第30屆

微分方程年會

國立政治大學綜合院館三樓演講廳
2022年1月14日至15日

年會手冊

主辦單位：國立政治大學應用數學系
協辦單位：台灣工業與應用數學會(TWSIAM)
科技部自然司科學推展中心數學組
國立政治大學

年會主旨

自 1993 年由中正大學數學系發起並承辦第一屆方微分方程年會，爾後本研討會已是每年國內微分方程領域的重要活動，可以說是國內歷史最悠久的學術年會之一。本研究會的主要目的是提供了國內外從事微分方程與其相關領域的研究學者或學生一個可以交流彼此研究成果及心得的平台，以促進國內微分方程領域的研究風氣與發展。

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第 30 屆微分方程年會議程

Jan 14 (Fri.)			
8:40-9:05	報到 Registration		
9:05-9:20	開幕式 Opening		
9:20-10:20	劉太平 (中研院) Chair: 許世壁（清華）		
10:20-10:50	Group photo, Tea break		
Differential Equations Chair: 王振男 (台大)		Computational Mathematics and Dynamical Systems Chair: 賴明治 (交大)	
10:50-11:40	陳建隆 (師大)	10:50-11:40	王偉仲 (台大)
11:40-12:30	陳逸昆 (台大)	11:40-12:30	胡偉帆 (中央)
12:30-13:30	Lunch		
Differential Equations Chair: 符聖珍 (政大)		Computational Mathematics and Dynamical Systems Chair: 楊智烜 (東海)	
13:30-14:20	方永富 (成大)	13:30-14:20	劉晉良 (清華)
14:20-15:10	陳子軒 (陽明交大)	14:20-15:10	施因澤 (中興)
15:10-15:30	Tea break		
Differential Equations Chair: 王信華 (清華)		Computational Mathematics and Dynamical Systems Chair: 陳賢修 (師大)	
15:30-16:20	薛名成 (陽明交大)	15:30-16:20	陳怡全 (中研院)
16:20-17:10	洪國智 (勤益)	16:20-17:10	張志鴻 (高大)
18:00	Banquet		

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<tr><td>9:20-10:20</td><td colspan="3">尤釋賢 (中研院)
Chair: 陳俊全 (台大)</td></tr>
<tr><td>10:20-10:40</td><td colspan="3">Tea break</td></tr>
<tr><td colspan="2">Differential Equations
Chair: 曾睿彬 (政大)</td><td colspan="2">Computational Mathematics and Dynamical Systems
Chair: 楊定揮 (淡大)</td></tr>
<tr><td>10:40-11:30</td><td>楊劼之 (成大)</td><td>10:40-11:30</td><td>謝世峰 (師大)</td></tr>
<tr><td>11:30-12:20</td><td>黃志強 (中正)</td><td>11:30-12:20</td><td>梁育豪 (高大)</td></tr>
<tr><td>12:20-13:20</td><td colspan="3">Lunch</td></tr>
<tr><td colspan="2">Differential Equations
Chair: 洪盟凱 (中央)</td><td colspan="2">Computational Mathematics and Dynamical Systems
Chair: 吳昌鴻 (陽明交大)</td></tr>
<tr><td>13:20-14:10</td><td>林奕亘 (陽明交大)</td><td>13:20-14:10</td><td>葉均承 (高師大)</td></tr>
<tr><td>14:10-15:00</td><td>羅春光 (中山)</td><td>14:10-15:00</td><td>黃聰明 (師大)</td></tr>
<tr><td>15:00-17:20</td><td colspan="3">Free discussion</td></tr>
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大會主講 Plenary Speaker

- 1 月 14 日

  - **劉太平院士 Tai-Ping Liu (中央研究院數學所)**
    演講主題：Kinetic Theory and Fluid Dynamics
    主講人履歷簡介
    劉太平於 1968 年畢業自國立臺灣大學數學系，於 1970 獲得美國俄勒岡州立大學碩士學位，於 1973 年獲得美國密西根大學數學系博士學位。1973 年至 1988 年任教於馬里蘭大學，1988 年至 1990 年任教於紐約大學，1990 年起任教於史丹佛大學。劉太平於 1992 年當選中研院院士，2000 年回台獲聘為中央研究院數學研究所特聘研究員，並曾任中研院數學所所長。其研究領域包含非線性偏微方程及應用、震波理論、動力學方程，並在這些領域上都有極大的學術貢獻。

- 1 月 15 日

  - **尤釋賢教授 Shih-Hsien Yu (中央研究院數學所)**
    演講主題：Compressible Navier-Stokes equation with a rough data
    主講人履歷簡介
    尤釋賢畢業自國立臺灣大學數學系，於 1986 取得學士學位、1989 年取得碩士學位，接著於 1994 獲得美國史丹佛大學數學博士學位。先後受聘於加州大學洛杉磯分校、大阪大學、香港城市大學、新加坡國立大學，目前為中央研究院數學研究所特聘研究員。其研究領域包含動力學方程、粘性守恆定律與有限差分方程，並在這些領域上都有極大的學術貢獻。

Kinetic Theory and Fluid Dynamics

Tai-Ping Liu

Institute of Mathematics, Academia Sinica

Abstract

There are two main goals in the study of the Boltzmann equation in kinetic theory, as envisioned by Boltzmann himself and also explicitly mentioned later as Hilbert Sixth Problem. The first goal is to derive the Boltzmann equation from Newtonian mechanics of interacting particles. The second goal is to relate the Boltzmann equation to the fluid dynamics. The first goal is historically, scientifically, and philosophically important in linking the time reversible micro scale particle system to the irreversible meso scale kinetic model. There is the preliminary success by Oscar Lanford [1] for this first goal, though this goal remains to be achieved. The second goal of relating the meso scale Boltzmann equation to the macro scale fluid dynamics is a rich field for mathematical study. There have been substantial progresses toward this second goal. From the physical side, there is the Kyoto School of Yoshio Sone and others, [2], for the successful initiation of modern fluid dynamics based on the Boltzmann equation. For the analytical consideration of the second goal, there is the realization that the Boltzmann equation is equivalent to an infinite system of partial differential equations. There are some analytical tools developed in the past two decades for reducing the infinite dimensional problem to a finite one, e.g. [3]. We will briefly mention the present state of the first goal and give a survey of the progress toward the second goal, e.g. [4]. Possibilities for future research will also be indicated.

References

[1] Lanford, Oscar E., III Time evolution of large classical systems. Dynamical systems, theory and applications (Rencontres, Battelle Res. Inst., Seattle, Wash., 1974), pp. 1-111. Lecture Notes in Phys., Vol. 38, Springer, Berlin, 1975.

[2] Sone, Y., *Molecular Gas Dynamics*: *Theory*, *Techniques*, *and Applications,* Birkhäuser, Boston, 2007.

[3] Liu, T.-P.; Yu, S.-H. Boltzmann equation: micro-macro decompositions and positivity of shock profiles. Comm. Math. Phys. 246 (2004), no. 1, 133–179.

[4] Liu, T.-P.; Yu, S.-H. Invariant manifolds for steady Boltzmann flows and applications. Arch. Ration. Mech. Anal. 209 (2013), no. 3, 869-997.

Compressible Navier-Stokes equation with a rough data

Shih-Hsien Yu

Institute of Mathematics, Academia Sinica

Abstract

In this talk, we will present a result on a compressible Navier-Stokes equation with an initial data in $BV \cap L^1$. One has show that Navier-Stokes equation is stable in $BV \cap L^1$ class. A constructive approach, which used a new way to study heat equation with rough data, will be reviewed.

微分方程領域 (Differential Equations)

- 1 月 14 日
  - **陳建隆 Jann-Long Chern (國立臺灣師範大學數學系)**
    On The Evolution Equation With A Dynamic Hardy-Type Potential
  - **陳逸昆 I-Kun Chen (國立臺灣大學數學系)**
    Regularity of Boltzmann equations in bounded domains
  - **方永富 Yung-Fu Fang (國立成功大學數學系)**
    Some Typical Problems on the Quantum Zakharov System
  - **陳子軒 Chi-Hin Chan (國立陽明交通大學應用數學系)**
    About the Hodge decomposition and the Stokes Equations on a hyperbolic space
  - **薛名成 Ming-Cheng Shiue (國立陽明交通大學應用數學系)**
    Continuous Data assimilation algorithms for the primitive equations based on partial measurements
  - **洪國智 Kuo-Chih Hung (國立勤益科技大學基礎通識教育中心)**
    Bifurcation diagrams of a diffusive generalized logistic problem with constant yield harvesting
- 1 月 15 日
  - **楊劭之 Ryosuke Takahashi (國立成功大學數學系)**
    Polyhomogeneous expansions and $\mathbb{Z}/2$-harmonic spinors branching along graphs
  - **黃志強 Chih-Chiang Huang (國立中正大學數學系)**
    Three-Phase Problem and Relative Topics
  - **林奕亘 Yi-Hsuan Lin (國立陽明交通大學應用數學系)**
    Inverse problems for partial differential equations, nonlinearity and nonlocality
  - **羅春光 Chun-Kong Law (國立中山大學應用數學系)**
    Spectral Analysis and Existence of Dirac points for some periodic quantum graphs

On The Evolution Equation With A Dynamic Hardy-Type Potential

Jann-Long Chern

Department of Mathematics, National Taiwan Normal University

Abstract

Motivated by the celebrated paper of Baras and Goldstein (1984), in this talk, we study the heat equation with a dynamic Hardy-type singular potential. In particular, we are interested in the case where the singular point moves in time. Under appropriate conditions on the potential and initial value, we show the existence, non-existence and uniqueness of solutions, and obtain a sharp lower and upper bound near the singular point.

This is a joint work with Profs. G. Hwang, J. Takahashi and E. Yanagida.

Regularity of Boltzmann equations in bounded domains

I-Kun Chen

Department of Mathematics, National Taiwan University

Abstract

In this talk, I shall introduce some development on regularity of stationary Boltzmann equations. Upon this issue, on the one hand, collision and transport provide some smoothing effect. On the other hand, boundary could cause some singularities. Subtle balance is needed for the discussion.

Some Typical Problems on the Quantum Zakharov System

Yung-Fu Fang

Department of Mathematics, National Cheng Kung University

Abstract

First we briefly discuss some works we have done for quantum Zakharov system (QZ): regarding Local Well-Posedness, Global Well-Posedness, Blowup Solution, and Small Data Scattering.

Next, we discuss: Standing Waves of (QZ), Existence and stability, Schrödinger Limit of (QZ) as wave speed goes to infinity, Semi-classical Limit of (QZ) as quantum parameter goes to zero, and Global Dynamics of (QZ).

Finally, we will discuss a result of blow up solution for a nonlinear Schrödinger equation in one spacial dimension with periodic condition.

About the Hodge decomposition and the Stokes Equations on a hyperbolic space

Chi-Hin Chan

Department of Applied Mathematics, National Yang Ming Chiao Tung University

Abstract

The Hodge decomposition is well-known for compact manifolds. The result has been extended by Kodaira to include non-compact manifolds and L2 forms. We further extend the Hodge decomposition to the Sobolev space H1 for general k-forms on non-compact manifolds of nonpositive constant sectional curvature. As a result, we also obtain a decomposition on RN.

This is a joint work with Magdalena Czubak and Carlos Pinilla Suarez .

Continuous Data assimilation algorithms for the primitive equations based on partial measurements

Ming-Cheng Shiue

Department of Applied Mathematics, National Yang Ming Chiao Tung University

Abstract

In this talk, we first recall continuous data assimilation algorithms that were proposed for designing finite-dimensional feedback controls for two-dimensional Navier-Stokes equations by Aouani et al.. That is, the assimilated solution with full data-driven nudging techniques converges to the reference solution in L^2 norm at an exponential rate in time. Later, there are several works devoted to the study of data assimilation algorithms based on partial measurements. In Farhart et al., the authors considered continuous data assimilation for the 2D Bénard convection through velocity measurements alone. In Biswas et al., the authors studied continuous data assimilation for the two-dimensional magneto-hydrodynamic equations by using one component of the velocity and magnetic fields.

In this talk, we will present the continuous data assimilation algorithms for three-dimensional viscous primitive equations that arise from the modeling of the atmosphere and the ocean on partial measurement. In Pei, the author already studied the algorithm for the three-dimensional primitive equations of the ocean with full measurements. Based on this work, the convergence of the assimilated solution to the reference solution L^2 norm can be provided based on velocity measurement only for the nonlinear thermodynamics, especially in the ocean.

If time is permitted, we will give more results about coupled atmosphere and ocean models with partial measurements that provides sufficient conditions on the finite-dimensional spatial resolution of the collected data and observational measurements to make sure that the approximate solutions obtained from the new algorithms converge to the unknown reference solutions over time.

Bifurcation diagrams of a diffusive generalized logistic problem with constant yield harvesting

Kuo-Chih Hung

Center for General Education, National Chin-Yi University of Technology

Abstract

We study the one-dimensional diffusive generalized logistic problem with constant yield harvesting:

$$\begin{cases} u''(x) + \lambda g(u) - \mu = 0, \quad -1 < x < 1, \\ u(-1) = u(1) = 0, \end{cases}$$

where $\lambda, \mu > 0$. We assume that nonlinearity g satisfies $g(0) = g(1) = 0$, $g(u) > 0$ on $(0, 1)$, and g satisfies certain conditions. We prove that, for any fixed $\mu > 0$, on the $(\lambda, \|u\|_\infty)$-plane, the bifurcation diagram consists of a $\subset$-shaped curve and then we study the structures and evolution of bifurcation diagrams for varying $\mu > 0$. We also prove that, for any fixed $\lambda > \lambda_0^*$ for some $\lambda_0^* > 0$, on the $(\mu, \|u\|_\infty)$-plane, the bifurcation diagram consists of a reversed $\subset$-shaped curve with possibly the disjoint union of a strictly increasing curve, and we study the structures and evolution of bifurcation diagrams for varying $\lambda > \lambda_0^*$.

Polyhomogeneous expansions and $\mathbb{Z}/2$-harmonic spinors branching along graphs

Ryosuke Takahashi

Department of Mathematics, National Cheng Kung University

Abstract

In this talk, we will first reformulate the linearization of the moduli space of $\mathbb{Z}/2$-harmonic spinors branching along a knot. This formula tells us that the kernel and cokernel of the linearization are isomorphic to the kernel and cokernel of the Dirac equation with a polyhomogeneous boundary condition. In the second part of this talk, I will describe the polyhomogenous expansions for the $\mathbb{Z}/2$-harmonic spinors branching along graphs and formulate the Dirac equation with a suitable boundary condition that can describe the perturbation of graphs with some restrictions. This is joint work with Andriy Haydys and Rafe Mazzeo.

Three-Phase Problem and Relative Topics

Chih-Chiang Huang

Department of Mathematics, National Chung Cheng University

Abstract

This talk includes two parts. The first one is concerned with a classical 3-phase problem for a 2-component gradient system whose potential with 3 balanced wells in the plane. Based on variational method, we can construct traveling waves in an infinite strip to approximate the solution of 3-phase problem. This is a joint work with Prof. Chiun-Chuan Chen and Dr. Hung-Yu Chien.

In the second part, we consider a gradient system in an infinite cylindrical domain. On the bounded cross section of the cylinder, we assume that the system exactly has three local minimizers with 3 different energy levels, which can be viewed as a generalization of 3 non-balanced wells. Applying a variational approach, we study the existence or nonexistence of traveling waves connecting two local minimizers with successive or non-successive energy levels. Moreover, weakly wave interaction will be involved to study two waves with the same speed. This work is joint with Prof. Chiun-Chuan Chen and Prof. Shin-Ichiro Ei.

Inverse problems for partial differential equations, nonlinearity and nonlocality

Yi-Hsuan Lin

Deparment of Applied Mathematics, National Yang Ming Chiao Tung University

Abstract

We consider recent developments related to nonlinearity and nonlocality in inverse problems for partial differential equations(PDEs), together with useful methods from nearby fields. The talk includes nonlinear PDEs and models, nonlinear methods for linear models, and also nonlocal effects.

Spectral Analysis and Existence of Dirac points for some periodic quantum graphs

Chun-Kong Law

Department of Applied Mathematics, National Sun Yat-sen University

Abstract

One interesting property of graphene is the existence of Dirac points, which are essentially the points where different sheets of dispersion surface touch to form a conical singularity. According to Geim, these Dirac points accounts for the unusual electronic properties of graphene. We show that near the anti-periodic eigenvalues, there exist infinitely many Dirac points for several Archimedean tiling: hexagonal tiling (6^3), square tiling (4^4), truncated square tiling $(4, 8^2)$, and truncated trihexagonal tiling $(4, 6, 12)$. Applying Hochstadt's results, we show that the above situation occurs only when the potential function has a certain particular form. The proof makes use of some classical results in inverse spectral problems.

This is joint work with Eduardo Jatulan of University of the Philippines, Los Banos.

計算數學與動態系統領域
(Computational Mathematics and Dynamical Systems)

- 1 月 14 日
  - **王偉仲 Wei-Chung Wang (國立臺灣大學 MeDA Lab 與應用數學科學研究所)**
    Medical Data Analytics and Beyond
  - **胡偉帆 Wei-Fan Hu (國立中央大學數學系)**
    Machine learning approximation for solving sharp interface problems
  - **劉晉良 Jinn-Liang Liu (國立清華大學計算與建模科學研究所)**
    Molecular Mean-Field Theory in Bioelectricity and Electrochemistry
  - **施因澤 Yin-Tzer Shih (國立中興大學應用數學系)**
    A numerical scheme for the ground state of rotating spin-1 Bose-Einstein condensates
  - **陳怡全 Yi-Chiuan Chen (中央研究院數學所)**
    A note on holomorphic shadowing for Hénon maps – persistence of hyperbolic invariant sets
  - **張志鴻 Chih-Hung Chang (國立高雄大學應用數學系)**
    Topological entropy of symbolic dynamical systems on semigroups
- 1 月 15 日
  - **謝世峰 Shih-Feng Shieh (國立臺灣師範大學數學系)**
    The orthogonal flows for orthogonal iteration and applications
  - **梁育豪 Yu-Hao Liang (國立高雄大學應用數學系)**
    Flocking in an augmented Cucker-Smale model under the hierarchical networks
  - **葉均承 Chun-Chen Yeh (國立高雄師範大學數學系)**
    Simulate the Solutions for the Kirchhoff -Type Problem
  - **黃聰明 Tsung-Ming Huang (國立臺灣師範大學數學系)**
    A Novel 2-Phase U-net Algorithm Combined with Optimal Mass Transportation for 3D Brain Tumor Detection and Segmentation

Medical Data Analytics and Beyond

Weichung Wang

MeDA Lab and Institute of Applied Mathematical Sciences, National Taiwan University

Abstract

The rapid development of Artificial Intelligence (AI) introduces a promising new era of smart and precision medicine. Interdisciplinary collaborations play a critical role in the research, education, and productization of medical AI. We will illustrate how the Medical Data Analytics Framework may achieve the end-to-end R & D life-cycle. The framework includes project design, multimodality data, intelligent analytics, medical workflows, regulation and ethics, and solution landing. We will also demonstrate examples of how medical AI algorithms and tools can reduce physicians' loading and improve patient outcomes.

Machine learning approximation for solving sharp interface problems

Wei-Fan Hu

Department of Mathematics, National Central University

Abstract

In this talk, a new Discontinuity Capturing Shallow Neural Network (DCSNN) for approximating d-dimensional piecewise continuous functions and for solving sharp interface problems is developed. There are three novel features in the present network; namely, (i) jump discontinuity is captured sharply, (ii) it is completely shallow consisting of only one hidden layer, (iii) it is completely mesh-free for solving partial differential equations (PDEs). We first continuously extend the d-dimensional piecewise continuous function in $(d+1)$-dimensional space by augmenting one coordinate variable to label the pieces of discontinuous function, and then construct a shallow neural network to express this new augmented function. Since only one hidden layer is employed, the number of training parameters (weights and biases) scales linearly with the dimension and the neurons used in the hidden layer. For solving elliptic interface equations, the network is trained by minimizing the mean squared error loss that consists of the residual of governing equation, boundary condition, and the interface jump conditions. We compare the results obtained by the traditional grid-based immersed interface method (IIM) which is designed particularly for elliptic interface problems. The present results show better accuracy than the ones obtained by IIM. We conclude by solving a six-dimensional problem to show the capability of the present network for high-dimensional applications.

Molecular Mean-Field Theory in Bioelectricity and Electrochemistry

Jinn-Liang Liu

Institute of Computational and Modeling Science, National Tsing Hua University

Abstract

Water and ions give life. Their electrostatic and kinetic interactions play essential roles in biological and chemical systems such as DNA, proteins, ion channels, cell membranes, physiology, nanopores, supercapacitors, lithium dendrite growth, porous media, corrosion, geothermal brines, environmental applications, and the oceanic system. We have developed a molecular mean-field theory—fourth-order Poisson−Nernst−Planck−Bikerman theory—for modeling ionic and water flows in these systems by treating ions and water molecules of any volume and shape with interstitial voids, polarization of water, and ion-ion and ion-water correlations. The theory can compute electric and steric energies from all atoms in a protein and all ions and water molecules in a channel pore while keeping electrolyte solutions in the extra- and intra-cellular baths as a continuum dielectric medium with complex properties that mimic experimental data. The theory has been verified with experiments and molecular dynamics data from the gramicidin A channel, L-type calcium channel, potassium channel, and sodium/calcium exchanger with real structures from the Protein Data Bank. It was also verified with the experimental or Monte Carlo data of electric double-layer differential capacitance and ion activities in aqueous electrolyte solutions. It has been rigorously shown to exhibit important mathematical and physical properties such as asymptotic convergence to its classical counterparts when the size and correlation parameters tend to zero, i.e., the classical theories fail to account for these physical quantities in real world. We shall give an outlook of its further development in mathematics.

References

[1] J.-L. Liu and B. Eisenberg, Molecular mean-field theory of ionic solutions: a Poisson-Nernst-Planck-Bikerman model, Entropy 22, 550 (2020).
[2] C.-L. Li and J.-L. Liu, Generalized Debye-Hückel equation from Poisson-Bikerman theory, SIAM J. Appl. Math. 80, 2003-2023 (2020).
[3] J.-L. Liu and B. Eisenberg, Poisson-Fermi modeling of ion activities in aqueous single and mixed electrolyte solutions at variable temperature, J. Chem. Phys. 148, 054501 (2018).
[4] J.-L. Liu, H.-j. Hsieh, and B. Eisenberg, Poisson-Fermi modeling of the ion exchange mechanism of the sodium/calcium exchanger, J. Phys. Chem. B 120, 2658-2669 (2016).
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[7] J.-L. Liu, Numerical methods for the Poisson-Fermi equation in electrolytes, J. Comp. Phys. 247, 88-99 (2013).

A numerical scheme for the ground state of rotating spin-1 Bose-Einstein condensates

Yin-Tzer Shih

Department of Applied Mathematics, National Chung Hsing University

Abstract

We study the existence of nontrivial solution branches of three-coupled Gross-Pitaevskii equations (CGPEs), which are used as the mathematical model for rotating spin-1 Bose-Einstein condensates (BEC). The Lyapunov-Schmidt reduction is exploited to test the branching of nontrivial solution curves from the trivial one in some neighborhoods of bifurcation points. A multilevel continuation method is proposed for computing the ground state solution of rotating spin-1 BEC. By properly choosing the constraint conditions associated with the components of the parameter variable, the proposed algorithm can effectively compute the ground states of spin-1 ^{87}Rb and ^{23}Na under rapid rotation. Extensive numerical results demonstrate the efficiency of the proposed algorithm. In particular, the affect of the magnetization on the CGPEs is investigated.

A note on holomorphic shadowing for Hénon maps – persistence of hyperbolic invariant sets

Yi-Chiuan Chen

Institute of Mathematics, Academia Sinica

Abstract

In studying the complex Hénon maps, Mummert (in ”Holomorphic shadowing for Hénon maps” 2008 Nonlinearity, Vol. 21) defined an operator the fixed points of which give rise to bounded orbits. This enabled him to obtain an estimate of the solenoid locus. Instead of the contraction mapping theorem, in the talk, I shall present an implicit function theorem approach to his result. Moreover, our approach allows us to generalise his results to higher dimensional (generalised) Hénon maps.

Topological entropy of symbolic dynamical systems on semigroups

Chih-Hung Chang

Department of Applied Mathematics, National University of Kaohsiung

Abstract

Topological entropy is an important statistical property for dynamical systems. In this talk, I will introduce the recent development of topological entropy of symbolic dynamical systems on semigroups. Except for discussing the existence of topological entropy on abstract symbolic dynamical systems, some novel phenomena for hom-shifts on free semigroups have been revealed.

The orthogonal flows for orthogonal iteration and applications

Shih-Feng Shieh

Department of Mathematics, National Taiwan Normal University

Abstract

In the field of scientific computation, the orthogonal iteration plays an essential role in computing the invariant subspace corresponding to the largest k eigenvalues. In this paper, we construct a flow that connects the sequence of matrices generated by the orthogonal iteration. Such a flow is called an orthogonal flow. Besides, we also show that the orthogonal iteration forms a time-one mapping of the orthogonal flow. By using a suitable change of variables, the orthogonal flow can be transformed into a Riccati differential equation (RDE). Conversely, an RDE also can be transformed into a flow that can be represented by the orthogonal flow multiplied by an orthogonal matrix.

Flocking in an augmented Cucker-Smale model under the hierarchical networks

Yu-Hao Liang

Department of Applied Mathematics, National University of Kaohsiung

Abstract

The study of collective dynamics has attracted much attention over the past decades. It depicts a group of agents represents the identical dynamics under the interaction between themselves. Nowadays, several models have been constructed to study this phenomenon. Among them, the one proposed by Cucker and Smale has been extensively studied. In this talk, we will consider an augmented Cucker-Smale model under the hierarchical networks, where intrinsic accelerations of agents are governed by different functions. We shall show theoretically that flocking dynamics can be observed under some sufficient conditions on these different functions and the coupling strengths between agents. Some numerical simulations to support our results are provided. This is a joint work of Jonq Juang, Chih-Hung Chang and An-Tien Hsiao.

30th Annual Meeting of Differential Equations
Department of Mathematical Sciences, National Chengchi University
Jan. 14-15, 2022

Simulate the Solutions for the Kirchhoff -Type Problem

Chun-Chen Yeh

Department of Mathematics, National Kaohsiung Normal University

Abstract

We consider the following Kirchhoff-type problem

$$\begin{cases} \left(a + \lambda \int_{\mathbb{R}^3} |\nabla u|^2 dx + \lambda b \int_{\mathbb{R}^3} |u|^2 dx\right)(-\Delta u + bu) = f(u), \ \text{in}\mathbb{R}^3, \\ u \in H^1(\mathbb{R}^3), u > 0, \ \text{in}\mathbb{R}^3 \end{cases}$$

where $\lambda \leq$ is a parameter, a, b are positive constants and f reaches the critical growth. Without the Ambrosetti - Rabinowitz condition, we prove the existence of positive solutions for the Kirchhoff-typeproblem with a general critical nonlinearity. We want to visualize the solutions.

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A Novel 2-Phase U-net Algorithm Combined with Optimal Mass Transportation for 3D Brain Tumor Detection and Segmentation

Tsung-Ming Huang

Department of Mathematics, National Taiwan Normal University

Abstract

Utilizing the optimal mass transportation (OMT) technique to convert an irregular 3D brain image into a cube, a required input format for the U-net algorithm, is a brand new idea for medical imaging research. We develop a cubic volume-measure-preserving OMT (V-OMT) model for the implementation of this conversion. The contrast-enhanced histogram equalization grayscale of fluid attenuated inversion recovery (FLAIR) in a brain image creates the corresponding density function. We then propose an effective two-phase U-net algorithm combined with the V-OMT algorithm for training and validation. First, we use the U-net and V-OMT algorithms to precisely predict the whole tumor (WT) region. Second, we expand this predicted WT region with dilation and create a smooth function by convoluting the step-like function associated with the WT region in the brain image with a $5 \times 5 \times 5$ blur tensor. Then, a new V-OMT algorithm with mesh refinement is constructed to allow the U-net algorithm to effectively train Net1–Net3 models.

Finally, we propose ensemble voting postprocessing to validate the final labels of brain images. We randomly choose 1000 and 251 brain samples from theBraTS 2021 training dataset, which contains 1251 samples, for training and validation, respectively.

The Dice scores of the WT, tumor core (TC) and enhanced tumor (ET) regions for validation computed by Net1–Net3 were 0.93705, 0.90617 and 0.87470, respectively. A significant improvement in brain tumor detection and segmentation with higher accuracy is achieved. Moreover, for each brain image, it takes approximately 200 seconds to validate the WT region.

Author: Wen-Wei Lin, Jia-Wei Lin, Tsung-Ming Huang, Tiexiang Li, Mei-Heng Yueh, and Shing-Tung Yau

♦ 附錄

● 交通資訊

微分方程年會之 Google Map 定位網址：https://goo.gl/maps/WtQhc8xdzyh3u6rE6

公車

- 欣欣客運羅斯福路幹線（原 236)、236 區、237、611、295、指南客運 1503、282、530、東南客運小 10
- 捷運接駁公車棕 3 、棕 5、棕 6、棕 11、棕 15、棕 18、綠 1，至「政大站」下車
- 公車路線圖連結至台北市公車動態系統

捷運

- 搭乘捷運新店線（綠線）至公館站，轉搭羅斯福路幹線（原 236)、236 區、530、棕 11 至「政大站」下車。(上車站點：2 號出口過馬路右方公車亭）
- 搭乘捷運新店線（綠線）至景美站，轉搭棕 6 至「政大站」下車
- 搭乘捷運文湖線（棕線）至動物園，轉搭羅斯福路幹線（原 236)、236 區、237、611、282、295、棕 3 、棕 6、棕 18、綠 1、1503 至「政大站」下車。(上車站點：1 號出口過馬路右方公車亭）
- 搭乘捷運板南線（藍線）至市政府站，轉搭棕 18、綠 1 至「政大站」下車。(上車站點：市政府站 3 號出口）
- 搭乘捷運信義淡水線（紅線）到台北 101 ／世貿站，轉搭棕 18、綠 1 至「政大站」下車。(上車站點：台北 101 ／世貿站 5 號出口）

開車

- 從國道三號高速公路（木柵交流道 - 國 3 甲台北聯絡道 - 萬芳交流道）
  萬芳交流道下北二高-> 右轉木柵路四段-> 左轉秀明路經萬壽橋直行至萬壽路右轉
- 從台北市東區（經信義快速道路南向）
  信義快速道路（南向）接萬芳交流道下北二高-> 右轉木柵路四段-> 左轉秀明路經萬壽橋直行至萬壽路右轉
- 從辛亥路（辛亥隧道）
  過辛亥隧道-> 直行至興隆路左轉-> 左轉木柵路二段接秀明路過萬壽橋直行至萬壽路右轉
- 從和平東路（軍功路莊敬隧道）
  過莊敬隧道，走軍功路-> 右轉木柵路四段-> 左轉秀明路經萬壽橋直行至萬壽路右轉
- 從羅斯福路（公館）
  羅斯福路四段向南走-> 左轉興隆路-> 左轉木柵路二段接秀明路過萬壽橋直行至萬壽路右轉

● 晚宴資訊

餐廳名稱: 深坑大團園景觀餐廳

餐廳地址: 新北市深坑區阿柔里阿柔洋 25-1 號

餐廳電話: (02)2662-5328

晚宴時間: 1/14(五) 18:00 開始

接駁車

- 於政大指南郵局前搭乘，17:40 發車。

開車

- 車行北二高至深坑交流道下，繼續直行約二～三分鐘即可看到大團園的招牌。餐廳附設停車場 P.S. 下交流道約一分鐘後有測速照相機，請各位注意慢行。
  交通提醒:
  假日前往大團園煩請直行文山路 (勿左彎)，於「106 Clubhouse」(右手邊) 紅綠燈，左轉進來即可到達！

國立政治大學山下校區地圖
NCCU Downhill-Campus Map

行政單位 Administrative Units

- A1 社會科學資料中心 Social Sciences Information Center
- A5 達賢圖書館 Dah Hsian Library
- A6 中正圖書館 Main Library
- A14 電子計算機中心 Computer Center
- A15 健康中心 Health Center
- A16 行政大樓 Administration Building
- A22 駐警隊 Security Office
- A22 收發室 Mail Services

教學單位 Education Buildings / Facilities

- B2 井塘樓 Jing Tang Building
- B4 學思樓 Xue Si Building
- B5 逸仙樓 Yi Xian Building
- B7 志希樓 Zhi Xi Building
- B8 果夫樓 Guo Fu Building
- B14 資訊大樓 Information Building
- B18 新聞館 Journalism Building
- B19 大智樓 Da Zhi Building
- B20 大仁樓 Da Ren Building
- B21 大勇樓 Da Yong Building
- B25 研究大樓 Research Building
- B26 商學院 College of Commerce
- B27 綜合院館 General Building of Colleges
- B50 附設實驗幼兒園 The Affiliated Experimental Elementary School Preschool of NCCU
- B56 附設實驗小學 The Affiliated Experimental Elementary School of NCCU
- B60 圖書暨會議大樓(國際關係研究中心) Library & Conference Building (Institute of International Relations, IIR)
- B79 蓄養樓(國際關係研究中心) Xu Yang Building (Institute of International Relations, IIR)
- B80 慎固樓(國際關係研究中心) Shen Gu Building (Institute of International Relations, IIR)
- B91 附設中學 The Affiliated High School of NCCU

宿舍 Residence Dormitories

- C61 莊敬一舍 Zhuang Jing Dormitory No.1
- C62 莊敬二舍 Zhuang Jing Dormitory No.2
- C63 莊敬三舍 Zhuang Jing Dormitory No.3
- C64 莊敬四舍 Zhuang Jing Dormitory No.4
- C65 莊敬五舍 Zhuang Jing Dormitory No.5
- C66 莊敬六舍、七舍、八舍 Zhuang Jing Dormitory No.6, 7 & 8
- C67 莊敬九舍 Zhuang Jing Dormitory No.9
- C83 玫苑 Mei Yuan Residence Hall
- C86 齊賢新村 Qi Xian Village
- C87 指南新村 Zhi Nan Village

服務空間 Services

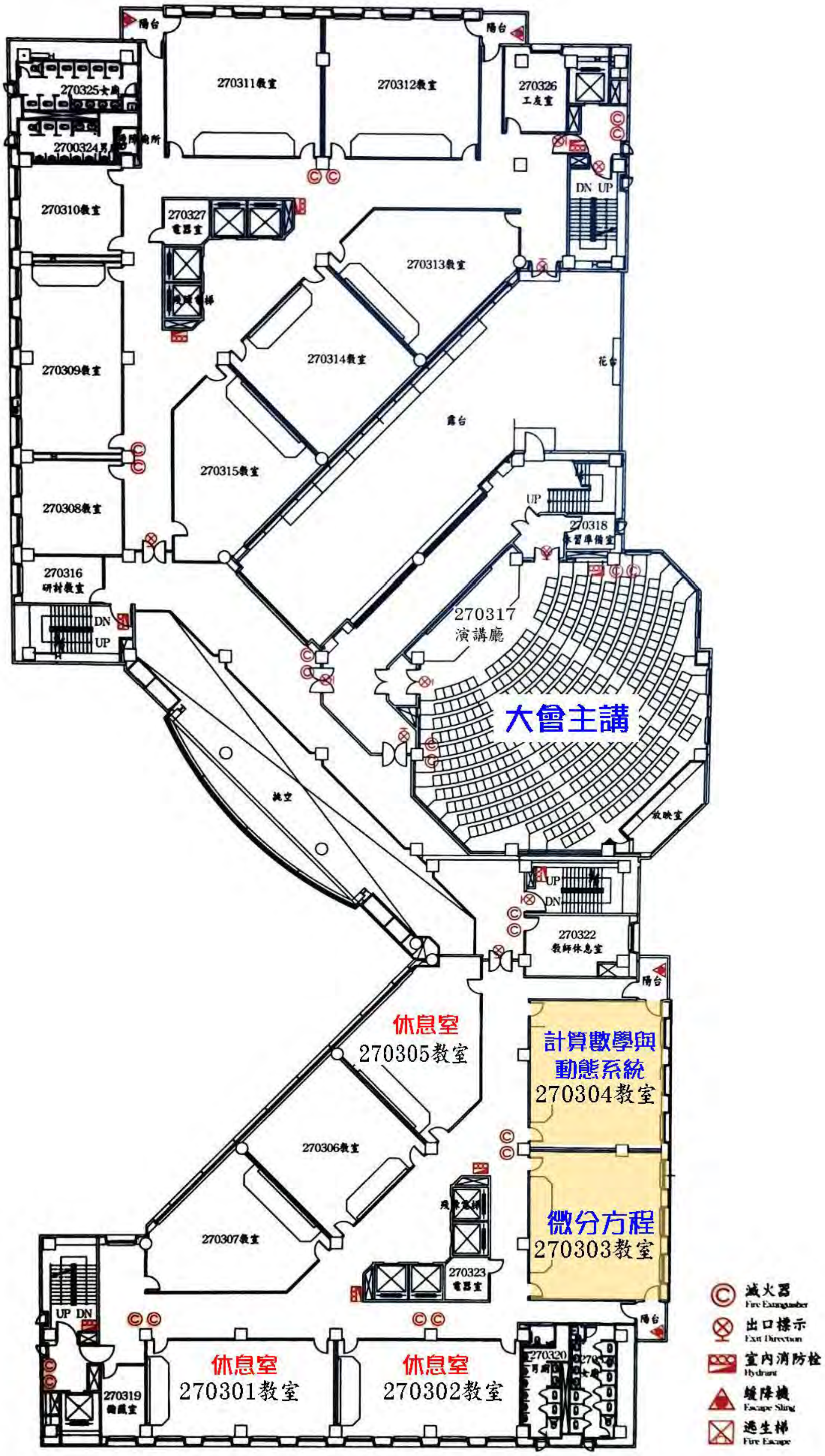
- D3 法學院預定地
- D9 校友服務中心 Alumni Center
- D10 風雩樓 Feng Yu Building
- D11 四維堂 Si Wei Hall
- D12 樂活館 Student Club Center
- D13 樂活小舖 Vivo Plaza
- D16 (A16) 水岸咖啡 Cafeteria
- D17 集英樓(福利社、書城) Ji Ying Building (Convenience Store, Book Store)
- D27 (B27) 中庭咖啡座 Outdoor Cafeteria

運動空間 Sports Facilities

- E1 田徑場 Track and Field Stadium
- E2 體育館 Gymnasium
- E3 四維網球場 Si Wei Tennis Court
- E4 游泳池 Swimming Pool
- E7 堤外籃球場 Riverbend Basketball Court
- E8 堤外棒球場 Riverbend Baseball Field

休憩景點 Attractions

- F1 景觀平台 Riverbend Viewing Platform
- F2 扇形廣場 Roman Square
- F3 八角亭 Ba Jiao Pavilion
- F4 李園 Plum Garden
- F5 四維道 Si Wei Boulevard
- F6 八德道 Ba De Avenue
- F7 風雨走廊 Covered Corridor
- F8 指南溪(醉夢溪) Zhi Nan Creek
- F9 古渡船頭 Historical Pier
- F10 渡賢橋 Du Xian Bridge
- F11 濟賢橋 Ji Xian Bridge


陽台
陽台
270311教室
270312教室
270326
工友室
270325女廁
270324男廁
270310教室
270327
電器室
270313教室
270314教室
270309教室
花台
露台
270315教室
270308教室
UP
270318
270316
研討教室
DN
UP
270317
演講廳
大會主講
挑空
放映室
UP
DN
270322
教師休息室
陽台
休息室
270305教室
計算數學與
動態系統
270304教室
270306教室
微分方程
270303教室
270307教室
270323
電器室
陽台
UP DN
休息室
270301教室
休息室
270302教室
270320
270319
滅火器
Fire Extinguisher
出口標示
Exit Direction
室內消防栓
Hydrant
緩降機
Escape Sling
逃生梯
Fire Escape

綜合院館三樓配置圖

主辦單位：國立政治大學應用數學系
連絡電話：02-29387046
年會網址：http://web.math.nccu.edu.tw/30awde