宁波东方理工大学
EASTERN INSTITUTE OF TECHNOLOGY, NINGBO

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Eastern Institute of Technolohy, Ningbo

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# 东方理工计算与应用数学研讨会
## EIT Frontier Workshop on Computational and Applied Mathematics
# 会议手册 Manual



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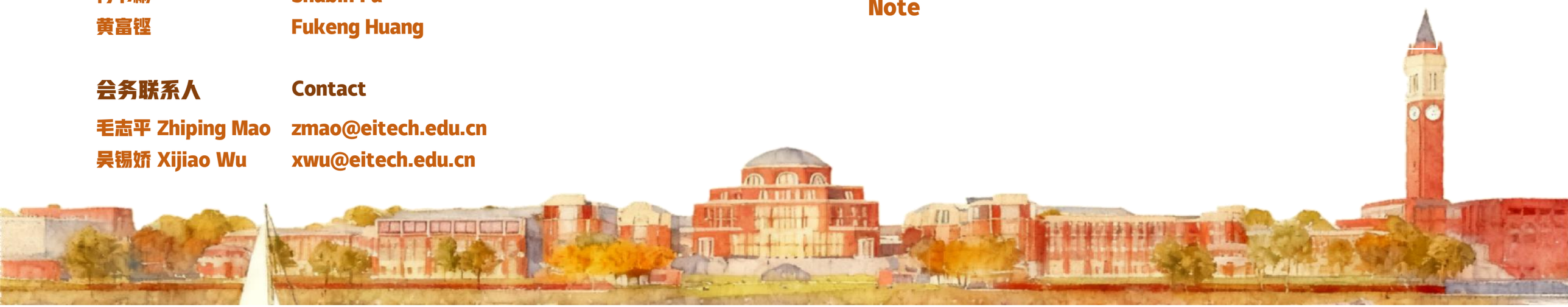
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| 会议当地组织者 | Organizing committee |
|---|---|
| 沈捷 | Jie Shen |
| 王晓明 | Xiaoming Wang |
| 陈敏 | Min Chen |
| 毛志平 | Zhiping Mao |
| 付书彬 | Shubin Fu |
| 黄富铿 | Fukeng Huang |

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# 宁波东方理工大学

## 学校介绍

宁波东方理工大学是一所由社会力量举办、国家重点支持、省市共同建设的高起点、小而精、研究型、国际化的新型研究型大学。

学校以服务国家发展、推动社会进步为使命，注重基础研究、突出前沿交叉、强化工程技术，形成以理学、工学、信息、商科为主，兼具特色人文社科的学科体系。

学校坚持志存高远、求真务实的培养理念，培养具有宽厚基础、创新能力、家国情怀、国际视野的拔尖创新人才。



## 学科定位

- 强化基础研究、聚焦前沿交叉、突出工程技术
- 形成以**理学、工学、信息、商科**为主，兼备特色人文社科的学科体系

| 理学 | 工学 |
| --- | --- |
| 数学、物理、化学、生命科学 | 先进制造、机器人、新材料、新能源、绿色化工、可持续发展等 |
| **信息** | **商科** |
| 人工智能、计算机、集成电路、自动化、电子信息等 | 金融科技、工商管理、大数据分析及应用等 |

## 办学规模

(至2035年)

| 10,000人 | 4:3:3 | 1450人 | 10 比 1 | 18个左右 | 10个左右 |
| --- | --- | --- | --- | --- | --- |
| 在校生规模 | 本硕博比例 | 专任教师总数 | 师生比 | 本科专业 | 博士生学位授予一级学科 |



# About EIT

Eastern Institute of Technology, Ningbo (EIT), with a high starting point, is poised to emerge as a new type of High-level, International, Research-oriented university initiated by social forces and highly supported by the governments of Zhejiang Province and Ningbo City, as well as other social forces. Chen Shiyi, a renowned educator and academician of the Chinese Academy of Sciences, serves as the Founding President of EIT.

EIT is committed to fostering social development through exceptional education, cutting-edge research, and a culture of innovation. At the heart of EIT’ s mission is the aspiration to advance economic and social progress of both the region and the nation. To achieve this, EIT emphasizes foundational and applied research, propelling advancements in engineering and technology, and highlighting interdisciplinary and impactful research in science, engineering, information technology and business management, supplemented by humanities and social sciences.

EIT aims to nurture innovative talents with ambitious aspirations and pragmatic mindsets, equipping them with a solid academic foundation, robust competencies, innovation skills, a sense of patriotism, and a global perspective.

## Our Mission

EIT aims to become a new type of international, high-level, innovative research university that puts emphasis on the cultivation of top-notch innovative STEM scholar and the synthesis of foundational and applied research. EIT applies itself to interdisciplinary research in cutting-edge fields, with a view to contributing to the economic and social development of both the region and the nation.



# 东方理工计算与应用数学研讨会
# About EIT Frontier Workshop on Computational and Applied Mathematics

为促进计算与应用数学各领域学者之间的交流与合作，拓展合作空间，宁波东方理工大学数学科学学院将于 2025 年 11 月 14 日至 11 月 16 日 在宁波举办“计算与应用数学前沿研讨会”。

本次研讨会将邀请约30名来自海内外知名学者参会。会议将围绕计算与应用数学领域的前沿研究开展深入探讨，重点聚焦偏微分方程理论、动力系统、人工智能、高阶数值方法以及数学与工程科学的交叉研究等国家战略需求与学科前沿方向。

This workshop will convene researchers in PDE theory, dynamical systems, scientific machine learning, high-order numerical methods to explore recent advances and tackle outstanding challenges.

## Attendees

**Claude-Michel BRAUNER**
University of Bordeaux, France & Tongji University, China

**蔡小川 Xiaochuan Cai**
University of Macau

**陈文斌 Wenbin Chen**
Fudan University

**陈艺冰 Yibing Chen**
Beijing Institute of Applied Physics and Computational Mathematics

**冯新龙 Xinlong Feng**
Xinjiang University

**胡光辉 Guanghui Hu**
University of Macau

**黄秋梅 Qiumei Huang**
Beijing University of Technology

**李步扬 Buyang Li**
The Hong Kong Polytechnic University

**李剑 Jian Li**
Shaanxi University of Science and Technology

**李进开 Jinkai Li**
South China Normal University

**李铁军 Tiejun Li**
Peking University

**廖洪林 Honglin Liao**
Nanjing University of Aeronautics and Astronautics

**刘建国 Jianguo Liu**
Duke University

**邱建贤 Jianxian Qiu**
Xiamen University

**屈长征 Changzheng Qu**
Ningbo University

**芮洪兴 Hongxing Rui**
Shandong University

**申仲伟 Zhongwei Shen**
Westlake University

**谭忠 Zhong Tan**
Xiamen University

**王术 Shu Wang**
Beijing University of Technology

**王筱平 Xiaoping Wang**
The Chinese University of Hong Kong, Shenzhen

**王亚光 YaGuang Wang**
Shanghai Jiao Tong University

**王中庆 Zhongqing Wang**
University of Shanghai for Science and Technology

**文再文 Zaiwen Wen**
Peking University

**吴勃英 Boying Wu**
Harbin Institute of Technology

**向淑晃 Shuhuang Xiang**
Central South University

**谢和虎 Hehu Xie**
Academy of Mathematics and Systems Science, CAS

**姚正安 Zheng-an Yao**
Sun Yat-sen University

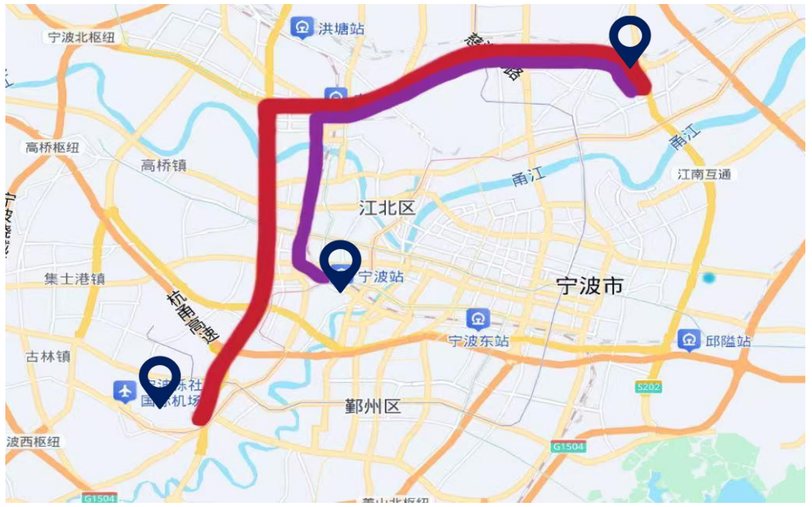
**张超 Chao Zhang**
Jiangsu Normal University

**张继伟 Jiwei Zhang**
Wuhan University

**TBA**
.....



# 路线图
# MAP




| | |
|---|---|
| **Line** | |
| **Route** | Airport - Hotel |
| **Distance** | About 33km |
| **Duration** | About 40min by taxi |

| | |
|---|---|
| **Line** | |
| **Route** | High speed railway station - Hotel |
| **Distance** | About 24km |
| **Duration** | About 30min by taxi |




| | |
|---|---|
| **Line** | |
| **Route** | Hotel-Tentative Campus |
| **Distance** | About 500m |
| **Duration** | About 7min on foot |

# 日程表
# SCHEDULE

## November 14th

**镇海开元名都酒店**
**Zhenhai Grand New Century Hotel, Ningbo**

| TIME | PROGRAM |
|---|---|
| 15:00-20:00 | Registration |
| 18:30 | Dinner 一楼院士厅 |

## November 15th

**过渡校区一号楼1楼MBA会议室**
**MBA Conf. Room, 1F, Building 1, EIT Tentative Campus**

| TIME | PROGRAM | SPEAKER | HOST |
|---|---|---|---|
| 08:45-09:00 | Opening Ceremony | 沈捷<br>Jie Shen | 王晓明<br>Xiaoming Wang |
| 09:00-09:30 | Analysis of the adhesion model and the reconstruction problem in cosmology | 刘建国<br>Jianguo Liu | 沈捷<br>Jie Shen |
| 09:30-10:00 | An energy-stable minimal deformation rate scheme for mean curvature flow and surface diffusion | 李步扬<br>Buyang Li | 王中庆<br>Zhongqing Wang |
| 10:00-10:25 | 合照 Group Photo + 茶歇 Nutrition Break | | |
| 10:25-10:55 | Learning stochastic dynamics from snapshots through regularized unbalanced optimal transport | 李铁军<br>Tiejun Li | 王筱平<br>Xiaoping Wang |
| 10:55-11:25 | 面向材料断裂模拟的新型有限元算法及其高性能计算 | 张继伟<br>Jiwei Zhang | 芮洪兴<br>Hongxing Rui |
| 11:25-11:55 | Equivalence of L2- and discrete l2-norms on Q1-FE spaces in any finite dimension and applications | 冯新龙<br>Xinlong Feng | 张超<br>Chao Zhang |
| 11:55-13:30 | 午餐 Lunch | | |



## November 15th

**过渡校区二号楼**
**Building 2, EIT Tentative Campus**

| TIME | PROGRAM | SPEAKER | HOST |
|---|---|---|---|
| | **Parallel Section-Numerics** | **7楼会议室<br>Conf. Room, 7F** | |
| 13:30-14:00 | ODE-based Learning to Optimize | 文再文<br>Zaiwen Wen | Claude-Michel<br>BRAUNER |
| 14:00-14:30 | 时空一致高精度格式的若干进展 | 陈艺冰<br>Yibing Chen | 邱建贤<br>Jianxian Qiu |
| 14:30-15:00 | A class of refined implicit-explicit Runge-Kutta methods with robust time adaptability for the Cahn-Hilliard model | 廖洪林<br>Honglin Liao | 陈文斌<br>Wenbin Chen |
| | **Parallel Section-PDE Analysis** | **6楼会议室<br>Conf. Room, 6F** | |
| 13:30-14:00 | Resolvent Estimates for the Stokes Operator | 申仲伟<br>Zhongwei Shen | 王晓明<br>Xiaoming Wang |
| 14:00-14:30 | TBA | | 谭忠<br>Zhong Tan |
| 14:30-15:00 | Global well-posedness of the inviscid resistive isentropic compressible MHD system | 李进开<br>Jinkai Li | 姚正安<br>Zheng-an Yao |
| 15:35-18:00 | TBA | | |
| 18:30 | 晚宴 Dinner | | |

# 日程表
# SCHEDULE

## November 16th

永久校区 EIT Campus　　主持人：黄富锂 Host: Fukeng Huang

| TIME | PROGRAM | SPEAKER | HOST |
|---|---|---|---|
| 08:45-09:15 | Modeling blood flows in the human cardiovascular system | 蔡小川 Xiaochuan Cai | 胡光辉 Guanghui Hu |
| 09:15-09:45 | Wellposedness and regularization-by-noise for the stochastic Prandtl equation | 王亚光 Yaguang Wang | 陈敏 Min Chen |
| 09:45-10:15 | Error estimate of the fully decoupled ZEC method to the Cahn-Hilliard phase field model for two-phase incompressible flows | 黄秋梅 Qiumei Huang | 王术 Shu Wang |
| 10:15-10:35 | 茶歇 Nutrition Break | | |
| 10:35-11:05 | 张量神经网络及其应用 | 谢和虎 Hehu Xie | 吴勃英 Boying Wu |
| 11:05-11:35 | 参数依赖相场的两相铁磁/磁流体流动模型高效有限元方法研究 | 李剑 Jian Li | 向淑晃 Shuhuang Xiang |
| 11:35-14:00 | 午餐 Lunch | | |
| 14:00-18:00 | 自由讨论 Discussion | | |
| 18:30 | 晚餐 Dinner | | |



# 报告题目及摘要
# KEYNOTE SPEECH

**刘建国**
**Jianguo Liu**
Duke University

## Analysis of the adhesion model and the reconstruction problem in cosmology

In cosmology, a basic explanation of the observed concentration of mass in singular structures is provided by the Zeldovich approximation, which takes the form of free-streaming flowfor perturbations of a uniform Einstein-de Sitter universe in co-moving coordinates. The adhesion model suppresses multi-streaming by introducing viscosity. We study mass flow in this model by analysis of Lagrangian advection in the zero-viscosity limit. Under mild conditions, we show that a unique limiting. Lagrangian semi-flow exists. Limiting particle paths stick together after collision and are characterized uniquely by a differential inclusion. The absolutely continuous part of the mass measure agrees with that of a Monge-Ampère measure arising by convexification of the free-streaming velocity potential. But the singular parts of these measures can differ when flows along singular structures merge, as shown by analysis of a 2D Riemann problem. The use of Monge-Ampère measures and optimal transport theory for the reconstruction of inverse Lagrangian maps in cosmology was introduced in work of Brenier & Frisch. In a neighborhood of merging singular structures in our examples, however, we show that reconstruction yielding a monotone Lagrangian map cannot be exact a.e., even off of the singularities themselves. This is a joint work with Bob Pego of CMU.

**Bio:** Jian-Guo Liu is a Professor of Mathematics and Physics at Duke University. He earned his bachelor’s and master’s degrees in mathematics from Fudan University in China and his Ph.D. from the University of California, Los Angeles. His research focuses on partial differential equations, kinetic theory, numerical analysis, and the mathematical modeling of complex systems such as non-equilibrium chemical reactions and self-organization. He is also a Fellow of the American Mathematical Society.



**李步扬**
**Buyang Li**
The Hong Kong Polytechnic University

## An energy-stable minimal deformation rate scheme for mean curvature flow and surface diffusion

We propose a new parametric finite element method, referred to as the BGN-MDR method, for simulating both mean curvature flow and surface diffusion for closed hypersurfaces, as well as open hypersurfaces with moving contact lines in three dimensions. The method is also applicable to closed and open curves with moving contact points in two dimensions. The proposed scheme inherits the energy stability from the BGN scheme proposed by Barrett, Garcke, and Nürnberg in 2008, and offers improved mesh quality similar to the minimal deformation rate (MDR) method proposed by Hu and Li in 2022, especially for small time step sizes where the BGN scheme may become unstable and result in deteriorated meshes.

**Bio:** 李步扬于2012年于香港城市大学获得博士学位，先后在南京大学、德国图宾根大学、香港理工大学从事教学和研究工作，现为香港理工大学应用数学系教授。主要研究领域为偏微分方程的科学计算和数值分析。

**李铁军**
**Tiejun Li**
Peking University

## Learning stochastic dynamics from snapshots through regularized unbalanced optimal transport

Reconstructing dynamics using samples from sparsely time-resolved snapshots is an important problem in both natural sciences and machine learning. Here, we introduce a new deep learning approach for solving regularized unbalanced optimal transport (RUOT) and inferring continuous unbalanced stochastic dynamics from observed snapshots. Based on the RUOT form, our method models these dynamics without requiring prior knowledge of growth and death processes or additional information, allowing them to be learned directly from data. The effectiveness of our method is demonstrated with a synthetic gene regulatory network, high-dimensional Gaussian Mixture Model, and single-cell RNA-seq data from blood development. This is a joint work with Peijie Zhou and Zhenyi Zhang.

**Bio:** 北京大学数学科学学院教授，北京大学数学科学学院信息与计算科学系主任，北京大学大数据科学研究中心副主任。国家自然科学基金委优秀青年及杰出青年基金获得者，入选教育部“新世纪优秀人才”支持计划。研究领域为随机模型及算法、数据科学的理论及应用。在化学反应随机动力学稀有事件、能量景观、tau-leaping方法的分析；复杂网络的模型约化；复杂流体多尺度理论及数值分析方面做出了重要成果

**张继伟**
**Jiwei Zhang**
Wuhan University

## 面向材料断裂模拟的新型有限元算法及其高性能计算

非局部模型是基于非局部效应建立起来的数学物理模型，其中一个典型的范例是近场动力学，一直是计算数学领域研究的重要研究方向。全三维非局部模型的有限元实现涉及高维积分、巨大的计算量和存储量，因此在算法设计、网格生成、数据结构优化、面向CPU和GPU并行平台的算法架构等诸多方面都提出了巨大的计算挑战。本报告将简单介绍我们在近场动力学的基于切球策略的有限元高精度算法及其高性能实现等方面所做的努力和尝试，并将这些高性能有限元算法应用到基于近场动力学的材料断裂模拟。

**Bio:** 武汉大学数学与统计学院教授，博士生导师。2003和2006年在郑州大学获得学士和硕士学位，2009年在香港浸会大学获得博士学位，随后在南洋理工大学和纽约大学克朗所从事博士后研究，2014年5月在北京计算科学研究中心工作，2018年11月到武汉大学工作。主要研究领域包括偏微分方程和非局部模型的数值解法，以及神经科学的建模与计算，得到了面上等项目的支持，在包括SINUM，SISC，MCOM，JCNS等国际知名期刊上发表多篇学术论文。

**冯新龙**
**Xinlong Feng**
Xinjiang University

## Equivalence of L2- and discrete l2-norms on Q1-FE spaces in any finite dimension and applications

In this work, we primarily focus on  Q1 finite element spaces in any finite dimension, equipped with the discrete \ell_h^2 inner product induced by the simple row-sum mass lumping. We establish the uniform (with respect to the mesh size h) equivalence between the discrete \ell_h^2 norm and  L2 norm on these spaces, for both uniform and nonuniform meshes. Our main contribution is the derivation of sharp bounds for the equivalence between these two norms. Numerical examples demonstrate that these bounds are indeed sharp. Furthermore, we establish the equivalence between the discrete h_h^1 norm and the continuous H1 norm, along with corresponding numerical results. As an application, we also provide the equivalence between discrete and continuous norms in the context of error estimates for central finite difference solutions on polygonal domains.

**Bio:** 博士，二级教授，博士生导师。研究领域为计算数学、计算流体力学、不确定性量化、人工智能与机器学习等。主持完成多项国家自然科学基金项目，在SIAM、IEEE国际著名期刊合作发表学术论文百余篇。

**文再文**
**Wenzai Wen**
Peking University

## ODE-based Learning to Optimize

In recent years, ordinary differential equation (ODE) has become a promising starting point to understand the nature of acceleration methods. However, there still exits gap between ODE and optimization methods. In this talk, we introduce the idea behind learn to optimize and optimization-inspired ODE and try to provide a framework that automatically looks for efficient problem-orientational optimization methods with a guarantee of worst-case convergence.



**陈艺冰**
**Yibing Chen**
Beijing Institute of Applied Physics and Computational Mathematics

## 时空一致高精度格式的若干进展

如何设计健壮高效的高精度格式是当今计算流体力学领域最具挑战性的问题之一。 在E级计算时代，基于Lax-Wendroff思想的时空一致高精度格式展示了其潜在的优势。本报告重点回顾时空一致高精度算法的基本框架，并介绍其最新研究进展。

**Bio:** 北京应用物理与计算数学研究所研究员，全国重点实验室副主任，国家重点研发计划项目首席，入选国家高层次人才计划。长期从事极端条件下多介质流体力学算法研究、多物理耦合数值模拟软件研制工作，主持研制具有完全自主产权的极端条件下三维多物理多介质数值模拟软件；曾获军队科技进步一等奖等奖项

**廖洪林**
**Honglin Liao**
Nanjing University of Aeronautics and Astronautics

## A class of refined implicit-explicit Runge-Kutta methods with robust time adaptability for the Cahn-Hilliard model

One of main obstacles in verifying the energy dissipation laws of implicit-explicit Runge-Kutta (IERK) methods for phase field equations is to establish the uniform boundedness of stage solutions without the global Lipschitz continuity assumption of nonlinear bulk. With the help of discrete orthogonal convolution kernels, an updated time-space splitting technique is developed to establish the uniform boundedness of stage solutions for a refined class of IERK methods in which the associated differentiation matrices and the average dissipation rates are always independent of the time-space discretization meshes. This makes the refined IERK methods highly advantageous in self-adaptive time-stepping procedures as some larger adaptive step-sizes in actual simulations become possible. From the perspective of optimizing the average dissipation rate, we construct some parameterized refined IERK methods up to third-order accuracy, in which the involved diagonally implicit Runge-Kutta methods for the implicit part have an explicit first stage and allow a stage-order of two such that they are not necessarily algebraically stable. Then we are able to establish, for the first time, the original energy dissipation law and the unconditional $L^2$ norm convergence. Extensive numerical tests are presented to support our theory.

**Bio:** 应用数学博士，2018年至今任教于南京航空航天大学数学学院。2001年在原解放军理工大学获理学硕士学位，2010年在东南大学获理学博士学位，2001-2017年任教于原解放军理工大学。学术研究方向为微分方程数值解，目前主要关注相场方程，不可压流体以及多相流模型的时间变步长离散与自适应算法, 基于离散正交卷积核、离散互补卷积核等离散工具、在非均匀以及高阶时间离散格式方面形成了一套独具特色的算法设计与理论分析方法；在Math Comp，SIAM J Numer Anal, SIAM J Sci Comput，J Comput Phys, IMA J Numer Anal，Sci China Math等国内外专业期刊上发表学术研究论文六十余篇。

**申仲伟**
**Zhongwei Shen**

Westlake University

## Resolvent Estimates for the Stokes Operator

This talk is concerned with the study of resolvent estimates and the analyticity of the semigroup in $L^p$ for the Stokes operator. In the case of smooth domains ($C^2$), the resolvent estimates are known to hold for all $1< p\le \infty$. If the domain is Lipschitz, the estimates were established for a limited range of p, depending on the dimension, using the method of layer potentials and a real-variable argument. In this talk, I will present some recent work, joint with Jun Geng, for the case of $C^1$ domains. In particular, I will discuss a key step in the case $p=\infty$, which involves some new estimates that connect the pressure to the gradient of the velocity in the $L^q$ average, but only on scales above certain level.

**Bio:** Zhongwei Shen received his B.S. in mathematics from Peking University, M.S. from the Institute of Mathematics of the Chinese Academy of Sciences, and his Ph.D. from the University of Chicago. He jointed the faculty at the University of Kentucky in 1995, where he was promoted to professor in 2003 and served as chair of the Mathematics Department from 2007 to 2011. Since July 2025, he has been a Chair Professor of Mathematics in the Institute for Theoretical Sciences at the Westlake University.

**李进开**
**Jinkai Li**

South China Normal University

## Global well-posedness of the inviscid resistive isentropic compressible MHD system

Due to the absence of dissipation mechanism to the inviscid compressible systems, it is a challenging problem to prove their global solvability. In this talk, we are concerned with the initial-boundary value problem to the inviscid and resistive isentropic compressible magnetohydrodynamic (MHD) system on three dimensional torus $\mathbb T^3$. Global well-posedness and large time behavior of solutions are established for the isentropic setting, under the condition that the initial data $(\rho_0, u_0, H_0)$ is a small perturbation around the constant state $(1, 0, w)$, with $w$ satisfying the Diophantine condition. The main observation is that the spatial derivatives of the density along directions perpendicular to $w$ are dissipated. Such dissipation mechanism is generated from the interaction between the velocity field and the background magnetic field. This verifies the weak stabilizing effects of the magnetic filed on the dynamics in the scenario of inviscid isentropic flows. Due to different dissipation mechanisms for the density, velocity, and magnetic field, three ties of dissipative energies are designed, that is, high order Sobolev norms of the perturbed magnetic field, intermediate order Sobolev norms of the perturbed density, and low order Sobolev norms of the velocity field.



**蔡小川**
**Xiaochuan Cai**

University of Macau

## Modeling blood flows in the human cardiovascular system

The recent development of supercomputing technologies has enabled the development of some fast methods for solving the incompressible Navier-Stokes equations to model blood flows in the human cardiovascular system with clinical accuracy. Such computational methods offer a new generation of techniques to predict the health of the cardiovascular system and help the diagnosis of certain diseases such as high blood pressure, and heart attack. These high-fidelity full-body numerical computations also provide insights into the optimal or sub-optimal states of the health of the human cardiovascular system and suggest ways to improve and maintain a healthy lifestyle.

**Bio:** Xiao-Chuan Cai received his BSc degree in 1984 from Peking University, MSc in 1988 and PhD in 1989 from Courant Institute, New York University. After about 30 years in the Department of Computer Science, University of Colorado Boulder, he recently jointed the Department of Mathematics, University of Macau, as a Chair Professor. He is a fellow of SIAM.

**王亚光**
**Yaguang Wang**

Shanghai Jiao Tong University

## Well-posedness and regularization-by-noise for the stochastic Prandtl equation

In this talk, we study the local and global existence of analytic/Gevrey solutions to the stochastic Prandtl equation in two and three dimensions, from which we observe the regularization effect of the noise. This is a joint work with Meng Zhao.

**黄秋梅**
**Qiumei Huang**

Beijing University of Technology

## Error estimate of the fully decoupled ZEC method to the Cahn-Hilliard phase field model for two-phase incompressible flows

In the construction of high-order unconditionally energy stable numerical schemes for Cahn-Hilliard-Navier-Stokes model, the computational complexity arising from nonlinear coupling terms presents a significant challenge. To overcome this challenge, we reformulate the original model into an equivalent one and propose a fully decoupled, linear, Crank-Nicolson scheme. The unconditional energy stability of the proposed method is proved by the zero energy contribution property and the error estimate of the scheme is obtained by mathematical induction, which provide a framework for discretization schemes in coupled models. Some numerical experiments are performed to verify the efficiency of the considered scheme.

**Bio:** 教授，博士生导师，北京工业大学数学统计学与力学学院院长。现任中国数学会理事、中国工业与应用数学学会谱方法专委会委员、北京计算数学学会常务理事等。发表SCI论文50余篇，主持国家自然科学基金5项，主持北京自然科学基金重点项目课题、北京自然科学基金面上项目等，入选北京市科技新星计划、北京市教委青年拔尖人才计划，获贵州省科技进步二等奖、第五届北京高校青年教学名师奖、第五届全国高校教师教学创新大赛二等奖等。

谢和虎
Hehu Xie
Academy of Mathematics and Systems Science, CAS

## 张量神经网络及其应用

本报告介绍一种张量型的神经网络结构，这种神经网络最重要的一个特点是可以将高维神经网络函数的积分转化成一维函数的积分，进而可以设计出高精度的高维积分方法，并且计算量是维数的多项式量级。接下来，我们利用张量神经网络可进行高精度高维积分的特点设计了求解高维问题的高精度机器学习算法，并将之应用于一些高维偏微分方程的求解。这里将关注高维的边值问题和特征值问题。报告的目的是展示机器学习求解高维问题同样可以得到高精度，为大家带来更多的视角。

**Bio:** 中国科学院数学与系统科学研究院研究员，2003 年本科毕业于北京大学数学科学学院，2008 年在中国科学院数学与系统科学研究院获博士学位，同年在中国科学院数学与系统科学研究院开始工作，2009 年至 2010 年在德国马格德堡大学从事博士后工作。
主要研究特征值问题高效数值算法、理论及计算软件开发，高维偏微分方程数值解，非线性偏微分方程数值算法等。提出了求解特征值问题的多水平校正和扩展子空间算法，开发了相应的软件包 PASE；设计了求解代数特征值问题的广义共轭梯度算法和相应的软件包 GCGE，并成功应用于国防研究；提出了求解高维问题的张量神经网络及其相应的机器学习算法，该算法获得了2023年大湾区AI4Science竞赛的特等奖。目前担任北京计算数学学会副理事长、常务理事。

李剑
Jian Li
Shaanxi University of Science and Technology

## 参数依赖相场的两相铁磁/磁流体流动模型高效有限元方法研究

主要针对带有磁场方程控制的两相铁磁/电磁流体问题的相场依赖的密度和粘度（大密度比问题）等难点问题，构造高效数值格式并分析能量耗散性，同时给出一些大密度比的数值模拟。

**Bio:** 陕西科技大学数学与数据科学学院教授、博士生导师。先后获批享受国务院政府特殊津贴、教育部新世纪优秀人才、全国优秀教师等荣誉。主要从事偏微分方程高效数值方法研究、新能源问题可计算建模和流体计算人工智能方法研究。在计算数学期刊 Numerische Mathematik, SIAM Journal on Numerical Analysis 等发表 SCI 论文多篇，在 Springer 出版社、科学出版社出版中英文专著/教材4 部。与加拿大 AICISE 中心合作稠油开采报告 3 篇。作为项目负责人先后完成了教育部新世纪优秀人才支持计划项目、国家自然科学基金等项目；科研成果获陕西省自然科学奖一等奖和陕西省自然科学奖二等奖各 1 项；获得陕西省教学成果二等奖。



# 笔记
# NOTE


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