and technological fields.

In ICM 2014, we proposed that Cauchy-Riemann equations of zeta functions in conjunction with Bézout theorem as follows:

- $\{s:=Real(\zeta'(s))=0\} \cap \{s':=Imag(\zeta'(s))=0\}$
  $= \{(0.5+i*t_1), (\sigma_t+i*t_2)\}$
- $\sigma_t \in \mathbb{R}$
- $\zeta(0.5+i*t_1) = 0$
- $\zeta(\sigma_t+i*t_2)$ *is a saddle point*

In ICM 2018, we further investigated critical strip in the context of dynamical systems. We presented that the isolation of individual non-trivial zeta zeros by the divergent regions asserts Montgomery's Pair Correlation Conjecture and further provides global-local connections of zeta zeros for constructing the structure for the proof of Riemann Hypothesis.

In this presentation, we propose the strategic path from the establishments of proofs of Riemann Hypothesis in finite field to infinite field together with isolation of zeta zeros, global-local connections, and Cauchy-Riemann equations of zeta functions.

Keywords: Riemann Hypothesis, Zeta Function, Cauchy-Riemann equation, dynamical systems.

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Automorphism groups of holomorphic vertex operator algebras of central charge 24

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In this talk, we will first discuss the full automorphism group of a certain orbifold VOA $V_{\Lambda_g}^g$ associated with a coinvariant lattice Λ_g of the Leech lattice. We will also discuss how to use the information of $\mathrm{Aut}\,(V_{\Lambda_g}^g)$ to determine the full automorphism groups of several holomorphic VOAs of central charge 24.

This is a joint work with K. Betsumiya and H. Shimakura.

Class Number Relations Arising From Intersections Of Shimura Curves And Humbert Surfaces

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Abstract

In this talk, I will present coefficients of Cohens Eisenstein series of weight 5/2 as some class number relations. These relations arise from the intersections of Shimura curves and Humbert surfaces on the Siegel modular threefold, and can be considered as a higher-dimensional analogue of the classical Hurwitz-Kronecker class number relation.

This is a joint work with Yifan Yang.

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ON THE ALGEBRAICITY OF THE SYMMETRIC SIXTH POWER L-FUNCTIONS OF ELLIPTIC MODULAR FORMS

SHIH-YU CHEN

Abstract. Deligne's conjecture predicted that the period for the critical values of a symmetric even power L-function of an elliptic modular form is equal to a power of the Petersson norm of the associated modular form. In this talk, we present our result on the algebraicity of the symmetric sixth power L-functions of elliptic modular forms. We show that the period in this case is equal to product of Petersson norms of the associated modular form and certain holomorphic Siegel modular form of degree two. Our result is compatible with Deligne's conjecture.

分析

Analysis

Organizer：王雅書

地點：理學大樓 S102

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13:30-14:15	Solvability of a semilinear heat equation via a quasi scale invariance Chair:黃毅青	Norisuke Ioku
14:25-14:50	Chaotic translations on weighted Orlicz spaces Chair:黃毅青	陳中川 Chung-Chuan Chen

2019年12月8日(星期日)		Speaker
10:10-10:55	On the boundedness of bilinear pseudo-differential operators of $S_{0,0}$-type Chair:王雅書	Naohito Tomita
11:00-11:45	Two weight T1 theorem for fractional Riesz transforms Chair:王雅書	沈俊嚴 Chun-Yen Shen
11:50-12:15	Zero product preservers and homomorphisms between matrix algebras Chair:王雅書	蔡明誠 Ming-Cheng Tsai
13:30-13:55	Optimality and duality for complex multi-objective programming Chair:王雅書	黃同瑤 Tone-Yau Huang
13:55-14:20	The Birkhoff–von Neumann theorem version of row-stochastic matrices Chair:王雅書	陳宏益 Hong-Yi Chen

Normal states are determined by their facial distances

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Let M be a semi-finite W^*-algebra with normal state space $\mathfrak{S}(M)$. For any $\phi \in \mathfrak{S}(M)$, let

$$M_\phi := \{x \in M : x\phi = \phi x\}$$

be the centralizer of ϕ with center $\mathcal{Z}(M_\phi)$. We show that for $\phi, \psi \in \mathfrak{S}(M)$, the following are equivalent.

- $\phi = \psi$.
- $\mathcal{Z}(M_\psi) \subseteq \mathcal{Z}(M_\phi)$ and $\phi|_{\mathcal{Z}(M_\phi)} = \psi|_{\mathcal{Z}(M_\phi)}$.
- ϕ, ψ have the same distances to all the closed faces of $\mathfrak{S}(M)$.

We are then able to give an alternative proof of the following fact. Let G be a locally compact group. Let A be any one of the (complex) Banach algebras: $L_1(G)$, $M(G)$, $WAP(G)$, $LUC(G)$, $B(G)$, and $A(G)$, consisting of integrable functions, regular Borel complex measures, weakly almost periodic functions, bounded left uniformly continuous functions, positive definite functions, and positive definite functions vanishing at infinity, respectively, on G. We show that the metric semigroup

$$A_{+,1} := \{f \in A : f \geq 0 \text{ and } \|f\| = 1\}$$

(the convex structure is not considered) is a complete invariant for G.

This is a joint work with Anthony To-Ming Lau (Alberta) and Chi-Keung Ng (Nankai).

Keywords: W^*-algebras; normal states; F-algebras; facial structures; locally compact groups.

Solvability of a semilinear heat equation via a quasi scale invariance

Norisuke Ioku
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Classification theory on local in time solvability of nonlinear heat equations is investigated. Without assuming a concrete growth rate on a nonlinear term, we reveal the threshold integrability of initial data which classify existence and nonexistence of solutions via a quasi-scaling and its invariant integral. Global in time solvability is also studied. Typical nonlinear terms, for instance polynomial type, exponential type and its sum, product and composition, can be treated as applications. This is a joint work with Yohei Fujishima(Shizuoka University).

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Chaotic translations on weighted Orlicz spaces

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This is a joint work with K-Y. Chen, Prof. S. Öztop and Prof. S. M. Tabatabaie. Let G be a locally compact group, and let w be a weight on G. Let Φ be a Young function. We give some characterizations for translation operators to be topologically transitive and chaotic on the weighted Orlicz space $L_w^\Phi(G)$. In particular, transitivity is equivalent to the blow-up/collapse property in our case. Moreover, the dense set of periodic elements implies transitivity automatically.

Keywords: Chaos, Translation, Orlicz spaces.

On the boundedness of bilinear pseudo-differential operators of $S_{0,0}$-type

Naohito Tomita (Osaka University, Japan)

The Hörmander symbol class $BS^m_{0,0}$, $m \in \mathbb{R}$, consists of all $\sigma(x,\xi,\eta) \in C^\infty((\mathbb{R}^n)^3)$ such that

$$|\partial_x^\alpha \partial_\xi^\beta \partial_\eta^\gamma \sigma(x,\xi,\eta)| \le C_{\alpha,\beta,\gamma}(1+|\xi|+|\eta|)^m \tag{1}$$

for all multi-indices α, β, γ, and the bilinear pseudo-differential operators T_σ is defined by

$$T_\sigma(f,g)(x) = \frac{1}{(2\pi)^{2n}} \int_{(\mathbb{R}^n)^2} e^{ix\cdot(\xi+\eta)} \sigma(x,\xi,\eta) \widehat{f}(\xi)\widehat{g}(\eta)\, d\xi d\eta,$$

where f, g are Schwartz functions on $\mathbb{R}^n$ and $\widehat{f}, \widehat{g}$ are the Fourier transforms of f, g. In the first part of this talk, we consider the problem of determining the sharp order m (in (**??**)) to assure the $L^p \times L^q \to L^r$ boundedness. This part is based on a joint work with Akihiko Miyachi (Tokyo Woman's Christian University). In the second part, we concentrate on the $L^2 \times L^2 \to L^1$ boundedness, and look for weaker conditions than the classical one (**??**) to assure it. This part is based on a joint work with Tomoya Kato (Gunma University) and Akihiko Miyachi.

Two weight T1 theorem for fractional Riesz transforms

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In this talk we present our recent advances showing the two weight T1 theory for any fractional Riesz transforms when one of the measures is supported on a curve. An application of our theorem gives a characterization of the embedding problem for model spaces.

Zero product preservers and homomorphisms between matrix algebras

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In this talk, we give concrete description of the structures of ring, algebra and Jordan homomorphisms, and linear disjointness preservers between matrix algebras of different sizes. After giving full descriptions of ring, algebra and Jordan homomorphisms between matrices, we show that a linear map $\Phi : M_n \to M_r$ preserving zero products carries the form

$$\Phi(A) = S \begin{pmatrix} R \otimes A & 0 \\ 0 & \Phi_0(A) \end{pmatrix} S^{-1},$$

for some invertible matrices R in M_k, S in M_r and a zero product preserving linear map $\Phi_0 : M_n \to M_{r-nk}$ with range consisting of nilpotent matrices. When $\Phi(I_n)$ is diagonalizable, especially self-adjoint, normal, or an idempotent, we have $\Phi_0(X)\Phi_0(Y) = 0$ for all X, Y in M_n. If Φ preserves self-adjoint matrices, then we can assume $S^{-1} = S^*$, $R^* = R$ and $\Phi_0 = 0$. Similar results for double zero product preservers and orthogonality preservers are obtained..

Keywords: disjointness preserver, zero product, matrix spaces, matrix algebras.

Optimality and duality for complex multi-objective programming

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We consider a complex multi-objective programming problem (CMP). In order to establish the optimality conditions theorem of problem (CMP), we introduce the properties of optimal efficient solutions and scalarization techniques. Furthermore, the parametric dual and second-ordered parametric dual models are discussed, and their duality theorems are proved.

Keywords: multi-objective programming, efficient solutions, generalized convexity, duality problem

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The Birkhoff–von Neumann theorem version of row-stochastic matrices

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The Birkhoff–von Neumann (BNT) theorem states that every $n \times n$ doubly stochastic matrix, whose nonnegative real entries and each of rows and columns sums equal to 1, can be written as a convex combination of $n \times n$ permutation matrices. The BNT has been proved many times in numerous literature with a number of different methods, some inductive, some constructive, see [3, 4] for examples. In this work, we prove that every row-stochastic (RS) matrix of order $m \times n$ (the summation of entries of each row is equal to 1) can be written as a convex combination of n^m $\{0, 1\}$-RS matrices by using a fundamental theorem: Hahn-Banach theorem. We also construct two algorithms for finding the coefficients of a convex combination of a row-stochastic matrix. This is a joint work with Huai-Xin Cao, Zhi-Hua Guo, Tsung-Lin Lee, and Ngai-Ching Wong.

Keywords: stochastic matrix, Birkhoff–von Neumann theorem, simplex method, heuristic method.

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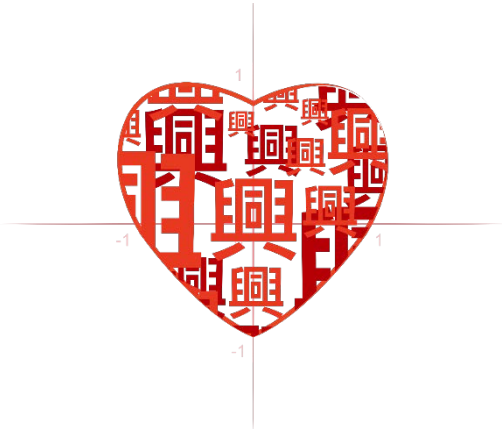

微分幾何與代數幾何

Differential and Algebraic Geometry

Organizer：邱鴻麟

地點：理學大樓 S113

2019年12月7日(星期六)		Speaker
11:20-12:05	On the Sobolev quotient of CR manifolds of 3D Chair:宋瓊珠	鄭日新 Jih-Hsin Cheng
13:30-14:15	Poisson equation: estimates and applications Chair:鄭日新	宋瓊珠 Chiung-Jue Anna Sung
14:25-14:50	Higher dimensional prescribed scalar curvature manifolds with horizon Chair:邱鴻麟	李國瑋 Kuo-Wei Lee
14:50-15:15	The sigularities of the network flow Chair:邱鴻麟	張瑞恩 Jui-En Chang

2019年12月8日(星期日)		Speaker
11:00-11:25	Spectral Stability of the $\overline{\partial}$-Neumann Laplacians Chair:邱鴻麟	祝偉霞 Weixia Zhu
11:50-12:15	Nonorientable Lagrangian surfaces in rational 4-manifolds Chair:邱鴻麟	何忠益 Chung-I Ho

On the Sobolev quotient of CR manifolds of 3D

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Abstract

We exhibit examples of compact three-dimensional CR manifolds of positive Webster class, *Rossi spheres*, for which the pseudo-hermitian mass as defined in [1] is negative, and for which the infimum of the CR-Sobolev quotient is not attained. To our knowledge, this is the first geometric context on smooth closed manifolds where this phenomenon arises, in striking contrast to the Riemannian case. This is joint work with Andrea Malchiodi and Paul Yang.

Keywords:CR manifold, Rossi sphere, pseudo-hermitian mass, CR-Sobolev quotient

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Poisson equation: estimates and applications

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In this talk, we intend to explain some estimates for the Green's function on complete manifolds admitting a weighted Poincaré inequality. The estimates are then applied to study the Poisson equation on such manifolds. Applications will also be mentioned. This is a joint work with Ovidiu Munteanu and Jiaping Wang.

Higher dimensional prescribed scalar curvature manifolds with horizon

Kuo-Wei Lee
National Changhua University of Education

In this talk, we will construct higher dimensional asymptotically flat, time symmetric initial data with prescribed scalar curvature and with horizon. The idea comes from the Bartnik's quasi-spherical ansatz [1], Cabrera and Miao's observations on positive scalar curvature metrics on higher dimensional spheres [2], and Smith's construction on prescribed scalar curvature manifolds near the horizon [3].

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The sigularities of the network flow

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The network flow defines a geometric flow on an essentially singular geometric object. As other geometric flows, usually singularities will occur in finite time. We gives a description about the behaviors when the flow approaches the singular time. When using Huisken's monotonicity, the blow-up limits of a finite-time singularity should be a solution which shrinks self-similarly. This talk gives a survey of the known results about the classification of the self-similarly shrinking solutions and the open questions.

Keywords: Network flow, Singularities, Self-similar solution

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Spectral Stability of the $\bar{\partial}$-Neumann Laplacians

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We study spectral stability of the $\bar{\partial}$-Neumann Laplacian on a bounded domain in $\mathbb{C}^n$ when either the underlying domain or the operator is perturbed. This is a joint work with Siqi Fu.

When the perturbation of domain is measured by Hausdorff distance, we can establish upper semi-continuity properties for the variational eigenvalues of the $\bar{\partial}$-Neumann Laplacian on bounded pseudoconvex domains in $\mathbb{C}^n$, lower semi-continuity properties on pseudoconvex domains that satisfy property (P), and quantitative estimates on smooth bounded pseudoconvex domains of finite D'Angelo type in $\mathbb{C}^n$.

When the $\bar{\partial}$-Neumann Laplacian is perturbed by the Kohn-Nirenberg elliptic regularization which was obtained by adding a constant $t > 0$ times an elliptic operator to the $\bar{\partial}$-Neumann Laplacian. We will establish spectral stability of these operators as $t \to 0^+$ and show that the spectral stability of the Kohn-Nirenberg elliptic regularization requires less stringent condition on the boundary than the $\bar{\partial}$-Neumann Laplacian itself due to the coercive estimates. Indeed, we can establish a sharp quantitative estimate for the variational eigenvalues without the finite type assumption.

Keywords: $\bar{\partial}$-Neumann Laplacian, Spectrum; Stability, Pseudoconvex domain, Property (P), Finite type, Variational eigenvalue, Kohn-Nirenberg regularization.

Nonorientable Lagrangian surfaces in rational 4-manifolds

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The existence of Lagrangian submanifolds is an important problem in symplectic geometry. Most of the study focus on orientable cases. In this talk, we will give topological and homological constraints for nonorientable surfaces in symplectic rational 4-manifolds.

Keywords: Lagrangian surfaces, rational blow down, Lagrangian surgery

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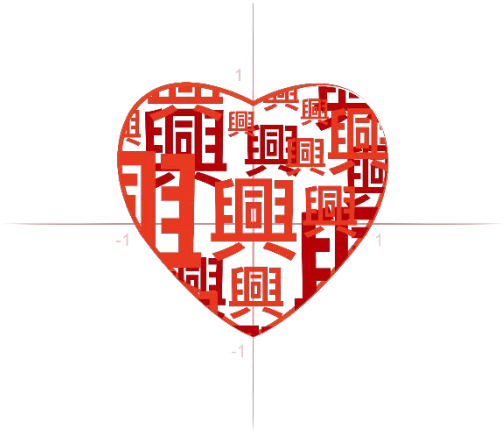

動態系統與生物數學

Dynamical Systems and Biomathematics

Organizer：謝世峰

地點：資訊科學大樓 U302

2019年12月7日(星期六)		Speaker
11:20-12:05	A Bifurcation of the Kuramoto Model on Networks Chair:謝世峰	Hayato Chiba
13:30-14:15	The Riemann hypothesis and holomorphic index in complex dynamics Chair:謝世峰	Tomoki Kawahira
14:25-14:50	Flocking of Cucker-Smale Models on General Coupling Networks with Free-Will Accelerations Chair:陳賢修	梁育豪 Yu-Hao Liang
14:50-15:15	Topologically Mixing Properties of Multiplicative Integer System Chair:陳賢修	張志鴻 Chih-Hung Chang

2019年12月8日(星期日)		Speaker
10:10-10:55	Can multiple species coexist in an ecosystem ? Chair:謝世峰	王烽彬 Feng-Bin Wang
11:00-11:25	On the backward bifurcation of a network-based epidemic model with imperfect vaccination Chair:李信儀	李俊憲 Chun-Hsien Li
11:25-11:50	Time-asymptotic dynamics of hermitian riccati differential equations Chair:李俊憲	林惠娥 Huey-Er Lin
11:50-12:15	The Generalized Riemann Solver of the Multilane Traffic Flow Model Chair:李俊憲	李信儀 Hsin-Yi Lee
13:30-14:15	Dynamics and Bifurcations of the Hindmarsh-Rose models Chair:謝世峰	陳賢修 Shyan-Shiou Chen
14:25-14:50	Competition for light in forest population dynamics: from computer simulator to mathematical model Chair:謝世峰	張正陽 Zheng-Yang Zhang
14:50-15:15	Problems and Partial Corrections for the article "Quickest Change Detectioon and Kullback-Leibler Divergence for Two-State Hidden Markov Models" Chair:謝世峰	陳俊英 Chun-Ying Chen

A Bifurcation of the Kuramoto Model on Networks

Hayato Chiba (Tohoku Univ. AIMR)

The Kuramoto model is a system of globally coupled phase oscillators for describing synchronization phenomena such as firefly flashing, firing of neurons and circadian muscle cells.

In this talk, the Kuramoto model defined on networks is considered. For the mean-field limit of the model, a bifurcation from the incoherent state to the synchronized state is investigated based on the generalized spectral theory. This reveals that a network topology affects the dynamics through the eigenvalue problem of a certain Fredholm integral operator which defines the structure of a network.

The Riemann hypothesis and holomorphic index in complex dynamics

Tomoki Kawahira (Tokyo Institute of Technology)

We give an interpretation of the Riemann hypothesis in terms of complex and topological dynamics. For example, the Riemann hypothesis is affirmative and all zeros of the Riemann zeta function are simple if and only if a certain meromorphic function has no attracting fixed point. To obtain this, we use holomorphic index (residue fixed point index), which characterizes local properties of fixed points in complex dynamics. We also give some other interpretations and observations by means of Newton's method.

Flocking of Cucker-Smale Models on General Coupling Networks with Free-Will Accelerations

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Phenomena of collective motions such as flocking of birds and schooling of fishes are ubiquitous in the world. Several models have been established to study these. Among them, the one introduced by Cucker and Smale has gained much attention. In this talk, we will discuss the flocking dynamics of the discrete-time Cucker-Smale model under general interaction network topologies with agents having their free-will accelerations. Some theoretical results for the flocking motions would be provided. This is a joint work with Prof. Jonq Juang.

Topologically Mixing Properties of Multiplicative Integer System

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Abstract

Motivated from the study of multiple ergodic average, the investigation of multiplicative shift spaces has caused researcher's interests. This talk focuses on the relations of topologically mixing properties of multiplicative shift spaces and traditional shift spaces. Suppose that X is the multiplicative subshift comes from the shift space Y. Then X is (topologically) transitive/mixing if and only if Y is extensible/mixing. After introducing directional mixing property, we derive the equivalence between directional mixing property of X and weakly mixing property of Y.

Can multiple species coexist in an ecosystem ?

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Competition for resources is a fundamental topic in theoretical ecology. There has been a lot of mathematical models in competition studies. The simplest competition models neglect differences between individuals, using one ordinary differential equation to govern the dynamics of each species. These population dynamics are coupled to dynamics of one or more resources by assuming a constant quota of nutrient per individual, or equivalently, a constant yield of individuals from consumption of a unit of resource. In fact, quotas may vary, leading to variable-internal-stores models.

Ecologists are interested in the mechanism of coexistence/diversity in competitor communities. In this talk, I first review a mathematical model of two species competing in a well mixed chemostat for one resource that is stored internally. For this simple model, two or more species cannot coexist, a result known as the Competitive Exclusion Principle. After introducing additional factors such as multiple resources, toxin mortality, intraguild predation, and spatially/ temporally variations into the model, we find that coexistence or bistability (where outcomes depend on initial conditions) becomes possible.

This talk is based on my recent works joint with Drs. James P. Grover, Sze-Bi Hsu, Jifa Jiang, King-Yeung Lam, Hua Nie, Junping Shi, and Xiaoqiang Zhao.

Keywords: internal storage, coexistence, bistability, intraguild predation, toxin mortality.

On the backward bifurcation of a network-based epidemic model with imperfect vaccination

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We present a study on a network-based susceptible-infected-susceptible epidemic model with a vaccinated compartment. The model incorporates three candidate imperfect vaccines, namely, leaky, all-or-nothing, and waning vaccines. We obtain a threshold value $\mathcal{R}_v$, which determines the stability of a disease-free equilibrium. Furthermore, we perform a bifurcation analysis and conditions that ensure the occurrence of backward bifurcation are derived. More specifically, we show that a stable disease-free equilibrium can coexist with a stable endemic equilibrium when $\mathcal{R}_v < 1$. Numerical experiments are conducted and their results validate the theoretical results.

Keywords: epidemic model, vaccination, equilibria, stability, backward bifurcation.

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TIME-ASYMPTOTIC DYNAMICS OF HERMITIAN RICCATI DIFFERENTIAL EQUATIONS

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The matrix Riccati differential equation (RDE) raises in a wide variety of applications for science and applied mathematics. We are particularly interested in the Hermitian Riccati Differential Equation (HRDE). Radon's Lemma gives a solution representation to HRDE. Although solutions of HRDE may show the finite escape time phenomenon, we can investigate the time asymptotic dynamical behavior of HRDE by its extended solutions. In this paper, we adapt the Hamiltonian Jordan canonical form to characterize the time asymptotic phenomena of the extended solutions for HRDE in four elementary cases. The extended solutions of HRDE exhibit the dynamics of heteroclinic, homoclinic and priodic orbits in the elementary cases under some conditions. This is a joint work with Yueh-Cheng Kuo and Shih-Feng Shieh.

Keywords: Riccati differential equation, Hermitian Riccati differential equation, Radon's Lemma, finite escape time phenomenon, extended solutions, Hamiltonian Jordan canonical form.

The Generalized Riemann Solver of the Multilane Traffic Flow Model

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In this paper we consider a multilane model of traffic flow, which is governed by a hyperbolic system of balance laws. The system of balance laws is given as a 2 by 2 nonlinear hyperbolic system with a discontinuous source term. The global existence of entropy solutions to the Cauchy problem of this multi-lanes model is established by a new version of the generalized Glimm method. The generalized solutions of the Riemann problem, which is the building block of the generalized Glimm scheme, are constructed by Lax's method and an invention of perturbations solving linearized hyperbolic equations with modified source terms. The residuals are estimated for the consistency of the generalized Glimm scheme. The wave interaction estimates are provided for the decay of Glimm functionals and the result of the asymptotic behavior of solutions. This is a joint work with Shih-Wei Chou and John M. Hong.

Keywords: Aw-Rascle Model; multilane model; hyperbolic systems of conservation laws; generalized riemann solver; generalized Glimm scheme; wave interaction.

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Dynamics and Bifurcations of the Hindmarsh-Rose models

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Abstract

In this talk, we first present the bifurcation scenarios of a two-dimensional Hindmarsh–Rose type model with four parameters and simulate some resemblances of neurophysiological features for this model using spike-and-reset conditions. Secondly, we derive requirements for the existence of a Hopf bifurcation in the model and derive equations for the direction and stability of the bifurcation with delay as the bifurcation parameter. When a Hopf bifurcation due to delay occurs, canard-like mixed-mode oscillations are produced at the parameter value for which either the fold bifurcation of cycles or homoclinic bifurcation occurs in the system without delay. Finally, we extend the HR model to one with recurrent neural feedback and spatial information.

Competition for light in forest population dynamics: from computer simulator to mathematical model

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In the presentation I will introduce a size-structured population dynamical model with one and two species for forest growth, and compare this model with a computer forest simulator named SORTIE. The main ingredient taken into account in both models is the competition for light between trees. The parameters of the mathematical model are estimated by fitting to the data generated by SORTIE when the parameter values of SORTIE correspond to the ones previously evaluated for the Great Mountain Forest in USA. We see that the best fit of the parameters of the mathematical model is obtained when the competition for light influences only the growth rate of trees. We also construct a size-structured population dynamical model with spatial structure, and we conduct numerical simulations to observe the spread of trees in space. This work is supervised by Prof. Pierre Magal.

Keywords: computer forest simulator, size-structured model, spatially structured model, state-dependent delay differential equations.

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Problems and Partial Corrections for the article "Quickest Change Detection and Kullback-Leibler Divergence for Two-State Hidden Markov Models"

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Fuh and Mei [1] compute the Kullback-Leibler (KL) divergence of a two-state hidden Markov model (HMM) through the invariant probability measure, characterized by a Fredholm integral equation. The KL divergence is expressed as $J(\theta_1) - J(\theta_0)$, the difference of two upper Lyapunov exponents in their paper. However, there are several subtle problems, in particular the invariant (filter) measure and numerical approximation methods, in their present formulation. We figure out the problems and give corrections for computing $J(\theta_1)$, specifically on the formulas (28) on p.4874, (31-37) on p.4874-4875, and the subsection about numerical methods on p.4875 in [1]. It is quite involved to correct $J(\theta_1)$, and much more involved to correct the other term $J(\theta_0)$ (more accurate $J(\theta_0, \theta_1)$). It needs another paper to study another term (hence the KL divergence). We also elaborate on comparisons of our results and theirs, and show the validity and invalidity of the major results in Fuh and Mei [1].

In addition to corrections, we clarify the concept of filter distribution, the root cause of one class of problems in [1], by regarding it as a second-order distribution. It is known that the HMM filter process is a Markov chain in [2] (and references therein). Denote by Q the transition probability kernel. We derive explicit formulas for Q under various parameter assumptions θ's in theorem 2, and examine Q under the numerical setting θ_1. Under ergodic assumption θ_E, We derive the correct Fredholm integral equation that characterizes the invariant measure in theorem 3, and compute the Lyapunov exponent as an expectation with respect to the invariant measure in theorem 4. In particular, we show an equivalent relation between the Lyapunov exponent for the product of HMM random matrices and the entropy of an HMC, and reveal the close connections between information theory and dynamical systems that have been explored in [3] and [4]. Extensions of our results and methodology are explored in Chen [5], and shall be presented under a more systematic framework and notation system in the coming papers.

Keywords: HMM, filter, invariant measure, Lyapunov exponent, Fredholm integral equation, product of random matrices, entropy rate, dynamical system

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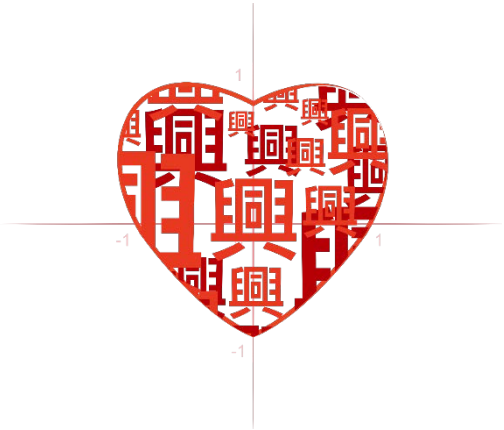

偏微分方程

Partial Differential Equations

Organizer：吳昌鴻

地點：資訊科學大樓 U301

2019年12月7日(星期六)		Speaker
11:20-12:05	Approximation and Existence of Vacuum States in the Multi-scale Flows of Compressible Euler Equations Chair:黃信元	洪盟凱 Meng-Kai Hong
13:30-13:55	Revisit Abelian and Tauberian theorem for Logarithmic asymptotic behavior Chair:張覺心	陳逸昆 I-Kun Chen
13:55-14:20	A kinetic model for a polyatomic gas with temperature-dependent specific heats and its application to shock-wave structure Chair:張覺心	郭鴻文 Hung-Wen Kuo
14:25-14:50	On a new class of fractional partial differential equations Chair:黃博峙	謝天長 Tien-Tsan Shieh
14:50-15:15	The fractional Calderón problem Chair:黃博峙	林奕亘 Yi-Hsuan Lin

2019年12月8日(星期日)		Speaker
10:10-10:55	On the Uniqueness and Structure of Solutions to the System Arising from Maxwell-Chern-Simons O(3) Sigma Model Chair:李俊璋	陳志有 Zhi-You Chen
11:00-11:25	Debye layer in Poisson-Boltzmann model with isolated singularities Chair:李俊璋	謝佳佑 Chia-Yu Hsieh
11:25-11:50	N-barrier maximum principle for reaction-diffusion equations Chair:吳昌鴻	洪立昌 Li-Chang Hung
11:50-12:15	On a class of indefinite nonlinear Schrödinger-Poisson system with steep potential well Chair:吳昌鴻	王冠祥 Kuan-Hsiang Wang

Approximation and Existence of Vacuum States in the Multi-scale Flows of Compressible Euler Equations.

Meng-Kai Hong
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Abstract

In this paper, we study the approximation and existence of vacuum states in the multi-scale gas flows governed by the Cauchy problem of compressible Euler equations containing a small parameter \eta in the initial density. The system of Euler equations is reduced to a hyperbolic resonant system at the vacuum so that the weak solution of the Riemann problem is not suitable as the building block of Glimm (or Godunov) scheme to establish the existence of weak solutions with vacuum states. We construct a new type of approximate solutions, which are the weak solutions to the regularized Riemann problem of the leading order system by the asymptotic expansion around vacuum states. Such approximate solution is obtained by solving the pressureless Euler equations with generalized Riemann data, it consists of constant states separated by a composite hyperbolic wave, which is a combination of one nonlinear hyperbolic waves and two discontinuous linear waves. We show the stability of such regularized Riemann solution, together with the numerical simulations, under the small perturbations of generalized Riemann data. Adopting such solution as the building block of generalized Glimm scheme, we establish the existence of the vacuum solutions by showing the stability and consistency of the scheme. The numerical simulation indicates that, for any small time t, the approximate solutions converges to the exact solutions of the Cauchy problem in L^1 as \eta approaches 0. The theoretical proof of L^1 convergence is also provided. The results of this paper can be applied to some hyperbolic resonant systems of balance laws. This is a joint work with Chia-Chieh Jay Chu (NTHU), Hsin-Yi Lee (NCU) and Ying-Chieh Lin (NUK).

Revisit Abelian and Tauberian theorem for Logarithmic asymptotic behavior

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We revisit the relation between asymptotic behavior between large time and small frequency under Laplace transform. For logarithmic case, we have a simple proof for Abelian and Tauberian theorem. This result is a a special case of Karamata's general and highly technical theorem. Thanks to properties of logarithm, our proof only involves elementary real analysis and calculus. This talk is based on a joint work with Jhe-Kuan Su.

Keywords: Laplace transform, Tauberian theorem.

A kinetic model for a polyatomic gas with temperature-dependent specific heats and its application to shock-wave structure

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The ellipsoidal statistical (ES) model of the Boltzmann equation for a polyatomic gas, proposed by Andries *et al.* [P. Andries et al., Eur. J. Mech. B/Fluids **19**, 813 (2000)], is extended to a polyatomic gas with temperature-dependent specific heats (thermally perfect gas). Then, the new model equation is used to investigate the structure of a plane shock wave with special interest in CO_2 gas, which is known to have a very large bulk viscosity, and in the case of relatively strong shock waves. The numerical and asymptotic analyses are performed in parallel to the paper by S. Kosuge and K. Aoki [S. Kosuge and K. Aoki, Phys. Rev. Fluids **3**, 023401 (2018)], where the structure of a shock wave in CO_2 gas was investigated using the ES model for a polyatomic gas with constant specific heats (calorically perfect gas). From the numerical and analytical results, the effect of temperature-dependent specific heats is clarified. This is a joint work with Shingo Kosuge and Kazuo Aoki.

Keywords: Boltzmann equation, ellipsoidal statistical model, polyatomic gas, temperature-dependent specific heats, shock-wave structure

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On a new class of fractional partial differential equations

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In this work we continue to advance the theory regarding the Riesz fractional gradient in the calculus of variations and fractional partial differential equations begun in an earlierwork of the same name. In particular, we here establish an L^1 Hardy inequality, obtain further regularity results for solutions of certain fractional PDE, demonstrate the existence of minimizers for integral functionals of the fractional gradient with non-linear dependence in the field, and also establish the existence of solutions to corresponding EulerLagrange equations obtained as conditions of minimality.

Keywords: Fractional gradient, fractional Hardy inequality, fractional partial differential equations, interpolation, Dirichlet forms

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The fractional Calderón problem

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Abstract

We review recent progress in the fractional Calderón problem, where one tries to determine an unknown coefficient in a fractional Schrödinger equation from exterior measurements of solutions. This equation enjoys remarkable uniqueness and approximation properties, which turn out to yield strong results in related inverse problems.

On the Uniqueness and Structure of Solutions to the System Arising from Maxwell-Chern-Simons $O(3)$ Sigma Model

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In this talk, we will talk about the uniqueness of topological multivortex solutions for the self-dual Maxwell-Chern-Simons $O(3)$ sigma model with Chern-Simons coupling parameter sufficiently large and the charge of electron either sufficiently small or large. Besides, we also establish the sharp region of flux-pairs for the non-topological solutions and provide the classification of radial solutions of all types for single vortex point case. This is a joint work with Jann-Long Chern.

Keywords: uniqueness, topological multivortex solution, Maxwell-Chern-Simons

Debye layer in Poisson-Boltzmann model with isolated singularities

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In this talk, we will show the existence of solutions to the charge-conserving Poisson-Boltzmann equation with Dirichlet boundary condition on $\partial\Omega$. Here Ω is a smooth simply connected bounded domain in $\mathbb{R}^n$ with $n \geq 2$. When $n = 2$, the solutions can have isolated singularities at prescribed points in Ω. As a small parameter ϵ tends to zero, the solutions develop Debye boundary layer near the boundary $\partial\Omega$. In the interior of Ω, the solutions converge to a unique constant. The limiting constant is explicitly calculated in terms of a novel formula which depends only on the supplied Dirichlet data on $\partial\Omega$. In addition, we also give a quantitative description on the asymptotic behaviour of the solutions as $\epsilon \to 0$. This is a joint work with Yong Yu (CUHK).

Keywords: Poisson-Boltzmann equation, boundary layer, asymptotic behaviour

N-barrier maximum principle for reaction-diffusion equations

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This talk is devoted to the *N-barrier maximum principle* (NMBP) for the following n equations

$$d_i(u_i)_{xx} + \theta(u_i)_x + u_i^{l_i} f_i(u_1, u_2, \cdots, u_n) = 0, \quad x \in \mathbb{R}, \quad i = 1, 2, \cdots, n, \qquad (1)$$

where $u_i = u_i(x)$, d_i, $l_i > 0$, $\theta \in \mathbb{R}$, and $f_i(u_1, u_2, \cdots, u_n) \in C^0(\mathbb{R}^+ \times \mathbb{R}^+ \times \cdots \times \mathbb{R}^+)$ for $i = 1, 2, \cdots, n$. (1) arise from the study of traveling waves solutions of reaction-diffusion equations. For a solution $u_i(x)$ $(i = 1, 2, \cdots, n)$ of (1), the NBMP asserts that lower and upper bounds of $\sum_{i=1}^n \alpha_i u_i(x)$ can be given in terms of the parameters in (1) for arbitrary α_i $(i = 1, 2, \cdots, n)$. We will introduce briefly our work as follows:

- **Linear diffusion**: We prove the NBMP for (1) in [3]. In particular, the case $n = 2$ is proved in [2]. Under more restricted conditions on the parameters in (1) with $n = 3$, we give the lower and upper bounds of $u_1 + u_2 + u_3$ in [1].
- **Nonlinear diffusion**: With $(u_i)_{xx}$ replaced by $(u_i^2)_{xx}$, the NBMP is established for $n = 2$ in [4].
- **Discretized diffusion**: Recently, we have generalized the NBMP for a discretized diffusion version of (1) when $n = 2$ in [5].

Finally, as an application we use our NBMP to show the nonexistence of a three-species system.

Keywords: maximum principle, traveling wave solutions, reaction-diffusion equations.

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On a class of indefinite nonlinear Schrödinger-Poisson system with steep potential well

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In this talk, we are concerned with the Schrödinger-Poisson systems with steep potential well and sign-changing weight functions. More precisely, the nonlinearity is a combination of a linear term and a superlinear term in the form $\lambda f(x)u + g(x)|u|^{p-2}u$, where $\lambda > 0, 4 \leq p < 6$ and f and g are allowed to be sign-changing. It is well known that a class of Schrödinger-Poisson systems with the above nonlinearity and the potential being positive constant has two positive solutions when the limit of infinity $\lim_{|x|\to\infty} g(x) = g_\infty < 0$ and either $K = 0$ a.e. in the set $\{x \in \mathbb{R}^3 : g(x) = 0\}$ or $\int_{\mathbb{R}^3}(ge_1^4 - K\phi_{e_1}e_1^2)dx < 0$ holds, see Huang-Rocha-Chen, J. Differential Equations 255 (2013); Chen, Nonlinear Anal. 21 (2015); Shen-Han, J. Math. Anal. Appl. 426 (2015). The main purpose is to obtain the existence and multiplicity of positive solutions without the above assumptions for g and K. The results are obtained via variational method. This is a joint work with Prof. Tsung-fang Wu.

Keywords: Non-autonomous Schrödinger-Poisson system, indefinite nonlinearity, steep potential well, variational methods.

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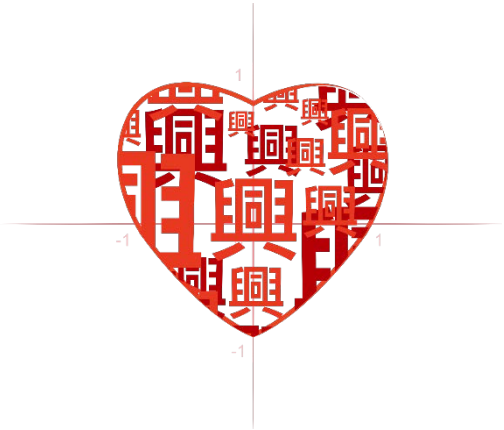

離散數學

Discrete Mathematics

Organizer：符麥克

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2019年12月7日(星期六)		Speaker
11:20-12:05	Asymptotics and statistics on Fishburn matrices and their generalization Chair:符麥克	黃顯貴 Hsien-Kuei Hwang
13:30-13:55	About Tiny-Pan Coin-Weighing Problem Chair:李渭天	韓永楷 Wing-Kai Hon
13:55-14:20	Finding non-minority balls with majority and plurality queries Chair:李渭天	張惠蘭 Huilan Chang
14:25-14:50	The number of pattern occurrences in random planar maps Chair:李渭天	余冠儒 Guan-Ru Yu
14:50-15:15	On the number of root ancestral congurations for a matching gene tree and species tree under uniform model and Yule model Chair:李渭天	Ariel R.Paningbatan

2019年12月8日(星期日)		Speaker
10:10-10:55	Permutation statistics and signed statistics Chair:傅東山	游森棚 Sen-Peng Eu
11:00-11:25	Signed mahonian identities on permutations with subsequence restrictions Chair:余冠儒	徐祥峻 Hsiang-Chun Hsu
11:25-11:50	On the integer {k}-domination number of circulant graphs Chair:余冠儒	劉家安 Chia-An Liu
11:50-12:15	Multichannel Conflict-Avoiding Code Chair:余冠儒	羅元勳 Yuan-Hsun Lo

Asymptotics and statistics on Fishburn matrices and their generalizations

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October 19, 2019

Fishburn matrices, introduced in the 1970s in the contexts of interval orders (in order theory) and directed graphs, are nonnegative, upper-triangular ones without zero row or zero column. They have later found to be bijectively equivalent to several other combinatorial structures such as ascent sequences, pattern-avoiding permutations, pattern-avoiding inversion sequences, Stoimenow matchings, and regular chord diagrams. In addition to their rich combinatorial connections, the corresponding asymptotic enumeration and the finer distributional properties are even more enriching and challenging, as will be presented in this talk. In particular, while the asymptotics of some classes of Fishburn matrices were known, the stochastic aspects of the major characteristic statistics have remained open up to now.

We develop a direct saddle-point analysis (without relying on any modular forms, identities or functional equations) to establish the asymptotics of Fishburn matrices and a large number of others with a similar sum-of-finite-product form for their (formal) general functions. In addition to solving several conjectures, the application of our saddle-point approach to the distributional aspects of statistics on Fishburn matrices is also examined with many new limit theorems characterized, representing the first of their kind for such structures.

This talk is based on joint work with Emma Yu Jin (University of Vienna).

Keywords: Generating function, asymptotic enumeration, saddle-point method, quantum modular forms, limiting distribution.

About Tiny-Pan Coin-Weighing Problem

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We study a special form of integer partition of n, where the target is to find a maximal partition P, with the maximum number of parts, that does not include any partition of f as its subset. Let $\rho(f, n)$ denote the number of parts in P. We show that such a problem is closely related to the tiny-pan coin weighing problem where each pan of the balance scale can hold exactly one coin, thereby deriving exact bounds for $\rho(f, n)$ in some of the cases. Furthermore, we show that $\rho(f, n)$ is ultimately periodic as a function of n.

This is a joint work with Te-Sheng Tan and Dai-Yang Wu.

Keywords: Coin Weighing Problem, Tiny Pan, Integer Partition

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Finding non-minority balls with majority and plurality queries

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Given a set of n colored balls, a *majority, non-minority or plurality ball* is one whose color class has size more than $n/2$, at least $n/2$ or larger than any other color class, respectively. We describe linear time algorithms for finding non-minority balls using query sets of size q of the following form: the answer to a majority/plurality query Q is a majority/plurality ball in Q or the statement that there is no such ball in Q.

This is a joint work with Dániel Gerbner and Balázs Patkós.

Keywords: search balls, sequential algorithm, majority queries.

The number of pattern occurrences in random planar maps

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The study of planar maps goes back to Tutte [12, 13] to mid-1960s. However, within the last 20 years there has been a renewed interest in the mathematical study of planar maps which started mainly due to the work by Schaeffer [10]. Recently there has also been a growing interest in local convergence [11] which means that a distribution of probability that a given local structure occurs around the root (or around a random vertex/ or anywhere in a random map) stabilizes.

The problem of pattern occurrences can be classified into two categories. One of them refers to local problems concerning pattern occurrences around the root [7, 9], the other involves global situations with patterns occurring anywhere in maps [2, 3, 5, 6]. Moreover, not only the pattern enumeration but also the submap enumeration is interested [1].

In this talk, I will present some results related to both local and global issues together with the history of planar maps. Whereas local problems can be completely solved, global problems is solved in general only in first order, which means that we can characterize the expected number of occurrences of a given pattern. In the global context, it is widely believed that the random variable that counts the number of occurrences of a pattern satisfies a central limit theorem [8].

Keywords: planar maps, pattern occurrence, generating functions, quadratic method, central limit theorem, local convergence.

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On the number of root ancestral configurations for a matching gene tree and species tree under uniform model and Yule model

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For a given pair of gene tree and species tree, the *ancestral configurations* for an internal node of the species tree are the set of distinct gene lineages that are present under the node. Results on the number of *root* ancestral configurations, which are the ancestral configurations for the root, under uniform model and Yule model will be discussed in this presentation. In particular, choosing both trees uniformly at random from the set of labeled topology with n leaves, the number of root ancestral configurations of such random trees is shown to asymptotically follow a lognormal distribution with mean $\sim 0.272n$ and variance $\sim 0.034n$. A similar result also holds for Yule model but with mean and variance of the number of root configurations grow asymptotically like $\sim 1.43^n$ and $\sim 2.04^n$. This is joint work with Filippo Disanto (University of Pisa), Michael Fuchs (National Chengchi University) and Noah Rosenberg (Stanford University).

Keywords: analytic combinatorics, gene trees, phylogenetics, species trees

Permutation statistics and signed statistics

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In this talk we give a brief survey on permutation statistics and present some recent works themed around signed statistics.

Keywords: permutation statistics, equidistribution, Euler numbers, Eulerian numbers, Coxeter groups, Mahonian, signed Mahonian, Euler-Mahonian

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Signed mahonian identities on permutations with subsequence restrictions

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In this talk, we will introduce some results surrounding Caselli's conjecture on the equidistribution of the major index with sign over the two subsets of permutations of $\{1, 2, \ldots, n\}$ containing respectively the word $12 \cdots k$ and the word $(nk+1) \cdots n$ as a subsequence, under a parity condition of n and k. We derive broader bijective results on permutations containing varied subsequences. Hence, we obtain the signed mahonian identities on families of restricted permutations, in the spirit of a well-known formula of Gessel–Simion, covering a combinatorial proof of Caselli's conjecture. We also derive an extension of the insertion lemma of Han and Haglund–Loehr–Remmel which allows us to obtain a signed enumerator of the major-index increments resulting from the insertion of a pair of consecutive numbers in any place of a given permutation.

Keywords: signed major index, equidistribution, permutation with subsequence restrictions, linear extensions, pattern avoiding permutations, insertion lemma

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On the integer $\{k\}$-domination number of circulant graphs

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Let $G = (V, E)$ be a simple undirected graph. G is a circulant graph defined on $V = \mathbb{Z}_n$ with difference set $D \subseteq \{1, 2, \ldots, \lfloor \frac{n}{2} \rfloor\}$ provided two vertices i and j in $\mathbb{Z}_n$ are adjacent if and only if $\min\{|i-j|, n-|i-j|\} \in D$. For convenience, we use $G(n; D)$ to denote such a circulant graph.

A function $f : V(G) \to \mathbb{N} \cup \{0\}$ is an integer $\{k\}$-domination function if for each $v \in V(G)$, $\sum_{u \in N_G[v]} f(u) \geq k$. By considering all $\{k\}$-domination functions f, the minimum value of $\sum_{v \in V(G)} f(v)$ is the $\{k\}$-domination number of G, denoted by $\gamma_k(G)$. In this paper, we prove that if $D = \{1, 2, \ldots, t\}$, $1 \leq t \leq \frac{n-1}{2}$, then the integer $\{k\}$-domination number of $G(n; D)$ is $\lceil \frac{kn}{2t+1} \rceil$. For more details please see [1]. This is a joint work with Yen-Jen Cheng and Hung-Lin Fu.

Keywords: Circulant graph, integer $\{k\}$-domination number, Euclidean algorithm, integer linear program.

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Multichannel Conflict-Avoiding Codes

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A conflict-avoiding code (CAC) $\mathcal{C}$ of length n and weight k is a collection of k-subsets of $\mathbb{Z}_n$ such that $\Delta(x) \cap \Delta(y) = \emptyset$ for any $x, y \in \mathcal{C}$ and $x \neq y$, where $\Delta(x) = \{a - b : a, b \in x, a \neq b\}$. CAC was introduced by Levenshtein and Tonchev [1] as a scheduling mechanism for multiple-access collision channel without feedback. Recently, we extend CACs to support multichannel wireless networks [2]. Upper bounds on the codewords for multichannel conflict-avoiding codes with weights three and four are derived, and optimal codes attaining these bounds are given.

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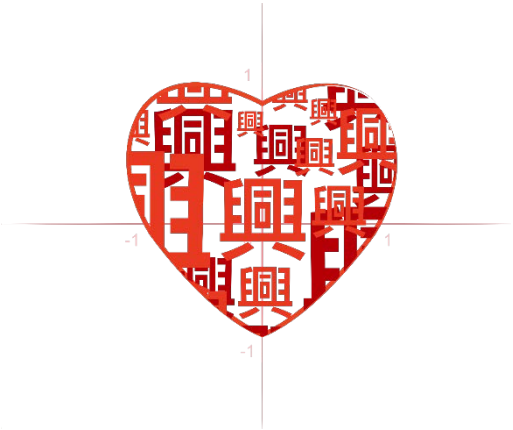

計算數學

Computational Mathematics

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2019 年 12 月 7 日(星期六)		Speaker
11:20-12:05	Motivations, Derivations and Global Error Analysis of Splitting Methods Chair:施因澤	Qin Sheng
13:30-13:55	Data Assimilation Technique with Long Short Term Memory Networks for Highway Traffic Flow Prediction Chair:謝博文	黃楓南 Feng-Nan Hwang
13:55-14:20	Numerical methods for minimization problems on surfaces Chair:胡偉帆	朱家杰 Chia-Chieh Chu
14:25-14:50	Efficient Eigensolvers for Graph Laplacian Models Chair:胡偉帆	黃韋強 Wei-Qiang Huang

2019 年 12 月 8 日(星期日)		Speaker
10:10-10:55	Mathematical modeling and computation of potassium ion channels Chair:謝博文	洪子倫 Tzyy-Leng Horng
11:00-11:25	Manifold Parameterization: Theory and Practice Chair:謝博文	樂美亨 Mei-Heng Yueh

Motivations, Derivations and Global Error Analysis of Splitting Methods

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Splitting methods have been used for solving a broad spectrum of problems in scientific applications. They are designed for the numerical solutions to not only differential equations, but also optimization and machine learning procedures. A splitting method decomposes an original problem to several subproblems, computes separately the solution of each of them, and then combines all sub-solutions to form an approximation of the solution to the original problem. Motivations of different splitting methods are inspired by problems with multiple operators in natural ways. In all cases, the computational advantage is that it is faster to compute the solution of the split components separately, than to compute the solution directly when they are treated together. However, this comes at the cost of an error introduced by the splitting, so strategies must be devised for controlling the error. This talk studies splitting mechanisms via operator formulations. A survey will be conducted in global error estimates of popular exponential splitting strategies. Adaptive splitting, a highly effective decomposition collaborating with mesh adaptations, will also be briefly elaborated.

Keywords: splitting, operators, error analysis

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Data Assimilation Technique with Long Short Term Memory Networks for Highway Traffic Flow Prediction

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Developing an accurate and reliable computational tool for traffic flow prediction has always been an active research topic in transportation engineering and planning. In general, the available predictive tools are falls into three categories, i.e., parametric methods, nonparametric methods, and PDE-based simulations. In particular, the machine learning methods, such as the k-nearest neighbor (K-NN) method and the long short term memory networks (LSTM) belong to the nonparametric methods, while the Autoregressive integrated moving average (ARIMA) and its variants are the most representative parametric methods. In this work, we propose the data assimilation technique with the long short term memory networks (LSTM) for predicting the highway traffic flows. The proposed method is developed based on the framework of the Karman filtering algorithm, which consists of two key components: the prediction step and the correction step. The predicted value is obtained by performing numerical simulation and then corrected by Karman filtering with real data. As the numerical simulator, which is a kernel component of the predictive tool, we use an explicit Godunov's method to discretize the Lighthill-Whitham-Richards model, where the MacNicholas formulation is used as the fundamental relation between the velocity and density. Since the data at the upstream boundary point in the future period is not available. The pseudo-predicted values obtained by using LSTM are used for setting boundary conditions. In this study, we use Seasonal ARIMA (SARIMA), LSTM methods as baseline methods and compare them with our proposed method. The numerical results show that our method outperforms SARIMA and LSTM. This is joint work with Chia-Ming Chang (NCU, Math) and Chia-Hui Chang (NCU, CSIE).

Keywords: Highway traffic flow prediction, PDE-based simulation, Karman filtering, Data assimilation.

Numerical methods for minimization problems on surfaces

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Partial differential equations on surfaces have wild applications in many areas, such as material science, surfactant problems, image processing and biology. These PDEs usually originate from minimizing energy functions defined on surfaces. This work targets applications that use implicit or non-parametric representations of closed surfaces or curves and require numerical solution for minimization problems defined on the surfaces.

Our framework showed that the energy function defined on surfaces can be extended to the energy function defined on the nearby tubular neighborhood that gives the same energy when input the constant-along-normal extension. Furthermore, the extended energy function gives the same minimizer as which the original energy function gives in the sense of restriction on the surface. This new approach connects the original energy function to an extended energy function and provides a good framework to solve PEDs numerically on Cartesian grids. In this talk, we introduce the framework and the related problems have been solved by the proposed method, such as Laplace-Beltrami operator, TV-denoising and obstacle problems defined on surfaces. Recently, under this framework, we develop a modified level-set method to solve interface problem on Cartesian grids. This is a joint work with Professors Richard Tsai and Ming-Chih Lai.

Keywords: partial differential equations on surface, Laplace-Beltrami operator, TV-denosing, level-set method

Efficient Eigensolvers for Graph Laplacian Models

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The graph Laplacian eigenvalue problem is an important model for solving the problems of clustering or dimensionality reduction. To this end, computing some smallest eigenvalues and corresponding eigenvectors of a graph Laplacian matrix is often of interest. However, due to the graph Laplacian matrix is positive semi-definite, its singularity makes the classical eigensolvers, such as the inverse power method or the Lanczos methods, inefficient since we need to solve related linear systems.

In this talk, we will introduce structured numerical algorithms for dealing with the graph Laplacian eigenvalue problem. We propose the numerical algorithms according to the properties and structures of the graph Laplacian matrix obtained by different models. Numerical experiments demonstrate that the structured eigensolvers outperform classical methods.

Keywords: Graph Laplacain, Eigenvalue Problem, Spectral Embedding, Spectral Clustering

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Mathematical modeling and computation of potassium ion channels

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Ion channels are pore-forming trans-membrane proteins that allow ions to enter/leave cell. There are many important cell functions involving ion channel, e.g., establishing and regulating action potential in neurons and myocytes. The average time for an ion passing through ion channel is in the order of ms, which is infeasible for molecular dynamics simulation so far. Continuum model like Poisson-Boltzmann equation (PB) and Poisson-Nernst-Planck (PNP) equations are popular to describe ion channel in equilibrium and non-equilibrium situations. KcsA potassium channel is chosen to be studied here, since it is one of few ion channels having X-ray crystallographic structure. 3D PB and PNP simulations of KcsA channel have been a challenging task, since (1) geometry is complicated especially the narrow selectivity filter (SF) part requiring high resolution over there when generating meshes; (2) mathematical models are complicated since classical PB/PNP needs to be further modified to consider both finite-size effect of ions and solvation energy; (3) macroscopic physical parameters such as dielectric constant and diffusion coefficient at SF are generally unknown. Here, Bikerman model, a modified PB/PNP model considering finite-size effect of ions, is employed and modified to study this KcsA potassium channel. The basic idea of Bikerman model is to include entropy of water when ionic concentration is no more dilute. This will cause potassium to saturate at SF where negative carbonyl oxygen charges pose very strong electric field to attract potassium. For computation, Poisson equation in governing equations is extended to be pseudo-time-dependent with the steady-state solution being our only interest. Governing equations are semi-discretized in space by 2nd order finite volume method under Cartesian grids with the cell edge value to cope with interface and boundary conditions. Runge-Kutta method is then utilized to do the time integration. GPU parallel computation is applied to accelerate this large-scale computation. From simulation results, we found potassium is saturated inside SF and it reveals binding sites in agreement with molecular dynamics simulation. Additional pile-ups of potassium right outside SF are also found to help achieving electro-neutrality, which is identified as additional binding sites in potassium channels.

Keywords: Poisson-Boltzmann, Poisson-Nernst-Planck, Bikerman, ion channel, finite-size effect, finite volume method

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Manifold Parameterization: Theory and Practice

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A manifold parameterization is a homeomorphism that maps the manifold onto the domain of a canonical shape. The mapping induces a coordinate system on the manifold, which can be used to simplify the issues arising from geometry processing and computer graphics. In this talk, I will introduce some related theoretical backgrounds and my recent works on computational algorithms for parameterizations of surfaces and 3-manifolds. Applications on computer graphics will be demonstrated thereafter.

Keywords: Manifold, Parameterization, Conformal, Volume-Preserving

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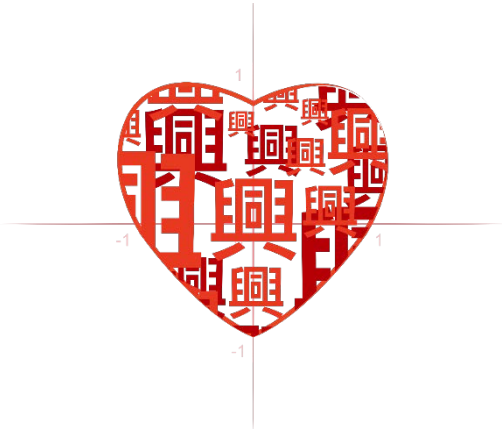

機率

Probability

Organizer：許元春

地點：資訊科學大樓 U517

2019 年12 月7 日(星期六)		Speaker
11:20-12:05	Limit theorems and wrapping transformations in bi-free probability theory Chair:許元春	黃皓瑋 Hao-Wei Huang
13:30-14:15	Invariant measure and flow associated to the Φ^4-quantum field model on the three-dimensional torus Chair:許順吉	Seiichiro Kusuoka
14:25-14:50	Asymptotic behavior of random walk in cooling random environment Chair:許順吉	Yuki Chino
14:50-15:15	Gaussian fluctuations in two-dimensional surface growth models Chair:許順吉	Yu-Ting Chen

2019 年12 月8 日(星期日)		Speaker
10:10-10:55	Monte Carlo Markov Processes and Related Problems Chair:許元春	黃啟瑞 Chii-Ruey Hwang
11:00-11:45	Random walk conditioned on survival among Bernoulli obstacles: sub-critical phase Chair:黃啟瑞	Ryoki Fukushima
11:45-12:10	Optimal Markov Chain Monte Carlo Sampling Chair:黃啟瑞	陳定立 Ting-Li Chen
12:10-12:35	Automatic Sleep Scoring by the Scattering Transform, Diffusion Maps, and Hidden Markov models Chair:黃啟瑞	劉聚仁 Gi-Ren Liu

Limit theorems and wrapping transformations in bi-free probability theory

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In classical probability, Lévy and Khintchine demonstrated that the limit law associated with any triangular array of infinitesimal random variables is infinitely divisible. In this talk, we shall manifest the analogous results for distributions on the plane and bi-torus in the framework of bi-free probability theory. Like the classical situation, bi-freely additive and multiplicative infinitely divisible distributions, and solely these distributions serve as the limiting distributions of a triangular array of infinitesimal random variables. The bi-free harmonic analysis developed by ourselves performs an essential role in the study of bi-free limit theorems. These limit theorem consequences also establish tight bonds between classical and bi-free probability theories. If time permits, some other relevant topics will be discussed.

Invariant measure and flow associated to the Φ^4-quantum field model on the three-dimensional torus

Seiichiro Kusuoka
(Kyoto University)

We give a direct construction global flows for the stochastic quantization equation to the quantum field theoretical Φ^4-model on the 3-dimensional torus. For the construction we prepare stationary processes of approximation equations of the stochastic quantization equation and show the tightness of approximation processes. The limit of marginal distributions is also stationary with respect to the limit process and is regarded as a Φ^4_3-measure on the torus. In this sense, we introduce a new construction of a Φ^4_3-measure. For the proof we use the method of singular stochastic partial differential equations, Besov spaces and paraproducts.

Asymptotic behavior of random walk in cooling random environment

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One-dimensional Random Walk in Cooling Random Environment (RWCRE) is obtained as a patchwork of one-dimensional Random Walk in Random Environment (RWRE) by resampling the environment along a sequence of deterministic times. The RWCRE model can be seen as a model that interpolates between the classical static model and the model with i.i.d. resamplings every unit of time.

In this talk, we have two results about the asymptotic behavior of RWCRE. First, we investigate how the recurrence versus transience criterion known for RWRE changes for RWCRE. Second, we explore the fluctuation for RWCRE when RWRE is either recurrent or satisfies a classical central limit theorem. In the previous work, we showed that SLLN and LDP for RWCRE were the same as those for RWRE under a certain condition for the resampling. However, two results in this talk are different from those for RWRE. They really depend in a delicate way on how we choose resampling. In particular, sub-diffusive scaling and convergence to mixtures of different limit laws are possible.

This talk is based on a joint work with L. Avena, C. da Costa and F. den Hollander (Leiden University).

Keywords: random walk in random environment, random walk in dynamical random environment, asymptotic behavior

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Gaussian fluctuations in two-dimensional surface growth models

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In this talk, I will discuss stochastic surface growth dynamics within the anisotropic class of the Kardar–Parisi–Zhang (KPZ) equation. Fluctuations of the dynamics are conjectured to be Gaussian in the limit of large time as if an unusual nonlinear term in the equation does not exist. The first proofs, proven recently, study iterated scaling limits of some particle systems. I will discuss these results and explain the particular roles of the de Moivre–Laplace theorem and the Poisson limit theorem for the problem.

Monte Carlo Markov Processes and Related Problems

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Abstract: Monte Carlo Markov processes have been widely used to calculate the expectations of statistics or to approximate the underlying probability when direct sampling is not feasible. The evaluation of the approximation depends on various criteria, e.g. asymptotic variance, spectral gap, convergence exponent in variational norm etc. This is a survey of our work. Open problems will be discussed.

Random walk conditioned on survival among Bernoulli obstacles: sub-critical phase

Ryoki Fukushima
(Research Institute for Mathematical Sciences, Kyoto University)

I will present two recent results on a discrete time random walk conditioned to avoid Bernoulli obstacles on the d-dimensional integer lattice obtained in joint works with Jian Ding, Rongfeng Sun and Changji Xu. The first result on this model dates back to a famous work by Donsker and Varadhan on the Wiener sausage in 1975. Since then, it has been intensively studied and various localization results have been proved. In particular, the random walk is known to localize in a ball of sub-diffusive size under the annealed law. Our first result gives a more detailed geometric description of the range of the random walk. More precisely, we showed that it completely fills the ball where the walk is localized, and in addition we got a sharp estimate on the size of its boundary.

Our second result is about the response to an external force. If we give a bias to the random walk, then the model is known to undergo a phase transition: for a large bias, the walk is ballistic whereas for a small bias, it is sub-ballistic. This phase transition was proved by Sznitman and later, Ioffe and Velenik studied the ballistic phase in detail. In the sub-ballistic phase, physicists conjectured that the walk is localized in a sub-diffusive scale as in the unbiased case, but it has not been proved. We prove this conjecture with a precise information on the behavior of whole path.

Optimal Markov Chain Monte Carlo Sampling

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In this talk, I will introduce optimal Markov chain Monte Carlo (MCMC) sampling. The focus is on homogeneous Markov chains. I will first define the problem of finding the optimal transition matrix based on minimizing the asymptotic variance. Results on three types of optimal transition matrices [1, 2, 3] will be presented, and one open problem will be mentioned. I will also discuss the locally optimal sampler (LOS): an MCMC sampling that performs local updates based on the optimal transition matrix. In our simulation studies, the LOS was shown to provide an improved rate of convergence over the MetropolisVHastings and the Gibbs Sampler. The implementation of the LOS requires only minor modifications in existing Gibbs sampling code.

Keywords: Markov chain Monte Carlo, asymptotic variance, transition matrix

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Automatic Sleep Scoring by the Scattering Transform, Diffusion Maps, and Hidden Markov models

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This presentation discusses an unsupervised approach for sleep dynamics exploration and automatic annotation by combining modern harmonic analysis tools. We apply a nonlinear-type time frequency analysis tool to extract the frequency-domain features from a pair of physiological signals. The dynamics of the spectral information is visualized by the multiview diffusion maps. Based on the feature sequence and the expert-determined sleep stages, we construct a hidden Markov model to predict the sleep stages of new subjects. The prediction performance is validated on a publicly available benchmark database, Physionet Sleep-EDF SC and ST, with the leave-one-subject-out cross validation. This talk includes the joint works [1, 2] with Yu-Lun Lo, John Malik, Yuan-Chung Sheu, and Hau-Tieng Wu.

Keywords: multiview diffusion maps, hidden Markov models.

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最佳化

Optimization

Organizer：陳鵬文

地點：理學大樓 S106

2019 年12 月7 日(星期六)		Speaker
11:20-12:05	Healthcare Data Handling Using Markov Decision Processes Chair:陳鵬文	陸行 Hsing Luh
13:30-13:55	Signal reconstruction by conjugate gradient algorithm based on smoothing l_1-norm Chair:陳鵬文	陳界山 Jein-Shan Chen
13:55-14:20	Continuation methods for Optimization Problems Chair:陳鵬文	郭岳承 Yueh-Cheng Kuo
14:25-14:50	Variational Inequality With DC Program as Constraint Chair:彭冠舉	莊智升 Chih-Sheng Chuang

2019 年12 月8 日(星期日)		Speaker
10:10-10:55	Alternative arrangement of level sets of a pair of quadratic functions Chair:陳鵬文	許瑞麟 Ruey-Lin Sheu
11:00-11:25	A Study on Category-level Promotion and Customized Product Assortment under Multinomial Logit Choice Model Chair:許瑞麟	林仁彥 Jen-Yen Lin
11:25-11:50	Common Zero to Finite Mappings with Sums of Two Monotone Operators and Applications Chair:陳鵬文	林來居 Lai-Jiu Lin
11:50-12:15	The Schatten *p*-norm on R^n Chair:陳鵬文	黃建豪 Chien-Hao Huang

Healthcare Data Handling Using Markov Decision Processes

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Handling healthcare data is chanllenging, including learning information from disease progression, risk accessment, and medical treatment decisions, etc., which is often sequential and uncertain. Markov decision processes (MDPs) are an appropriate technique for modeling and solving such stochastic and dynamic decisions. This talk gives an overview of MDP models and solution techniques of MDP that enrich reinforcement learning framework. We describe MDP modeling in the context of reinforcement learning and discuss when MDPs are an appropriate technique. We review selected successful applications of MDPs to show opportunities for applying MDPs to healthcare data handling.

Keywords: Markov Decision Processes, Conditional Probabilities, Reinforcement Learning, Optimization Modeling.

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Signal reconstruction by conjugate gradient algorithm based on smoothing l_1-norm

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The l_1-norm regularized minimization problem is a non-differentiable problem and has a wide range of applications in the field of compressive sensing. Many approaches have been proposed in the literature. Among them, smoothing l_1-norm is one of the effective approaches. This paper follows this path, in which we adopt six smoothing functions to approximate the l_1-norm. Then, we recast the signal recovery problem as a smoothing penalized least squares optimization problem, and apply the nonlinear conjugate gradient method to solve the smoothing model. The algorithm is shown globally convergent. In addition, the simulation results not only suggest some nice smoothing functions, but also show that the proposed algorithm is competitive in view of relative error.

Keywords: l_1-norm regularization, compressive sensing, conjugate gradient algorithm, smoothing function.

Continuation methods for Optimization Problems

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In this talk, a continuation method for computing local optimal solution curves of the cost parameterized optimization problem is presented. We recast the problem to a parameterized nonlinear equation derived from its Lagrange function and show that the point where the positive definiteness of the projected Hessian matrix vanishes must be a bifurcation point on the solution curve of the equation. Based on this formulation, the local optimal curves can be traced by the continuation method, coupled with the testing of singularity of the Jacobian matrix. Using the proposed procedure, we successfully compute the energy diagram of rotating Bose-Einstein condensates.

For a nonnegative tensor $\mathcal{A} \in \mathbb{R}^{n_1 \times \cdots \times n_m}$, the rank-1 approximation of the tensor $\mathcal{A}$ can be formulated as an optimization problem. Continuation method [1] is guaranteed to compute a local optimizer of the optimization problem.

Keywords: continuation method, nonnegative tensor, rank-1 approximation.

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Variational Inequality With DC Program as Constraint

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In this paper, we consider the variational inequality with DC programming as constraint. For this, we give several algorithms to study this problem.

Keywords: variational inequality, DC programming

Alternative arrangement of level sets of a pair of quadratic functions

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In this talk, we investigate some geometric properties about the arrangement of level sets of a pair of quadratic functions $\{f < 0\}$ and $\{g = 0\}$; or $\{f = 0\}$ and $\{g = 0\}$. We are especially interested in the cases when $\{f < 0\}$ or $\{f = 0\}$ has two connected components and when all the connected components are in an alternative arrangement with the components of $\{g = 0\}$ in the space. Then, something "bad" could happen. For example, the S-lemma with equality fails; or the joint numerical range of $\{(f(x), g(x))|x \in \mathbb{R}^n\}$ cannot be convex. Applying these results, we can identify some types of non-convex quadratic optimization problems subject to two quadratic constraints, which can be solved in polynomial time.

Keywords: Quadratically constrained quadratic programming, S-lemma, quadratic surfaces, arrangement of level sets.

A Study on Category-level Promotion and Customized Product Assortment under Multinomial Logit Choice Model

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As consumers gradually use network to review some products, a lot companies try to organize a platform for selling their products. Also, companies use their platform to collect guests' data and use data analysis tools to study the demand. Whether collecting data or analyzing the data, companies need to express a customized product assortment to their consumers and collect their choice. Hence to provide a useful assortment is necessary. In this talk, we discuss how a company provides an assortment to their consumers in a web page by solving a fractional programming problem. We employ a robust approach for the category-level promotion and customized assortment optimization problem. We present the structural properties of the problems and organize efficient computational methods to solve the problems. Also, we do some experiments for showing the efficiencies of our method.

Keywords: Customized Product Assortment, Fractional Programming, Robust Optimization

Common Zero to Finite Mappings with Sums of Two Monotone Operators and Applications

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Abstract

In this paper, we establish a parallel algorithm which converges strongly to common fixed point for finite $\rho-$ strongly quasi-nonexpansive mappings. Then we study common zeros for the operators such that each operator is the sum of two operators. From this result, we study the following problems: Common zero to monotone mappings; common minimizer to finite mappings with the sums of two mappings; common minimizer point to finite mappings; common minimizer to finite constrained mappings; common solution to finite mixed type variational inequalities; common solution to finite constrained variational inequalities; common minimizer to finite quadratic optimization problem; common solution to finite signal recovery problems. Strongly convergent theorems are established with parallel algorithms without uniform monotonicity or uniform convexity on any operator we consider. We give a unified treatment to these problems and some special cases of our problems are also studied in this paper.

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The Schatten p-norm on $\mathbb{R}^n$

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It is well known that the Schatten p-norm defined on the space of matrices is useful and possesses nice properties. In this paper, we explore the concept of Schatten p-norm on $\mathbb{R}^n$ via the structure of Euclidean Jordan algebra. Two types of Schatten p-norm on $\mathbb{R}^n$ are defined and the relationship between these two norms is also investigated. This is a joint work with Jein-Shan Chen and Chu-Chin Hu.

Keywords: Schatten p-norm, Euclidean Jordan algebra, second-order cone.

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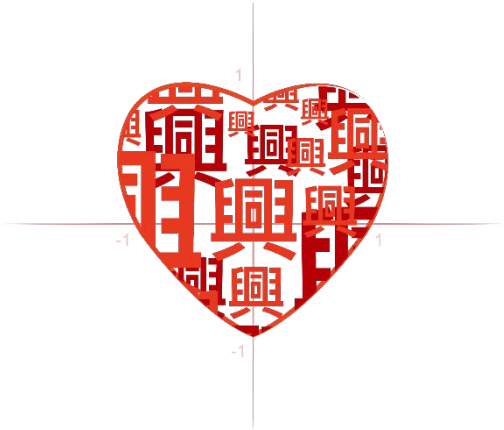

統計

Statistics

Organizer：沈宗荏

地點：資訊科學大樓 U502

2019 年12 月7 日(星期六)		Speaker
11:20-12:05	Joint analysis of panel count and interval-censored data using distribution-free frailty analysis Chiar:沈宗荏	温啟仲 Chi-Chung Wen
13:30-13:55	Analytical expression for the integrated squared density partial derivative of a multivariate normal mixture distribution Chiar:沈宗荏	蔡旻曉 Min-Hsiao Tsai
13:55-14:20	台灣參與國際數學奧林匹亞競賽之統計分析 Chiar:沈宗荏	高竹嵐 Chu-Lan Kao
14:25-14:50	Comparison of the marginal hazard model and the sub-distribution hazard model under an assumed copula Chiar:沈宗荏	Takeshi Emura

2019 年12 月8 日(星期日)		Speaker
10:10-10:55	Local variable selection criterion based on a prediction perspective Chiar:沈宗荏	陳春樹 Chun-Shu Chen
11:00-11:25	Data-driven multistratum designs with the generalized Bayesian D-D criterion for highly uncertain models Chiar:沈宗荏	林長鋆 Chang-Yun Lin
11:25-11:50	A non-parametric method for inferring parameters in ecological networks Chiar:沈宗荏	劉維中 Wei-Chung Liu
11:50-12:15	On the matrix condition of phylogenetic tree Chiar:沈宗荏	鍾冬川 Tony Jhwueng

Joint analysis of panel count and interval-censored data using distribution-free frailty analysis

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We propose a joint analysis simultaneously analyzing recurrent and non-recurrent events subject to general types of interval censoring. The proposed analysis allows for general semiparametric models, including the classes of Box-Cox transformation and inverse Box-Cox transformation models for the recurrent and nonrecurrent events, respectively. A frailty variable is used to account for the potential dependence between the recurrent and non-recurrent event processes. We apply the pseudo likelihood for interval-censored recurrent event data, usually termed as panel count data, and the sufficient likelihood for interval-censored non-recurrent event data. Conditioning on the sufficient statistic for the frailty, and using the working assumption of independence over examination times, the sufficient likelihood does not rely on distributional assumptions on the frailty, and can deal with general interval censorship. We illustrate the proposed methodology by a joint analysis of the numbers of occurrences of basal cell carcinoma over time and time to the first recurrence of squamous cell carcinoma based on a skin cancer dataset, as well as a joint analysis of the numbers of adverse events and time to premature withdrawal from study medication based on a scleroderma lung disease dataset. This is a joint work with Yi-Hau Chen.

Keywords: Correlated data; Joint model; Recurrent event; Semiparametric model; Survival analysis.

Analytical expression for the integrated squared density partial derivative of a multivariate normal mixture distribution

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This investigation describes the derivation of the analytical expression for the integrated squared density partial derivative (ISDPD) in a multivariate normal mixture model. The analytical expression of the ISDPD is derived for arbitrary dimensions with partial derivative orders up to four. Although the value of the ISDPD can be obtained by using the common numerical integration via mathematical software (such as Maple, Mathematica, Matlab, etc), it suffers from the limitation of computation time when the dimension or the number of mixture components of the considered multivariate normal mixture model are large. Moreover, numerical comparison indicates the benefits of speed offered by our proposed analytical expression are far superior to the numerical integration performed by Maple. With this analytical expression, the ISDPD can apace be calculated with no assistance of numerical integration.

Keywords: integrated squared density partial derivative, multivariate normal mixture model, numerical integration, computation time.

台灣參與國際數學奧林匹亞競賽之統計分析

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台灣於 2019 年參與第六十屆國際數學奧林匹亞競賽之團體排名達到歷史新低，但這是否代表台灣隊之競賽能力退步？此退步與否又應如何評估？本文在考慮各屆參賽國與選手差異，以及各年度題目難度與得分結構之差異下，結合貝氏 ordinal regression 與 EM 演算法，對台灣隊之能力進行分析。研究結果顯示台灣隊之能力並無顯著下降。本文所提出之新研究方式，期望能對未來台灣參與類似競賽與測驗上，從統計上提供新的分析工具。

Keywords: 國際數學奧林匹亞，Ordinal Regression，EM 演算法。

Comparison of the marginal hazard model and the sub-distribution hazard model under an assumed copula

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For the analysis of competing risks data, three different types of hazard functions have been considered in the literature, namely the cause-specific hazard, the sub-distribution hazard, and the marginal hazard function.

Let X be a nonnegative random variable for time to "Event 1" and Y be the one for time to "Event 2". Under competing risks, we observe the first occurring event time $T = \min(X, Y)$, and the event indicator $\delta = \mathbf{I}(T = X)$, where $\mathbf{I}(\cdot)$ is the indicator function. The *marginal hazard function* for Event 1 is defined as

$$\lambda_1(t) = \Pr(t < X \le t + dt \mid X > t)/dt .$$

The marginal distribution is not identifiable from the distribution of (T, δ) unless some assumptions are made on the joint distribution of (X, Y) [1]. Other types of hazard functions of interest are therefore often considered for competing risks analysis. What can be identified from (T, δ) without knowing or assuming the distribution of (X, Y) is the *cause-specific* (CS) *hazard function* [2]. For Event 1 it is defined as

$$\lambda_1^{CS}(t) = \Pr(t < T \le t + dt, \delta = 1 \mid T > t)/dt .$$

The other identifiable quantity is the *sub-distribution hazard function* [3]. For Event 1, it is defined as

$$\lambda_1^{Sub}(t) = \Pr(t < T \le t + dt, \delta = 1 \mid \{T > t\} \cup \{T \le t, \delta = 0\})/dt .$$

While the relationship between the cause-specific hazard and the sub-distribution hazard has been extensively studied [4], the relationship to the marginal hazard function has not yet been analyzed due to the difficulties related to non-identifiability. In this paper, we adopt an assumed copula model [5] to deal with the model identifiability issue, making it possible to establish a relationship between the sub-distribution hazard and the marginal hazard function.

To model the dependence between two competing event times, we adopt a *survival copula model* [6]

$$\Pr(X > x, Y > y) = C_\theta\{ S_1(x), S_2(y) \}$$

where $C_\theta : [0,1]^2 \mapsto [0,1]$ is a copula function with a parameter θ [7]. The copula function can be any bivariate distribution function having the uniform marginal distribution on (0,1).

Under the survival copula model, we derive a mathematical relationship between $\lambda_1(\cdot)$ and $\lambda_1^{Sub}(\cdot)$. Furthermore, we establish a necessary and sufficient condition for $\lambda_1(\cdot)$ and $\lambda_1^{Sub}(\cdot)$ to be equivalent. We then compare the two methods of fitting the Cox model to competing risks data [3, 8]. We also extend our comparative analysis to *clustered* competing risks data under a *joint frailty-copula model* [9, 10]. For illustration, we analyze two survival datasets from lung cancer and bladder cancer patients.

This full paper [11] is currently under review and joint work with Shih JH, Il Do Ha, and Ralf Wilke.

Key words: Clustered survival data, competing risk, Cox model, frailty model, survival analysis

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Local variable selection criterion based on a prediction perspective

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Variable selection and spatial prediction both are important issues in spatial statistics. If spatially varying means exist among different subareas, globally fitting a spatial regression model for the study area may be not suitable. To alleviate deviations from model assumptions, we propose a local variable selection criterion to locally select variables for each subarea. The proposed local criterion considers the global spatial dependence of observations and the characteristics of each subarea are also identified. It results in a composite spatial predictor which not only provides a more accurate spatial prediction, but also reduces the prediction variance. Statistical inferences of the proposed methodology are justified both theoretically and numerically.

Keywords: Information criterion, prediction variance, resampling, squared prediction error

Data-driven multistratum designs with the generalized Bayesian D-D criterion for highly uncertain models

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Abstract

Multistratum designs have gained much attention recently. Most criteria, such as the D criterion, select multistratum designs based on a given model that is assumed to be true by the experimenters. However, when the true model is highly uncertain, the model used for selecting the optimal design can be seriously misspecified. If this is the case, then the selected multistratum design will be not efficient for fitting the true model. To deal with the problem of high uncertain models, we propose the generalized Bayesian D-D (GBDD) criterion, which selects multistratum designs based on the experimental data. Under the framework of multistratum structures, we develop theorems and formula that are used for conducting Bayesian analysis and extracting information about the true model from the data to reduce model uncertainty. The GBDD criterion is easy and flexible in use. We provide several examples to demonstrate how to construct the GBDD-optimal split-plot, strip-plot, and staggered-level designs. By comparing with the D-optimal designs and one-stage generalized Bayesian

D-optimal designs, we show that the GBDD-optimal designs have higher efficiency on fitting the true models. The extensions of the GBDD criterion for more complicated cases, such as more than two stages of experiments and more than one class of potential terms, are also developed.

KEY WORDS: Bayesian D criterion, D criterion, split-plot design, staggered-level design, strip-plot design, two-stage experiment.

A non-parametric method for inferring parameters in ecological networks

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The simplest type of ecological networks, or a food web, is a representation of who eats whom in an ecosystem. Such a network is often generated by a single dataset aggregated from one or several surveys. Point estimates of network parameters can be calculated from the data, but how to quantify their corresponding interval estimates still remains elusive. Here, a simple bootstrap-based resampling procedure is proposed for inferring network parameters. First, for a particular network parameter, we obtain its point estimate by calculating the corresponding statistics from the original network. Second, we generate a resampled network by sampling with replacement the same number of species from the original network, and for each resampled species we record how many prey items it consumes in the original network. Third, a resampled species is allowed to consume its original prey species if such a species is also present; if not then it instead consumes the resampled species that is most topologically similar to its original prey species. Several resample networks can be constructed from which the sampling distribution and the interval estimate for this particular statistics can then be determined. We demonstrate our methodology on two different ecological networks and discuss its application in comparing ecosystems of various sizes and complexity.

Keywords: ecological network, food web, network parameter, bootstrap, resampled network, sampling distribution, interval estimate.

On the matrix condition of phylogenetic tree

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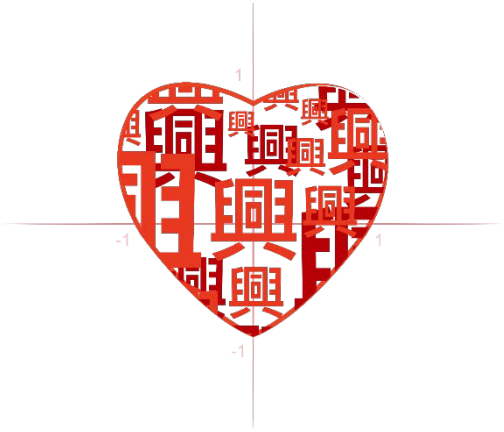
Phylogenetic comparative analyses incorporate phylogenetic tree to study evolutionary relationship among a group of related species. A phylogenetic tree of n taxa can be algebraically transformed into an n by n squared symmetric phylogenetic covariance matrix C where each element c_{ij} in C represents the affinity between extant species i and extant species j. Because C plays an important role in phylogenetic comparative analysis, it deserves a rigorous investigation of the matrix condition of C. The condition number of matrix C denoted by κ is defined by the ratio of the maximum eigenvalue of C to the minimum eigenvalue of C. When tree has ill-conditioned matrix C, results obtained from subsequent analyses such as computing the likelihood that requires inversion of C may not be stable. To remediate this problem, we propose several methods to appropriately adjust the phylogenetic tree and improve the matrix condition of C for the purpose of obtaining reliable results.

Keywords: matrix condition, Brownian motion, phylogenetic comparative analysis



數學科普

Mathematical Out-reaching

Organizer：陳宏賓

地點：理學大樓 S101

2019 年12 月8 日(星期日)		Speaker
11:00- 11:25	從想像出發– Our IMAGINARY journey Chair:陳宏賓	高欣欣 Shin-Shin Kao
11:25- 11:50	在歐洲當一名數學記者 Chair:陳宏賓	林家妤 Shark Lin
11:50- 12:15	以藝喻數 多面自造 Chair:陳宏賓	嚴志弘 Chih-Hung Yen
13:30- 15:10	以藝喻數 多面自造 Chair:陳宏賓	嚴志弘 Chih-Hung Yen

從想像出發– Our IMAGINARY journey

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Abstract

2015年, 中華民國數學會在高雄國立科學工藝博物館籌辦「IMAGINARY超越無限•數學印象」特展，2016年再緊接著於台北國立台灣科學教育館繼續展出。當時的摸索、走一步看一步的艱辛, 彷彿就在昨日; 這兩次大規模的展覽和後續系列科普活動的經驗, 給我們一些啓發。盼望藉著這個分享, 讓聽眾更多了解數學會科普委員會的理念與近期的規劃, 彼此激盪成長。

In the year of 2015, The Mathematics Society of the Republic of China held an exhibition 'IMAGINARY：Infinity and Beyond' in the National Science and Technology Museum in Kao-hsiung. In the year of 2016, the same big event was held immediately in National Taiwan Science and Education Center in Taipei. All the details and experiences were built up by trials and errors, little by little. However, by these two exhibitions and all the following events, we've learned inspiring lessons. In this talk, we want to share with the audience about the mission of the committee of promoting mathematics and our recent projects, in order to have more interactions.

Keywords: IMAGINARY, exhibition, the committee of promoting mathematics.

在歐洲當一名數學記者

林家妤 (Shark Lin)

海德堡桂冠論壇(Heidelberg Laureate Forum)為數學與電腦科學界一年一度的盛事，各大獎項的得主聚集在海德堡，與 200 名不同年代、文化和學術背景的年輕研究者相互碰撞，產生各種知識、思想及經驗交流。今年有幸受邀至海德堡擔任論壇記者，本場講座將會分享現場第一手的觀察與採訪經驗，以及歐洲其他國家的數學機構訪問之旅。

以藝喻數 多面自造

嚴志弘 (Chih-Hung Yen)
國立嘉義大學應用數學系

摘要

隨著時代的發展，科學技術日新月異，特別是信息和通信技術的變化，對學校系統中的行為和活動產生了深遠的影響。如何滿足社會複雜和不斷變化的需求已成為教育機構面臨的最大挑戰。因此，各種教育創新實踐應運而生。而藝術與數學的跨域結合則是其中之一。

此外，正如探究與實作是研究科學的方法，也是科學史進展的基本精神，如果探究和實作是數學活動的主要特徵，那麼學生 (甚至普羅大眾) 將更容易對數學感興趣，並願意理解數學。

在這次的活動中，我們將和各位分享辦理藝數展覽與工作坊的實際經驗，並特地安排手作互動課程，讓各位能親身體驗藝術與數學合而為一的樂趣。

大會會場示意圖


興大路
學府路
興大路
環校道路
ATM
校門
人文大樓
(文學院)
萬年樓
(語言中心)
西側一門
停車費繳費機
莊敬路
類廬
警衛室
惠蓀堂
莊敬路
圓廳
小禮堂
惠蓀路
樂群路
東側一門
國農中心
理工大樓
生物產業管理研究所
生物科技學研究所
動植物防疫檢疫大樓
食品暨生物科技大樓
食安大樓
食品暨生物科技實習工廠
森林館
水保館
水保二館
椰林路
綜合教學大樓
弘道路
行政大樓
中興路
化材大樓
結構蛋白中心
電機大樓
(電資學院)
生命科學大樓
(生科院)
應用科技大樓
(工學院)
西側二門
社管大樓
(法政學院、管理學院)
西側三門
中興湖
圖書館
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農環大樓
(農資學院)
作物科學大樓
園藝示範園區
資訊科學大樓
理學大樓
(理學院)
化學館
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農資院溫室區
機械系館
機械工廠
(機械工廠新建工程預定地)
創新育成中心
生機大樓
機械二館
混泥土中心
東側三門
籃球場
溜冰場
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水工實驗室
土木環工大樓
立體機車停車場
(預定地)
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女宿-誠軒
傳達室
女宿-樸軒
女宿-勤軒
女宿-華軒
教職員宿舍
A棟
B棟
女宿-怡軒
學人宿舍
郵局
南門路
興大二村
(預定生宿舍地)
國立中興大學
National Chung Hsing University
校園平面配置示意圖
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銀行
飲料店
ATM 提款機
實習商店
汽車停車區
書店
機車停車區
公車站牌
N
男宿-仁齋
男宿-義齋
男宿-禮齋
男宿-智齋
男宿-信齋
守衛室
運動場
籃球場
網球場
體育館
作物實習館
室內游泳池
動物醫學研究中心
大動物試驗中心
農藝系實驗地
農藝系工作室
動科系館
獸醫館
(獸醫學院)
動物疾病診所中心
獸醫教學醫院
實驗動物室
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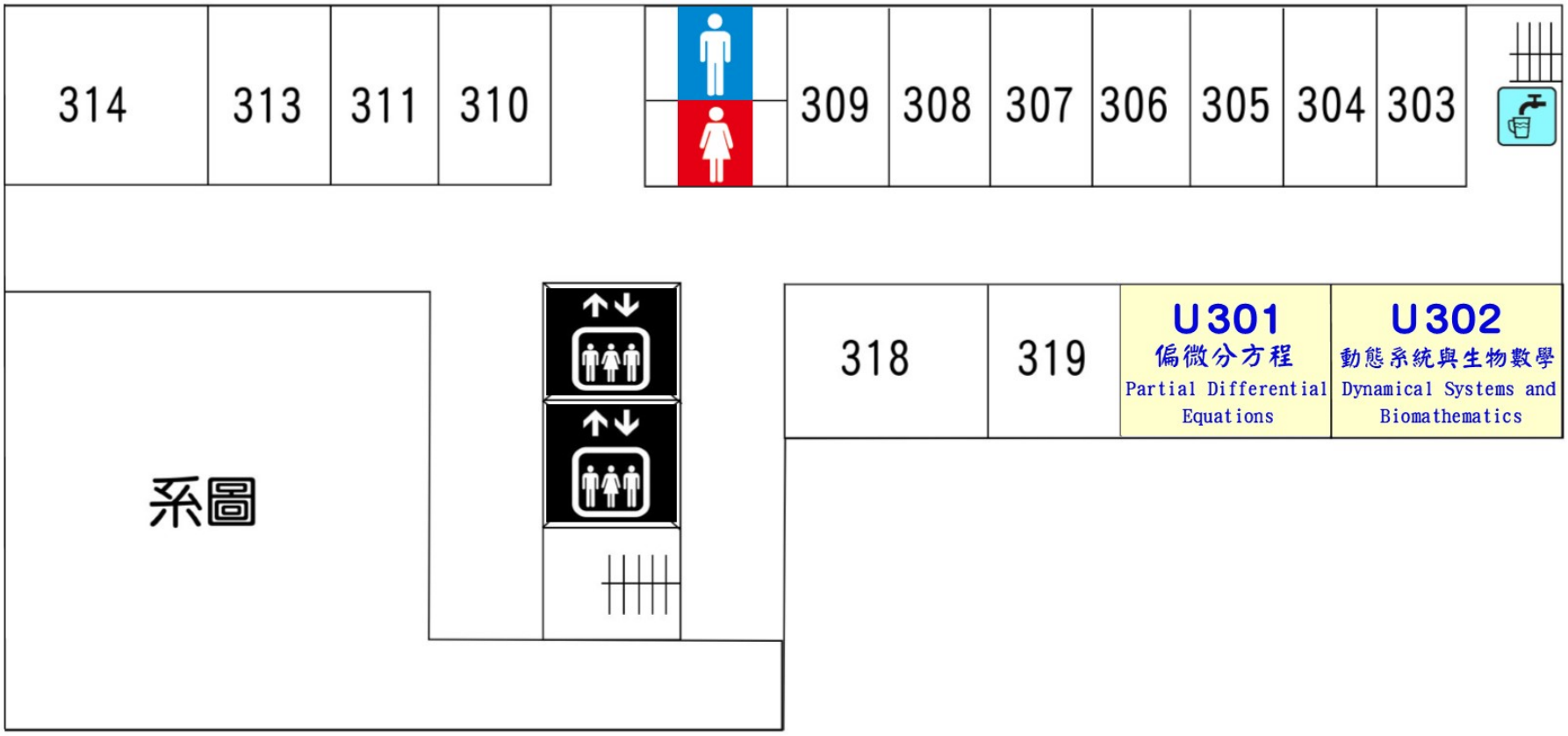
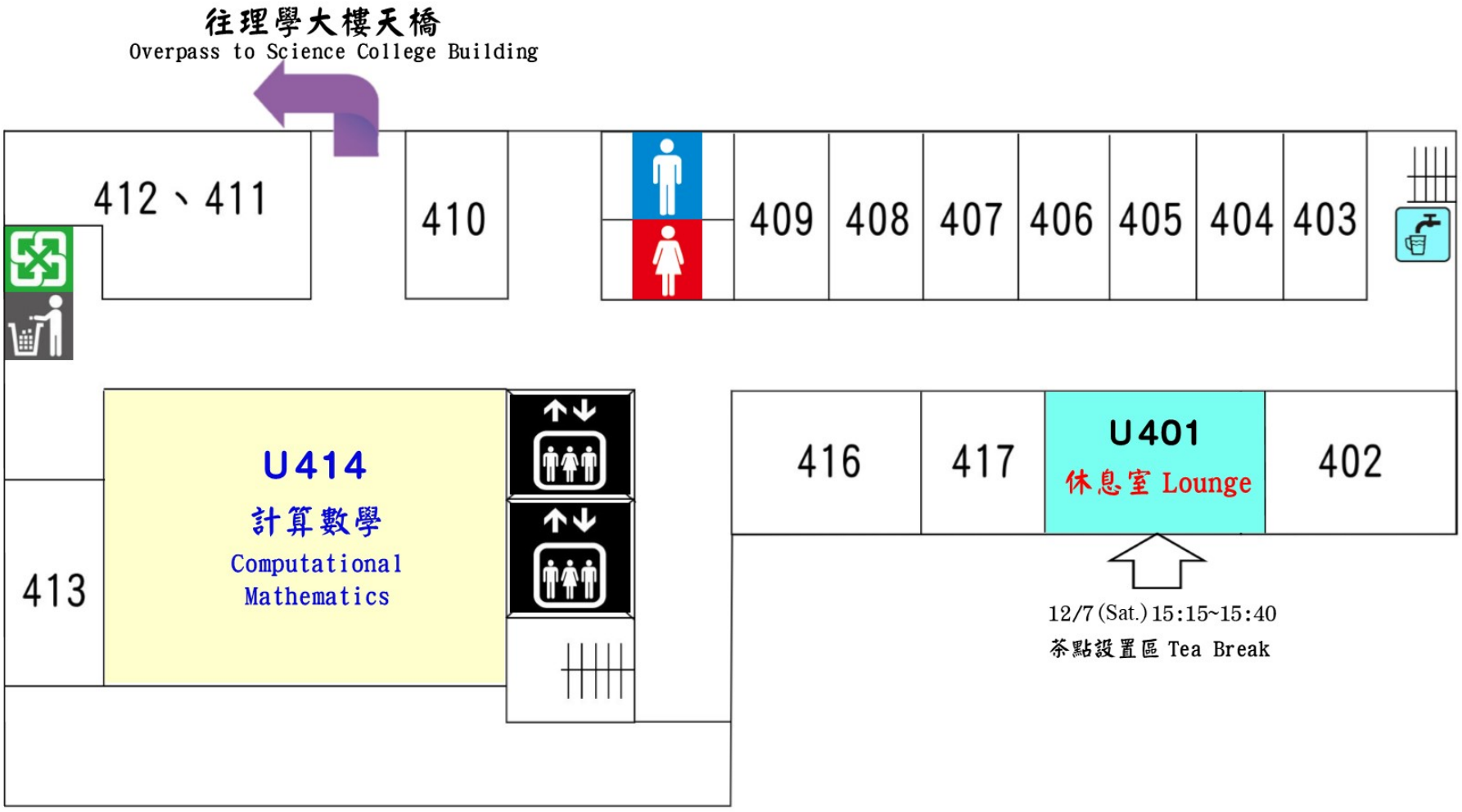
高爾夫球練習場



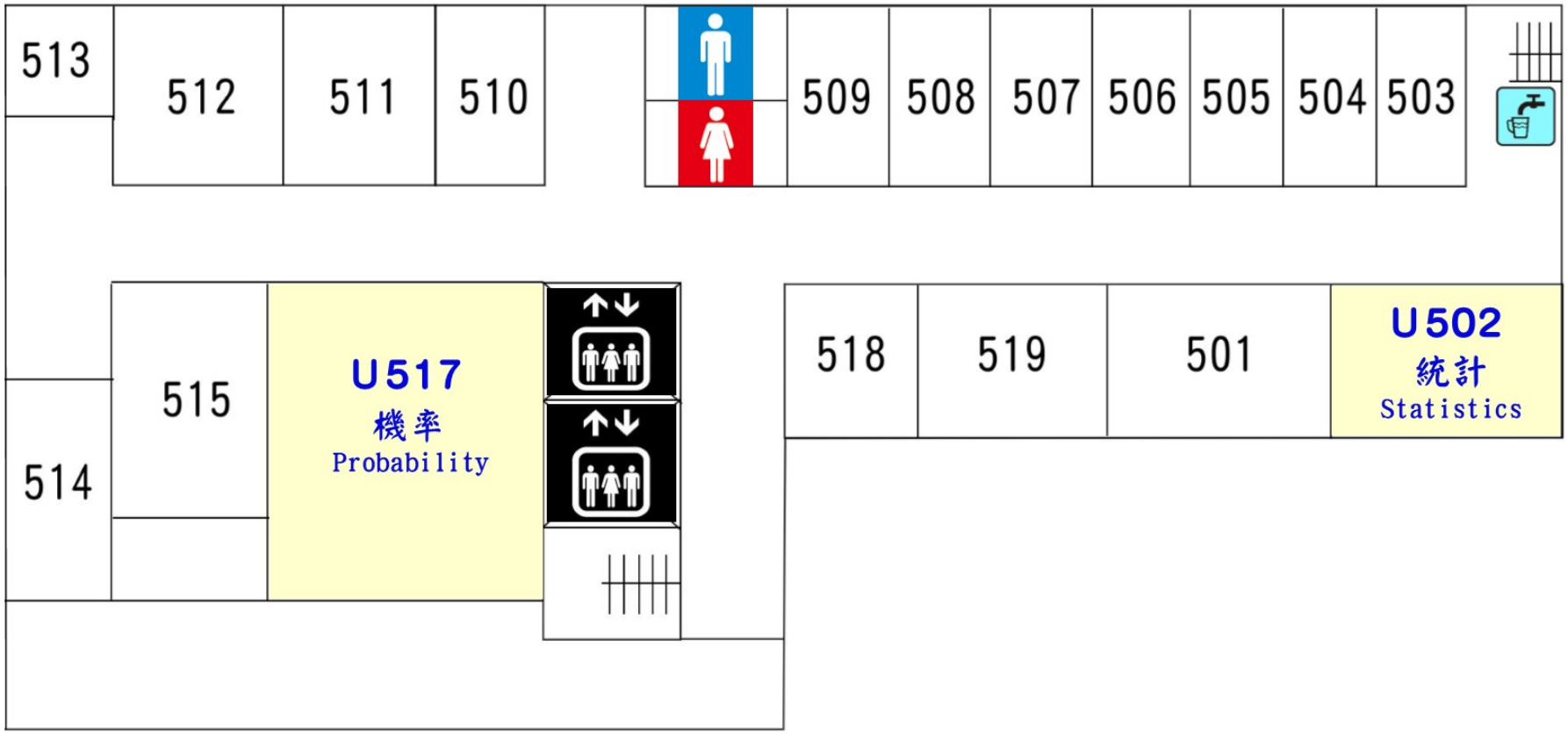
資訊科學大樓三樓平面圖

Information Science Building Level 3



資訊科學大樓四樓平面圖

Information Science Building Level 4



資訊科學大樓五樓平面圖

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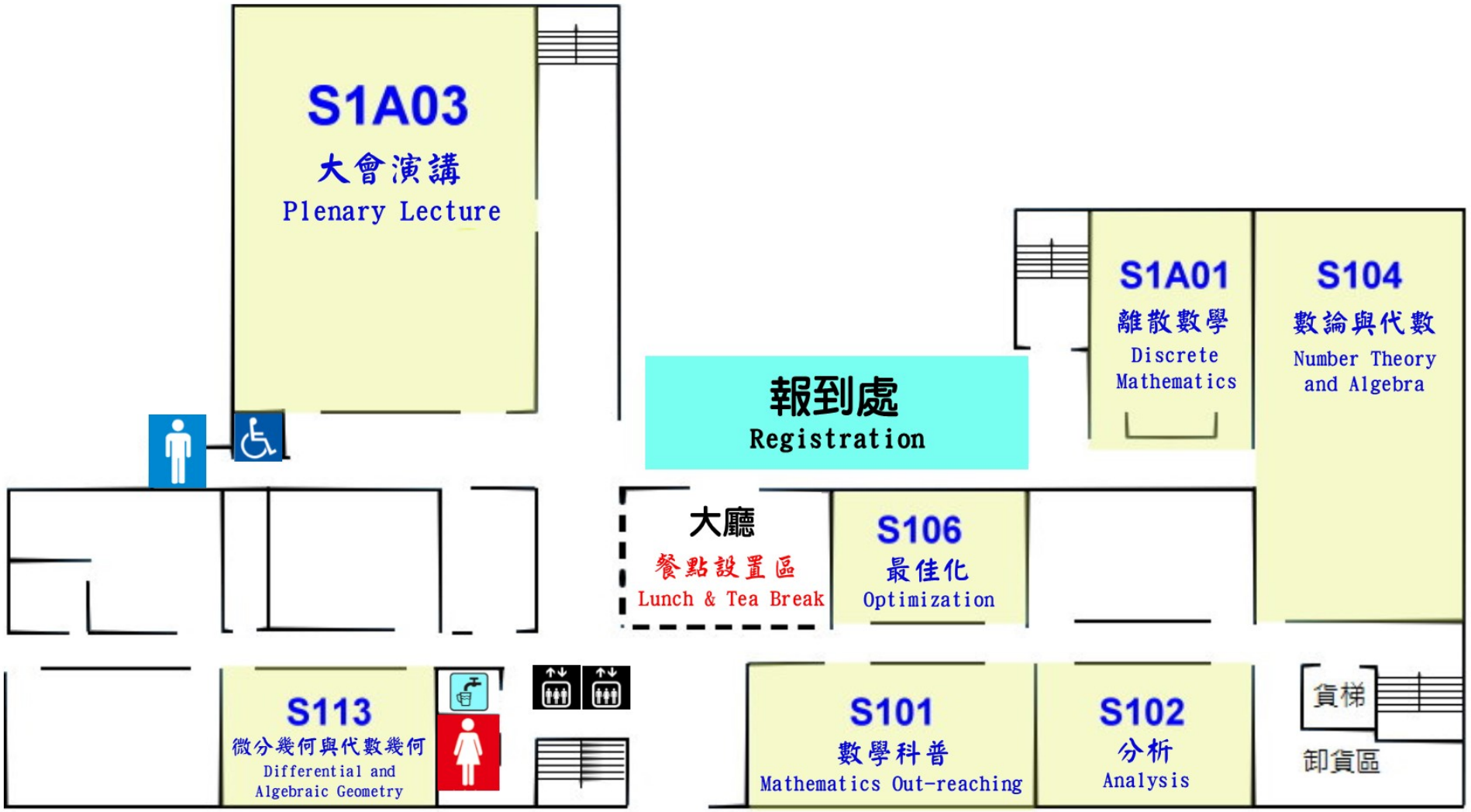
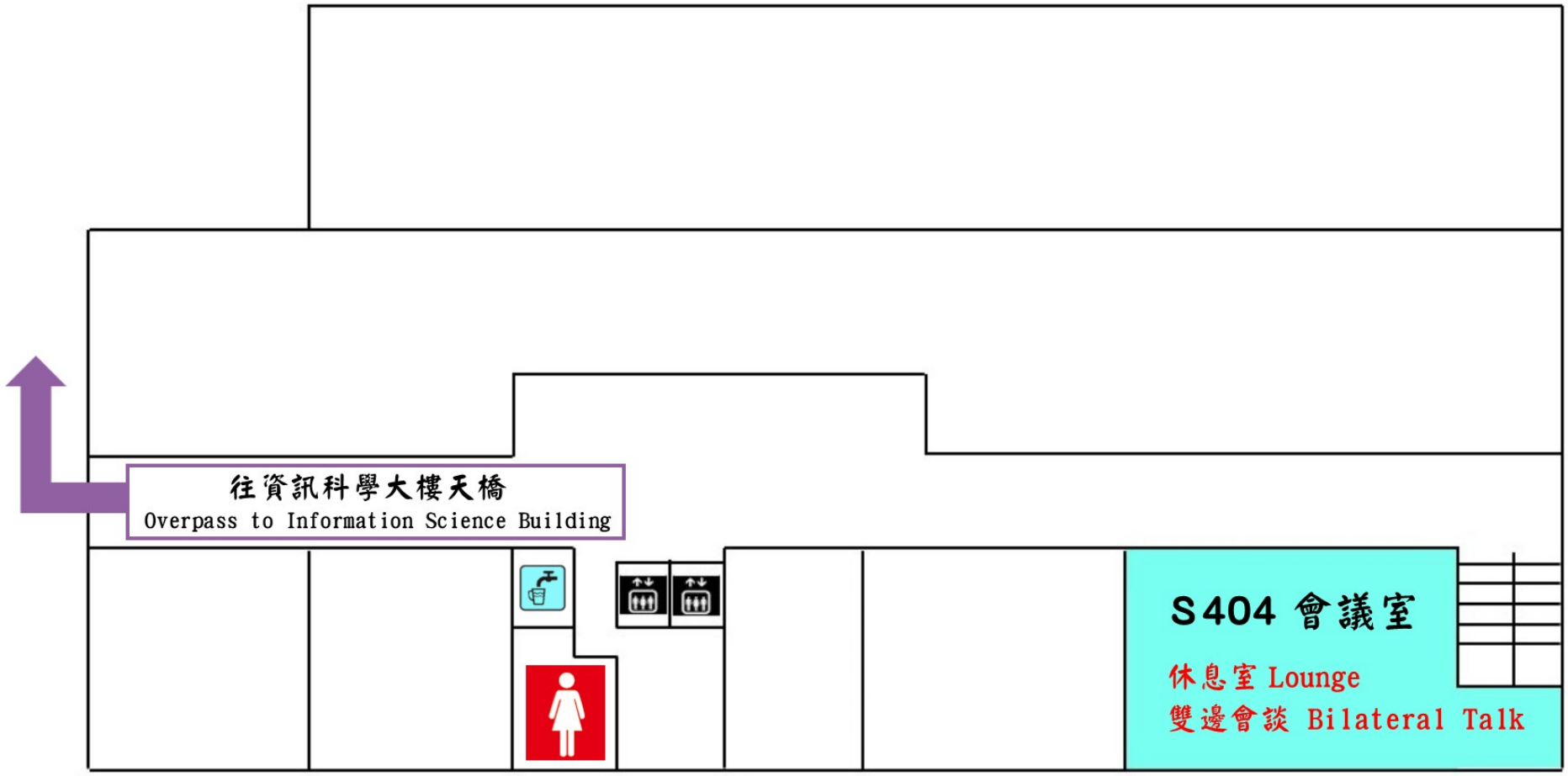


理學大樓一樓平面圖

Science College Building Level 1



理學大樓四樓平面圖
Science College Building Level 4