天元數學國際交流中心
Tianyuan Mathematics Research Center

TY-2026-C-050

偏微分方程的理论与计算研讨会

Workshop on Theory & Computation of PDEs

会议手册

Conference Program



2026年10月25日–31日

October 25–31, 2026

中国·昆明　Kunming, China

召集人 / Organizers

杨汉春　Hanchun Yang

云南大学　Yunnan University

包维柱　Weizhu Bao

新加坡国立大学　National University of Singapore

中心简介　/　会议信息　/　会议日程　/　报告题目及摘要

天元数学国际交流中心简介

About Tianyuan Mathematics Research Center

天元数学国际交流中心（以下简称“中心”）成立于2023年7月，由中国科学院、国家自然科学基金委员会、中国数学会、中国科学院数学与系统科学研究院，以及昆明市有关部门共同支持建设的数学与交叉科学交流机构。旨在搭建数学及其跨学科应用领域的学术交流平台，提升我国数学整体研究水平，成为国际一流的数学交流与合作研究中心。

中心位于昆明市宜良县柴石滩水库库区，三面环山、一面临水，环境优美，海拔约1700米。距长水国际机场约90公里（车程约1.5小时），距石林风景区约30公里，距九乡风景区约20公里。

中心总建筑面积约6000平方米，设有大报告厅（可容纳100人，配备高清LED屏）、中型会议室1间、小型会议室4间、研讨/工作室21间、图书阅览室1间、咖啡厅1间。专家楼配有56间宿舍及自助洗衣房、公共休息区等配套设施。

中心官方网站：`http://tianyuan.amss.ac.cn/`

Introduction to Tianyuan Mathematics Research Center

The Tianyuan Mathematics Research Center (established in July 2023) is jointly supported by the Chinese Academy of Sciences, the National Natural Science Foundation of China, the Chinese Mathematical Society, the Academy of Mathematics and Systems Science of the Chinese Academy of Sciences, and relevant departments of Kunming City. It aims to build a platform for academic exchange in mathematics and interdisciplinary applications, enhance China’s overall mathematical research level, and become a world-class center for mathematical exchange and collaborative research.

It is located in the national-level public welfare forest in the Chaishitan Reservoir area of Yiliang, Kunming, Yunnan Province, surrounded by mountains on three sides and facing water on one side. The center has a total land area of about 27,000 square meters, with three two-story main buildings, namely the Research Building, the Expert Building and the Logistics Building, which can accommodate nearly 200 people for academic activities, and are equipped with a library and reading room, a restaurant and a certain number of offices and guest rooms.

The center has a total construction area of approximately 6,000 square meters. It features a main lecture hall (capacity: 100 people, equipped with an HD LED screen), one medium-sized seminar room, four small meeting rooms, 21 seminar/workshop rooms, one library and reading room, and one café. The Expert Building is equipped with 56 guest rooms, as well as supporting facilities such as a self-service laundry room and a public lounge.

Official website: `http://tianyuan.amss.ac.cn/`

会议信息

Conference Information

一、研讨主题、内容及意义

本次研讨会围绕“偏微分方程的理论与计算”这一主题，聚焦非线性波与界面演化、多尺度动力学及复杂流动的高效模拟，交流数学模型、解的结构与适定性、数值方法设计和误差分析等方面的研究进展，促进理论研究与科学计算的相互启发。主要研讨内容包括：

（1）双曲守恒律与多维黎曼问题。从标量守恒律到可压缩Euler方程及其简化模型，研讨一维与二维黎曼问题中激波、稀疏波和接触间断的相互作用及解的结构，重点交流广义特征分析、激波正规反射与四激波相交等问题的研究进展，以及解析构造与数值验证相结合的方法。

（2）非线性色散方程与多尺度计算。围绕非线性薛定谔/Gross–Pitaevskii、Klein–Gordon和薛定谔–Poisson方程，交流时间分裂谱方法、指数波积分器、多尺度时间积分与高阶WKB方法，重点讨论半经典和非相对论极限中的高振荡、长时间模拟与误差控制，以及低正则势和空间白噪声势下算法的稳定性与收敛性。

（3）自由边界、接触线与几何演化。研讨含固定物体的二维浮体问题的适定性、弹性薄片上的接触线运动、毛细折叠与薄膜动力学，研究界面演化、固体变形和润湿行为的耦合机制；交流平均曲率流和几何流的高阶参数有限元方法，关注收敛性、网格质量、能量稳定性以及面积或体积保持等问题。

（4）动理学与复杂流动的高效高精度算法。围绕经典与量子Boltzmann方程以及可压缩Navier–Stokes方程，研讨快速傅里叶谱算法、加速迭代、高精度WENO格式和高效时间推进方法，关注碰撞算子的高效计算、近连续流区的迭代收敛、激波捕捉与光滑区域精度之间的协调，以及复杂流场数值模拟的稳定性和计算效率。

（5）气动热、气动弹性与数据驱动建模。面向高超声速气动热预测、流态辨识与飞行器气动弹性仿真，交流基于方程约化的降维建模、物理方程与数据拟合相结合的预测方法、热流信号的特征提取与聚类，以及气动与结构紧耦合的数值方法，探讨数学模型、高精度算法与实验和工程应用之间的相互促进。

研讨意义。会议旨在促进双曲守恒律、色散方程、几何流、动理学与计算流体力学等方向的深入交流，推动理论分析、保结构算法、多尺度计算和数据驱动方法的交叉融合，为理解复杂流动与界面现象、提高数值模拟的可靠性和效率提供新的思路。通过专题报告与充分讨论，凝练新的研究问题和合作方向，为青年学者学习前沿理论与方法提供交流平台。

二、活动日程

报到	2026年10月25日
报告	2026年10月26日至10月30日
离会	2026年10月31日
地点	天元数学国际交流中心（云南省昆明市宜良县柴石滩水库）

三、相关事项

1. 本次研讨会得到天元数学国际交流中心资助，参会人员的住宿及餐饮由中心承担，其余费用（含往返交通费）由参会人员自理。
2. 中心统一安排往返昆明高铁站/长水机场及昆明市区的接送服务。请及时登录项目管理系统（`http://tianyuanpm.amss.ac.cn/`）登记行程信息。
3. 中心距离医院较远，建议访客随身携带一些必备药品。

会议联系人

程红军	云南大学	13608882540
王钦	云南大学	18788515727

会议日程（Schedule）

10 月 25 日（星期日）			
报道（Registration）			
10 月 26 日（星期一）			
8:30—8:50	开幕式		
时间 Time	报告人 Speaker	题目 Title of talk	主持人 Chair
8:50—10:00	Bao Weizhu	Computational methods for the dynamics of the nonlinear Schroedinger/Gross-Pitaevskii equations	杨汉春
10:00—10:10	茶歇（Coffee Break）		
10:10—10:55	明梅	Well-posedness of 2D F. John's floating body problem with fixed objects	汪球
10:55—11:40	Tang Rong	A convergent minimal-deformation-rate method for mean curvature flow	
11:40—14:00	午餐（Lunch Break）		
14:00-16:00	讨论交流	Finite element method for geometric PDEs and applications	Bao Weizhu
16:00-18:00	讨论交流	Two-Dimensional Riemann Problem for the Euler equations	杨汉春
18:00—19:00	晚餐（Dinner Break）		

10月27日 （星期二）			
时间 Time	报告人 Speaker	题目 Title of talk	主持人 Chair
8:30—9:30	Weiqing Ren	Contact line dynamics on elastic sheets	申义庆
9:30—10:30	Cai Zhenning	Fast spectral methods and accelerated iterations for the boltzmann equation	
10:30—10:40	茶歇（Coffee Break）		
10:40—11:25	汪球	方程约化与数据驱动：高超声速气动热的两类降维问题	Weiqing Ren
11:25—12:10	Zhang Zhuohan	Error Estimate of an Exponential Wave Integrator for the Nonlinear Schrodinger Equation with Spatial White Noise Potential	
11:40—14:00	午餐（Lunch Break）		
14:00-16:00	讨论交流	Water waves problems	明梅
16:00-18:00	讨论交流	Two-Dimensional Riemann Problem for the Euler equations	杨汉春
18:00—19:00	晚餐（Dinner Break）		

10月28日 （星期三）			
时间 Time	报告人 Speaker	题目 Title of talk	主持人 Chair
8:30—10:00	Bao Weizhu	Multiscale methods and analysis for the highly oscillatory nonlinear Klein-Gordon equation	杨汉春
10:00—10:10	茶歇（Coffee Break）		
10:10—10:55	申义庆	可压缩复杂流场的高效高精度数值算法及应用	Cai Zhenning
10:55—11:40	Wang Dongmin	Arbitrarily high-order structure-preserving parametric finite element methods for geometric flows	
11:40—14:00	午餐（Lunch Break）		
14:00-16:00	讨论交流	High-precision weighted basic oscillation-free scheme	申义庆
16:00-18:00	讨论交流	Measure solutions in conservation laws	程红军
18:00—19:00	晚餐（Dinner Break）		

10月29日（星期四）			
时间 Time	报告人 Speaker	题目 Title of talk	主持人 Chair
8:30—10:00	盛万成	Two-dimensional Riemann problem: from scalar conservation laws to compressible Euler equations	杨汉春
10:00—10:10	茶歇（Coffee Break）		
10:10—10:55	王汉权	A higher-order WKB-based Fourier spectral method for Schrodinger-Poisson equation in the semi-classical limit	郑冠男
10:55—11:40	王钦	Shock theory for Riemann problems of fluid mechanics equations	
11:40—14:00	午餐（Lunch Break）		
14:00-16:00	讨论交流	Conjectures of 2D Riemman solutions for the Euler equations	盛万成
16:00-18:00	讨论交流	Shock reflection problems in gas dynamics	王钦
18:0—19:00	晚餐（Dinner Break）		

10月30日 （星期五）			
时间 Time	报告人 Speaker	题目 Title of talk	主持人 Chair
8:30—10:00	盛万成	Two-dimensional Riemann problem: from scalar conservation laws to compressible Euler equations	杨汉春
10:0—10:10	茶歇（Coffee Break）		
10:10—10:55	郑冠男	飞行器气动弹性数值仿真研究进展	申义庆
10:55—11:40	程红军	Two-dimennsional Riemann problems for hyperbolic conservation laws	
11:40—14:00	午餐（Lunch Break）		
14:00-16:00	讨论交流	Related topics on the Euler equations	杨汉春
16:00-18:00	讨论交流	针对欧拉方程及其相关模型的理论和数值计算方法等研究兴趣，分组讨论	王钦
18:00—19:00	晚餐（Dinner Break）		
10月31日 （星期六）			
离会（Departure）			

报告题目及摘要

Titles and Abstracts

Computational methods for the dynamics of the nonlinear Schroedinger/Gross-Pitaevskii equations

Bao Weizhu
National University of Singapore

Abstract. In this talk, I begin with the (nonlinear) Schroedinger/Gross-Pitaevskii equations (NLSE/GPE) for modeling Bose-Einstein condensation (BEC), nonlinear optics, quantum physics and chemistry, etc., and review some dynamical properties of NLSE/GPE including conserved quantities, dispersion relation, center-of-mass dynamics, soliton solutions and semiclassical limits. Different numerical methods will be presented including finite difference time domain (FDTD) methods and time-splitting spectral (TSSP) method, and their error estimates and comparison will be discussed. Extensions to NLSE/GPE with an angular momentum rotation term, non-local dipole-dipole interaction, multi-component and logarithmic nonlinearity will be presented. Applications to soliton interactions, collapse and explosion of BEC, quantum transport and quantized vortex interaction will be investigated. Finally, I report our very recent results of energy regularization methods for NLSE with logarithmic nonlinearity and improved uniform error bounds on TSSP for the long-time dynamics of NLSE by using the regularization compensation oscillatory (RCO) technique as well as error estimates on numerical methods for NLSE with low regularity potential and nonlinearity.

Multiscale methods and analysis for the highly oscillatory nonlinear Klein-Gordon equation

Bao Weizhu
National University of Singapore

Abstract. In this talk, I will review our recent works on numerical methods and analysis for solving the highly oscillatory nonlinear Klein-Gordon equation (NKGE) including the nonrelativistic regime, involving a small dimensionless parameter which is inversely proportional to the speed of light. In this regime, the solution is highly oscillating in time and the energy becomes unbounded, which bring significant difficulty in analysis and heavy burden in numerical computation. We begin with four frequently used finite difference time domain (FDTD) methods and obtain their rigorous error estimates in the nonrelativistic regime by paying particularly attention to how error bounds depend explicitly on mesh size and time step as well as the small parameter. Then we consider a numerical method by using spectral method for spatial derivatives combined with an exponential wave integrator (EWI) in the Gautschi-type for temporal derivatives to discretize the NKGE. Rigorous error estimates show that the EWI spectral method show much better temporal resolution than the FDTD methods for the NKGE in the nonrelativistic regime. In order to design a multiscale method for the NKGE, we establish error estimates of FDTD and EWI spectral methods for the nonlinear Schroedinger equation perturbed with a wave operator. Based on a large-small amplitude wave decomposition to the solution of the NKGE, a multiscale time integrator (MTI) is presented for discretizing the NKGE in the nonrelativistic regime. Rigorous error estimates show that this multiscale method converges uniformly in spatial/temporal discretization with respect to the small parameter for the NKGE in the nonrelativistic regime. Extension to the long-time dynamics of the NKGE with weak nonlinearity is discussed and improved uniform error bounds on time-splitting spectral method are presented based on a new technique – regularity compensation oscillation. Finally, applications to several high oscillatory dispersive partial differential equations will be discussed. This is based on joint works with Yongyong Cai, Yue Feng, Yong Lu, Chunmei Su, Wenfan Yi, Jia Yin, Zhifei Zhang and Xiaofei Zhao.

Fast Spectral Methods and Accelerated Iterations for the Boltzmann Equation

Cai Zhenning
National University of Singapore

Abstract. The numerical solution of the Boltzmann equation remains computationally challenging due to the high dimensionality of the collision operator and the slow convergence of conventional iterative methods, particularly

in the near-continuum regime. In this talk, I will present several recent developments aimed at improving the efficiency of numerical solvers for both classical and quantum Boltzmann equations.

We first introduce a fast Fourier spectral method for evaluating the classical Boltzmann collision operator linearized around a local Maxwellian. By exploiting the structure of the equilibrium distribution, the method achieves a computational complexity of $O(N^4 \log N)$, where N is the number of velocity modes in each direction, eliminating the angular quadrature factor required by conventional methods. This efficient evaluation enables the development of a modified Newton method for solving the steady-state Boltzmann equation, in which the full nonlinear collision operator is retained in the residual while the linearized operator is used to compute Newton corrections. To further accelerate convergence in the near-continuum regime, we introduce a macroscopic synthetic system based on the Chapman–Enskog expansion.

Finally, we extend the fast spectral approach to the quantum Boltzmann equation for Bose and Fermi gases by constructing an effective linear collision operator that preserves the fundamental conservation laws and satisfies a linearized H-theorem. The resulting approximation can also serve as an efficient Jacobian in a modified Newton solver for the full quantum Boltzmann equation. Numerical experiments demonstrate the accuracy and computational efficiency of these methods in various rarefied gas flow problems.

Two-dimensional Riemann problems for hyperbolic conservation laws

程红军
Yunnan University

Abstract. We consider a hyperbolic system of nonlinear conservation laws, that is, the pressure system independent of density and energy from the Liou–Steffen flux-splitting scheme on the compressible Euler equations. First, the one-dimensional Riemann problem is solved with eight kinds of structures. Second, the two-dimensional Riemann problem is discussed; the solution reveals a variety of geometric structures; by the generalized characteristic analysis method and studying the pointwise interactions of waves, we construct 29 kinds of structures of solution consisting of shocks, rarefaction waves and contact discontinuities; the theoretical analysis is confirmed by numerical simulations.

Well-posedness of 2D F. John's floating body problem with fixed objects

明梅
Yunnan University

Abstract. We consider the well-posedness of 2D F. John's floating body problem for fixed objects in one horizontal dimension with a potentially emerging bottom. This problem describes the interactions of waves with a partially immersed object using the linearized Bernoulli equations. The fluid domain therefore has corners where the object meets the free surface, which consists of various connected components. We also characterize the associated trace space within the Beppo-Levi space $\dot{H}^1(\Omega)$, revealing non-local coupling between surface components. This is a joint work with D. Lannes.

Contact Line Dynamics on Elastic Sheets

Weiqing Ren
National University of Singapore

Abstract. Moving contact lines arise when one fluid displaces another on a solid substrate. While their modelling and simulation have been widely studied, most previous work has focused on rigid substrates. In this talk, we investigate the case of highly deformable elastic sheets. We first consider the capillary folding of thin elastic sheets with pinned contact lines. Using a three-dimensional model that combines interfacial energy with nonlinear shell elasticity, we study the relaxation dynamics and equilibrium shapes, and obtain numerical results that capture a range of experimentally observed folding behaviours. In the second part, we consider the motion of a thin liquid film on a highly bendable elastic sheet. Under lubrication approximation, we derive coupled evolution equations for the fluid interface and the sheet deformation. A matched asymptotic analysis in the limit of vanishing slip length yields an extended Cox-Voinov relation linking contact line speed to apparent contact angle. The results show that substrate deformability significantly influences wetting dynamics.

可压缩复杂流场的高效高精度数值算法及应用

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摘要 流动控制方程是指利用流体运动满足的质量、动量和能量守恒定律推导出来的守恒方程组（Navier-Stokes方程，NS方程），由于其中的非线性特性及边界条件的复杂性，数值模拟是当前研究该方程及其应用的一种重要手段。本报告主要介绍近年来作者针对NS方程数值求解方法的一些研究与应用。

（1）激波是广泛存在于可压缩流动中的一个重要现象。近几十年来，计算流体力学的数值方法主要是围绕怎样才能准确捕捉激波而又能在光滑区域满足高精度的要求而不断得到发展的。其中，加权基本无振荡（WENO）格式既能有效的捕捉激波，在光滑流动区域又具有较高的精度而在计算流体力学研究中得到广泛的应用。近年来，作者基于WENO格式的思想，针对WENO格式的一些不足之处，如在过渡点（连接光滑区域与激波）、极值点等的精度降低，提出和发展了系列的多步加权WENO格式、一致高阶收敛WENO格式；提出保持离散单元物理贡献一致性，发展了方程组共用权WENO格式等。

（2）时间推进算法是求解NS方程的另一个重要组成部分。对复杂流动的大规模、长时间数值模拟，除了要求所使用的方法具有一定的精度和分辨率外，还要求其计算过程具有较强的稳定性及较高的计算效率。为此，我们提出发展最后一级隐式的低耗散Runge-Kutta时间推进方法，基于Chebyshev多项式的显式Runge-Kutta-Chebyshev方法，基于WENO格式离散谱的优化Runge-Kutta方法等。

报告人简介 申义庆，中国科学院力学研究所研究员，中国科学院大学岗位教授，博士生导师。云南大学数学系计算数学专业学士、硕士，2001年获中国科学院力学研究所流体力学博士学位。2001-2003年，清华大学数学科学系博士后。2006-2011年，美国迈阿密大学机械与航空工程系研究科学家。2011年力学所引进国外杰出人才回所工作，入选2012年度中科院BR计划。主要从事流体力学数值方法、复杂流场数值模拟等方面的研究工作。

Two-dimensional Riemann problem: from scalar conservation laws to compressible Euler equations

盛万成
Shanghai University

Abstract. In this talk, by introducing the generalized characteristic analysis theory of the two-dimensional Riemann problem, we review related works on two-dimensional Riemann problems for hyperbolic conservation laws, mainly those related to the compressible Euler equations in gas dynamics. It contains five sections: 1. Historical review. 2. Scalar conservation laws. 3. Euler equations and its simplified models. 4. Generalized characteristic analysis method. 5. Some related research topics and results.

A Convergent Minimal-Deformation-Rate Method for Mean Curvature Flow

Tang Rong
National University of Singapore

Abstract. Artificial tangential motion helps maintain mesh quality in computations of evolving surfaces, but it also makes convergence analysis difficult. In this talk, I will present a fully discrete parametric finite element method for mean curvature flow of closed surfaces in three dimensions, based on the minimal-deformation-rate (MDR) approach. The normal velocity follows mean curvature flow, while the tangential component minimizes the deformation-rate energy.

The scheme uses an L^2-projected averaged normal and is linear at each time step, without auxiliary evolution equations for curvature or the normal vector. The analysis uses closest-point projection to compare the computed and exact surfaces without matching their parametrizations. For sufficiently smooth flows, we establish error estimates for finite elements of degree at least three under a suitable time-step restriction. Numerical examples demonstrate good mesh quality without remeshing.

I will also discuss possible extensions of the MDR framework to other moving-interface models. This is joint work with Tiantian Huang and Buyang Li.

方程约化与数据驱动：高超声速气动热的两类降维问题

汪球
中国科学院力学研究所空天飞行高温气动全国重点实验室

摘要 随着高超声速飞行器向可复用、低成本方向发展，热防护设计需要减少过大裕度，对气动热预测和流动状态辨识提出更精细的要求。然而，复杂三维流动求解成本高，大量高频热流数据中的有效信息也难以充分提取。本报告围绕这两类问题，介绍方程约化与数据驱动的研究进展，探索兼顾精度与效率的气动热建模和实验数据分析方法。

（1）基于方程约化的气动热理论建模。 利用流动与几何的对称性，在正交曲线坐标系下推导三维钝体对称面边界层方程，结合边界层变换与数值求解方法，实现准三维流动问题的简化求解。在此基础上，将理论拓展至单温度、五组分化学非平衡流动，并结合符号回归建立典型外形气动热的显式关联模型，探索物理方程与数据拟合相结合的高效预测方法。

（2）基于数据驱动的热流信号降维与流态辨识。针对高超声速风洞实验中大量高频热流时序信号，结合小波变换、自编码器与聚类算法，提取热流信号的多尺度时频特征，构建低维特征表示，实现层流、转捩和湍流状态的自动辨识，并进一步探索可学习时频特征与半监督聚类方法，提高复杂实验数据的分析与规律识别能力。针对可信标签有限的问题，探索无标签预训练与少量标签监督微调，评估跨工况辨识能力。

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Arbitrarily High-Order Structure-Preserving Parametric Finite Element Methods for Geometric Flows

Wang Dongmin
National University of Singapore

Abstract. In this talk, I will present a framework for high-order structure-preserving parametric finite element methods (PFEMs) for geometric flows. We first review the Barrett–Garcke–Nürnberg (BGN) formulation and discuss the challenges arising in its high-order time discretization. Motivated by these observations, we introduce a new weak formulation based on local pullback flow maps, which reformulates the geometric evolution on a fixed reference manifold over each time interval. Based on this formulation, we construct high-order Runge–Kutta PFEMs and establish their energy stability, first for planar curves and then for evolving surfaces. Structure-preserving discretizations on the exact preservation of enclosed area or volume and further extensions will also be discussed.

A higher-order WKB-based Fourier spectral method for Schrodinger-Poisson equation in the semi-classical limit

王汉权
Yunnan University of Finance and Economics

Abstract. For the semi-classical Schrodinger-Poisson (SP) equation with some ϵ-dependent initial data, we first reformulate the SP equation into a new system based on WKB, then conduct asymptotic analysis with the multi-scale expansion and get the leading-order system, first-order system and so on, finally apply Fourier spectral method to solve the resultant leading-order system and first-order system and obtain a higher-order WKB-based Fourier spectral method for the Schrodinger-Poisson equation in the semi-classical limit, respectively. Numerical results in 1d and 2d show that the method is uniformly accurate and asymptotic preserving in the density level. Numerical analysis are also presented to confirm this observation.

Shock Theory for Riemann Problems of Fluid Mechanics Equations

王钦
Yunnan University

Abstract. Fluid mechanics is an important branch of mechanics, which greatly affects people's daily life and the progress of science and technology. Shock wave is a very significant phenomenon in fluid mechanics. In this talk, we will first introduce the history research of the Riemann problem of one-dimensional fluid mechanics equations, and then present the latest research progress of the shock wave theory in the two-dimensional Riemann problem, including the shock regular reflection and general four shocks intersection problems.

飞行器气动弹性数值仿真研究进展

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摘要 飞行器气动弹性是指飞行器弹性结构在气动力作用下发生变形，而变形又反过来改变气动力，由此形成气动力与结构弹性之间的相互耦合作用。气动弹性问题通常包括静气动弹性、颤振和抖振三类：静气动弹性是指可忽略惯性力的定常气动弹性变形问题；颤振是气动力、弹性力和惯性力耦合作用下的自激振动，当飞行速度超过临界速度时振动发散，可能导致结构破坏；抖振则是由外部非定常气流分离等激励引起的强迫振动。报告人团队长期从事计算流体力学、空气动力学及气动弹性数值仿真研究。基于自主开发的高精度流体力学计算程序，团队发展了基于混合网格Navier-Stokes方程的紧耦合气动弹性数值仿真程序。该程序采用高精度流体力学求解器和大规模并行计算方法，能够精确、高效地仿真航空航天、高速列车、船舶工程等领域的复杂流动气动弹性问题与流固耦合数值仿真问题。本报告将从基本概念出发，简要介绍国内外研究现状和相关数值计算方法，展示气动弹性数值仿真计算的研究成果，并结合相关工程型号中的应用推广，全面介绍飞行器气动弹性数值仿真研究进展。

报告人简介 郑冠男，高级工程师，就职于中国科学院力学研究所流固耦合系统力学重点实验室流固耦合与数值仿真课题组，长期从事计算流体力学，空气动力学，气动弹性数值仿真研究工作。基于自行开发编写的高精度流体力学计算程序，发展了基于混合网格Navier-Stokes方程的紧耦合气动弹性数值仿真程序，该程序采用高精度的流体力学求解器和大规模并行计算方法，能够精确高效地仿真航空航天、高速列车、船舶工程等领域的复杂流动气动弹性问题和流固耦合数值仿真问题。所发展的计算程序在经过大量标模验证后，大量应用于国内的航空航天、轨道交通，船舶工程等型号设计当中，为相关型号的研发提供了有效的数据支撑和高效的仿真手段。利用该计算程序为合作单位解决多项核心技术难题，创造了极大的社会和经济价值，同时相关成果获得过国防科学技术奖三等奖一项，发表相关领域专业论文四十余篇。目前，兼任中国力学学会流固耦合力学专业委员会秘书长，中国航空学会飞行器载荷分会总干事；同时兼任中国空气动力学会空气弹性力学专业委员会和低跨超声速专业委员会委员；以及中国航空学会航空声学分会和空气动力学分会委员职务。

Error Estimate of an Exponential Wave Integrator for the Nonlinear Schrödinger Equation with Spatial White Noise Potential

Zhang Zhuohan
National University of Singapore

Abstract. Nonlinear Schrödinger equations with rough potentials are important models for quantum dynamics in disordered media and Anderson localization. Recent works by Bao and Wang have analyzed the error estimate under L^∞ and L^p for $1 \leq p \leq 2$ potential using discrete Strichartz estimate. In this talk, we consider a filtered EWI for the one-dimensional periodic cubic Schrödinger equation with spatial white noise potential. The distributional nature of white noise prevents a direct extension of existing integrability-based stability arguments. We address this difficulty through resolvent estimates and Riesz spectral projections, obtaining discrete linear stability with an arbitrarily small regularity loss. Combining this stability mechanism with Bony paraproduct estimates for consistency, we establish pathwise L^2 convergence of every order strictly below $1/2$. This provides a framework for analyzing exponential integrators beyond function-valued potentials.