2022

中華民國數學年會

TMS Annual Meeting

清華大學數學系

大會手冊

Conference Program

Jan. 16 (Mon.) - 17 (Tue.), 2023

2022 中華民國數學年會

2022 Taiwan Mathematical Society Annual Meeting

會議時間：2023 年 1 月 16 日（一）至 2023 年 1 月 17 日（二）
會議地點：國立清華大學旺宏館國際會議廳、綜合三館
主辦單位：中華民國數學會
承辦單位：國立清華大學數學系
協辦單位：國科會自然處科學推展中心數學組、國立清華大學

學術委員會

Scientific Committee

國立台灣大學數學系	謝銘倫(召集人)
國立成功大學數學系	吳恭儉
國立中央大學數學系	楊肅煜
國立台灣大學數學系	崔茂培
國立政治大學應用數學系	陳隆奇
國立高雄大學應用數學系	吳宗芳
國立清華大學數學系	潘戊衍(111 年年會主辦學校)

承辦單位籌備人員

Organizing Committee

國立清華大學數學系	邱鴻麟
國立清華大學數學系	江金城
國立清華大學數學系	潘戊衍
國立清華大學數學系	李卓彥
國立清華大學數學系	卓士堯
國立清華大學數學系	東聖甯

2022 中華民國數學年會
2022 Taiwan Mathematical Society Annual Meeting

2023 年 1 月 16 日(星期 一)

08:00 - 09:30	報到註冊	旺宏館 1F 大廳
09:40 - 10:00	年會開幕式 主持人：謝銘倫 理事長	旺宏館 國際會議廳
10:00 - 10:50	大會演講 王慕道教授 主持人：李瑩英 教授	
10:50 - 11:00	團體照	旺宏館 國際會議廳
11:00 - 11:20	茶會、討論	綜三館 1F大廳

Room	旺宏館 國際會議廳	R101	R201
11:20 – 12:00 共同演講	演講者：陳榮凱教授 (數學學門卓越領航主持人) 主持人：賴青瑞教授	[線上] 演講者： 孟悟理 Ulrich Menne 教授(數學學門重點計畫主持人) 主持人：蔡忠潤教授	演講者：薛名成教授 (數學學門重點計畫主持人) 主持人：夏俊雄教授

12:00 – 13:45	午餐 Lunch Break	綜三館 1F大廳

Sessions	數論與代數	微分幾何	分析與最佳化	偏微分方程	代數幾何	離散數學	動態系統與 生物數學	計算數學	機率與財務工程
Room	4F RoomB	R119	R201	R118	R723	R101	R734	R203	R631
13:45 – 14:15 領域演講 場次一	演講者：王姿月 主持人：張介玉	演講者：吳進通 主持人：崔茂培	演講者：沈俊嚴 主持人：林欽誠	演講者：林太家 主持人：吳宗芳	演講者：林學庸 主持人：余正道	演講者：符麥克(Michael Fuchs) 主持人：余冠儒	演講者：陳國璋 主持人：班榮超	演講者：楊肅煜(40) 主持人：黃聰明	演講者：劉聚仁(40) 主持人：陳冠宇
14:15– 14:45 領域演講 場次二	演講者：陳志瑋 主持人：張介玉	演講者：王業凱 主持人：崔茂培	演講者：司曇得(Daniel Spector) 主持人：沈俊嚴	演講者：陳志有 主持人：吳宗芳	演講者：賴青瑞 主持人：余正道	演講者：林晉宏 主持人：郭大衛	演講者：吳昌鴻 主持人：張志鴻	14:35開始 演講者：吳金典(40) 主持人：黃楓南	14:35開始 演講者：金璟允(40) 主持人：陳冠宇
14:45 – 15:15 領域演講 場次三	演講者：魏福村 主持人：張介玉	演講者：李國瑋 主持人：崔茂培	演講者：許瑞麟 主持人：沈俊嚴	演講者：洪盟凱 主持人：吳宗芳	演講者：陳正傑 主持人：余正道	演講者：Shagnik Das(線上) 主持人：林延鉏	演講者：梁育豪 主持人：陳賢修		
15:15 – 15:30	茶會、討論								綜三館 1F大廳
15:30 – 16:20	大會演講 學術獎得獎人 楊一帆教授(台大數學系) 主持人：謝銘倫教授								旺宏館 國際會議廳
16:20 – 16:30	休息與換場								
16:30 – 18:00	16:30~16:45數學學門業務報告 頒獎典禮、年會傳承 中華民國數學會會員代表大會								旺宏館 國際會議廳
18:25	晚宴								晶宴會館 御豐館

2022 中華民國數學年會
2022 Taiwan Mathematical Society Annual Meeting

2023 年 1 月 17 日(星期二)

08:30 - 09:00	報到註冊	旺宏館 1F 大廳
09:00 - 09:50	大會演講 學術獎得獎人 蕭欽玉研究員(中研院數學所) 主持人：鄭日新研究員	旺宏館 國際會議廳
09:50 - 10:05	茶會、討論	綜三館 1F大廳

Room	R101	旺宏館 國際會議廳
10:05 – 10:50 共同演講	Yongnam Lee 教授 (KMS) 主持人：陳榮凱教授	林文偉教授 主持人：黃聰明教授

Sessions	數論與代數	微分幾何	分析與最佳化	偏微分方程	代數幾何	離散數學	動態系統與 生物數學	計算數學	機率與財務工程
Room	4F RoomB	R119	R201	R118	R723	R101	R734	R203	R631
11:00 – 11:20 領域演講 場次四	演講者：賴俊儒 主持人：魏福村	演講者：王以晟 主持人：何南國	演講者：黃皓瑋 主持人：方向	演講者：阮文先 主持人：吳恭儉	演講者：章源慶 主持人：余正道	演講者：陳秋媛(30) 主持人：游森棚	演講者：謝世峰 主持人：王堉彬	演講者：鄧君豪(線上) 主持人：胡偉帆	演講者：劉宣谷 主持人：須上苑
11:20– 11:40 領域演講 場次五	演講者：官彥良 主持人：魏福村	演講者：郭孝豪 主持人：何南國	11:30開始 演講者：方向 主持人：黃皓瑋	11:30開始 演講者：黃信元 主持人：吳恭儉	演講者：王賜聖 主持人：余正道	演講者：盧沛鐸(20) 主持人：郭君逸	11:30開始 演講者：張覺心 主持人：王琪仁	演講者：陳人豪 主持人：胡偉帆	11:30開始 演講者：翁新傑 主持人：須上苑
11:40– 12:00 領域演講 場次六	演講者：蔡宛育 主持人：魏福村	演講者：張瑞恩 主持人：何南國			演講者：陳延安 主持人：余正道	演講者：羅元勳(20) 主持人：張飛黃		演講者：嚴健彰 主持人：胡偉帆	
12:00 – 13:35	午餐 Lunch Break								綜三館 1F大廳
	12:00 – 13:35 女數學人活動：電影欣賞								R201
13:35 – 14:05 領域演講 場次七	演講者：鄭堯(線上/20) 主持人：魏福村	演講者：楊劼之 主持人：夏杼		演講者：郭庭榕(30) 主持人：黃信元	演講者：陳奕元(20) 主持人：余正道	演講者：俞韋亘 主持人：翁志文	演講者：鄭昌源(30) 主持人：王堉彬	演講者：陳昇國(20) 主持人：朱家杰	
14:05 – 14:35 領域演講 場次八	13:55開始 演講者：佐藤信夫(線上30) 主持人：魏福村			演講者：蔡亞倫(30) 主持人：黃信元		演講者：徐祥峻 主持人：賴欣豪		14:00開始 演講者：陳孟勳(20) 主持人：朱家杰	
14:35 – 15:05 領域演講 場次九									
15:05	賦歸								

2022 Taiwan Mathematical Society Annual Meeting

January 16, 2023 (Monday)

08:00 - 09:30	Registration								Macronix Building 1F
09:40 - 10:00	Opening Ceremony Chair: President Ming-Lun Hsieh								Macronix Building International Conference Hall
10:00 - 10:50	Plenary Lecture by Professor Mu-Tao Wang Chair: Professor Yng-Ing Lee								
10:50 - 11:00	Group Photo Session								Macronix Building International Conference Hall
11:00 - 11:20	Coffee Break								General Building III 1F
Room	International Conference Hall, Macronix Building			R101, General Building III			R201, General Building III		
11:20 – 12:00 Keynote Talks I	Speaker: Jungkai Alfred Chen Chair: Ching-Jui Lai			Speaker: (online) Ulrich Menne Chair: Chung-Jun Tsai			Speaker: Ming-Cheng Shiue Chair: Chun-Hsiung Hsia		
12:00 – 13:45	Lunch Break								General Building III 1F
Sessions	Number Theory and Algebra	Differential Geometry	Analysis & Optimization	Partial Differential Equations	Algebraic Geometry	Discrete Mathematics	Dynamical Systems and Biomathematics	Computational Mathematics	Probability & Financial Engineering
Room	4F RoomB	R119	R201	R118	R723	R101	R734	R203	R631
13:45 – 14:15 Special Sessions I	Speaker: Tzu-Yueh Wang Chair: Chieh-Yu Chang	Speaker: Chin-Tung Wu Chair: Mao-Pei Tsui	Speaker: Chun-Yen Shen Chair: Chin-Cheng Lin	Speaker: Tai-Chia Lin Chair: Tsung-Fang Wu	Speaker: Hsueh-Yung Lin Chair: Jeng-Daw Yu	Speaker: Michael Fuchs Chair: Guan-Ru Yu	Speaker: Kuo-Chang Chen Chair: Jung-Chao Ban	Speaker: Suh-Yuh Yang(40) Chair: Tsung-Ming Huang	Speaker: Gi-Ren Liu(40) Chair: Guan-Yu Chen
14:15– 14:45 Special Sessions II	Speaker: Chih-Whi Chen Chair: Chieh-Yu Chang	Speaker: Ye-Kai Wang Chair: Mao-Pei Tsui	Speaker: Daniel Spector Chair: Chun-Yen Shen	Speaker: Zhi-You Chen Chair: Tsung-Fang Wu	Speaker: Ching-Jui Lai Chair: Jeng-Daw Yu	Speaker: Jephian C.-H. Lin Chair: David Kuo	Speaker: Chang-Hong Wu Chair: Chih-Hung Chang	14:35 - Speaker: Chin-Tien Wu(40) Chair: Feng-Nan Hwang	14:35 - Speaker: Kyung-Youn Kim(40) Chair: Guan-Yu Chen
14:45 – 15:15 Special Sessions III	Speaker: Fu-Tsun Wei Chair: Chieh-Yu Chang	Speaker: Kuo-Wei Lee Chair: Mao-Pei Tsui	Speaker: Ruey-Lin Sheu Chair: Chun-Yen Shen	Speaker: Meng-Kai Hong Chair: Tsung-Fang Wu	Speaker: Jheng-Jie Chen Chair: Jeng-Daw Yu	Speaker: Shagnik Das(online) Chair: Yen-Chi Roger Lin	Speaker: Yu-Hao Liang Chair: Shyan-Shiou Chen		
15:15 – 15:30	Coffee Break								General Building III 1F
15:30 – 16:20	Special Lecture by Yi-Fan Yang Chair: Ming-Lun Hsieh								Macronix Building International Conference Hall
16:20 – 16:30	Coffee Break								
16:30 – 18:00	16:30~16:45 Message from the NSTC math division								Macronix Building International Conference Hall
	TMS Meeting & Award Ceremony								
18:25	Banquet								

2022 Taiwan Mathematical Society Annual Meeting

January 17, 2023 (Tuesday)

08:30 - 09:00	Registration								Macronix Building 1F
09:00 - 09:50	Special Lecture by Chin-Yu Hsiao Chair: Professor Jih-Hsin Cheng								Macronix Building International Conference Hall
09:50 - 10:10	Coffee Break								General Building III 1F
Room	R101, General Building III					International Conference Hall, Macronix Building			
10:10 – 10:50 Keynote Talks II	Special Lecture by Professor Yongnam Lee (KMS) Chair: Professor Jungkai Alfred Chen					Special Lecture by Professor Wen-Wei Lin Chair: Professor Tsung-Ming Huang			
Sessions	Number Theory and Algebra	Differential Geometry	Analysis & Optimization	Partial Differential Equations	Algebraic Geometry	Discrete Mathematics	Dynamical Systems and Biomathematics	Computational Mathematics	Probability & Financial Engineering
Room	4F RoomB	R119	R201	R118	R723	R101	R734	R203	R631
11:00 – 11:20 Special Sessions IV	Speaker: Chun-Ju Lai Chair: Fu-Tsun Wei	Speaker: Yi-Sheng Wang Chair: Nan-Kuo Ho	Speaker: Hao-Wei Huang Chair: Xiang Fang	Speaker: Van Tien Nguyen Chair: Kung-Chien Wu	Speaker: Wan-Keng Cheong Chair: Jeng-Daw Yu	Speaker: Chiuyuan Chen(30) Chair: Sen-Peng Eu	Speaker: Shih-Feng Shieh Chair: Feng-Bin Wang	Speaker: Chun-Hao Teng(online) Chair: Wei-Fan Hu	Speaker: Hsuan-Ku Liu Chair: Shang-Yuan Shiu
11:20– 11:40 Special Sessions V	Speaker: Yen-Liang Kuan Chair: Fu-Tsun Wei	Speaker: Siao-Hao Guo Chair: Nan-Kuo Ho	11:30 - Speaker: Xiang Fang Chair: Hao-Wei Huang	11:30 - Speaker: Hsin-Yuan Huang Chair: Kung-Chien Wu	Speaker: Sz-Sheng Wang Chair: Jeng-Daw Yu	Speaker: Pei Duo-Yu(20) Chair: Jun-Yi Guo	11:30 - Speaker: Chueh-Hsin Chang Chair: Chi-Jen Wang	Speaker: Jen-Hao Chen Chair: Wei-Fan Hu	11:30 - Speaker: Hsin-Chieh Wong Chair: Shang-Yuan Shiu
11:40– 12:00 Special Sessions VI	Speaker: Wan-Yu Tsai Chair: Fu-Tsun Wei	Speaker: Jui-En Chang Chair: Nan-Kuo Ho			Speaker: Yen-An Chen Chair: Jeng-Daw Yu	Speaker: Yuan-Hsun Lo(20) Chair: Fei-Huang Chang		Speaker: Chien-Chang Yen Chair: Wei-Fan Hu	
12:00 – 13:35	Lunch Break								General Building III 1F
	Forum of Female Mathematicians								R201
13:35 – 14:05 Special Sessions VII	Speaker: Yao Cheng(online/20) Chair: Fu-Tsun Wei	Speaker: Takahashi Ryosuke Chair: Eugene Zhu Xia		Speaker: Ting-Jung Kuo(30) Chair: Hsin-Yuan Huang	Speaker: I-Yuan Chen(20) Chair: Jeng-Daw Yu	Speaker: Wei-Hsuan Yu Chair: Chih-Wen Weng	Speaker: Chang-Yuan Cheng(30) Chair: Feng-Bin Wang	Speaker: Sheng-Gwo Chen(20) Chair: Chia-Chieh Chu	
14:05 – 14:35 Special Sessions VIII	13:55 - Speaker:Nobuo Sato(Online/30) Chair: Fu-Tsun Wei			Speaker: Ya-Lun Tsai(30) Chair: Hsin-Yuan Huang		Speaker: Hsiang-Chun Hsu Chair: Hsin-Hao Lai		14:00 - Speaker: Meng-Huo Chen(20) Chair: Chia-Chieh Chu	
14:35 – 15:05 Special Sessions IX									
15:05	Let's mee at Chengchi University next time!								

目錄
Contents

大會演講
Plenary Talks

王慕道 Mu-Tao Wang

Department of Mathematics Columbia University
Email : mtwang@math.columbia.edu
Fields: Geometric Analysis and General Relativity

Determine homotopy classes by the mean curvature flow

A map is said to be homotopic equivalent to another map if there is a continuous path of maps connecting the two. Surprisingly a geometric flow such as the mean curvature flow provides natural paths to deform a map to a canonical representative in its homotopy class. I shall discuss this approach and its applications, and in particular some recent results regarding the homotopy class of maps between complex projective spaces. This is based on joint work with Chun-Jun Tsai and Mao-Pei Tsui, both of National Taiwan University.

Education

- Ph. D. in Mathematics, 1998, Harvard University, Cambridge, MA,U.S.A. Thesis advisor Professor Shing-Tung Yau, " Generalized harmonic maps and representations of discrete groups".
- M.S. in Mathematics, 1992, National Taiwan University, Taiwan.
- B.S. in Mathematics, 1988, National Taiwan University, Taiwan.Pei Tsui, both of National Taiwan University.

Affiliation

- Columbia University

Research area

- Geometric Analysis and General Relativity

Honer

- Academician, Academia Sinica, Taiwan, 2022.
- Fu prize of Mathematics, 2012.
- Morningside Gold Medal, International Congress of Chinese Mathematicians, 2010.
- Kavli Fellow, National Academy of Sciences, 2007.
- Chern Prize, International Congress of Chinese Mathematicians, 2007.
- Sloan Research Fellow, Alfred P. Sloan Foundation, 2003-2005.
- Harold M. Bacon Memorial Teaching Award, Stanford University.

楊一帆 Yi-Fan Yang

Department of Mathematics, National Taiwan University
Email: yangyifan@ntu.edu.tw
Fields:Number Theory

modular curves, Shimura curves, and their modular forms

In this talk we will give a quick overview of the arithmetic significance of modular curves and Shimura curves. We will then describe recent development in explicit methods for Shimura curves.

Education

· Ph. D. in Mathematics, 2000, University of Illinois at Urbana-Champaign, U.S.A.

Affiliation

· National Taiwan University

Research area

· 數論

Honer

· 2013 科技部傑出研究獎
· 2008 吳大猷先生紀念獎
· 2007 中華民國數學會青年數學家獎
· 2006 中央研究院年輕學者著作獎

蕭欽玉 Chin-Yu Hsiao

Institute of Mathematics, Academia Sinica
Email: chsiao@math.sinica.edu.tw
Fields:Microlocal Analysis, Complex Geometry and CR (Cauchy-Riemann) Geometry

Bergman kernel asymptotics in complex geometry and geometric quantization theory

The study of Bergman kernel plays an important role in several complex variables, complex geometry and mathematical physics. In the first part of this talk, I will explain why ”Bergman kernel” is important and introduce some of my results about Bergman kernel asymptotic expansions. In the second part of this talk, I will talk about geometric quantization theory. Recently, joint with Rung-Tzung Huang, Xiaonan Ma and George Marinescu, we developed ” Bergman kernel method” to study ”quantization commutes with reduction problems” in various geometric situations. I will explain this Bergman kernel method in some simple situation.

Education

· Ph.D. in Mathematics,2008,École Polytechnique.

Affiliation

· Academia Sinica

Research area

· 微局部分析, 複幾何及柯西黎曼幾何

Honer

· 2022 Simons Visiting Professorship, Mathematisches. Forschungsinstitut Oberwolfach.
· 2021 Academia Sinica Investigator Award,
· 2016 Outstanding Research Award by MOST, Taiwan

共同演講
Keynote Talks

地點：旺宏館國際會議廳

2023 年 1 月 16 日（星期一）		Speaker
11:20 – 12:00	**An Introduction to higher dimensional spaces and the Laboratory of Birational Geometry** Chair: 蔡忠潤	陳榮凱 Jung-kai Alfred Chen

2023 年 1 月 17 日（星期二）		Speaker
10:05 – 10:50	**Computational Conformal Geometry and Optimal Mass Transport with Applications on Medical Images** Chair: 黃聰明	林文偉 Wen-Wei Lin

地點：綜三館 R101

2023 年 1 月 16 日（星期一）		Speaker
11:20 – 12:00	**Advancing and connecting geometric measure theory and scientific computing** Chair: 蔡忠潤	[線上] 孟悟理 Ulrich Menne

2023 年 1 月 17 日（星期二）		Speaker
10:05 – 10:50	**Smooth specialization of hypersurfaces** Chair: 陳榮凱	Yongnam Lee

地點：綜三館 R201

2023 年 1 月 16 日（星期一）		Speaker
11:20 – 12:00	**New development of computation and applications for ice sheet dynamics** Chair: 夏俊雄	薛名成 Ming-Cheng Shiue

An Introduction to higher dimensional spaces and the Laboratory of Birational Geometry

Jungkai Chen
Department of Mathematics
National Taiwan University

Abstract

The goal of the Science Vanguard Research Project "Geometry and geography of higher dimensional spaces–theory, singularity, and applciation" is to investigate higher dimensional algebraic geometry, focusing on theory of singularities and their application. Unlike the usual personal project, we consider the purpose of this Vanguard Project as two-folds: on one hand, we aim to foster frontier research; and on the other hand, we aim to build up a research team at the international level. To this end, we built up a research team called "Laboratory of Birational Geometry".

In this talk, we are going to introduce the following aspects.

- The research work of the PI
- The organization of the research team.
- The research work of the team members.

Advancing and connecting geometric measure theory and scientific computing

Ulrich Menne
Department of Mathematics
National Taiwan Normal University

16 January 2023

Abstract

This presentation is centred on a project—led by Chun-Chi Lin, Mei-Heng Yueh, and myself—studying non-smooth m dimensional surfaces (varifolds) in Euclidean space. The non-smoothness is prompted by the needs of geometric variational problems, mathematical models in the sciences, and scientific computing whereas the study concerns the convergence, curvature, and regularity of these surfaces. An emphasis will be placed on those of our results stemming from an effort to bridge geometric measure theory and scientific computing as pioneered by Kenneth A. Brakke in his study of the mean curvature flow.

New development of computation and applications for ice sheet dynamics

Chia-Chieh Chu[1], Min-Hung Chen[2], Hsueh-Chen Lee[3] and Ming-Cheng Shiue[4]

1.Department of Mathematics, National Tsing HuiaUniversity

2.Department of Mathematics, National Cheng Kung University

3.Center for General Education, Wenzao Ursuline University of Languages

4.Department of Applied Mathematics, National Yang Ming Chiao Tung University

Abstract

Ice sheet dynamics are described by the full nonlinear Stokes equations with a strainrate-dependent viscosity coupling with thermal effect, subglacial drainage and ice stream sliding. The study of ice sheet dynamics is important because it has the potential as shown in the literature to affect the sea level rises. The computational challenges of solving this system come from the typical larger range of ice sheets, its long time period and complexities such as the nonlinear viscosity depending on the strain rate and the temperature.

In this talk, two issues about numerical methods and the applications will be presented. For the first issue, the nonlinear Stokes equations will be studied by applying finite element method, weak Galerkin method and Hybridizable Discontinuous Galerkin method, which are considered as the first step toward understanding the computational difficulties of the whole system. We implement the weak Galerkin method to nonlinear Stokes equation. We use Picard iteration to overcome the difficulty of nonlinearity and get the convergent results. We also implement the Hybridizable Discontinuous Galerkin method to solve the steady Stokes equations and assess its performance through numerical experiments.

For the second issue, this work describes the glacier iceberg calving as the terminus of a tidewater glacier, for example, Greenland's

Jakobshavn Isbræ. The streamlined diffusion stabilization method is employed for solving the nonlinear Stokes sheet model. We use an approach based on pressure and normal stress solutions to adjust the grounding line position. We show effective principal stress (EPS) contours and profiles for grounded glaciers and a notch glacier with basal crevasses open at the grounding line. Results show that the water pressure affects the notch glacier with basal crevasses open at the grounding line. The ungrounded stress profile shows a drastic variation compared with the fully grounded tidewater glacier. It should be one effect on the glacier iceberg calving. Numerical results are also presented to elucidate the impact of the slip length, notch length, grounding line, and surface slope. Finally, the streamlined diffusion stabilization effects on numerical solutions are presented.

Smooth specialization of hypersurfaces

Yongnam Lee
Department of Mathematical Sciences, KAIST, and
IBS Center for Complex Geometry

Abstract

In this presentation, we give a structure theorem for projective manifolds W_0 with the property of admitting a one parameter deformation where W_t is a hypersurface in a projective smooth manifold Z_t. Their structure is the one of special iterated univariate coverings, which we call normal type. We give an application to the case where Z_t is a projective space, respectively an abelian variety. We also give a characterizaton of smooth ample hypersurfaces in abelian varieties and describe an irreducible connected component of their moduli space. This is based on joint work with Fabrizio Catanese.

Computational Conformal Geometry and Optimal Mass Transport with Applications on Medical Images

Wen-Wei Lin
Department of Applied Mathematics
National Yang Ming Chiao Tung University

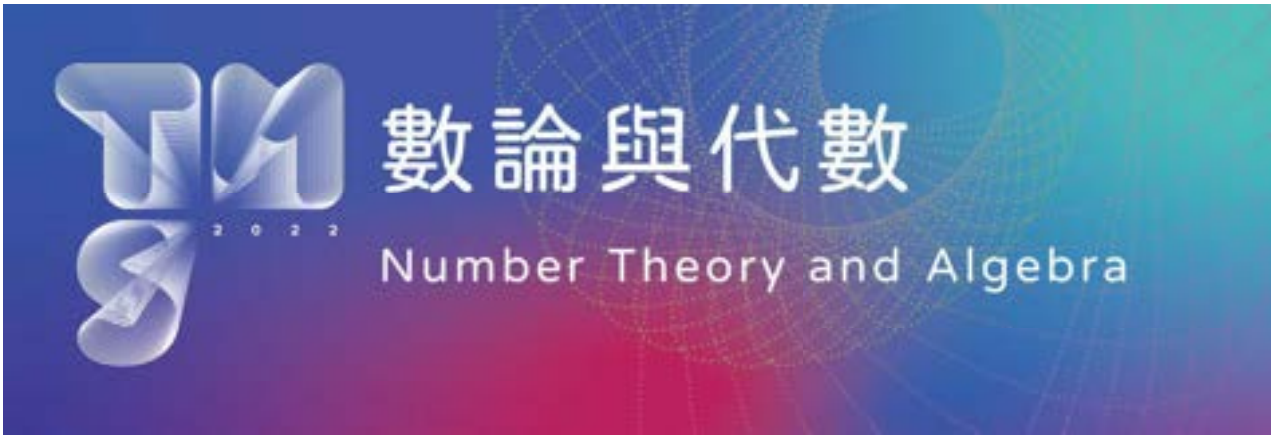
Abstract

In this talk, we would like to introduce the computational conformal geometry and optimal mass transport with its applications on medical images. The well-known uniformization theorem shows that a closed surface of genus-zero is equivalently conformal to a unit sphere. However, the numerical method and its convergence should be addressed. We will propose efficient algorithms on conformal energy minimization (CEM), stretch energy minimization (SEM) and volume stretch energy minimization (VSEM) for finding the conformal (angle-preserving) and equiareal (area-preserving) parametrizations, respectively, between a simply connected closed surface and a sphere, as well as, the volume-preserving parametrization between a 3-manifold with a single genus-zero boundary and a unit ball. Based on the SEM and VSEM algorithms we further develop the reliable and robust algorithms for solving the optimal mass transport (OMT) between an irregular 3D domain and a unit ball, while minimizing the deformation cost, and keeping the minimal distortion and the local mass ratios unchanged. Combining the proposed OMT with the U-net machine learning algorithm, we develop a novel two-phase OMT algorithm successfully applying for the detection and segmentation of 3D brain tumors with high training and validation Dice scores.

領域演講
Special Sessions

數 論 與 代 數

Number Theory and Algebra



Organizer: 張介玉

地點：綜三館 4F RoomB

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	**Filtration Methods in Diophantine Geometry and Nevanlinna Theory** Chair: 張介玉	王姿月 Tzu-Yueh Wang
14:15 - 14:45	**Whittaker modules for Lie superalgebras** Chair: 張介玉	陳志瑋 Chih-Whi Chen
14:45 - 15:15	**Function Field Analogue of Shimura's Conjecture on Period Symbols** Chair: 張介玉	魏福村 Fu-Tsun Wei

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:20	**The Quantum Wreath Product** Chair: 魏福村	賴俊儒 Chun-Ju Lai
11:20 - 11:40	**A Practical Post-Quantum Signature: NOVA** Chair: 魏福村	官彥良 Yen-Liang Kuan
11:40 - 12:00	**Unitary algorithm for real reductive groups** Chair: 魏福村	蔡宛育 Wan-Yu Tsai
13:35 - 13:55	**Local newforms for generic representations of unramified U_{2n+1}** Chair: 魏福村	鄭　堯 [線上] Yao Cheng
13:55 - 14:25	**Iterated beta integrals** Chair: 魏福村	佐藤信夫 [線上] Nobuo Sato

Filtration Methods in Diophantine Geometry and Nevanlinna Theory

Julie Tzu-Yueh Wang
Institute of Mathematics
Academia Sinica

Abstract

In 1994 Faltings and Wüstholz introduced a new geometric method in the study of Diophantine approximation, called the filtration method, which involved working with "many" sections of a line bundle and producing many linear combinations of them vanishing along appropriate divisors. This was further developed by Evertse and Ferretti. Independently, Corvaja and Zannier also worked with filtrations of the same kind, which was further refined and developed by Levin and Autissier, etc. Recently, Ru and Vojta formulated a general version of the celebrated Schmidt's Subspace Theorem that unifying many known results with filtration methods. We will introduce these developments and state some applications of Ru-Vojta's theorem in the study of integral points and gcd theorem. We will also mention some corresponding results in Nevanlinna theory. This talk includes joint works with Erwan Rousseau and Amos Turchet and a joint work with Yu Yasufuku.

Whittaker modules for Lie superalgebras

Chih-Whi Chen
Department of Mathematics
National Central University

Abstract

Whittaker modules are a natural generalization of weight modules in the Bernstein-Gelfand-Gelfand category O. In this talk, we introduce a construction of simple Whittaker modules for Lie superalgebras. We present a solution to the problem of determining the composition factors of the standard Whittaker modules in terms of composition factors of Verma modules. We explain the connection between the Whittaker modules and the finite-dimensional modules over finite W-superalgebras.

This talk is based on joint work with Shun-Jen Cheng and Volodymyr Mazorchuk.

Function Field Analogue of Shimura's Conjecture on Period Symbols

Fu-Tsun Wei
Department of Mathematics
National Tsing Hua University

Abstract

In this talk, we first introduce the notion of Shimura's period symbols over function fields and establish their fundamental properties. We further formulate and prove an analogue of Shimura's conjecture on the algebraic independence of these symbols. Our results enable us to clarify the algebraic relations among quasi-periods of a "non-degenerate CM" abelian t-module defined over an algebraic function field. Further applications to special values of various gamma functions in positive characteristic will be discussed if time permits. This is joint work with W. D. Brownawell, C.-H. Chang, and M. A. Papanikolas.

The Quantum Wreath Product

Chun-Ju Lai
Institute of Mathematics
Academia Sinica

Abstract

I will talk about a new operation (which we call the quantum wreath product) that produces a algebra $B \wr_Q \mathcal{H}(d)$ from a given algebra B, a given rank d, and a choice Q of parameters. This provides a uniform treatment to structure and representation theory of all Hecke-like algebras, including but not limited to the Ariki-Koike algebras, the Yokonuma-Hecke algebras, the Hu subalgebra, and the extended affine Hecke algebras of type A.

A Practical Post-Quantum Signature: NOVA

Yen-Liang Kuan
Department of Applied Mathematics
National Dong Hwa University

Abstract

A universal quantum computer attack could break classical public key cryptography using Shor's algorithm. Therefore we need new public-key cryptosystems that can resist quantum computing. In this talk, we will talk about a new signature scheme which is a noncommutative ring based unbalanced oil and vinegar signature scheme with key-randomness alignment: NOVA (Noncommutative Oil and Vinegar with Alignment). This is a joint work with L.-C. Wang, P.-E. Tseng and C.-Y. Chou.

Unitary algorithm for real reductive groups

Wan-Yu Tsai
Department of Applied Mathematics
Chung Yuan Christian University

Abstract

In this talk, we follow a paper by Adams-van Leeuwen-Trapa-Vogan, to introduce an algorithm for computing the irreducible unitary representations of a real reductive group G. By Langlands classification, any irreducible representation is exhibited with an invariant Hermitian form as a deformation of a unitary representation from the Plancherel formula. This "unitary algorithm" traces the signature of the form through this deformation, counting changes at reducibility points. Furthermore, we will present the potential work to generalize this algorithm to a nonlinear double cover of a real reductive group.

Local newforms for generic representations of unramified U_{2n+1}

Yao Cheng
Department of Mathematics
Tamkang University

Abstract

Newforms have their root in the classical theory of Atkin-Lehner for modular forms. In the modular form setting, newforms are cusp forms which are simultaneously eigenfunctions of all Hecke operators. Consequently, their Fourier coefficients satisfy strong recurrence relations and their L-functions are well behaved. Probably inspired by the connection between modular forms and representations of p-adic GL_2, W. Casselman developed the theory of local newforms for generic representations of p-adic GL_2. His result was subsequently extended to other p-adic classical groups by many authors. In a recent preprint, Atobe-Oi-Yasuda established the theory of local newforms for generic *tempered* representations of unramified p-adic U_{2n+1}. Their result was later extended to every generic representations in our latest work. In this talk, we will introduce these works with sketchy proofs. If time permits, we will also mention possible arithmetic applications.

Iterated beta integrals

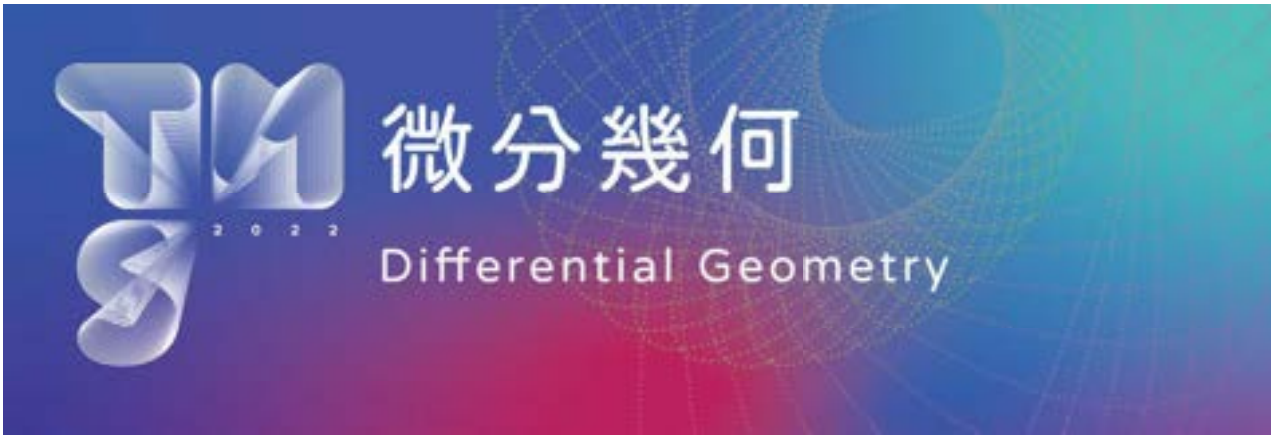
Nobuo Sato
Department of Mathematics
National Taiwan University

Abstract

The Iterated beta integrals are a common generalization of the hyperlogarithms and beta integrals introduced by Hirose and myself in our previous work on a generalization of Zagier's formula on multiple zeta values. They satisfy a certain invariance property which gives rise to various new hyperlogarithm identities. In my talk, I would like to give a brief introduction to the iterated beta integrals and the applications and discuss further interesting properties we found in our subsequent studies.

微 分 幾 何

Differential Geometry



Organizer: 何南國

地點：綜三館 R119

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	**Legendrian mean curvature flow** Chair: 崔茂培	吳進通 Chin-Tung Wu
14:15 - 14:45	**The mass of the static extensions of small spheres** Chair: 崔茂培	王業凱 Ye-Kai Wang
14:45 - 15:15	**The mathematical structure of Bézier curves in the plane** Chair: 崔茂培	李國瑋 Kuo-Wei Lee

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:20	**Knot theory with Legos** Chair: 何南國	王以晟 Yi-Sheng Wang
11:20 - 11:40	**Singular set and curvature blow-up rate of the level set flow** Chair: 何南國	郭孝豪 Siao-Hao Guo
11:40 - 12:00	**Stability of regular shrinkers in the network** Chair: 何南國	張瑞恩 Jui-En Chang
13:35 - 14:05	**Collapsing of ALH* -Gravitational Instantons** Chair: 夏杼	楊劼之 Ryosuke Takahashi

Legendrian mean curvature flow

Chin-Tung Wu
Department of Applied Mathematics
National Pingtung University

Abstract

In this talk, we will study the existence of minimal Legendrian submanifolds in eta-Einstein Sasakian manifolds via the Legendrian mean curvature flow which is initiated by K. Smoczyk. This is a joint work with Shu-Cheng Chang and Yingbo Han.

The mass of the static extensions of small spheres

Ye-Kai Wang
Department of Applied Mathematics
National Yang Ming Chiao Tung University

Abstract

Bartnik proposed a definition of quasilocal mass in general relativity in 1989. The definition leads to several outstanding problems in geometric analysis, most notably the Static Extension Conjecture. We discuss some recent result in this direction and the question of small sphere limits of Bartnik mass. This talk is based on joint work with Brian Harvie.

The mathematical structure of Bézier curves in the plane

Kuo-Wei Lee
Department of Mathematics
National Changhua University of Education

Abstract

Bézier curves are interesting and mysterious curves defined by the sum of ordered control points (vectors) with Bernstein polynomial weights. They are broadly applied in computer graphing design. In this talk, we will observe Bézier curves in mathematical parts. Not only we summarize some general properties of Bézier curves, but also we will discuss the mathematical structure of Bézier curves of degree two and higher degree.

Knot theory with Legos

Yi-Sheng Wang
Department of Applied Mathematics
National Sun Yat-sen University

Abstract

A genus g handlebody-knot is a handlebody of genus g embedded in 3-dimensions. In the case $g = 1$, it is equivalent to a classical knot—a closed curve in the 3-space.

Much of the topological content of a handlebody-knot can be extracted from its exterior, namely the complementary part of the embedded handlebody in 3-dimensions. It is one of the primary tools to classify handlebody-knots and construct their invariants. In fact, in the genus one case, the homeomorphism type of a handlebody-knot exterior completely determines the isotopy type of the handlebody-knot.

In this talk, we consider genus 2 handlebody-knots, and explain how their exteriors can be pieced together from simple building blocks, our"lego bricks", and how such decompositions can be used to classify handlebody-knots and study their symmetries.

Singular set and curvature blow-up rate of the level set flow

Siao-Hao Guo
Department of Mathematics
National Taiwan University

Abstract

Under certain conditions such as the 2-convexity, a singularity of the level set flow is of type I (in the sense that the rate of curvature blow-up is constrained before and after the singular time) if and only if the flow shrinks to either a round point or a C^1 curve near that singular point. Analytically speaking, the arrival time is C^2 near a critical point if and only if it satisfies a Łojasiewicz inequality near the point.

Stability of regular shrinkers in the network flow

Jui-En Chang
Department of Mathematics
National Chung Cheng University

Abstract

Abstract: The singularities of network flow are modeled by self-similarly shrinking solutions called regular shrinkers. Here, we study stability of regular shrinkers. All regular shrinkers with two or more enclosed regions can be perturbed away. Among the regular shrinkers with one enclosed region, 4-ray star, 5-ray star, fish, and rocket are unstable.

Collapsing of ALH^*-Gravitational Instantons

Ryosuke Takahashi
Department of Mathematics
National Cheng Kung University

Abstract

In 1977, S. Hawking defined the gravitational instantons which can be regarded as the scaling limit of Calabi-Yau 2-ford. The ALH^*-gravitational-instanton is one of them with exotic volume growth $r^{\frac{4}{3}}$. In this talk, we will study the pointed Gromov-Hausdorff limit of ALH^*-gravitational instantons. This will prove the conjecture of Kontsevich-Sobelman. This is a joint work with Yu-Shen Lin.

分析與最佳化

Analysis & Optimization

Organizer: 李明憶

地點：綜三館 R201

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	Falconer Distances problem in Euclidean Spaces Chair: 林欽誠	沈俊嚴 Chun-Yen Shen
14:15 - 14:45	Riesz potentials around $L^1$and L^∞ Chair: 沈俊嚴	司靈得 Daniel Spector
14:45 - 15:15	Solving the quadratic surfaces intersection problem Chair: 沈俊嚴	許瑞麟 Ruey-Lin Sheu

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:30	Additivity Violations of Random Quantum Channels of non-white Wishart Types Chair: 方向	黃皓瑋 Hao-Wei Huang
11:30 - 12:00	Random Analytic Functions with Polynomial Growth Rate Chair: 黃皓瑋	方向 Xiang Fang

Falconer Distances problem in Euclidean Spaces

Chun-Yen Shen
Department of Mathematics
National Taiwan University

Abstract

The well-known Falconer conjecture states that any compact set $E \subset R^d$ with $\dim_H(E) > \frac{d}{2}$ (Hausdorff dimension), its distance set $\Delta(E) = \{|x-y|, x, y \in E\}$ has positive Lebesgue measure. This conjecture is widely open and has been one of the most active research topics in the area of Harmonic analysis and Geometric measure theory. In this talk, we will talk about our recent new result that proves a stronger distance result for general product sets. Our result is the first one that improves the previous result of Mattila and Sjölin in 1999 for general product sets.

Riesz potentials around L^1 and L^∞

Daniel Spector
Department of Mathematics
National Taiwan Normal University

Abstract

The spaces L^1 and L^∞ do not behave like other L^p spaces in relation to the Riesz potential, a fact which was observed from the very beginning. These anomalies have made life interesting over the last almost century, where the progressive study of this topic has led to the discovery of a number of results. In this talk the speaker will review the literature that he is aware of and share his perspective of the present state of the art. Open problems will be mentioned.

Solving the quadratic surfaces intersection problem

Ruey-Lin Sheu
Department of Mathematics
National Cheng Kung University

Abstract

In this talk, we try to answer an open question, often referred to as the (QSIC) problem, proposed by Pólik and Terlaky in SIAM Review 2007 that: *how we can decide whether two quadratic surfaces,* $\{f = 0\}$, $\{g = 0\}$*, intersect without actually computing the intersections?* We first formulate (QSIC) into a polynomial optimization problem of degree 4, denoted by Problem (P). If the joint numerical range $\{(f(x), g(x))|x \in \mathbf{R}^n\} \subset \mathbf{R}^2$ is convex, we can compute the optimal value of (P) by the separating hyperplane theorem. Otherwise, we reduce (P) to become a quadratic optimization problem with one equality quadratic constraint and solve by $\mathcal{S}$-lemma with equality. The real difficulty comes when the two quadratic surfaces do not intersect but one approaches asymptotically to the other. It is equivalent to that the optimal value of problem (P) is not attainable, a difficult but fundamental problem which even the optimization community seldom want to handel. We resolve the feasibility issue by studying the topological separation property of the two quadratic surfaces $\{f = 0\}$, $\{g = 0\}$ and thus solve the (QSIC) problem completely.

Additivity Violations of Random Quantum Channels of non-white Wishart Types

Hao-Wei Huang
Department of Mathematics
National Tsing Hua University

Abstract

Most core problems in quantum information theory have elementary formulations but still resist solutions, one of which is the additivity conjecture of the minimum output entropy of quantum channels. All previously known results, including extensive numerical work, are consistent with the conjecture until it was shown to be false by Hasting and successive works by others. In this talk, we will briefly introduce the history and developments regarding this problem, present our random quantum channels composed of non-white Wishart ensembles and explore their additivity violations. The noted additivity violations occurring in our constructed random quantum channels are acquired by utilizing random matrix theory.

Random Analytic Functions with Polynomial Growth Rate

Xiang Fang
Department of Mathematics
National Central University

Abstract

Let $f(z) = a_0 + a_1 z + a_2 z^2 + \cdots$ be an analytic function over the unit disk in the complex plane. Let

$$Rf(z) = \pm a_0 \pm a_1 z \pm a_2 z^2 \pm \cdots$$

be its randomization. We characterize those $f(z)$, in terms of coefficients, s uch t hat $R\ f$ h as a p olynomial g rowth r ate a lmost surely. We show that the rate is almost surely a constant, leading to a well defined n otion o f g rowth r ate f or $R\ \ f$. T hen w e s how t hat t he rate of Rf is improved when compared with that of f, and the order of improvement is at most $1/2$. The proof relies the Dudley-Fernique entropy integrals, as reformulated by Marcus and Pisier.

(Joint work with Pham Trong Tien at Vietnam National University, Hanoi)

偏微分方程

Partial Differential Equations

Organizer: 吳恭儉

地點：綜三館 R118

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	Poisson-Boltzmann equations with steric effects Chair: 吳宗芳	林太家 Tai-Chia Lin
14:15 - 14:45	Vortex Condensate Solutions for the Self-Dual Maxwell-Chern-Simons $U(1)$ Model Chair: 吳宗芳	陳志有 Zhi-You Chen
14:45 - 15:15	Global Transonic Solutions of Compressible Euler-Poisson Equations in Semiconductors Chair: 吳宗芳	洪盟凱 Meng-Kai Hong

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:30	Blowup for the Keller-Segel System Chair: 吳恭儉	阮文先 Van Tien Nguyen
11:30 - 12:00	Recent progress on the Liouville systems Chair: 吳恭儉	黃信元 Hsin-Yuan Huang
13:35 - 14:05	Curvature equation with conic singularties and integrable system Chair: 黃信元	郭庭榕 Ting-Jung Kuo
14:05 - 14:35	Recent progress on Maxwell's conjecture Chair: 黃信元	蔡亞倫 Ya-Lun Tsai

Poisson-Boltzmann equations with steric effects

Tai-Chia Lin (林太家)
Department of Mathematics
National Taiwan University

Abstract

When ions are crowded, the effect of steric repulsion between ions becomes significant and the conventional Poisson-Boltzmann (PB) equation (without steric effect) should be modified. Several modified PB equations had been developed before. In this lecture, a general model of PB equations called Poisson-Boltzmann equations with steric effects (PB-steric equations) will be introduced. The concentrations of ions and solvent molecules are determined by the Lambert type functions under the assumptions of steric effects and chemical potentials. Theorems of the asymptotic limit of PB-steric equations with the Robin boundary condition may show the approach of previous modified PB equations. Moreover, we find the oscillatory total charge density function (which cannot be obtained in the conventional and modified PB equations) under the assumptions of steric effects and chemical potentials.

Vortex Condensate Solutions for the Self-Dual Maxwell-Chern-Simons $U(1)$ Model

Zhi-You Chen
Department of Mathematics
National Changhua University of Education

Abstract

In this talk, we consider the coupled equations arising from the self-dual Maxwell-Chern-Simons $U(1)$ model. We prove the existence of topological solutions and non-topological solutions for any ratio of the Chern-Simons mass scale over the electric charge. Moreover, the uniqueness of topological solutions was obtained. In addition, we also establish the structure of the existence of condensate solutions under the Chern-Simons parameter and the electric charge.

Global Transonic Solutions of Compressible Euler-Poisson Equations in Semiconductors

John M. Hong
Mathematics of department
Central University

01/16, 2023

Abstract

In this talk, we consider an initial-boundary value problem of compressible Euler-Poisson equations arising in semiconductors. The equations form a 3-by-3 hyperbolic system of balnace laws with the global source. We establish the global existence of the transonic entropy solution by framework of a generized Glimm scheme. We show that the global source in the momentum equation can be replaced by a local source from the Rankine-Hugoniot jump condtion. A modified version of wave-interaction estimate and decay of Glimm functionals near the sonic states are provided for the stability of the scheme. In addition, the entropy inequaity is also given. This is a joint work with Shih-Wei Chou and Jay Chu.

Blowup for the Keller-Segel System

Van Tien Nguyen
Department of Mathematics
National Taiwan University

Abstract

In this talk I will present constructive examples of blowup solutions to the Keller-Segel system in $\mathbb{R}^d$.

- L^1-critical ($d = 2$): There exist finite time blowup solutions that are of Type II with finite mass. Blowup rates are quantized according to the spectrum of a linearized operator in the self-similar setting. There is also the case of multiple collapsing blowup solutions formed by a collision of single-solutions.
- L^1-supercritical($d \geq 3$): We exhibit finite time blowup solutions that are completely unrelated to the self-similar scale, in particular, they are of Type II with finite mass. Interestingly, the radial blowup profile is linked to the traveling wave of the 1D viscous Burgers equation. There also exist solutions that blow up in finite time with infinite mass. The solution is asymptotically self-similar with a logarithmic correction to its profile for $d = 3, 4$. We found such an asymptotic profile can be either radial or completely non-radial.

The talk is based on results obtained in collaboration with Collot (Paris Cergy), Ghoul (NYU Abu Dhabi), Masmousdi (NYU), Nouaili (Paris Dauphine), Zaag (Paris Nord).

Recent progress on the Liouville systems

Hsin-Yuan Huang
Department of Applied Mathematics
National Yang Ming Chiao Tung University

Abstract

The Liouville systems have several applications to the various areas of biology, geometry and physics. For example, the abelian Chern-Simons system with n-Higgs fields can be regarded as a perturbation of the Liouville system. Also, the nonlocal Liouville system corresponds to the stationary or self-similar Patlak-Keller-Segel system. In this talk, I will review some recent results on this system, and its connection to the Patlak-Keller-Segel system. I will especially focus on the bubbling phenomenon of the solutions.

Curvature equation with conic singularties and integrable system

Ting-Jung Kuo
Department of Mathematics
National Taiwan Normal Uinversity

Abstract

Let $\left(E_\tau, dz^2\right)$, $\tau \in \mathbb{H}$ be a flat torus. We consider the follwing PDE:

$$\Delta u + e^u = \sum_{j=1}^{N} 4\pi\alpha_j \delta_{p_j} \text{ on } E_\tau \tag{1}$$

where δ_{p_j} is the dirac measure and $\alpha_j > -1$. In the literature, equation (1) is arised from conformal geometry. Indeed, (1) is equivalent to saying that the conformal metric $ds^2 = \frac{1}{2}e^u |dz|^2$ with conic singularties at p_j has the Gaussian curvature 1. By classical Liouville theorem, the curvature equation is also an integrable system which yields a complex ODE (a generalization of the classical Lame equation) and the solvability of equation (1) is equivalent to saying that the corresponding complex ODE is always apparent and has unitary monodromy. The study of the monodromy of a general complex ODE is diffi cult in general. However, recently, we also discover its relation with KdV theory. In this talk, I will talk about this deep connection and focus on the study of the complex ODE from monodromy point of view.

Recent progress on Maxwell's conjecture

Ya-Lun Tsai
Department of Applied Mathematics
National Chung Hsing University

2023/1/17

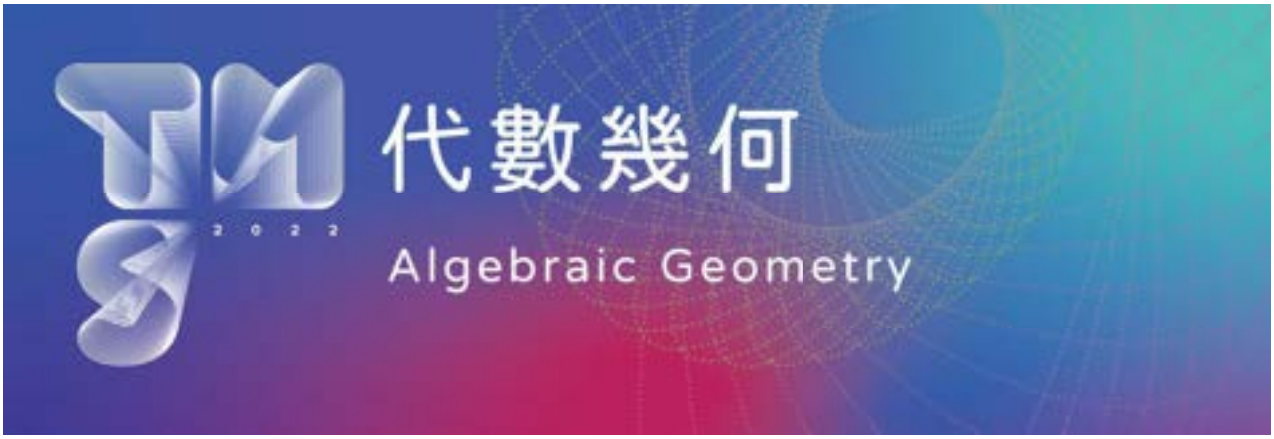
Abstract

In 1954, J. C. Maxwell made an claim in his book, *A Treatise on Electricity and Magnetism*, that the total number of points of equilibrium (all assumed nondegenerated) of any configuration with l charges in R^3 never exceeds $(l-1)^2$.

To this day, such problem is still open even for $l = 3$. In this talk, we will present some recent progress on this problem, called Maxwell's conjecture. Especially, we will focus on some results for $l = 4$.

代 數 幾 何

Algebraic Geometry



Organizer: 余正道

地點：綜三館 R723

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	**Zero entropy automorphisms on compact Kähler manifolds** Chair: 余正道	林學庸 Hsueh-Yung Lin
14:15 - 14:45	**Geometry of canonical Fano threefolds** Chair: 余正道	賴青瑞 Ching-Jui Lai
14:45 - 15:15	**The accumulation points of threefold canonical thresholds** Chair: 余正道	陳正傑 Jheng-Jie Chen

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:20	**Gaudin Hamiltonians on unitarizable modules over classical Lie (super)algebras** Chair: 余正道	章源慶 Wan-Keng Cheong
11:20 - 11:40	**On the birational structure of Calabi–Yau threefolds in ruled Fano manifolds** Chair: 余正道	王賜聖 Sz-Sheng Wang
11:40 - 12:00	**Log canonical foliation singularities on surfaces** Chair: 余正道	陳延安 Yen-An Chen
13:35 - 13:55	**Coherent Springer theory** Chair: 余正道	陳奕元 I-Yuan Chen

Zero entropy automorphisms on compact Kähler manifolds

Hsueh-Yung Lin
Department of mathematics
National Taiwan University

Abstract

We will survey some recent results about zero entropy automorphisms on compact Kähler manifold, based partially on several joint works with T.-C. Dinh, C. Gachet, K. Oguiso, L. Wang, X. Yu, and D.-Q. Zhang.

Geometry of canonical Fano threefolds

Ching-Jui Lai
Department of Mathematics
National Cheng Kung University

Abstract

From the minimal model program, it is known that the class of mildly singular (terminal, canonical, or klt) Fano varieties is one of the building blocks for the birational classification of projective varieties, and it is of fundamental interest to understand the explicit geometry of them. The classification of smooth Fano manifolds of dimension no more than three has been completed after the work of the Italian school, Iskovskih, Shokurov, Mori, and Mukai. In this talk, we discuss some recent progress and problems about extending the classification to canonical Fano threefolds.

The accumulation points of threefold canonical thresholds

Jheng-Jie Chen
Department of Mathematics
National Central University

Abstract

In this talk, we will briefly introduce the minimal model program and Sarkisov program. Then, we move to the study the set of 3-fold canonical thresholds. The following is my main result:

If $k \geq 2$ is a positive integer and $\mathrm{ct}(X, S)$ is a threefold canonical threshold with $\frac{1}{k} < \mathrm{ct}(X, S) < \frac{1}{k-1}$ where S is a Q-Cartier prime divisor of a projective 3-fold X, then we conclude that the numerator of the difference $\mathrm{ct}(X, S) - \frac{1}{k}$ has an upper bound in terms of k provided that the numerator of rational number $\mathrm{ct}(X, S)$ is large. More precisely, if a, m, p, q are positive integers such that $\mathrm{ct}(X, S) = \frac{a}{m} = \frac{1}{k} + \frac{q}{p}$, we obtain $q \leq 6k^2$ when $a \geq 18k^3(2k + 1)$. In particular, $\frac{1}{k}$ is the unique accumulation point of the set of 3-fold canonical thresholds in the open interval $(\frac{1}{k}, \frac{1}{k-1})$. This implies the ascending chain condition for the set of canonical thresholds in dimension 3.

The argument relies on the classification of divisorial contractions that contract divisors to points in dimension 3 by several works of Kawamata, Hayakawa and Kawakita and Yamamoto.

Gaudin Hamiltonians on unitarizable modules over classical Lie (super)algebras

Wan Keng Cheong
Department of Mathematics
National Cheng Kung University

Abstract

I will describe a one-to-one correspondence between the sets of eigenvectors of the Gaudin Hamiltonians for infinite-rank classical Lie (super)algebras of types a, c, d and those for the corresponding Lie algebras. I will also study the Gaudin Hamiltonians on unitarizable modules over finite-rank classical Lie (super)algebras of types a, c, d. This talk is based on joint work with Ngau Lam.

On the birational structure of Calabi–Yau threefolds in ruled Fano manifolds

Sz-Sheng Wang
Institute of Mathematics
Academia Sinica

Abstract

Calabi–Yau manifolds arise naturally in birational geometry and mirror symmetry. I will describe explicitly the chamber structure of the movable cone for a general complete intersection Calabi–Yau threefold X in certain $(n+4)$-dimensional $\mathbf{P}^n$-ruled Fano manifolds of index $n+1$ and hence verify the Morrison–Kawamata cone conjecture for such X. This is joint work with A. Ito and C.-J. Lai.

Log canonical foliation singularities on surfaces

Yen-An Chen
Mathematics
National Center for Theoretical Sciences

Abstract

Singularities play an important role in studying birational geometry as well as the foliations. In this talk, we will show the classification of log canonical foliation singularities on surfaces. As an application, the set of minimal log discrepancies on foliated surfaces satisfies the ascending chain condition.

Coherent Springer theory

Harrison Chen
Institute of Mathematics
Academia Sinica

Abstract

We will begin by discussing the geometric solution to the Kazhdan-Lusztig conjecture via D-modules and perverse sheaves on the flag variety, which involves identifying a category of representations with a category of constructible sheaves on a stratified space, under which one can parameterize irreducible representations by strata, and compute Ext groups in terms of cohomology. In a sense, such data gives a complete description of this finite length category.

We will then discuss Springer theory, which employs similar methods toward the character theory of a reductive group with finite coefficients $G(\mathbf{F}_q)$. The first object one encounters is the *Springer sheaf*, which knows about characters of unipotent principal series representations of $G(\mathbf{F}_q)$. A contemporary perspective sees it as being born from a categorical trace formalism applied to the 2-category of categorical representations of the group G.

Finally, we will move on to coherent Springer theory, which arises in a manner much like Springer theory, instead with applications to representations of reductive groups with coefficients in a non-Archimedian local field $G(F)$. The representation theory of $G(F)$ is not finite length, thus it is expected that any geometric parameterization of its objects should come in families, i.e. it should be a moduli stack, which brings us to algebraic geometry. To reach this realm, we pass through Langlands duality from the automorphic/representation side to the spectral/Galois side. The categories here contain coherent sheaves, in particular the coherent Springer sheaf, a sheaf on a stack of unipotent Langlands parameters closely related to the unipotent principal series representations for $G(F)$.

離 散 數 學

Discrete Mathematics

Organizer: 傅東山

地點：綜三館 R101

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	Counting phylogenetic networks with the component graph method Chair: 余冠儒	符麥克 Michael Fuchs
14:15 - 14:45	Bifurcation lemma and its applications to the inverse eigenvalue problem Chair: 郭大衛	林晉宏 Jephian C.-H. Lin
14:45 - 15:15	Covering grids with multiplicity Chair: 林延輯	Shagnik Das [線上]

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:30	An Enhanced Minimum Spanning Tree Algorithm for Achieving Collision-Free Transmissions in Massive IoT Networks Chair: 游森棚	陳秋媛 Chiu-Yuan Chen
11:30 - 11:50	Source-Detection in Networked-Structure Diffusion and Its Application in Contact Tracing Chair: 郭君逸	盧沛鐸 Pei-Duo Yu
11:50 - 12:10	Age of information under CRT sequences for a collision channel without feedback Chair: 張飛黃	羅元勳 Yuan-Hsun Lo
13:35 - 14:05	On the size of maximal binary codes with 2, 3, and 4 distances Chair: 翁志文	俞韋亘 Wei-Hsuan Yu
14:05 - 14:35	Statistics of partial permutations via Catalan matrices Chair: 賴欣豪	徐祥峻 Hsiang-Chun Hsu

Counting phylogenetic networks with the component graph method

Michael Fuchs
Department of Mathematical Sciences
National Chengchi University

Abstract

The *component graph method* was proposed by Louxin Zhang (and his collaborators) in order to solve several algorithmic problems for tree-child networks, galled networks, reticulation-visible networks and extensions of these classes. Moreover, the method was also used to obtain exact counts of the number of networks with n leaves and k reticulations. We recently used the method to obtain asymptotic counting results for these numbers, too. The purpose of this talk is twofold: first, we will introduce the method and some of our results and second, we will explain how these results are obtained by the method. The talk is based on joint work with Michael Wallner (TU Wien), Guan-Ru Yu (National Kaohsiung Normal University), Louxin Zhang (National Singapore University) and my PhD student Yu-Sheng Chang and (former) master students En-Yu Huang and Hexuan Liu.

Bifurcation lemma and its applications to the inverse eigenvalue problem

Jephian C.-H. Lin
Department of Applied Mathematics
National Sun Yat-sen University

Abstract

The inverse eigenvalue problem studies the spectral properties among a given set of matrices. For example, Colin de Verdière defined the parameter $\mu(G)$ as the largest multiplicity of λ_2 (the second smallest eigenvalue) among all weighted Laplacian matrices of G with the strong Arnold property, a non-degeneracy condition, and showed that $\mu(G) \leq 3$ if and only if G is planar. A key to this successful result is that the strong Arnold property allows us to perturb the matrix into a desired zero-nonzero pattern without changing its spectral property. In contrast, we will introduce the bifurcation lemma—a matrix with the strong property can be perturbed so that its spectral property changes slightly while its pattern stays the same—and demonstrate its impact on the inverse eigenvalue problem.

Covering grids with multiplicity

Shagnik Das
Department of Mathematics
National Taiwan University

Abstract

Let $S_1, S_2 \subseteq \mathbf{R}$ be two finite sets of size n, and suppose we wish to cover the points of the grid $\Gamma = S_1 \times S_2 \subseteq \mathbf{R^2}$ with as few lines as possible. It is straightforward to see that at least n lines are required. However, if our lines must avoid a given point $\vec{s_0} \in \Gamma$, then a celebrated theorem of Alon and Füredi shows that the minimum number of lines in such a cover jumps to $2(n-1)$.

In this talk, we consider the multiplicity version of this problem: in a k-cover, for some $k \in \mathbf{N}$, the lines must continue to avoid $\vec{s_0}$, but cover all other points of Γ at least k times. We shall show that the smallest k-cover of a typical grid contains $\left(\frac{3}{2} + o(1)\right) k(n-1)$ lines, improving a bound given by Ball and Serra. However, the standard grid $\Gamma_n = \{0, 1, \ldots, n-1\} \times \{0, 1, \ldots, n-1\}$ can be covered with fewer lines, and we will give nontrivial lower and upper bounds on the size of its smallest k-cover.

This is joint work with Anurag Bishnoi, Simona Boyadzhiyska and Yvonne den Bakker.

An Enhanced Minimum Spanning Tree Algorithm for Achieving Collision-Free Transmissions in Massive IoT Networks

Chiuyuan Chen
Department of Applied Mathematics
National Yang Ming Chiao Tung University

Abstract

The original Prim's algorithm forms a minimum spanning tree for a connected weighted graph by adding a closest vertex to the current subtree at each step. In this work, we enhance the original Prim's algorithm so that it can be used to partition massive IoT networks to achieve collision-free receiver-initiated data collection. In particular, two device mobility patterns are considered and two spanning forest based algorithms with four different flavors of cluster partitioning are proposed. (This is a joint work with Chia-An Hsu, Chung-Hsiang Tsai, Frank Y. Li, and Yu-Chee Tseng.)

Source-Detection in Networked-Structure Diffusion and Its Application in Contact Tracing

Pei-Duo, Yu
Department of Applied Mathematics
Chung Yuan Christian University

Abstract

Information propagation in online social networks and disease spreading through real-world social networks are common phenomena in networked structures. We study the epidemic source detection problem in contact tracing networks modeled as a graph-constrained maximum likelihood estimation problem using the susceptible-infected model in epidemiology. In this talk, we first introduce the problem formulation of the source detection problem and results on finite degree regular graphs and regular graphs with cycles. Thereby establishing an algorithm based on weighted graph distance that captures the optimality of this source detection problem. Then, we introduce how we apply the source detection algorithm to a problem arising from digital contact tracing during the COVID-19 pandemic. We compare the efficacy of two contact tracing strategies based on Breadth-first search (BFS) and Depth-first search (DFS) graph traversal. Lastly, we introduce a Graph Neural Network (GNN) learning framework to efficiently approximate the most-likely superspreader iteratively as the contact tracing networked data grows.

Age of information under CRT sequences for a collision channel without feedback

Yuan-Hsun Lo
Department of Applied Mathematics
National Pingtung University
yhlo@mail.nptu.edu.tw

Abstract

In many applications of Internet of Things, such as temperature and air pollution monitoring or traffic condition detection for autonomous driving, received information usually has a higher value when it is fresher. Age-of-information (AoI) is a newly defined performance metric to quantify the information freshness over such a wireless access networks. In this talk, I will focus on the collision channel without feedback and consider a deterministic access scheme, called CRT sequences, based on the Chinese Remainder Theorem. I will provide some new results on the average AoI and average peak AoI under CRT sequences, together with some properties of the sequence structure to optimize the AoI performance.

On the size of maximal binary codes with 2, 3, and 4 distances

Wei-Hsuan Yu
Mathematics Department
National Central University

Abstract

We address the maximum size of binary codes and binary constant weight codes with few distances. Previous works established a number of bounds for these quantities as well as the exact values for a range of small code lengths. As our main results, we determine the exact size of maximal binary codes with two distances for all lengths n at least 6 as well as the exact size of maximal binary constant weight codes with 2,3, and 4 distances for several values of the weight and for all but small lengths. The talk is based on the joint work with Barg, Glazyrin, Kao, Lai and Tseng on arXiv:2210.07496.

Statistics of partial permutations via Catalan matrices

Hsiang-Chun Hsu
Department of Mathematics
Tamkang University

Abstract

A generalized Catalan matrix $(a_{n,k})_{n,k\geq 0}$ is generated by two seed sequences $\mathbf{s} = (s_0, s_1, \ldots)$ and $\mathbf{t} = (t_1, t_2, \ldots)$ together with a recurrence relation. By taking $s_\ell = 2\ell + 1$ and $t_\ell = \ell^2$ we can interpret $a_{n,k}$ as the number of partial permutations, which are $n \times n$ $0,1$-matrices of k zero rows with at most one 1 in each row or column. In this talk we show that most of fundamental statistics and some set-valued statistics on permutations can also be defined on partial permutations and be encoded in the seed sequences.

動態系統與生物數學

Dynamical Systems and Biomathematics

Organizer: 王埠彬

地點：綜三館 R734

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:15	On finiteness of central configurations Chair: 班榮超	陳國璋 Kuo-Chang Chen
14:15 - 14:45	Classification of the spreading behaviors of a two-species diffusion-competition system with free boundaries Chair: 張志鴻	吳昌鴻 Chang-Hong Wu
14:45 - 15:15	Flocking in a New Discrete-Time and Discrete-State Cucker-Smale Model Chair: 陳賢修	梁育豪 Yu-Hao Liang

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:30	On the Orthogonal Flows Chair: 王埠彬	謝世峰 Shih-Feng Shieh
11:30 - 12:00	A variational approach to the semi-wave solutions of a free boundary problem with a multi-stable nonlinearity Chair: 王琪仁	張覺心 Chueh-Hsin Chang
13:35 - 14:05	Intra-and inter-specific competitions between stage-structured species in a patchy environment Chair: 王埠彬	鄭昌源 Chang-Yuan Cheng

On finiteness of central configurations

Kuo-Chang Chen
Department of Mathematics
National Tsing Hua University

Abstract

Self-similar solutions for the n-body problem, whose configurations are known as central configurations, are of special importance in celestial mechanics. Its finiteness is a long standing open problem. In this talk we will briefly outline some breakthroughs in the past two decades, in particular Hampton-Moeckel's work for the case n=4 (Invent. Math. 2006) and Albouy-Kaloshin's work for the case n=5 (Ann. Math. 2012). We will report our recent progress for the case n=6.

Classification of the spreading behaviors of a two-species diffusion-competition system with free boundaries

Chang-Hong Wu
Department of Applied Mathematics
National Yang Ming Chiao Tung University

Abstract

In this talk, we revisit the spreading behavior of two invasive species modeled by a diffusion-competition system with two free boundaries in a radially symmetric setting, where the reaction terms depict a weak-strong competition scenario. Numerical simulations suggested that for all possible initial states, only four different types of long-time dynamical behaviors can be observed: (1) chase-and-run coexistence, (2) vanishing of u with v spreading successfully, (3) vanishing of v with u spreading successfully, and (4) vanishing of both species. Here we rigorously prove that, as the initial states vary, there are exactly five types of long-time dynamical behaviors: apart from the four mentioned above, there exists a fifth case, where both species spread successfully and their spreading fronts are kept within a finite distance of each other all the time. This talk is joint work with Professor Yihong Du.

Flocking in a New Discrete-Time and Discrete-State Cucker-Smale Model

Yu-Hao Liang
Department of Applied Mathematics
National University of Kaohsiung

Abstract

Collective motions can be often observed in nature and experiments. Until now, several models have been proposed to explain these. In this talk, we introduce a new discrete-time and discrete-state flocking model based on the Cucker-Smale one. We then derive some sufficient conditions to assert the occurrence of flocking d ynamics. Roughly speaking, it happens when the communicate rate is less than or equal to some critical value. Some numerical simulations to support our theoretical results are also provided.

On the Orthogonal Flows

Shih-Feng Shieh
Department of Mathematics
National Taiwan Normal University

Abstract

This talk is concerned with the matrix differential e quation approximating the k-dimensional dominant eigenspace of a matrix. The solution of the matrix differential equation is orthogonal and is called generalized orthogonal flow. The existence and uniqueness of the generalized orthogonal flow are guaranteed for all time $t \in R$. An orthogonal flow, which has the shortest arc-length, has been constructed and is called the best path of generalized orthogonal flows. We show that the best path is Oja's flow. We also analyze the asymptotic behaviors and the convergence rate of the best path.

A variational approach to the semi-wave solutions of a free boundary problem with a multi-stable nonlinearity

Chueh-Hsin Chang
Department of Mathematics
National Chung Cheng University

Abstract

The semi-wave solutions is the traveling wave solutions defined in the half spaces which exhibit many important features for the spreading dynamics for the competing species. In this talk, we give the results about semi-wave solutions coming from the free boundary problems with monostable or bistable type reaction terms. We review the phase plane methods and provide variational methods for the existence of semi-wave solutions, and the dependence of wave speeds on the parameters in the Stefan conditions. This is a joint work with Prof. Chiun-Chuan Chen, Dr. Hung-Yu Chien and Prof. Chih-Chiang Huang.

Intra- and inter-specific competitions between stage-structured species in a patchy environment

Chang-Yuan Cheng
Department of Applied Mathematics
National Pingtung University

Abstract

Creatures have varied ability in their different life stages to compete for resource, space or mating, so that separating a population by life stages is an important baseline in describing an ecological population. In addition, behaviors of creatures (like competition between species and their life regulation) and the interact of species with environment (for example, dispersal according to the spatial heterogeneity of a habitat) are both considerable features to construct mathematical models. Based on the considerations, a model with two lifestages, immature and mature, and incorporating both intra- and inter-competitions between two species is explored to study invasion of species in a two-patch environment. The monotone dynamics in such a model provides us a property to explore its local and global dynamics. This is a joint work with Prof. Chih-Wen Shih and Dr. Kuang-Hui Lin.

計 算 數 學

Computational Mathematics

Organizer: 黃聰明

地點：綜三館 R203

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:25	**An entropy-weighted local intensity clustering-based model for segmenting intensity inhomogeneous images** Chair: 黃聰明	楊肅煜 Suh-Yuh Yang
14:35 - 15:15	**Some Experience on Interdisciplinary Collaboration from Computational Engineering and Image Analysis** Chair: 黃楓南	吳金典 Chin-Tien Wu

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:20	**High-order accurate schemes for shallow water equations** Chair: 胡偉帆	鄧君豪 [線上] Chun-Hao Teng
11:20 - 11:40	**Neural-network-based method for computing multiple excited states of the static Schrödinger equation** Chair: 胡偉帆	陳人豪 Jen-Hao Chen
11:40 - 12:00	**A Strong Artificial Intelligence Mimic of Bernard Lonergan's Cognitional Processes** Chair: 胡偉帆	嚴健彰 Chien-Chang Yen
13:35 - 13:55	**The local tangential lifting method for solving PDEs on regular surfaces** Chair: 朱家杰	陳昇國 Sheng-Gwo Chen
14:00 - 14:20	**Unconstrained exponential time differencing method on diffuse-interface model with Peng-Robinson equation of state** Chair: 朱家杰	陳孟豁 Meng-Huo Chen

An entropy-weighted local intensity clustering-based model for segmenting intensity inhomogeneous images

Suh-Yuh Yang
Department of Mathematics
National Central University

Abstract

This work proposes an entropy-weighted local intensity clustering-based model for segmenting intensity inhomogeneous images caused by the bias field. The variational model minimizes an energy functional consisting of a regularization term of the total length of object boundaries and a data-fitting term partitioning the image. Specifically, the total length is approximated by the convolution of the heat kernel with the characteristic functions of the segmented regions of interest. The data-fitting term is derived from the multiplicative bias field resulting in a local intensity clustering property and further weighted by the local entropy. One of the most advantageous features of the proposed model is that it can simultaneously segment the image and estimate the bias field for intensity inhomogeneity correction. Moreover, a simple and efficient iterative convolution-thresholding scheme can be applied to realize the model, exhibiting the energy-decaying property. Finally, numerical simulations are carried out to validate the superior performance of the approach. This is joint work with Wei-Ting Liao and Cheng-Shu You.

Some Experience on Interdisciplinary Collaboration from Computational Engineering and Image Analysis

Chin-Tien Wu
Applied Mathematics Department
National Yang-Ming Chiao-Tung University

01/16/2023

Abstract

In this talk, I would like to share my personal experience on inderdisciplinary collaboration. Topics in computational engineering, image analysis and artificial intelligent and industrial projects will be shown. I would also like to discuss some of our recent studies in noise covariance estimation rising from real time object tracking and control.

High-order accurate schemes for shallow water equations

Ting-An Chen, Chun-Hao Teng*
Department of Applied Mathematics
National Chung-Hsing University

Abstract

In this talk, we will present high-order accurate schemes for solving shallow water equations on spherical surfaces. The schemes are constructed based on the equations in a skew symmetric form, such that they are stable in a L_2 energy sense at the semidiscrete level. Numerical experiments have been conducted to verify the expected performances of the schemes. In addition, we also have used real data to conduct computations, and we have observed agreements between simulation fields and real data.

*Presenting author

Neural-network-based method for computing multiple excited states of the static Schrödinger equation

Jen-Hao Chen
Institute of Computational and Modeling Science
National Tsing Hua University

Abstract

A neural-network-based method is proposed to solve the multiple excited-state energies and corresponding wave functions of the static Schrödinger equation. The neural network models are trained by minimizing a specific loss function, in which the main components are the energy and deflation terms. The loss function is trained to obtain the minimum value of the energy term which is the desired energy level. Moreover, the deflation term transforms the energies of all computed states to the appropriate shift, and enables us to compute the next consecutive state. The results show that the accuracy and efficiency of proposed method outperforms other neural-network-based solvers.

A Strong Artificial Intelligence Mimic of Bernard Lonergan's Cognitional Processes

Chien-Chang Yen
Department of Mathematics
Fu-Jen Catholic University

Frank Budenholzer
Department of Chemistry
Fu-Jen Catholic University

Wayne Chen
Fu Jen Academia Catholica
Fu-Jen Catholic University

Abstract

Artificial intelligence (AI) can be divided into weak AI and strong AI. The self-driving car, mobile phone, robotic arms are classified as weak AI. Even the current deep learning is also a technique for weak AI because it is designed for a particular purpose. Strong AI, as compared with the weak AI, is regarded as a device that can think and learn like humans do. With regard to philosophical concerns, the self-consciousness and the emergence of intelligent creatures are more closely related to humanity. In this research, we are at the dawn of probing the Bernard Lonergan's cognitional processes: experience (E), understanding (U), judgment (J), decision (D), and reasoning (R) using algorithms and data. The aforementioned five processes are described as the followings: The process of experience (E) is to collect information and data in the past. It will lead to the understanding process (U). The (U) will move on to the process of judgment (J)

and the (J) may conclude in the decision process (D). All of the four processes, (E), (U), (J), and (D), are related to the process reasoning (R). Therefore, the relations are $E = E(R)$, $U = U(E, R)$, $J = J(U, R)$, $D = D(J, R)$ and $R = R(E, U, J, D)$.

In this talk, we will introduce the similarity plus (SP) code which is developed by ourselves. SP codes based on observation of human and it has the following characters:

1. The SP codes consists of frame and data.
2. The SP codes could generate others.
3. The main-driven program could be any one of them.
4. Each code can generate a new one (birth) and dies.
5. A random activation is involved.

Meanwhile, we are going to construct the model for the cognitional process. In more precise, once the input sentence given, the experience is to find the related information with the input sentence and the understanding is to extract the next feedback with the input sentence after the experience from the history data. The judgement is made from the understanding and the input sentence. The decision bases on the random choice and the reasoning is explored by the iteration of the cognitional process.

The local tangential lifting method for solving PDEs on regular surfaces

Sheng-Gwo Chen
Applied Mathematics
National Chiayi University

Abstract

We shall introduce the local tangential lifting method that we developed in 2013-2022 for solving some partial differential equations and approximating geometric invariants on regular surfaces. Our algorithm has two main steps: first, we lift the neighbourhood points to the approximating tangent space and obtain a local tangential polygon. Second, we use the Taylor's expansion to locally approximate the local parametrization of the underlying surface. We also try to solve the diffusion equations, the Cahn-Hilliard equations and to estimate the mean curvatures on regular surfaces by the LTL method in this talk. Some convergence problems will also be discussed. Numerical simulations are given to support theses results.

Unconstrained exponential time differencing method on diffuse-interface model with Peng-Robinson equation of state

Meng-Huo Chen
Department of Mathematics
National Chung Cheng Univeristy

Abstract

In this work, we apply the first order exponential time differencing method to solve the model problem for the diffuse-interface model with Peng-Robinson equation of state. We briefly discuss the framework of ETD and prove the unconditional stability of the our algorithm. Besides, we also derive the complexity of our algorithm and show that the calculation tasks (matrix multiplications, matrix inversion, etc.) in each time step follows strictly less than $O(n^2)$ of complexity, where n is the number of variables (or grid points). Our goal is to develop an algorithm whose computations in each time step (on-line calculation) avoid iterative solution (matrix inversion) in which the performance heavily depends on the matrix property and reduce the complexities of matrix-vector multiplications. In all, we look for an unconditionally stable algorithm with a better robustness. To this end, the matrix inverse and matrix exponential used in each time step are constructed by hierarchical matrix ($\mathcal{H}$-matrix) approximation with a rank $k \ll n$ and the complexities for their product with an n-vector can be shown to be $O(kn\log(n))$, which are better than $O(n^2)$.

機率與財務工程

Probability & Financial Engineering

Organizer: 陳冠宇

地點：綜三館 R631

2023 年 1 月 16 日（星期一）		Speaker
13:45 - 14:25	Asymptotic Analysis of Higher-order Scattering Transform of Gaussian Processes Chair: 陳冠宇	劉聚仁 Gi-Ren Liu
14:35 - 15:15	Estimates on transition densities for Markov processes with singular jumps Chair: 陳冠宇	金璟允 Kyung-Youn Kim

2023 年 1 月 17 日（星期二）		Speaker
11:00 - 11:30	A future study on Two assets contingent claims pricing problem Chair: 須上苑	劉宣谷 Hsuan-Ku Liu
11:30 - 12:00	A Theory of FinTech: Stablecoins Chair: 須上苑	翁新傑 Hsin-Chieh Wong

Asymptotic Analysis of Higher-order Scattering Transform of Gaussian Processes

Gi-Ren Liu
Department of Mathematics
National Cheng Kung University

Abstract

In this talk, we will discuss the distribution distance between the output F of the scattering transform (ST) of a Gaussian process and its scaling limit G. ST is a nonlinear transformation that involves a sequential interlacing convolution and nonlinear operators, which is motivated to model the convolutional neural network. We will show that the total variation distance between the distributions of the output of ST and a chi-square random variable with one degree of freedom converges to zero at an exponential rate. For achieving this goal, we derive a recursive formula to represent the nonlinearity of ST by a linear combination of Wiener chaos and then apply the Malliavin calculus and Stein's method to estimate the maximal difference between the expectation values of $h(F)$ and $h(G)$ over a specific s et o f test functions h. This talk is based on joint work with Yuan-Chung Sheu (National Yang Ming Chiao Tung University, Taiwan) and Hau-Tieng Wu (Duke University, USA).

Estimates on transition densities for Markov processes with singular jumps

Kyung-Youn Kim
Applied Mathematics
National Chung Hsing University

Abstract

We consider a non-local operator with a singular kernel. Corresponding to the non-local operator, there exists a discontinuous Markov process with the operator as infinitesimal generator, and a heat kernel of the operator is a transition density of the Markov process. In this talk, we study the heat kernel bounds for the anisotropic discontinuous Markov process. Let L_i be identical and independent 1–dimensional symmetric Lévy processes whose characteristic functions satisfy the weakly scaling condition. Define a Markov process $M := (M_1, \dots, M_d)$ whose jumping kernel is comparable to that of $L := (L_1, \dots, L_d)$. Then M only has a jump parallel to the axes. We discuss the sharp two-sided heat kernel estimates on $\mathbb{R}^d$ and $C^{1,1}$–open set $D \subset \mathbb{R}^d$. This is the joint work with Lidan Wang.

1. Heat kernel bounds for a large class of Markov process with singular jump. (with Lidan Wang), *Stochastic processes and their applications*. **145**: 165–203, 2022.
2. Dirichlet Heat kernel estimates for a large class of anisotropic Markov process. (with Lidan Wang). *submitted*.

A future study on Two assets contingent claims pricing problem

Hsuan-Ku Liu
Department of Mathematics and Information Education
National Taipei University of Education

Abstract

In this talk, we consider the two assets contingent claims pricing problem on the model with stochastic interest and stochastic correlation. We assumed that the risk-free interest rate evolves stochastically as Cox–Ingersoll–Ross process. The the correlation variable is assumed to satisfying the bound-Jacobi process. We first d erive the pricing partial differential e quation for t he E uropean-style contingent claim and investigate the properties of the value function. The neural network approach will be applied to find t he n umerical solution. For the American-style contingent claim, we provide the free boundary problem with the early exercise region. The early exercise region for the different k ind o f p roducts w ill b e d iscussed, w here t he product includes the exchange option, spread option, basket option, and better-of option. Moreover, the value function as well as the the early exercise region of the perpetual options are also considered.

A Theory of FinTech: Stablecoins

Hsin-Chieh Wong
Department of Statistics & Fintech and Green Finance Center (FGFC),
National Taipei University, Taiwan

Abstract

In this talk, I will give a brief overview of Fintech research based on my recent cryptocurrency papers. (1) How to create a good stablecoin is an important issue for payments within blockchain networks, whereby being often called the "Holy Grail of Cryptocurrency." In this topic, we attempt to design a dual-barrier structure that offers fixed-income stablecoins pegged to a traditional currency. (2) How to evaluate stablecoin is of great interest to both policymakers and investors. In this topic, we build a model to optimize stablecoin structure by extending the Leland-Toft endogenous default model based on geometric Brownian motion.

Keywords: Stablecoins, continuity correction, credit risk, endogenous default.

新鋭演講
Video Talks

新銳演講

中山大學應用數學系 / 許康康 (Kang-kang Xu) 博士後

The User-Irrep ressibility of CRT-based Sequences

中央研究院數學研究所 / Mikami, Ryota 研究學者

Tropical geometry and Chow groups

NCTS / 陳世昕 (Shih-Hsin Chen) 博士後

淺談能源議題與同步化理論及應用

中央大學數學系 / 王權豪(Keng Hao Ooi) 博士後

Harmonic Analysis in Nonlinear Potential Theory

臺灣大學數學系 / 阮文先(VAN TIEN NGUYEN) 助理教授

Research Activities

中央大學數學系 / 蔡昇甫(Shen-Fu Tsai) 助理教授

Extremal combinatories on pattern avoidance

清華大學數學系 / 東聖甯(Shen-Ning Tung) 助理教授

Research overview

附錄
Appendix

會場位置 Venue Map


演講樓層位置指引
綜合三館7樓 7F, General Building III
動態系統與生物數學 R734
Dynamical Systems and Biomathematics
代數幾何 R723
Algebraic Geometry
綜合三館6樓 6F, General Building III
機率與財務工程 R631
Probability & Financial Engineering
綜合三館4樓 4F, General Building III
數論與代數 RoomB
Number Theory and Algebra
綜合三館2樓 2F, General Building III
計算數學 R203
Computational Mathematics
分析與最佳化 R201
Analysis & Optimization
女數學人 R201
Forum of Female Mathematicians
綜合三館 General Building III
離散數學 R101
Discrete Mathematics
偏微分方程 R118
Partial Differential Equations
微分幾何 R119
Differential Geometry
茶會、午餐 1F大廳
諮詢處 1F大廳
旺宏館 Macronix Building
大會演講 國際會議廳
Plenary Talks
報到處 1F大廳
諮詢處 1F大廳
補助申請 1F大廳
Timetable

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