Plenary and Special Sessions

Soliton Solutions for Mean Curvature Flow

Yng-Ing Lee (李瑩英), National Taiwan University

Abstract

Mean Curvature Flow is a very canonical way to deform sub-manifolds to minimal sub-manifolds and it improves the geometry of sub-manifolds along the flow. Unfortunately, singularities may occur and will cause obstructions to continue the flow. It is thus very important to understand these singularities. Blowing up near an isolated singularity will lead to soliton solutions of Mean Curvature Flow. In this talk, I will report my study (with my collaborators) in this direction in the past few years. Special attentions are on Lagrangian Mean Curvature Flow which is a very important case for Mean Curvature Flow in high co-dimension.

Surface Geometry and General Relativity

Mu-Tao Wang (王慕道), Columbia University, U.S.A.

Abstract

Many classical results regarding surfaces in 3-dimensional Euclidean space such as Weyl's isometric embedding problem and the Minkowski inequality have their counterparts for surfaces in spacetime. These generalizations are not only of mathematical interest, but also of physically relevant importance. They are closely related to fundamental concepts such as gravitational energy and Cosmic censorship in general relativity. In my talk, I shall discuss some recent developments in these directions.

Geometry of Hypersurfaces with Constant Anisotropic Mean Curvature

Miyuki Koiso (小磯深幸),
Institute of Mathematics for Industry, Kyushu University, Japan

Abstract

A surface with constant anisotropic mean curvature (CAMC surface) is a stationary surface of a given anisotropic surface energy functional for volume-preserving variations. For example, minimal surfaces and surfaces with constant mean curvature in the Euclidean space and those in the Lorentz-Minkowski space are regarded as CAMC surfaces for a certain special anisotropic surface energy. The minimizer of an anisotropic surface energy among all closed surfaces enclosing the same volume is called the Wul shape, and the minimizer among surfaces with free boundary on a given support surface is sometimes called the Winterbottom shape. These concepts can be naturally generalized to higher dimensions, and they have many applications inside and outside mathematics. In this talk, we give fundamental geometric properties of CAMC hypersurfaces and recent progress in the research on the stability of CAMC hypersurfaces with free or fixed boundaries.

Green's Function

Tai-Ping Liu (劉太平), Institute of Mathematics, Academia Sinica

Abstract

We will illustrate the Green's function approach for solving partial differential equations by examples in fluid dynamics and kinetic theory. The approach yields quantitative information of the solutions that are of physical interests. Various methods are combined to explicitly construct the Green's functions. The nonlinear system is then solved using the Green's function and the Duhamel's principle.

Session on Number Theory and Algebra

On Multiple Zeta Values and Multiple Polylogarithms in Positive Characteristic

Chieh-Yu Chang (張介玉), National Tsing Hua University

Abstract

We consider the characteristic p multiple zeta values defined by Thakur, and Carlitz multiple polylogarithms. We prove a function field analogue of Goncharov's conjecture for MZVs. The same result is also established for multiple polylogarithms at algebraic points. Key ingredients of the proofs will be discussed.

Reference

[1] C.-Y. Chang, Linear independence of monomials of multizeta values in positive characteristic, arXiv:1207.2326.

D-module Structure of Local Cohomology Modules of Toric Algebras

Jen-Chieh Hsiao (蕭仁傑), National Cheng Kung University

Abstract

In this talk, the D-module finiteness results of local cohomolgy modules of toric algebras will be presented. This generalizes the classical results of polynomial algebras.

Symmetric Products and Hilbert Schemes: Comparing Their Quantum Cohomologies

Wan Keng Cheong (章源慶), National Cheng Kung University

Abstract

We would like to study the conjectural ring isomorphism between the orbifold quantum cohomology of the n-fold symmetric product of a smooth complex surface S and the quantum cohomology of the Hilbert scheme of n points on S.

On Cyclic Twists of an Elliptic Curve

Jung-Miao Kuo (郭容妙), National Chung Hsing University

Abstract

A recent result of Ciperiani and Krashen gives a simple formula for computing the relative Brauer groups of certain special homogeneous spaces for an elliptic curve, which they call cyclic twists. We will determine three-torsion cyclic twists of an elliptic curve and describe explicitly their relative Brauer groups.

Multiple Dirichlet Series over Function Fields

Ting Fang Lee (李亭芳),
Taida Institute for Mathematical Sciences, National Taiwan University

Abstract

Let π_1, π_2, η be a automorphic representations of $\mathrm{GL}_1(\mathbb{A}_K)$. Fisher and Friedberg [1] showed the weighted sum of the twists of $L(s_1, \pi_1)L(s_2, \pi_2)$ by quadratic characters χ_D,

$$\sum_D \prod_{j=1}^{2} L(s_j, \pi_j \otimes \chi_D, D) a(s_j, \pi, D)|D|^{-w},$$

is a meromorphic function of three complex variables and satisfies a non-abelian finite group of functional equations, and is a rational function in q^{-s_1}, q^{-s_2}, and q^{-w} where $a(s_j, \pi, D)$ is the correction factor. We will recall the construction, analytic continuation, and rationality of these 3-variable Dirichlet series, closely following the paper of Fisher and Friedberg [1]. We then compute the explicit rational function of the 3-variable Dirichlet series over the curve $\mathbb{P}^1$ over $\mathbb{F}_q$ where the function field is $\mathbb{F}_q(x)$.

Reference

[1] B. Fisher and S. Friedberg Sums of Twisted GL(2) L-functions over function fields *Duke Mathematical Journal* , Vol. 117, No. 3, 2003

Finite-dimensional Irreducible Modules of the Universal Askey-Wilson Algebra

Hau-wen Huang (黃皜文), National Center for Theoretical Sciences

Abstract

Let $\mathbb{F}$ denote a field and fix a nonzero $q \in \mathbb{F}$ such that $q^4 \neq 1$. The universal Askey-Wilson algebra is an associative unital $\mathbb{F}$-algebra $\Delta = \Delta_q$ defined by generators and relations. The generators are A, B, C and the relations assert that each of

$$A + \frac{qBC - q^{-1}CB}{q^2 - q^{-2}}, \qquad B + \frac{qCA - q^{-1}AC}{q^2 - q^{-2}}, \qquad C + \frac{qAB - q^{-1}BA}{q^2 - q^{-2}}$$

is central in Δ. In this talk we summarize a classification of the finite-dimensional irreducible Δ-modules up to isomorphism, provided that $\mathbb{F}$ is algebraically closed and q is not a root of unity.

On Erdős-Pomerance Conjecture for Rank One Drinfeld Modules

Yen-Liang Kuan (官彥良),
Taida Institute for Mathematical Sciences, National Taiwan University

Abstract

In this talk, we will introduce the Erdős-Pomerance conjecture for rank one Drinfeld modules. This is a joint work with Wentang Kuo and Wei-Chen Yao. Let k be a global function field of characteristic p which contains a prime divisor of degree one and the field of constants $\mathbb{F}_q$. Let ∞ be a fixed place of degree one and A be the ring of elements of k which have only ∞ as a pole. Let ψ be a sgn-normalized rank one Drinfeld A-module defined over $\mathscr{O}$, the integral closure of A in the Hilbert class field of A. We prove an analogue of a conjecture of Erdős and Pomerance for ψ. Given any $\alpha \in \mathscr{O} \setminus \{0\}$ and an ideal $\mathfrak{M}$ in $\mathscr{O}$, let $f_\alpha(\mathfrak{M}) = \{f \in A \mid \psi_f(\alpha) \equiv 0 \pmod{\mathfrak{M}}\}$ be the ideal in A. We denote by $\omega\big(f_\alpha(\mathfrak{M})\big)$ the number of distinct prime ideal divisors of $f_\alpha(\mathfrak{M})$. If $q \neq 2$, we prove that there exists a normal distribution for the quantity

$$\frac{\omega\big(f_\alpha(\mathfrak{M})\big) - \frac{1}{2}(\log \deg \mathfrak{M})^2}{\frac{1}{\sqrt{3}}(\log \deg \mathfrak{M})^{3/2}}.$$

Fusion Rules among Irreducible $V_{\sqrt{2}A_2}^{\tau}$-Modules

Sian-Yang Chen (陳憲揚), Institute of Mathematics, Academia Sinica

Abstract

Let $\sqrt{2}A_2$ be the $\sqrt{2}$ times the root lattice of type A_2 and τ a fixed point free isometry of order three of the lattice $\sqrt{2}A_2$. The orbifold VOA $V_{\sqrt{2}A_2}^{\tau}$ has been studied extensively and is an important component for understanding the $\mathbb{Z}_3$ orbifold construction of the famous Moonshine VOA. Fusion rules among some untwisted type modules are also obtained by Tababe and Yamada in 2007.

In this talk, we will determine completely fusion rules among irreducible $V_{\sqrt{2}A_2}^{\tau}$-modules. We will first compute certain intertwinning operators among irreducible modules of twisted type using a coset construction. Lower bounds on their fusion rules are also obtained. Next, we compute the quantum dimensions of irreducible $V_{\sqrt{2}A_2}^{\tau}$-modules. These quantum dimensions give upper bounds on fusion rules among irreducible $V_{\sqrt{2}A_2}^{\tau}$-modules. Together with the lower bounds obtained earlier, we determine explicitly fusion rules among all irreducible $V_{\sqrt{2}A_2}^{\tau}$-modules of twisted type. This completes the program for determining the fusion rules among irreducible $V_{\sqrt{2}A_2}^{\tau}$-modules.

Session on Discrete Mathematics

Spectral Radius and Degree Sequence of a Bipartite Graph

Chih-wen Weng (翁志文), National Chiao Tung University

Abstract

Let G be a simple bipartite graph with bipartition $U \cup V$ of orders p and q respectively. Let $d_1, d_2, \cdots, d_p$ and $d'_1, d'_2, \cdots d'_q$ be degree sequences in non-increasing order according to vertices in U and V respectively. The *spectral radius* $\rho(G)$ of G is the largest eigenvalue of the adjacency matrix of G. For positive integers s at most p and t at most q, we give a sharp upper bound for $\rho(G)$ by a function of $d_1, d_2, \cdots, d_s$ and $d'_1, d'_2, \cdots, d'_t$. As an application, we give affirmative answers to two previous conjectures [A. Bhattacharya, S. Friedland, U.N. Peled, On the first eigenvalue of bipartite graphs, *Electron J. Combinatorics*, 15 (2008), ♯R144], and [Yi-Fan Chen, Hung-Lin Fu, In-Jae Kim, Eryn Stehr, Brendon Watts, On the largest eigenvalues of bipartite graphs which are nearly complete, *Linear Algebra and its Applications*, 432 (2010) 606-614]. This is a joint work with Chia-an Liu.

On the Minimum Rank Problems of Graphs

Yu-pei Huang (黃喻培), I-Shou University

Abstract

Let G be a simple undirected graph on n vertices. The matrices having G as a described graph are the symmetric matrices indexed by the vertices of G, whose off-diagonal entries are nonzero if the corresponding vertices are adjacent, and zero otherwise. The minimum rank $m(G)$ of G is defined as the minimum rank among these matrices. In this talk we will briefly introduce some current progress about the minimum rank problems. This is a joint work with Liang-Yu Hsieh.

The Polycube Associated to 3-dimensional Space Tessellations

Chih-Hung Yen (嚴志弘), National Chiayi University

Abstract

Let the 3-dimensional space $\mathbb{R}^3$ be divided into *unit cubes*, that is, the eight corners of a cube have the coordinates (x,y,z), $(x+1,y,z)$, $(x,y+1,z)$, $(x+1,y+1,z)$, $(x,y,z+1)$, $(x+1,y,z+1)$, $(x,y+1,z+1)$, $(x+1,y+1,z+1)$ for some integers x, y, and z. For each unit cube, we use the coordinate of its lower left corner on the first floor to denote itself. Obviously, unit cube (x,y,z) and unit cube (x',y',z') share a unit square if $|x'-x|+|y'-y|+|z'-z|=1$. And a finite and nonempty set of unit cubes, denoted by U, is said to be *connected* if, for any two distinct unit cubes (x,y,z) and (x',y',z') in U, there exists

a sequence $(x,y,z) = (x_1,y_1,z_1),(x_2,y_2,z_2),\ldots,(x_{t-1},y_{t-1},z_{t-1}),\ (x_t,y_t,z_t) = (x',y',z')$ for some positive integer t such that (i) unit cube (x_i,y_i,z_i) belongs to U for all $i \in \{1,2,\ldots,t\}$ and (ii) unit cube (x_i,y_i,z_i) and unit cube $(x_{i+1},y_{i+1},z_{i+1})$ share a unit square for all $i \in \{1,2,\ldots,t-1\}$. Then a *polycube* is defined as a finite, nonempty, and connected set of unit cubes.

A polycube P is said to *tessellate* the 3-dimensional space if the 3-dimensional space is consisting of the images of P under the *translations* of vectors in portions of $\mathbb{Z}^3$ that do not overlap except along their sides. We also say that there exists a *tessellation* of the 3-dimensional space using a polycube P if P tessellates the 3-dimensional space.

In this talk, except a more detailed survey, we propose some results for determining tessellating polycubes.

Crosstalk Analysis for Microring Based Optical Interconnection Networks

Bey-Chi Lin (林琲琪), National University of Tainan

Abstract

Recently a new approach was proposed to tackle the wavelength non-uniformity problem of the silicon photonic ring technology. By lowering the Q value of the ring, the likelihood of finding a common operating wavelength can be significantly increased. But lowering Q will increase the crosstalk level in such a network. This crosstalk problem can be tackled with a generalized space dilation technique.

Since crosstalk is a central issue of this approach, computing the crosstalk level accurately is critical for a microring-based photonic interconnect. Prior work on crosstalk analysis for interconnects based on directional couplers assumed that the extinction ratios are the same for the two switching states. But this is usually not the case for silicon photonic microrings. In this talk, I am going to show an analytical model for analyzing the crosstalk level in a microring-based optical interconnection network. The analytical approach can be used for studying the crosstalk problem in optical networks based on other optical switching technologies.

Joint Equidistributions on Classical Coxeter Groups

Yuan-Hsun Lo (羅元勳), National Taiwan Normal University

Abstract

The classical Coxeter groups consist of the symmetric group $\mathfrak{S}_n$, signed permutation group B_n and even signed permutation group D_n. Petersen [1] discovered a new statistic, called *sorting index*, on these groups and proved that it is Mahonian, i.e., is equidistributed with the corresponding length function. He also proved that $(\mathsf{inv},\mathsf{rlmin})$ and $(\mathsf{sor},\mathsf{cyc})$ are joint equildistributed over $\mathfrak{S}_n$. A generalization to B_n and D_n is obtained by Chen et al. [2]. In this work we generalize these results further to three or four statistics. Our main results consist of a collection of equidistributed triple or quadruple statistics for each

type. For example, over $\mathfrak{S}_n$ we define a new Stirling statistic $\mathsf{lrmincyc}_1$ and derive the following generating function:

$$\sum_{\mathfrak{S}_n} q^{\mathsf{inv}} x^{\mathsf{rlmin}} y^{\mathsf{lrmin}} = \sum_{\mathfrak{S}_n} q^{\mathsf{sor}} x^{\mathsf{cyc}} y^{\mathsf{lrmincyc}_1} = xy \prod_{i=2}^{n} (x + [i]_q + yq^{i-1} - 1 - q^{i-1}).$$

For B_n and D_n, we have the following 5-variable and 4-variable generating functions respectively:

$$\begin{aligned} &\sum_{B_n} q^{\mathsf{inv}_B} x_1^{\mathsf{rlmin}^+} x_2^{\mathsf{rlmin}^-} y_1^{\mathsf{lrmin}^+} y_2^{\mathsf{lrmin}^-} = \sum_{B_n} q^{\mathsf{sor}_B} x_1^{\mathsf{cyc}^+} x_2^{\mathsf{cyc}^-} y_1^{\mathsf{lrmincyc}_1^+} y_2^{\mathsf{lrmincyc}_1^-} \\ = \;& (x_1 y_1 + x_2 y_2 q) \prod_{i=2}^{n} \left(x_1 + q + \cdots + q^{i-2} + y_1 q^{i-1} + y_2 q^i + q^{i+1} + \cdots + q^{2i-2} + x_2 q^{2i-1} \right), \end{aligned}$$

and

$$\begin{aligned} &\sum_{D_n} q^{\mathsf{inv}_D} x_1^{\mathsf{rlmin}_D^+} x_2^{\mathsf{rlmin}_D^-} y^{\mathsf{lrmin}} = \sum_{D_n} q^{\mathsf{sor}_D} x_1^{\mathsf{cyc}_D^+} x_2^{\mathsf{cyc}_D^-} y^{\mathsf{lrmincyc}_1} \\ = \;& (x_1 y) \prod_{i=2}^{n} \left(x_1 + q + \cdots + q^{i-2} + (2y) q^{i-1} + q^i + \cdots + q^{2i-3} + x_2 q^{2i-2} \right). \end{aligned}$$

This is joint work with Sen-Peng Eu and Tsai-Lien Wong.

[1] T. K. Petersen, The sorting index, *Advances in Applied Mathematics*, 47(3): 615–630, 2011.

[2] W. Chen, G. Gong and J. Guo, The sorting index and permutation codes, *Advances in Applied Mathematics*, 50(3): 367–389, 2013.

[3] D. Foata, G.-H. Han, New permutation coding and equidistribution of set-valued statistics, *Theoretical Computer Science*, 410(38-40): 3743–3750, 2009.

Intersecting k-uniform Families Containing All the k-subsets of a Given Set

Wei-Tian Li (李渭天), National Chung Hsing University

Abstract

Let m, n, and k be integers satisfying $0 < k \leqslant n < 2k \leqslant m$. A family of sets $\mathscr{F}$ is called an (m,n,k)-*intersecting family* if $\binom{[n]}{k} \subseteq \mathscr{F} \subseteq \binom{[m]}{k}$ and any pair of members of $\mathscr{F}$ have nonempty intersection. Maximum (m,k,k)- and $(m,k+1,k)$-intersecting families are determined by the theorems of Erdős-Ko-Rado and Hilton-Milner, respectively. We determine the maximum families for the cases $n = 2k-1, 2k-2, 2k-3$, or m sufficiently large.

Joint work with Bor-Liang Chen, Kuo-Ching Huang, and Ko-Wei Lih.

Choice Identification Number of Complete Bipartite Graphs

Ting-Pang Chang (張定邦), National Sun Yat-sen University

Abstract

Let G be a graph, u be a vertex of G, and $B(u)$(or $B_G(u)$) be the set of u with all its neighbors in G. A set S of vertices is called an *identifying set* of G if there exists a function f from $V(G)$ to the set of all nonempty subsets of S such that (i) for each vertex u in G, $f(u) \subseteq B(u)$, and (ii) for every pair of distinct vertices u and v, $f(u)$ and $f(v)$ are distinct. f is called a *choice identification* of G with respect to S. The *choice identification number* $\iota_c(G)$ is the cardinality of a minimum identifying set of G. In this talk, I will present the identification numbers of complete bipartite graphs.

This is joint work with Professor Li-Da Tong.

Neighborhood Sequences of Graphs

Li-Da Tong (董立大), National Sun Yat-sen University

Abstract

Let G be a graph, u be a vertex of G, and $B(u)$(or $B_G(u)$) be the set of u with all its neighbors in G. A sequence $(B_1, B_2, ..., B_n)$ of subsets of an n-set S is a *neighborhood sequence* if there exist a graph G with a vertex set S and a permutation $(v_1, v_2, ..., v_n)$ of S such that $B(v_i) = B_i$ for $i = 1, 2, ..., n$. $(v_1, v_2, ..., v_n)$ is called an *adjacent SDR* of $(B_1, B_2, ..., B_n)$. In this paper, we study the reconstruction problem from a neighborhood sequence and investigate the neighborhood sequences with two distinct adjacent SDRs.

A Variation of Cover-Free Families and Its Applications

Huilan Chang (張惠蘭), National University of Kaohsiung

Abstract

We consider a variation of cover-free families: A $0/1$ matrix is $(r, w; z]$-*consecutive-disjunct* if for any cyclically consecutive w columns $C_1, \cdots, C_w$ and another cyclically consecutive r columns $C_{w+1}, \cdots, C_{w+r}$, there exist z rows interesting $C_1, \cdots C_w$ but none of $C_{w+1}, \cdots, C_{w+r}$. We prove that there is a $(r, w; z]$-consecutive-disjunct matrix of n columns with $ze^2k^w(1 + \ln(n/k - w + 1)(n - n/k - r + 1)) - 1$ rows where $k = r + w$. By applying consecutive-disjunct matrix, we show that for threshold group testing with consecutive positives, there exists a nonadaptive algorithm to identify a $(u - l - 1)$-approximate set in $16 \ln n + 4d - 16 \ln d + 16$ tests while the information-theoretic lower bound is $\lceil \log_2 n(d - u + 1) \rceil - 1$ when $n \geq d + u - 2$.

This is a joint work with Yi-Chang Chiu and Yi-Lin Tsai.

Decomposing Complete Graphs into Triangles and Claws

Chin-Mei Fu (高金美), Tamkang University

Abstract

Let K_n be a complete graph with n vertices, C_k denote a cycle of length k, and S_k denote a star with k edges. If $k = 3$, then we call C_3 a triangle and S_3 a claw. In this paper, we show that for any nonnegative integers p and q and any positive integer n, there exists a decomposition of K_n into p copies of C_3 and q copies of S_3 if and only if $3(p+q) = \binom{n}{2}$, $q \neq 1,2$ if n is odd, $q = 1$ if $n = 4$, and $q \geq \max\{3, \lceil \frac{n}{4} \rceil\}$ if n is even and $n \geq 6$.

On the Existence of 5-sun Systems

Yuan-Lung Lin (林遠隆), Tamkang University

Abstract

A k-sun graph $S(C_k)$ is a graph obtained from a k-cycle by adding a pendent edge to each vertex of the k-cycle. A k-sun system of order v is a decomposition of the complete graph K_v into k-sun graphs. In this paper, we find the necessary and sufficient condition for the existence of 5-sun system of order v. Moreover, we obtain cyclic 5-sun systems when $n \equiv 1,5 \pmod{20}$ and 1-rotational 5-sun systems when $n \equiv 0 \pmod{20}$.

Matrix Partitions of Chordal Graphs

Pei-Lan Yen (顏珮嵐), National Sun Yat-sen University

Abstract

Matrix partition problems generalize graph colouring and homomorphism problems, and occur frequently in the study of perfect graphs. There are two main problems for a matrix: the characterization problem and the complexity problem. We discuss the characterization problem for chordal graphs, and a specific type of matrices M. The problem corresponds to partitioning a chordal graph into a join of disjoint graphs $G_1, G_2, \ldots, G_k$ such that G_i or its complement is a_i-colourable, where $a_1, a_2, \ldots, a_k$ are given integers. We characterize these chordal graphs by finite sets of forbidden induced subgraphs. Moreover, we also discuss decision problems asking that whether G is a join of two k-colourable graphs. For fixed k, it is polynomial for chordal graphs while the problem is NP-complete for general graphs whenever $k \geq 3$ and polynomial otherwise. When k is not a fixed integer, the problem is NP-complete for general graphs.

Standard Young Tableaux and Colored Motzkin Paths

Te-Wei Hsu (許德瑋), Dept. of Physics, National Taiwan University

Abstract

In this paper, we propose a notion of colored Motzkin paths and establish a bijection between the n-cell standard Young tableaux (SYT) of bounded height and the colored Motzkin paths of length n. This result not only gives a lattice path interpretation of the standard Young tableaux but also reveals an unexpected intrinsic relation between the set of SYTs with at most $2d+1$ rows and the set of SYTs with at most $2d$ rows. This work has been published in Journal of Combinatorial Theory, series A [1].

[1] S.-P. Eu, T.-S. Fu, Justin T. Hou, T.-W. Hsu. Standard Young tableaux and colored Motzkin paths *J. Combin. Theory Ser. A* 120 (2013), 1786-1803.

Circular Total Chromatic Numbers of Graphs

Cheyu Lin (林哲宇), National Sun Yat-sen University

Abstract

The *circular total chromatic number* of a graph G, written $\chi_c''(G)$, is the infimum r permitting a function $c\colon V(G)\cup E(G)\to[0,r)$ such that $1\le\lceil c(x)-c(x')\rceil\le r-1$ whenever x and x' are two adjacent vertices, two adjacent edges, or an edge incident to a vertex. A real number r is said to be realizable as the circular total chromatic number of graphs if there is a graph G with $\chi_c''(G)=r$. A natural question is which real numbers are realizable. It is known that $r\in(3,4]$ is realizable if and only if $r=3+1/k$ for a positive integer k. Very little was known about realizable $r>4$. By determining the circular total chromatic numbers of some special graphs, it is shown in [Ghebleh, On the set of circular total chromatic numbers of graphs, Discrete Math. 312(5) (2013), 693–697] that for each integer $n\ge3$, there is a strictly decreasing sequence of realizable reals approaching n. However, it remained an open question as whether there is a bounded infinite strictly increasing sequence of realizable reals. In this paper, we answer this question is affirmative and prove that for any integer $n\ge4$, for $\varepsilon\in(0,1/3)$, there is a simple graph G with $\chi_c''(G)=n+1+\varepsilon$.

Edge Roman Domination on Graphs

Sheng-Hua Chen (陳聖華), National Taiwan University

Abstract

Let $G=(V,E)$ be a simple graph. An *edge Roman dominating function* on G is a function $f:E(G)\to\{0,1,2\}$ satisfying that every edge e_1 for which $f(e_1)=0$ is adjacent to at least one edge e_2 for which $f(e_2)=2$. The *weight* of a Roman dominating function is the value $f(E)=\sum_{e\in E(G)}f(e)$. The minimum weight $\gamma_{ER}(G)$ of a Roman dominating function on a graph G is called the *Roman domination number* of G. The concept of the edge Roman domination was first introduced in [1].

In this talk, we investigate some upper bounds using discharging method and other skills.

This is joint work with Chun-Hung Liu and Gerard Jennhwa Chang.

Reference

[1] P. Roushini Leely Pushpam, T. N. M. Nalini Mai, *Edge Roman domination in graphs,* J. Combin. Math. Combin. Comput. **69** (2009), 175-182.

Anti-Magic Labeling of Regular Graphs

Yu-Chang Liang (梁育菖), National Sun Yat-sen University

Abstract

An anti-magic labeling of a graph G is a one-to-one correspondence between $E(G)$ and $\{1,2,\ldots,|E|\}$ such that the sum of the labels assigned to edges incident to distinct vertices are different. If G has an anti-magic labeling, then we say G is anti-magic. This paper proves that for any regular graphs with odd degree are anti-magic.

This is joint work with Xuding Zhu.

Session on Partial Differential Equations

Stability Analysis for Standing Pulse Solutions to FitzHugh-Nagumo Equations

Chao-Nien Chen (陳兆年), National Changhua University of Education

Abstract

In this talk we consider the standing pulse solutions to the FitzHugh-Nagumo equations. Since the reaction terms are coupled in a skew-gradient structure, a standing pulse solution is a homoclinic orbit of a second order Hamiltonian system. By utilizing Maslov index theory, we investigate the stability of standing pulses for the FitzHugh-Nagumo equations. If time permits, related results for more general skew-gradient systems will be discussed.

Existence and Concentration of Positive Solutions for Indefinite Elliptic Equations with Steep Well Potential

Tsung-fang Wu (吳宗芳), National University of Kaohsiung, Taiwan

Abstract

In this talk, we will study the existence, multiplicity and concentration of positive solutions for the following indefinite semilinear elliptic equations:

$$\begin{cases} -\Delta u + \lambda V(x)\, u = f(x)\,|u|^{q-2}u + g(x)\,|u|^{p-2}u & \text{in } \mathbb{R}^N, \\ u \geq 0, & \text{in } \mathbb{R}^N, \end{cases}$$

where $1 < q < 2 < p < 2^*$ $\left(2^* = \frac{2N}{N-2} \text{ for } N \geq 3\right)$ and the parameters $\lambda > 0$. We assume that the potential V is a steep well potential and f, g are sign-changing which satisfy suitable conditions.

This is joint work with Yi-hsin Cheng.

The Existence of Solutions of 2-Dimensional Incompressible Navier-Stokes Equations on a Moving Domain in an Optimal Sobolev Space

Cheng-Fang Su (蘇承芳), National Central University

Abstract

We establish the existence of a solution to the Navier-Stokes equations on a moving domain with surface tension in an optimal Sobolev space for the case of two space dimension. No compatibility conditions are required to guarantee the existence of a solution.

Estimates of the Mean Field Equations with Integral Singular Sources II

Ting-Jung Kuo (郭庭榕), Taida Institute for Mathematical Sciences,
National Taiwan University

Abstract

Let M be a compact Riemann surface, $\alpha_j \in \mathbb{N}$ and $h(x)$ be a positive C^2 function of M. In this paper, we consider the following mean field equation:

$$\Delta u(x) + \rho\left(\frac{h(x)e^{u(x)}}{\int_M h(x)e^{u(x)}} - \frac{1}{|M|}\right) = 4\pi\sum_{j=1}^{d}\alpha_j\left(\delta_{q_j} - \frac{1}{|M|}\right) \text{ in } M.$$

We prove that for any $\rho > \rho_0$, the equation has one solution at least if the Euler characteristic $\chi(M\setminus\{q_1,...,q_d\}) \leq 0$, where $\rho_0 = \max_M(2K - \ln h + N^*)$, K is the Gaussian curvature and $N^* = 4\pi\sum_{j=1}^{d}\alpha_j$. Our proof relies on the bubbling analysis at the blowup point q_j, where the bubbling behavior might be simple as well as non-simple.

This is joint work with Chang-Shou Lin.

On a Spectral Analysis of Scattering Data in Camassa-Holm Equation

Chueh-Hsin Chang (張覺心), Institute of Mathematical Science,
National Taiwan University

Abstract

Physical details of Camassa–Holm (CH) equation that are difficult to get in space-time simulation are explored by solving the Lax pair equations within the direct and inverse scattering context. In this spectral analysis of the completely integrable CH equation we will consider the direct scattering analysis of the initial condition defined in the physical space coordinate through the time-independent Lax equation. Both of the continuous and discrete spectrum cases for the initial condition under current investigation are analytically derived. The scattering data derived from the direct scattering transform for non-reflectionless case are discussed in detail in the spectral domain from the physical viewpoint. Finally we will consider the numerical results about the long time asymptotic behaviors of solutions corresponding to our specified initial condition.

Traveling Wave Solutions of Delayed Epidemic Models

Cheng-Hsiung Hsu (許正雄), National Central University

Abstract

In this talk, we study the existence of traveling wave solutions of monostable delayed epidemic models. Moreover, we also investigate some properties of the traveling wave solutions and introduce the related problems.

Remarks on the Weak Formulation of the Navier-Stokes Equations on the 2D Hyperbolic Space

Chi Hin Chan (陳子軒), National Chiao Tung University

Abstract

In 2010, Chi Hin Chan and Magdalena Czubak observed for the *very first time* in [1] the non-uniqueness phenomena of finite energy Navier-Stokes flows on a 2D-hyperbolic space. This kind of non-uniqueness phenomena occurring in finite energy Navier-Stokes flows on a 2-dimensional negatively curved simply connected manifold is in sharp contrast to the well-known, classical uniqueness theorem for finite energy Navier-Stokes flows in the 2D Euclidean space. Recently, in [2], Chi Hin Chan and Magdalena Czubak have worked out a self-contained Leray-Hopf theory for finite energy weak solutions to the Navier-Stokes equation in the setting of a 2D hyperbolic space. This Leray-Hopf theory as constructed in [2] not only resolves the dilemma arising from the non-uniqueness phenomena observed in our previous work [1] in 2010, but also includes all weakly divergence free finite energy vector fields into the class of admissible finite energy initial datum for the Cauchy problem of the Navier-Stokes equation. In this talk, we will discuss these recent joint works by Chi Hin Chan and Magdalena Czubak, as well as some recent progress on this topic due to the work of Boris Khesin and Gerard Misiolek in 2012.

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Well-Posedness of the Homogeneous Landau Equation for Soft Potentials

Kung-Chien Wu (吳恭儉), National Kaohsiung Normal University

Abstract

We deduce some well-posedness results for the homogeneous Landau equation with soft potentials. Not only finite mass, energy, and entropy assumptions of the initial data, we assume additionally some moment conditions and integrability conditions. The main difficulty is that this equation presents a singularity for small relative velocities.

Boundary Singularity of Moments for the Linearized Boltzmann Equation

I-Kun Chen (陳逸昆), National Taiwan University

Abstract

We study the boundary singularity for stationary solutions of the linearized Boltzmann equation with hard-sphere potential. An asymptotic estimate for the gradient of the moments is established, which shows the logarithmic singularity near the boundary. Our formula holds for the solutions of the Milne and Kramers problems obtained by Bardos-Caflish-Nicolaenko, 1986. Our theorem requires the Hölder continuity of the boundary data. In particular, it applies to the complete condensation problem for half space.

Polarization Effect and Homogenization

Jiann-Sheng Jiang (江鑑聲), Tung Fang Design Institute

Abstract

Motivated by the two-scale convergence method introduced by G. Nguetseng and G. Allaire, we study the polarization effect induced by homogenization. By way of Vlasov-Poisson system, we characterize the mricroscopic properties of electrons in dielectric materials. The homogenized equations are obtained which describe the mean behaviors, and we get the modified Gauss law and the dielectric coefficient by way of polarization effect.

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Nevanlinna Theory and Discrete Painlevé Equations

Yik-Man Chiang (蔣翼邁), Hong Kong University of Science and Technology

Abstract

We review on Ablowitz, Halburd and Herbst's (2000) proposal to use classical Nevanlinna theory as an indicator for integrability test for second order non-linear difference equations. I will review the basics of the Nevanlinna theory and to show how Ablowitz's et al work on difference equations actually connects to old problems settled by Fuchs and Painlevé on first order algebraic differential equations in the late 19th century and beginning 10th century from a complex analytic viewpoint.

Forced Capillary-Gravity Waves Generated Outside of a Cylindrical Wavemaker of Infinite Depth under Hocking's Edge Condition

Nai-Sher Yeh (葉乃實), Fu-Jen Catholic University

Abstract

This presentation aims to construct a solution for the governing equations of forced capillary-gravity waves generated outside of an infinitely deep cylindrical wavemaker, influenced by surface tension and Hocking's edge condition. Its uniqueness as well as physical meaning will also be provided in here.

Session on Probability

Theory of Generalized Gaussian Functions: From One Dimension to Infinite Dimensions

Yuh-Jia Lee (李育嘉), National University of Kaohsiung

Abstract

The theory of distributions or generalized functions introduced by L. Schwartz may be reformulated by replacing the Lebesgue measure by a canonical Gauss measure. Then we extend the one-dimensional Theory of to reformulate the Gaussian White Noise Calculus initiated by Hida.

Comparison and Acceleration of the Convergence of Markov Processes

Chii-Ruey Hwang (黃啓瑞), Institute of Mathematics, Academia Sinica

Abstract

Markov processes may be used to approximate the underlying distribution when direct sampling is difficult. The measurement of an approximation depends on the comparison criterion which includes for example spectral gap, asymptotic variance, convergence exponent in variational norm, etc. The worst-case analysis, the average-case analysis, uniform comparison, optimal sampling, accelerating convergence, antisymmetric perturbation are considered. Specific examples as well as related problems will be discussed.

Self versus Social Optimization in Managing Observable Queues

Chia-Li Wang (王家禮), National Dong Hwa University

Abstract

Suppose customers arrive at an observable queueing system for service with a utility function of reward and cost. The self (customer) decision is whether to queue or to balk, whereas the social (system administrator) goal is to maximize the profit of the whole system. While the optimal self policy is relatively easy to obtain, the optimal social policy, which is of more practical importance, often requires a tedious and ad hoc analysis because of the external effect. We introduce a simple and general approach for determining the optimal admission control policy. We construct a labeling scheme for admitting extra customer while avoiding incurring the external cost. Then, a marginal analysis based on the labeling scheme sheds the insight into why the optimal self and social policies are different for a broad class of systems, and provides a general formula to compute the optimal social threshold when the social benefit function is unimodal. A new mean of bringing the self-optimal threshold to match the social-optimal one by assigning priorities is described, and equilibrium of the optimal self policy is also addressed.

W-Entropy Formula, Perelman's Ricci Flow and Optimal Transport on Manifolds with Weighted Measure

Xiang-Dong Li (李向東), Chinese Academy of Sciences

Abstract

In this talk, I will present some recent results in the study of the W-entropy formula, Perelman's Ricci flow and the optimal transport problems on manifolds with weighted measure. After a brief review of Perelman's W-entropy formula for Ricci flow, I will present our results on the W-entropy formula for the heat equation of the Witten Laplacian on manifolds with weighted measure. Then I will present some results on the optimal transport problems for the Fokker-Planck diffusions on manifolds equipped with Perelman's Ricci flow, which can be viewed a natural correspondence of some previous results due to Otto, Lott-Villani, von Renesse-Sturem, McCann-Topping and Lott, etc. We point out that there is an interesting similarity between our W-entropy formula for the Witten Laplacian and Lott-Villani and Sturm's result on the monotonicity of the Boltzmann entropy along geodesic on the Wasserstein space over compact Riemannian manifolds. Finally we prove the entropy monotonicity theorem on a family of flows which interpolate the geodesic flow and the gradient flow on the Wasserstein space over compact: Riemannian manifolds. This is a joint work with my PhD student Songzi Li.

PyS^{3}DE: Solvers for Stochastic Differential Equations

Chu-ching Huang (黃朝錦), Chang-Gung University

Abstract

Stochastic differential equations are rapidly becoming the popular field in which to express mathematical models involving intrinsic noises which could not be ignored. This article describes the use of Python for implementing a library, PyS^{3}DE, which avails both symbolic and numeric solvers.

Inputting SDE in mathematical form, PyS^{3}DE could automatically generate the scheme for high-order performance; the symbolic solver can solve linear and reduced nonlinear SDE's. The well-formulated math-readable namespace supported by PyS^{3}DE gives a shortcuts to extend the new scheme to the symbolic solver if any. PyS^{3}DE also avails the numeric schemes for jump-diffusion SDE's, including Euler, Milstein-Maghoodi and adapted schemes.

Semi-Discrete Semi-Linear Parabolic SPDEs

Shang-Yuan Shiu (須上苑), National Central University

Abstract

We consider the following semi-discrete semi-linear Itô stochastic heat equation [SHE]:

$$\frac{du_t(x)}{dt} = (\mathscr{L}u_t)(x) + \sigma(u_t(x))\frac{dB_t(x)}{dt}$$

with initial profile u_0: $Z^d \to R_+$, where $\mathscr{L}$ is the generator of a continuous time random walk, and $\{\{B_t(x), t \geq 0\}, x \in Z^d\}$ are independent Brownian motions. In order to know how solution behaves, we study local properties of solution, such as regularity, local approximation by SDE. If the underlying random walk is transient and the noise level is low, then solution can be a.s. uniformly dissipative provided that the initial value $u_0 \in \ell^1(\mathbf{Z}^d)$. This is joint work with Georgiou, Joseph, Khoshnevisan.

On The Cover Time of a Random Walk with Reflection Barriers

May-Ru Chen (陳美如), National Sun Yat-sen University

Abstract

Imagine that a particle starts from the origin of the x-axis and moves at times $t = 0, 1, \ldots$ one step to the right with probability p or one step to the left with probability $q = 1 - p$, which is usually called a simple random walk. For a given positive integer n, define the cover time to be the time when the number of points visited has just increased to the given number n. In this talk, we first review the cover time of a simple random walk starting from 0. Next, we consider the simple random walk with reflection barriers and then give the expression of the probability generating function of the corresponding cover time.

Session on Dynamical Systems and Mathematical Biology

Biological Rhythms and Dynamical Systems

Chih-Wen Shih (石至文), National Chiao Tung University

Abstract

Biological rhythms include rhythms from cellular level to system level; for example, neural rhythm with periods from 0.001 to 10 seconds,, circadian rhythm with 24 hours' period, ovarian cycle with 28 days' period, and rhythms in ecology and epidemiology with a couple of years' period. We plan to survey recent progress in this area, and introduce the associated mathematical models describing these biological rhythms. We shall also introduce the phase models and the synchronization theory developed by Kuramotto and the extension to delayed coupled systems developed by Strogatz. We then present a basic study on the collective period of coupled Van der Pol oscillators, through Hopf bifurcation analysis and numerical computation. Finally, we compare our investigation on the kinetic model of segmentation clock, an oscillating multicellular genetic network, with what were implicated from the phase models.

Covering Relation and Liapunov Condition for Topological Conjugacy

Ming-Chia Li (李明佳), National Chiao Tung University

Abstract

In dynamical systems, getting topological conjugacy is not an easy task. Smale[1] proved that the hyperbolic horseshoe map is topologically conjugate to the Bernoulli shift, Hirsch and Pugh[2] proved that a hyperbolic map is topologically conjugate to its small C^1 perturbations, and Robinson[3] proved that a hyperbolic map with transversality condition is topologically conjugate to its small C^1 perturbations on the whole compact manifold. Instead of hyperbolicity, we introduce a topological approach to establish topological conjugacy. We show that covering relations with a mild Liapunov condition ensures topological conjugacy to symbolic dynamics. Furthermore, a map with covering relations and a Liapunov condition is topologically conjugate to its small C^1 perturbations. We also use such an approach to study nonuniform hyperbolicity for perturbations of nonautonomous dynamical systems. This is a joint work with Ming-Jiea Lyu.

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Drug Models of Cardiac Channelopathies

Chu-Pin Lo (羅主斌), Providence University

Abstract

First I will elucidate how to design suitable protocols to measure some important electrophysiological properties of ion channels, such as activation, inactivation, and recovery. Then I will introduce some channel state-dependent drug models for studying mechanisms of arrhythmogenesis in ion channelopathies, such as Class Ic drug models of flecainide for fast sodium Nav 1.5 channel and RyR2 channel in Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT), and Class Ib drug models of mexiletine and lidocaine for Nav 1.5 channel in Long-QT syndrome.

New Poisson-Boltzmann Equations with Finite Size Effects

Chiun-Chang Lee (李俊璋), National Hsinchu University of Education

Abstract

Traditionally, the Poisson-Boltzmann equation is used to describe the ion transport in electrolytes without the effects of ion radii. To describe electrolytes with finite size effects involving different ion radii, we derive new Poisson-Boltzmann type equations with steric effects (PB_{ns} equations) having coefficients depending on ion radii and a small dielectric constant. For two species ions (one anion and one cation), symmetry and non-symmetry breaking conditions are expressed by coefficients of the PB_{ns} equation. In particular, when non-symmetry breaking condition holds true, we prove that the PB_{ns} equation is asymptotically close to the modified Poisson-Boltzmann equations developed by Andelmann et al as the dielectric constant goes to zero. On the other hand, when symmetry breaking condition holds true, numerical simulations show that the charge densities of the solutions of PB_{ns} equations having fluctuations near the boundary. Such phenomenon cannot be found in conventional PB equation.

This is a joint work with YunKyong Hyon, Tai-Chia Lin and Chun Liu.

Global Dynamics of a Tri-Trophic Model for Two Patches with Cost of Dispersal

Chang-Hong Wu (吳昌鴻), National University of Tainan

Abstract

In this talk, we will focus on a three-trophic level food chain model proposed by DeAngelis et al. (2011), in two patches, to understand how cost of dispersal affects population dynamics. Under some suitable assumptions, we completely determine the global dynamics of the model and show that there exists an "optimal" dispersal rate from patch 2 to patch 1 for the consumer such that, in terms of the theory of Adaptive Dynamics, it is a globally evolutionarily stable strategy and also a convergent stable strategy. If there is a minimum dispersal speed from patch 1 to patch 2, we are able to completely determine the evolutionarily stable strategy for dispersal between two patches. Our result suggests that even if most individuals die during the movement, a positive dispersal rate can still evolve. This is a joint work with Yuan Lou (The Ohio State University)

On Solvability of Singular Algebraic-Difference Equations

Chee-Fai Yung (容志輝), National Taiwan University

Abstract

In this talk, we shall address the solvability of singular algebraic-difference equation $Ex_{k+1} = Ax_k + Bu_k, k \in \mathbb{N}$. Here E, A are linear operators on finite-dimensional vector space X over the field of complex numbers $\mathbb{C}$, and E is in general singular. B is a linear transformation from U to X, where U is also a finite-dimensional vector space over $\mathbb{C}$. In particular, we characterize the geometric structure of the solution spaces, both for finite and infinite length solution sequences. We shall also discuss some related control problems.

The Existence of Solitary Wave Solutions for Three Species Lotka-Volterra Model

Yi-Hao Guo (郭益豪), National Chiayi University

Abstract

Abstract: In this talks, first we introduce Wu's method to solve a system of polynomial equations. Employing the hyperbolic tangent function expansion method, Wu's method and Maple, we study the existence of solitary wave solutions for three species Lotka-Volterra model.

Mathematical Analysis and Numerical Simulation of a Mathematical Model of Mixed Immunotherapy and Chemotherapy of Tumors

Hsiu-Chuan Wei (魏秀娟), Feng Chia University

Abstract

In this study, a mathematical model of tumor growth with mixed immunotherapy and chemotherapy is considered. Mathematical analysis and numerical simulation using human data in clinical literature is conducted. Mathematical analysis is performed to obtain the parameter condition for the stability of the tumor-free equilibrium. The stability condition gives an important indicator of the ability of the host to fight a cancer. Then, a numerical method for the bifurcation analysis of the system with pulsed external inputs is employed for numerical simulation. The effect of mixed immunotherapy and chemotherapy is studied via bifurcation analysis.

Synchronization for a Network of Chaotic Oscillators

Jui-Pin Tseng (曾睿彬), National Pingtung University of Education

Abstract

The talk presents a novel approach to establish the synchronization of a network of linearly coupled systems. Under our framework, the coupling configuration of the coupled systems could be quite general, with the coupling matrix not assumed to be time-independent, symmetric, with zero row-sums, or with positive off-diagonal entries. We apply the present approach to study the synchronization of a network of chaotic oscillators. Our criteria for the synchronization could depend on the scale of the coupled oscillators. We shall show that some coupled chaotic oscillators can satisfy our synchronization criterion and hence achieves synchronization as the scale is small; however, the synchrony will be lost as the scale gets larger. We also show that chaotic behavior can emerge; conversely, that chaotic behavior can be suppressed, as the non-diffusively coupled Lorenz equations are synchronized under our synchronization criteria.

Distribution of the Prüfer Angle in p-Laplacian Eigenvalue Problems

Yu-Chen Luo (羅御宸), National Sun Yat-sen University

Abstract

A sequence $\{x_n\} \subset (0,1)$ is said to be equidistributed in $(0,1)$ if for any subinterval $(a,b) \subset (0,1)$,

$$\lim_{N\to\infty} \frac{1}{N} \sum_{n=1}^{N} \chi_{(a,b)}(x_n) = b - a.$$

We show that for the p-Laplacian eigenvalue problem, when $x \in (0,1)$ is irrational, a sequence of modified Prüfer angles $\{\psi_n(x)\}$ after modulo π_p is equidistributed in $(0,\pi_p)$. The result helps us to understand more about the Prüfer angle.

This is joint work with Y.H. Cheng and C.K. Law .

Session on Statistics

Survival Prediction under Dependent Censoring: A Copula-based Approach

Yi-Hau Chen (程毅豪), Institute of Statistical Science, Academia Sinica

Abstract

Dependent censoring arises in biomedical studies when the survival outcome of interest is censored by competing risks. In survival data with microarray gene expressions, gene selection or gene filtering based on the univariate Cox regression analyses has been used extensively in medical research, which however, is only valid under the independent censoring assumption. In this paper, we first consider a copula-based framework to investigate the bias caused by dependent censoring on univariate gene selection. Then, we utilize the copula-based dependence model to develop an alternative gene selection procedure. Simulations show that the proposed procedure adjusts for the effect of dependent censoring and thus outperforms the existing method when dependent censoring is indeed present. The non-small-cell lung cancer data is analyzed to demonstrate the usefulness of our proposal.

Parallel Stochastic Search (PaSS) Algorithm for Variable Selection

Ray-Bing Chen (陳瑞彬), National Cheng Kung University

Abstract

A new stochastic search algorithm is proposed for information criterion variable selection problems. The proposed algorithm integrates the stochastic stepwise selection approach with the particle swarm optimization. The key idea of the proposed algorithm is to search the best model for a pre-specified information criterion by quickly exploring the candidate model space from multiple start models and sharing the search information among all individual search paths. In addition to directly solve the information criterion variable selection problems, the proposed algorithm can also be used to generate the variable selection ensembles. Several examples are used to demonstrate the performances of our proposed algorithm.

Finding the Optimal Threshold of the Parametric ROC Curve under the Continuous Diagnostic Measurement

Yi-Ting Hwang(黃怡婷), National Taipei University

Abstract

The accuracy of a binary diagnostic test can be assessed easily through comparing the sensitivity and specificity with the status of respondents. When the diagnostic test is resulted in a continuous version, the assessment of accuracy depends upon a specified threshold. The receiver operating characteristic (ROC) curve including all possible combinations of sensitivity and specificity provides an appropriate measure to evaluate the overall accuracy of the diagnostic test. Nevertheless, in practice, a threshold is still needed to have an easier clinical usage. The determination of a proper threshold depends upon how important the practitioner views the specificity and sensitivity. Given a particular concern of specificity and sensitivity, this paper derives the optimal threshold under two commonly used parametric assumption on the diagnostic test (Binormal model and Bilogistic model). Since the optimal threshold does not have a closed form, the numerical results are given in tables for many parameter settings, so the practitioner can easily find the optimal threshold for their studies.

Population Loss Rate Estimation by Incidence

Wen-Han Hwang (黃文瀚), National Chung Hsing University

Abstract

The population loss rate of a species over a time frame can clearly be defined by the change of population abundances at the beginning and the end; however, it is seldom or even difficult to have reliable information about the abundances especially if the geographic and temporal scales on the population are large. The article develops a relationship/model between the population loss rate and the occupancy rates (using incidence-based data). The main object is then to estimate the population loss rate induced from the occupancy rates. Note that the later quantities only require occurrence data and are often available in practice. In addition, the method is also applicable to determining the level of a species' extinction risk in conservation biology. We show some inspiring relations between the proposed model and some methods in the literature, these relations are useful to explain phenomena found from data analyses. From the conducted simulation study using two census plant data, it turns out that the proposed model is promising to be the bridge between the occupancy rates and the population loss rate. And so, the induced estimate of population loss rate from the developed model is satisfactory. Based on the suggested model (negative binomial model) describing the pattern of individuals in the study region and also accounting for the aggregation by the individuals, the induced estimate of the population loss rate is more accurate than that by assuming the individuals randomly distributed, where the induced estimator is usually underestimation when the individuals are mostly removed just at random.

Bayesian Analysis of Business Cycles in Japan Using Markov Switching Model with Stochastic Volatility and Fat-tail Distribution

Toshiaki Watanabe (渡部敏明), Hitotsubashi University

Abstract

This article analyzes the business cycles in Japan by applying Markov switching (MS) models to the monthly data on the coincident indicator of composite index (CI) during the period of 1985/01-2012/12 calculated by Economic and Social Research Institute (ESRI), Cabinet Office, the Government of Japan. It is shown that the impact of the financial crisis in 2008 and the Tohoku earthquake in 2011 on this index is so large that the simple MS model with normal error and constant volatility cannot detect the business cycle turning points properly. The MS model is extended by incorporating with Student's t error and stochastic volatility (SV) and a Bayesian method via Markov chain Monte Carlo is developed for the analysis of the extended models. It is also shown that the MS model provides the estimates of the business cycle turning points close to those published by ESRI once SV is introduced. The marginal likelihood provides evidence that the MS model with both t error and SV fits the data best.

Mixed Domain Asymptotics for a Stochastic Process Model with Time Trend and Measurement Error

Ching-Kang Ing (銀慶剛), Institute of Statistical Science, Academia Sinica

Abstract

We consider a stochastic process model with time trend and measurement error. We establish consistency and derive the limiting distributions of the maximum likelihood (ML) estimators of the variance component parameters under a mixed asymptotic framework (including the fixed domain and increasing domain frameworks as its special cases) even when the number of time trend variables grows with the sample size or the time trend model is misspecified. We fully characterize the convergence rates of the ML estimators in terms of the growing rate of the domain and the degree of model mis-specification/complexity. The results show some interesting change-point behaviors. This is joint work with C.-H. Chang and H.-C. Huang.

State Space Method for Quadratic Estimator of Integrated Variance in the Presence of Market Microstructure Noise

Daisuke Nagakura (長昌大輔),
Department of Economics, Keio University, Japan

Abstract

Recently, several authors have considered a class of integrated variance estimators, called the quadratic estimator (QE), that takes a quadratic form in observed returns. The QE includes several existing IV estimators, such as the realized variance, realized kernels, etc. Although, even in the presence of market microstructure noise (MMN) in observed prices, some special cases of the QE are consistent and hence do not have the bias due to MMN asymptotically, they still have the bias in finite samples. A state space method is developed so that one can filter out the bias in the QE due to the MMN. A slightly restrictive assumption on the price process is assumed. However, under the assumption, the state space method can always r educe the MSE of a given QE in finite samples.

Optimizing Two-level Supersaturated Designs by Particle Swarm

Frederick K. H. Phoa (潘建興), Institute of Statistical Science, Academia Sinica

Abstract

Supersaturated designs (SSDs) are often used in screening experiments with a large number of factors to reduce the number of experimental runs. As more factors are used in the study, the search for an optimal SSD becomes increasingly challenging because of the large number of feasible selection of factor level settings. This talk tackles this discrete optimization problem via a metaheuristic algorithm based on Particle Swarm Optimization (PSO) techniques. Using the commonly used $E(s^2)$ criterion as an illustrative example, we were able to modify the standard PSO algorithm and find SSDs that satisfy the lower bounds calculated in Bulutoglu and Cheng (2004) and Bulutoglu (2007), showing that the PSO-generated designs are $E(s^2)$–optimal SSDs. This is a joint work with Professors Ray-Bing Chen, Wei-Chung Wang and Weng Kee Wong.

Session on Geometry

Alexandrov's Soap Bubble Theorem

Duy-Minh Nhieu (饒維明), National Central University

Abstract

One of the oldest problem in geometry is no doubt the isoperimetric problem. However, we are not concerned with this problem in this presentation but rather a closely related one, namely, Alexandrov's "soap bubble theorem". We present three different approaches to the solution of this problem. These methods are: Alexandrov's original idea of the moving plane method (or reflection principle), Reilly' proof that uses elementary means and finally, a beautiful estimate due to Ros from which Alexandrov's theorem follows.

The Asymptotic Expansion of Tian-Yau-Zelditch on Riemann Surfaces

Chiung-ju Liu (劉瓊如), National Taiwan University

Abstract

In this talk, we will learn about the asymptotic expansion of Tian-Yau-Zelditch on polarized Kahler manifolds. Then the current development will be discussed. In addition, the behavior on Riemann surfaces with -1 constant scalar curvature will be presented.

Bott-Chern Cohomology and $\delta_+\delta_-$-Lemma for Bi-Generalized Hermitian Manifolds

Chung-I Ho (何忠益), National Tsing Hua University

Abstract

A bi-generalized Hermitian structure is given by two commuted generalized comple structure and is more general than generalized Kahler structures. We define the Bott-Chern and Aeppli cohomology for bi-generalized Hermitian manifolds. Then we show that they are of finite dimensional for compact manifolds and also discuss the relations with the general $d\bar{d}$-lemma.

The Integrability Conditions and the Umbilic Property for Hypersurfaces in Heisenberg Groups

Hung-Lin Chiu (邱鴻麟), National Central University

Abstract

In this talk, we are going to introduce some basic materials and properties for hypersurfaces in Heisenberg groups, including the integrability conditions and the umbilic property in some sense. In particular, we will focus on the Caddazi-like equations and say something about its applications to the classification of the singular set.

On the Toda Systems of VHS Type

Chen-Yu Chi (齊震宇), National Taiwan University

Abstract

We consider the Toda systems of VHS type with singular sources and provide a criterion for the existence of solutions with prescribed asymptotic behaviour near singularities. We also prove the uniqueness of solution. Our approach uses Simpson's theory of constructing Higgs-Hermitian-Yang-Mills metrics from stability.

Symplectic Geometry of Representation Varieties

Eugene Z. Xia (夏杼), National Cheng Kung University

Abstract

This is an introductory presentation of the symplectic geometry of representation varieties over orientable surfaces. These varieties are natural generalizations of tori and they provide examples of (complete) integrable systems with interesting dynamics.

Primitive Cohomology on Symplectic Manifolds

Chung-Jun Tsai (蔡忠潤), National Taiwan University

Abstract

Motivated by supersymmetry, L.-S. Tseng and S.-T. Yau developed primitive cohomology theories on symplectic manifolds. In this talk, we will explain the relation between primitive cohomologies and Lefschetz maps. Interestingly, it induces a differential graded algebra structure on the primitive cohomologies. I will also explain this DGA structure, and present an example to demonstrate that the DGA structure does encode more information. This is based on the joint work with L.-S. Tseng and S.-T. Yau.

On Log Rational Connectedness of Some Special Terminal Threefolds

Jiun-Cheng Chen (陳俊成), National Tsing Hua University

Abstract

Let X be a projective Fano variety and X^{sm} be its smooth locus. It is well-known that if X is smooth, then it is rationally connected. I will discuss some recent progress on the rationally connectedness of the smooth locus for some special terminal threefolds

Session on Computational Mathematics

3D Poisson-Fermi-Nernst-Planck Modeling of Biological Ion Channels

Jinn-Liang Liu (劉晉良), National Hsinchu University of Education

Abstract

Abstract: A 3D PFNP modeling research project for studying biological ion channels is briefly described. Starting with an introduction of ion channel, we present (1) PFNP model, (2) the visual molecular dynamics software (VMD) for generating data required for PFNP simulation, (3) the protein data bank (PDB) for the atomic information of channel proteins, (4) numerical methods that implement Poisson-Boltzmann, Poisson-Fermi, and Nernst-Planck theories, and (5) numerical results for electric double layers, Born ion model, gramicidin A channel, and L-type calcium channel.

High-Order Numerical Methods for Second-Order Wave Equations

Chun-Hao Teng (鄧君豪), National Chiao Tung University

Abstract

Many wave phenomena in acoustics, electromagnetic, and general relativity, are governed by second-order wave equations. To numerically compute these wave problems, it is often encountered that the space domains are large compared the characteristic wavelength. Hence, the propagating waves have to travel long distances or have to require long time integrations. As a consequence, accumulation of the numerical dispersion error affects the simulation quality. It is known that high-order methods are more efficient than the low-order methods in preserving low accumulation of dispersion error during long time integration. However, high-order schemes are very sensitive to the imposition of boundary conditions, and great care must be exercised to ensure stable computations of the schemes.

In this talk we present high-order schemes based on arbitrary grid points spectral method in space and the Runge-Kutta-Nyström algorithm in time, to solve second order wave equations. The key toward to the success of constructing such a stable scheme hinges upon properly imposing penalty boundary conditions at every collocation equations. We shall use model problem to illustrate the conceptual ideas of the method. Special attention is paid to analyzing the stability of the scheme subject to various types of boundary conditions. Through conducting energy estimates it is shown that the scheme can be made stable by properly choosing the penalty parameters. Numerical experiments for model problems are conducted, and we observe the expected convergence results.

An Adaptively Mesh Method Based on the Least-Squares Finite Element Method for the Generalized Newtonian Flows Using the Carreau Model

Hsueh-Chen Lee (李雪甄), General Education Center,
Wenzao Ursuline University of Languages

Abstract

The goal of this work concerns a least-squares method for the solutions of the incompressible Carreau generalized Newtonian flows based on the application of the least-squares minimization principle to an equivalent first order system of the Navier-Stokes equations. To capture the flows region, an adaptive refinement algorithm based on mesh redistribution is developed for a least-squares functional. A mesh redistribution approach is considered to generate the refined grids which agree well with the physical attributes of the models. We provided an a prior error estimate for the linearized velocity-pressure-stress first-order system problem and showed numerical results supporting the estimate. We also proved that the least-squares approximation converges to the linearized versions solutions of the Carreau model at the best possible rate. Model problems considered in the study are the flow past a planar channel and 4-to-1 contraction problems. The results show that the adaptively refined meshes are automatic local grid refinement with different flow parameters, and the refinement results are of good quality.

A Study on the Galerkin Least-Squares Method for the Oldroyd-B Model

Chia Chen Liu (劉家禎), National Bei-Gang Senior High School

Abstract

In this talk, we consider numerical methods for both the Newtonian and the Oldroyd-B models of viscoelastic fluid flows by the Galerkin least-squares method (GLS). Model problems considered are the flow past a planar channel and a 4-to-1 contraction problems. An error estimate of the GLS method for the Oldroyd-B model is derived. Numerical results using software Freefem++ will be presented for both stokes and Oldroyd-B model.

Finite Dimensional Representation of Semi-Infinite Hankel Operators

Matthew M. Lin (林敏雄), National Chung Cheng University

Abstract

Bounded, semi-infinite Hankel matrices of finite rank over the space ℓ^2 of square-summable sequences occur frequently in classical analysis and engineering applications. The notion of finite rank often appears under different contexts and the literature is diverse. The first part of this talk reviews some elegant, classical criteria and establishes connections among the various characterizations of finite rank in terms of rational functions, recursion, matrix factorizations, and sinusoidal signals. All criteria require $2d$ parameters, though with different meanings, for a matrix of rank d. The Vandermonde factorization, in particular, permits immediately a singular-value preserving, finite

dimensional representation of the original semi-infinite Hankel matrix and, hence, makes it possible to retrieve the nonzero singular values of the semi-infinite Hankel matrix. The second part of this talk proposes using the LDL^* decomposition of a specially constructed sample matrix to find the unitarily equivalent finite dimensional representation. This approach enjoys several advantages, including the ease of computation by avoiding infinite dimensional vectors, the ability to reveal rank deficiency, and the established pivoting strategy for stability. No error analysis is given, but several computational issues are discussed.

On the Solution of the Linear Matrix Equation $X = Af(X)B + C$

Chun-Yueh Chiang (蔣俊岳), Center for General Education,
National Formosa University

Abstract

In this talk, we derive a formula to compute the solution of the linear matrix equation $X = Af(X)B + C$ via finding any solution of a specific Stein matrix equation $\mathscr{X} = \mathscr{A}\mathscr{X}\mathscr{B} + \mathscr{C}$, where the linear (or anti-linear) matrix operator f is period-n. According to this formula, we should pay much attention to solve the Stein matrix equation from recently famous numerical methods. For instance, Smith-type iterations, Bartels-Stewart algorithm, and etc.. Moreover, this transformation is used to provide necessary and sufficient conditions of the solvable of the linear matrix equation. On the other hand, it can be proven that the general solution of the linear matrix equation can be presented by the general solution of the Stein matrix equation. The necessary condition of the uniquely solvable of the linear matrix equation is developed. It is shown that several representations of this formula are coincident. Some examples are presented to illustrate and explain our results.

Recent Progress on Eulerian-Lagrangian Schemes for Nonlinear Transport

Chieh-Sen (Jason) Huang (黃杰森), National Sun Yat-sen University

Abstract

We develop a formally high order Eulerian-Lagrangian WENO finite volume scheme for nonlinear scalar conservation laws that combines ideas of Lagrangian traceline methods with WENO reconstructions. The particles within a grid element are transported in the manner of a standard Eulerian-Lagrangian (or semi-Lagrangian) scheme using a fixed velocity v. A flux correction computation accounts for particles that cross the v-traceline during the time step. If $v = 0$, the scheme reduces to an almost standard WENO5 scheme. The CFL condition is relaxed when v is chosen to approximate either the characteristic or particle velocity. Excellent numerical results are obtained using relatively long time steps. The v-traceback points can fall arbitrarily within the computational grid, and linear WENO weights may not exist for the point. A general WENO technique is described to reconstruct to any order the integral of a smooth function using averages defined over a general, nonuniform computational grid. Moreover, to high accuracy, local averages can also be reconstructed. By re-averaging the function to a uniform reconstruction grid that includes a point of interest, one can apply a standard WENO reconstruction to obtain a high order point value of the function.

A Multiscale Method Coupling Network and Continuum Models in Porous Media

Chia-Chieh Jay Chu (朱家杰), National Tsing Hua University

Abstract

In this talk, we present a numerical multiscale method for coupling a conservation law for mass at the continuum scale with a discrete network model that describes the pore scale flow in a porous medium. We developed single-phase flow algorithms and extended the methods to two-phase flow, for the situations in which the saturation. Our coupling method for the pressure equation uses local simulations on small sampled network domains at the pore scale to evaluate the continuum equation and thus solve for the pressure in the domain. For local simulation, it often requires a suitable initialization. We introduce a new choice of initialization from a optimization problem, which is often used in image processing. We present numerical results for single-phase flows with nonlinear flux-pressure dependence, as well as two-phase flow.

Accurate Gradient Approximation for Complex Interface Problems in 3D by an Improved Coupling Interface Method

Yu-Chen Shu (舒宇宸), National Cheng Kung University

Abstract

Most elliptic interface solvers are reduced to low orders in the neighborhood of complex interfaces where there are not enough number of neighboring interior points for high order interpolation. Such interpolation complexity increases especially in three dimensions. In this paper, we propose two recipes to overcome this difficulty. The recipes are to improve our previous method, the coupling interface method, but the idea is also applicable to other interface solvers. The main idea is the follows. The goal is to have first order approximation for second order derivatives at those exceptional points where there are not enough grid points for interpolation. Recipe 1 is to use the finite difference approximation for the second order derivatives at a nearby interior grid, if it is available. Recipe 2 is to flip domain signatures and introduce a ghost state so that a second-order method can be applied. This ghost state is the smooth extension of the solution at the exceptional point from the other side of the interface. The original state is recovered by a post-processing using nearby states and jump conditions. The choice of which recipes to use is determined by a classification of the exceptional points. The improved method renders the solution and its gradient uniformly second-order accurate in the entire computed domain. Careful numerical tests are performed to show a second order accuracy for gradients in two and three dimensions, including a real molecule (1D63) composed of hundreds of atoms.

A High-Order Quadrature-Free RKDG Method for Wave Problems on Structured Meshes with GPU Acceleration

Min-Hung Chen (陳旻宏), National Cheng Kung University

Abstract

In this work, we present a decoupled quadrature-free Runge-Kutta Discontinuous Galerkin (RKDG) method to solve the two-dimensional wave problems on structured meshes and use GPU to accelerate the code. The operations in the proposed decoupled quadrature-free scheme local to each computing elements and the scheme is well-suited for parallel computing and CUDA acceleration. Numerical experiments are conducted to study the convergence and the performance of the proposed scheme. We observe that the proposed decoupled quadrature-free scheme outperforms the coupled one and the speedup performance is significant especially for high polynomial degrees. On the issue of CUDA acceleration, the GPU outperforms the CPU by factors ranging from 17.6 to 47.7 in double precision computation. The CUDA code also reaches 10.77 GFLOPs with the polynomial degree 3. In most cases, our code can reach 10 % of the theoretical double precision peak performance of C1060.

Attaining the Optimal Gaussian Diffusion Acceleration

Sheng-Jhih Wu (吳聲志), Institute of Mathematics, Academia Sinica

Abstract

Diffusion processes with invariant equilibrium distributions can be used as a means to generate approximations. It is desirable to realize the desired distribution more effciently. An important task in such an endeavor is to design an equilibrium- preserving drift to accelerate the convergence. In the case of Gaussian diffusion, this problem can be cast as an inverse eigenvalue problem. In this talk, two approaches to achieve the optimal rate of Gaussian diffusion acceleration will be described. The asymptotical approach works universally for arbitrary Ornstein-Uhlenbeck pro- cesses, whereas the direct approach can be implemented as a fast divide-and-conquer algorithm. This is a joint work with Chii-Ruey Hwang and Moody T. Chu.

An Optimal Explicit Adaptive Temporal Scheme for Solving Chemotaxis Systems

Jui-Ling Yu (余瑞琳), Providence University

Abstract

We present a class of numerical methods for the chemotaxis system which is significant for biological and chemistry pattern formation problems. To solve chemotaxis systems, efficient and reliable numerical algorithms are essential for pattern generations. Along with the implementation of the method of lines, implicit or semi-implicit schemes are typical time stepping solvers to reduce the effect on time step constrains due to the stability condition. However, these two schemes are usually difficult to employ. In this talk, we propose a fully explicit discretization combined with a variable optimal time step strategy for solving the chemotaxis system. Instead of relying on empirical approaches to control the time step size, variable time step sizes are given explicitly. Yet, theorems about stability and convergence of the algorithm are provided in analyzing robustness and efficiency. Numerical experiment results on a testing problem and a real application problem are shown.

A Novel Symmetric Skew-Hamiltonian Isotropic Lanczos Algorithm for Spectral Conformal Parameterizations

Wei-Qiang Huang (黃韋強), National Chiao Tung University

Abstract

In the past decades, numerous methods for computing conformal mesh paramterizations have been developed in response to demand of vast applications in the field of geometry processing. Spectral conformal parameterization (SCP) [1] is one of these methods used to compute a quality conformal parameterization based on the spectral techniques. SCP focuses on a generalized eigenvalue problem (GEP) $L_C\mathbf{f} = \lambda B\mathbf{f}$ whose eigenvector(s) associated with the smallest positive eigenvalue(s) provide the conformal parameterization result.

This talk is devoted to studying a novel eigensolver for this GEP. Based on the structures of matrix pair (L_C, B), we show that this GEP can be transformed into a small-scaled compressed and deflated standard eigenvalue problem with a symmetric positive definite skew-Hamiltonian operator. We then propose a *symmetric skew-Hamiltonian isotropic Lanczos algorithm* ($\mathbb{S}$HILA) to solve the reduced problem. Numerical experiments show that our compressed deflating skill can exclude the impact of convergence from the kernel of L_C and transform the original problem to a more robust system. The novel $\mathbb{S}$HILA method can effectively avoid the disturbance of duplicate eigenvalues. As a result, based on the spectral model of SCP, our numerical eigensolver can compute the conformal parameterization accurately and efficiently.

Reference

[1] P. Mullen, Y. Tong, P. Alliez and M. Desbrun, Spectral Conformal Parameterization, Comput. Graph. Forum, 27(5) (2008), pp. 1487–1494.

A Hybrid Immersed Boundary and Immersed Interface Method for Interfacial Flow with Insoluble Surfactant in Electric Field

Wei-Fan Hu (胡偉帆), National Chiao Tung University

Abstract

In this talk, we develop a simple hybrid immersed boundary and immersed interface method to simulate the dynamics of surfactant-covered drop under the influence of an electric field in Navier-Stokes flows. The leaky-dielectric model is used to take into account the effect of electric model. Specifically, we consider the external electric force as an interfacial force rather than a global force. This step can avoid losing numerical accuracy on external electric force. An artificial tangential velocity has been added to the Lagrangian markers to ensure that the markers are uniformly distributed at all times. The corresponding modified surfactant equation is solved in a way such that the total surfactant mass is conserved. A series of numerical tests on the present scheme have been conducted to illustrate the applicability and reliability of the method. We first perform the convergence check for interfacial electric force. Then we valid the present method by comparing to theoretical results. Finally, the dynamics of surfactant-covered drop are investigated in detail.

Palindromic Quadratization and Structure-Preserving Algorithm for Palindromic Matrix Polynomials

Wei-Shuo Su (蘇偉碩), National Chiao Tung University

Abstract

In this talk, we develop and exploit efficient palindromic quadratization methods to solve the structure-palindromic polynomial eigenvalue problem. The problem originated from computing in the vibration analysis for fast trains in Germany and then in the study of surface acoustic wave filters. We are motivated to develop a structure-preserving algorithm to solving higher order systems of ordinary or partial differential equations. In the end, the numerical results shows that applying P-quadratization and other structure-preserving methods not only preserves the reciprocal property but also provides higher accuracy than polyeig in MATLAB.

Session on Analysis and Optimization

From Symmetric Cone Optimization to Non-Symmetric Cone Optimization

Jein-Shan Chen (陳界山), National Taiwan Normal University

Abstract

In this talk, I will briefly review symmetric cone optimization and then talk about recent development regarding non-symmetric cone optimization. Especially, I will focus on the structures of two types of non-symmetric cones. This talk aims to general audience, no prerequisite about optimization is required.

Pricing Asian Options via Taylor Approximations

Chin-Chun Lai (賴金君), National Sun Yat-sen University

Abstract

Asian options are path dependent derivatives whose payoff depends on some form of averaging prices of the underlying asset. The valuation of Asian options is always complicated and no closed form solution exists, in general. The difficulties come from the fact that the distribution of the arithmetic average is no longer log normal. Several analytic approaches have been proposed in the literature, including, among others, partial differential equations, Laplace and Fourier transform, and analytic approximations. In this article we derive new analytic approximate formulas for the pricing of Asian option with arithmetic averages via higher order Taylor approximations. The resulting formulas are in closed form. Comparisons with first and quadratic orders are included.

Customized PPA for Convex Optimization — Motivation and Applications

Bingsheng He (何炳生), Nanjing University, China

Abstract

The mathematical form of many problems in applications can written as a linearly constrained convex optimization

$$\min\{\theta(x) \mid Ax = b,\ x \in \mathscr{X}\}.$$

The first order optimal conditions of the linearly constrained convex programming is a mixed monotone variational inequality in primal and dual variables. The proximal point algorithm (PPA) in Euclidean-norm is classical but abstract. Hence, PPA only plays an important theoretical role in optimization and it is rarely used in the practical scientific computation. In this talk, we introduce the recently developed customized PPA in G-norm (G is a positive definite matrix). In the frame of customized PPA, it is easy to construct the contraction-type methods for convex optimization with different linear constraints. In each iteration of the proposed methods, we need only to solve the proximal subproblems which have the closed-form solutions or can be efficiently solved up to a high precision. Guided by the frame of customized PPA, the alternating direction method of multipliers is modified and it becomes more efficient. Some novel applications and numerical experiments are reported.

On Caristi Type Maps and Generalized Distances with Applications

Wei-Shih Du (杜威仕), National Kaohsiung Normal University

Abstract

In this talk, we prove some new existence theorems of fixed points for Caristi type maps and some suitable generalized distances without lower semi-continuity assumptions on dominated functions. As applications of our results, some new fixed point theorems and new generalizations of the Banach contraction principle are given.

New Quasi-Coincidence Point Polynomial Problems

Yi-Chou Chen (陳怡州)*, National Army Academy
Hang-Chin Lai, National Tsing Hua University

Abstract

Let$F : \mathbb{R} \times \mathbb{R} \to \mathbb{R}$ be a real-valued polynomial function of the form

$$F(x,y) = a_s(x)y^s + a_{s-1}(x)y^{s-1} + \cdots + a_0(x)$$

where the degree s of y in $F(x,y)$ is greater than or equal to 1. For arbitrary polynomial function $f(x) \in \mathbb{R}[x]$, $x \in \mathbb{R}$, we will find a polynomial solution $y(x) \in \mathbb{R}[x]$ to satisfy the following equation:

$$F(x,y(x)) = af(x) \tag{1}$$

where $a \in \mathbb{R}$ is a constant depending on the solution $y(x)$, namely a quasi-coincidence (point) solution of (1), and a is called a quasi-coincidence value. In this paper, we prove that the leading coefficient $a_s(x)$ of y in $F(x,y)$,

(i) $a_s(x)$ must be a factor of $f(x)$ and

(ii) each solution of (1) is of the form

$$y(x) = -a_{s-1}(x)/sa_s(x) + \lambda p(x)$$

where λ is arbitrary and $p(x) = c(f(x)/a_s(x))^{1/s}$ is also a factor of $f(x)$, c is a constant, provided the equation (1) has infinitely many quasi-coincidence (point) solutions.

A Nonconvex Minimization Approach to Phase Retrieval

Pengwen Chen (陳鵬文), National Chung Hsing University

Abstract

PhaseLift, proposed by E.J. Candes et al is one convex relaxation approach for phase retrieval problem. Even though the convex formulation yields the numerical attainability of the global optimality, the number of measurement could increase significantly in order to separate the convex cone and the subspace. In the paper, we discuss one orthogonal decomposition for PhaseLift. Some empirical studies demonstrate the effectiveness of this approach.

Some New Types for the Minimax Theorems

Yen-Cherng Lin (林炎成), Department of Occupational Safety and Health, China Medical University

Abstract

We study some new types for the minimax theorems with set-valued mappings, and propose several versions for minimax theorems in topological vector spaces setting. These problems arise naturally from some minimax theorems in the vector settings. The both types of scalar minimax theorems and set minimax theorems are also discussed. Furthermore, we propose three versions of minimax theorems for the last type. Some examples are also proposed to illustrate our theorems. As applications, we also discuss the existences of two kinds of saddle points for set-valued mappings. Our results are new or almost compare with the recent existing results.

The Optimal Preconditioners for Functions of Matrices

Xiaoqing Jin (金小慶), University of Macau, Macao

Abstract

The optimal preconditioner $c_U(A)$ of a given matrix A was proposed in 1988 by T. Chan. It has been proved to be efficient for solving a large class of structured systems since then. In this talk, we construct the optimal preconditioners for different functions of matrices. Let f be a function of matrices from $\mathbb{C}^{n\times n}$ to $\mathbb{C}^{n\times n}$. Given $A \in \mathbb{C}^{n\times n}$, there are two choices of constructing optimal preconditioners for $f(A)$: $c_U(f(A))$ and $f(c_U(A))$. We study properties of both $c_U(f(A))$ and $f(c_U(A))$ for different functions of matrices. Numerical experiments are given to illustrate the efficiency of our preconditioners when used to solve $f(A)\mathbf{x} = \mathbf{b}$.

Solutions for Variational Inclusion Problem with Applications to Multiple Sets Split Feasibility Problems

Lai-Jiu Lin (林來居), National Changhua University of Education

Abstract

In this paper, we first study the set of common solutions for two variational inclusion problems in a real Hilbert space, and establish a strong convergence theorem of this problem. As applications, we study unique minimum norm solution of the following problems: multiple sets split feasibility problems, system of convex constrained linear inverse problems, convex constrained linear inverse problems, split feasibility problems, convex feasibility problems. We establish iteration processes of these problems and show the strong convergence theorems of these iteration processes.

Common Fixed Points of Generalized Cyclic Meir-Keeler-type Contractions in Partially Ordered Metric Spaces

Ing-Jer Lin (林英哲), National Kaohsiung Normal University

Abstract

The purpose of this paper is to prove some common point theorems for the generalized cyclic Meir-Keeler-type (α,ψ,A,B)-contraction in partially ordered metric spaces. Our results generalize many recent common point theorems in the literature.

Completely Positive Interpolations of Compact, Trace-Class and Schatten-*p* Class Operators

Ming-Cheng Tsai (蔡明誠), National Sun Yat-sen University

Abstract

Extending Li and Poon's results on completely positive interpolation of matrices, we give characterizations to the existence of a completely positive linear map sending a Schatten-p class operator A to another B. We establish that if a multiple of the numerical range of A contains the numerical range of B, we can always find a completely positive linear map sending A to B. Given two commutative families of Schatten-p class operators $\{A_\alpha\}$ and $\{B_\alpha\}$, we provide sufficient and necessary conditions to ensure an interpolation map that is completely positive and trace-preserving.

The Multiple System of Split Monotonic Variational Inclusion Problem with Applications

Zenn-Tsun Yu (游鎮村), Nan Kai University of Technology

Abstract

In this paper, we apply the convergence theorem of the multiply sets split feasibility problem to study the convergence theorems of the following problems: The split feasibility problem; the multiply system of split mono- tonic variational inclusion problem; the multiply system of split equilibrium problem; the split multiply equilibrium problem; the split equilibrium prob- lem; the multiple system of split variational inequality problem; the split variational inequality problem; the mathematical programming with split multiple systems of variational constraints and the quadratic programming with split multiple systems of variational inequalities constraints. We es- tablish iteration processes and prove strong convergence theorems of these problems.

Higher-rank Numerical Ranges and Compressions of Matrices

Chi-Tung Chang (張其棟), Feng Chia University

Abstract

The rank-k numerical range of an n-by-n complex matrix A is defined by

$$\Lambda_k(A) \equiv \{\lambda \in \mathbb{C} : PAP = \lambda P \text{ for some rank-}k \text{ orthogoanl projection } P\}.$$

We use the compressions of matrices to characterize the matrix A such that $\Lambda_{k_1}(A) = \Lambda_{k_2}(A)$, where $1 \le k_1 \le k_2 \le n$. In particular, the equivalent conditions for $W(A) = \Lambda_k(A)$, where $W(A) \equiv \{\langle Ax,x\rangle : x \in \mathbb{C}^n, \|x\| = 1\}$ is the classical numerical range of A and $1 \le k \le n$, are obtained.

Non-deterministic Polynomials(NP): Distribution, Feedback Control, and Consistent Test

Hsih-Chia Hsieh (謝世佳)*, Providence University
Pei-Gin Hsieh, National Chung Cheng University

Abstract

Dynamic equilibrium is an attractors and is a common boundary on Poncare's inequality of variances $(x(t)-x^*)^2 \leq \lambda\sigma_x^2$:

$$\min\max \log \lambda_{t+1} Y_{t+1} = \lambda_t \log Y_t + \theta_2\sigma_x^2 + \theta_4\sigma_r^2 + \theta_6\sigma_{\log Y}^2 + \theta_8\sigma_\lambda^2 + v_t$$
$$\text{for } t := \{0,1,2,3,4,...,n\} \text{ as } n \to \infty$$

Dynamic general equilibrium is a moment generating function, is estimated by non-deterministic polynomials(NP), and is the unique, unbiased, and consistent test statistic between repeated experiments and theories.

A Differential Equations Approach to l_1-Minimization with Applications to Array Imaging

Yi-Ting Chen (陳奕廷), National Sun Yat-sen University

Abstract

An ordinary differential equation approach to the analysis of algorithms for constructing l_1 minimizing solutions to underdetermined linear systems of full rank. It involves a relaxed minimization problem whose minimum is independent of the relaxation parameter.

Strong Convergence Theorems for Split Feasibility Problems with Related Results in Hilbert Spaces

Chih-Sheng Chuang (莊智升), National Sun Yat-sen University

Abstract

In this paper, we present an algorithm and strong convergence theorem for relaxed split feasibility problems in infinite dimensional real Hilbert spaces. In fact, the algorithm given in this paper is new and interesting. Besides, we can consider feasibility problems and related problems in the final.