中国科学院数学与系统科学研究院应用数学研究所

北京理工大学数学与统计学院

深圳北理莫斯科大学计算数学与控制系

莫大-北理工-深北莫应用数学联合研究中心

2024年联合学术年会

议

程

2025.01.03 — 05 北京

中国科学院数学与系统科学研究院应用数学研究所

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2024 年联合学术年会

2025.01.03－05 北京

2025.1.3　报到地点：北京南宫泉都酒店

2025.1.4　学术报告

会议地点：二层宴会厅

8:25　开幕式致辞：骆顺龙、张希承

大会报告主持人：骆顺龙

8:30--09:10

报告人：戴彧虹（中国科学院数学与系统科学研究院)

题目：整数规划若干理论与应用进展

09:10--09:50

报告人：胡俊（北京大学）

题目：弹性力学问题混合有限元方法及北达飞易有限元软件引擎

09:50--10:05

茶歇

大会报告主持人：张希承

10:05--10:45

报告人：施展（中国科学院数学与系统科学研究院）

题目: 临界状态随机串并联图的电阻问题

10:45--11:25

报告人：王益（中国科学院数学与系统科学研究院）

题目：Time-asymptotic stability of composite waves of viscous shock and rarefaction wave to viscous conservation laws

11:25--12:05

报告人：Budak Boris（深圳北理莫斯科大学）

题目：Introduction to the faculty CMC and math center of MSU-BIT

12:05--13:00

午餐

基础数学分会场

地点：三层会议室一

主持人：王益

14:00--14:25

报告人：丁祥茂

题目：3D Gauge/Bethe dualities for arbitrary spin

14:25--14:50

报告人：杨建伟

题目：Dynamics of the semilinear wave equations outside the unit ball

14:50--15:15

报告人：骆泳铭

题目：Scattering of the focusing energy-critical NLS on waveguide manifold

15:15--15:30
茶歇

主持人：杨建伟
15:30--15:55
报告人：邓杨肯迪
题目：波导流形上薛定谔方程的双线性估计

15:55--16:20
报告人：吕勇
题目：Nonrelativistic limit of the Klein-Gordon equations: convergence rates and long time approximations

16:20--16:45
报告人：刘爽
题目：On principal eigenvalues for elliptic operators with shear flow

16:45--17:10
报告人：唐修棣
题目：Symplectic classification of compact almost-toric systems of dimension four

概率分会场

地点：三层会议室四

主持人：朱蓉禅
14:00--14:25
报告人：李向东
题目：随机矩阵、统计力学与随机分析

14:25--14:50
报告人：朱湘禅
题目：Non-unique ergodicity for the 2d stochastic Navier-Stokes equations with derivative of space-time white noise

14:50--15:15
报告人：曾强
题目：Large deviations for the extremal eigenvalues of Ginibre ensembles

15:15--15:30
茶歇

主持人：曾强
15:30--15:55
报告人：孙振尧
题目：On the subcritical self-catalytic branching Brownian motions

15:55--16:20
报告人：郑家愉
题目：On mean-field super Brownian motions

16:20--16:45
报告人：白天衣
题目：On CLT for range of critical branching random walk in high dimensions

16:45--17:10
报告人：Grégoire Véchambre
题目：The leftmost particle of branching subordinators

应用数学分会场

地点：三层贵宾室

主持人：胡煜成
14:00--14:25
报告人：王国亮
题目：The composition method for the e-positivity of graphs

14:25--14:50
报告人：朱天琪
题目：Complexity of the simplest species tree problem

14:50--15:15
报告人：Chaikovskii Dmitrii
题目：Asymptotic methods for solving source identification problems in nonlinear 3D partial differential equations

15:15--15:30
茶歇

主持人：王国亮
15:30--15:55
报告人：胡煜成
题目：白癜风进展过程的数学模拟

15:55--16:20
报告人：洪一平
题目：On spatio-temporal autocorrelation models for space-time data

16:20--16:45
报告人：季丽娜
题目：Exponential ergodicity of CBIRE-processes with competition and catastrophes

16:45--17:10
报告人：李国鹏
题目：Nonlinear PDEs with modulated dispersion – regularization by noise

计算与控制分会场

地点：三层贵宾室一

主持人：康文
14:00--14:25
报告人：Krainiukov Nikolai
题目：On some systems of word equations for automata

14:25--14:50
报告人：Melnikov Boris
题目：On the non-existence of a simple version of the polynomial algorithm extracting the root from the language

14:50--15:15
报告人：季霞
题目：A holomorphic operator function approach for the transmission eigenvalue problem of elastic waves

15:15--15:30
茶歇

主持人：季霞
15:30--15:55
报告人：Abramyan Mikhail
题目：On the study of the Waterloo automaton and Waterloo-like automata

15:55--16:20
报告人：Kamzolkin Dmitrii
题目：Time-optimal control of a harmonic oscillator with viscous friction

16:20--16:45
报告人：Ilyutko Victor
题目：Optimal control of a harmonic oscillator with parametric excitation

16:45--17:10
报告人：康文
题目：Stabilization of PDE systems and its application in multi-agent systems

优化与算法分会场

地点：三层会议室五

主持人：李庆娜
14:00--14:25
报告人：Ingtem Jennie
题目：Use of spline function in numerical differentiation of electroprospecting data for resolution enhancement

14:25--14:50
报告人：孟琪
题目：Towards universal physics-informed neural operator

14:50--15:15
报告人：张晔
题目：Generalized asymptotic regularization methods for inverse and ill-posed problems

15:15--15:30
茶歇

主持人：张晔
15:30--15:55
报告人：Demin Aleksei
题目：How many neurons are required to win the tic-tac-toe game?

15:55--16:20
报告人：李庆娜
题目：Bilevel optimization methods and theory in machine learning

16:20--16:45
报告人：王超
题目：Error estimates for a mixed finite element method for the Maxwell’s transmission eigenvalue problem

16:45--17:10
报告人：李春
题目：Uncertainty quantification for incomplete multi-view data using divergence measures

报告摘要

大会报告

戴彧虹　中国科学院数学与系统科学研究院
题目: 整数规划若干理论与应用进展
摘要: 整数规划问题丰富多样，广泛见之于经济、能源、通信、国防等各行各业。上个世纪五十年代，Dantzig 等通过建立整数规划模型求解了 49 个城市的旅行商问题。分支定界技术和割平面法促使整数规划成为一个独立的优化分支。本报告将介绍 CMIP 整数规划及其应用团队在预处理法、割平面法等方面理论进展，同时也将介绍在通信基站选址问题、社交网络影响最大化问题、机组组合问题、混流问题以及热油管道输运问题等方面应用案例。

胡俊　北京大学
题目: 弹性力学问题混合有限元方法及北达飞易有限元软件引擎
摘要: 弹性力学问题混合有限元方法的构造是一个有 50 多年历史的公开问题。其中最大困难在于离散应力与位移空间对既要满足混合有限元方法的稳定性，又要满足离散应力的对称性, 还要满足空间对匹配的完美性。很多学者都为此努力过，包括国际数学家大会一小时大会报告人 D. N. Arnold 和 F. Brezzi。本报告将介绍最近构造的应力空间和位移空间完美匹配的弹性力学问题稳定的混合有限元方法，以及基于该方法和 AI 算法等一系列算法为 CAE 求解器底层核心算法研发的新一代有限元结构分析软件引擎北达飞易。

施展　中国科学院数学与系统科学研究院
题目: 临界状态随机串并联图的电阻问题
摘要:　Hambly 和 Jordan 在 2004 年证明随机串并联图的电阻具有相变现象，并关于临界状态提出一个相当自然、简单但至今依旧没有得到证明的猜想。2020 年，Addario-Berry 等人提出一个更强的猜想。2023 年，Derrida 进一步加强了猜想，认为电阻的极限分布跟黎曼函数有关系。我将在报告中对这些猜想做些浅易的讨论。跟陈新兴和 Thomas Duquesne 合作。

王益　中国科学院数学与系统科学研究院
题目: Time-asymptotic stability of composite waves of viscous shock and rarefaction wave to viscous conservation laws
摘要: The talk is concerned with our recent developments on the large-time asymptotic stability of basic wave patterns, in particular the compositve wave of viscous shock and rarefaction wave, to both compressible Navier-Stokes equations and non-convex conservation laws.

Budak Boris　深圳北理莫斯科大学
题目: Introduction to the faculty CMC and math center of MSU-BIT
摘要: The report will provide information about the CMC Faculty of Lomonosov Moscow State

University, after which it will be outlined how the accumulated teaching and research experience in Russia was transferred to Shenzhen. The speaker will talk about the SMBU CMC Faculty, the organization of educational activities, extracurricular activities of students, bachelor's and master's degree programs, as well as research activities, including work with graduate students.The report will also outline the main directions of the faculty's scientific activities and development prospects.

基础数学分会场

丁祥茂　中国科学院数学与系统科学研究院

题目: 3D Gauge/Bethe dualities for arbitrary spin

摘要: Nekrasov proposed a general Bethe/Gauge duality between Bethe Anastz Equation (BAE) of an integrable model and a certain vacua equation of supersym- metric gauge theory. But up to now, only a few cases of the effective superpotentials of the gauge theories are carried out explicitly, for which most known their vacua duality to the Bethe Ansatz Equations (BAEs) of the spin-1/2 chain or quantum lattice non-linear Schrödinger equation. We refine the effective superpotential of supersymmetric gauge theory with roots of Lie algebras and encoding a fusion parameter μ into it. For the special valued $\mu = 0$ of the BCD-type gauge theory, we find that a certain number of spin sites sa of the spin chain must be negative to satisfy Bethe/Gauge duality. The numbers of lattice to be fixed depends on the gauge group. As a result, the length of the spin chain will additionally increase due to the fundamental representation which fix the unphysical degrees of freedom. The degen- erate case of $\mu = 0$ can fit the BAE of XX-model reduced from the XXZ spin chain, and the case of $\mu \to \infty$ corresponds to the quantum lattice non-linear Schrödinger (NLS) equation. The BAEs for XX-models ($\mu = 0$) are identical with ones of the quantum lattice NLS models ($\mu \to \infty$), and a kind of boson-fermion duality.

杨建伟　北京理工大学

题目: Dynamics of the semilinear wave equations outside the unit ball

摘 要 : We study the longtime dynamics of the solutions of semilinear wave equations with an energy supercritical growth.Nonlinear wave equations (NLW) is a typical model of infinite dimensional Hamiltonian system.The current study focus on the energy critical case, culminating the celebrated soliton resolution theorem of Duyckaerts-Kenig-Merle (DKM, Acta Math. 2023).Concerning energy supercritical case, very few results are known. In this talk, we study the NLW outside the unit ball, with energy super-critical growth. We give very precise description on the longtime dynamics with new structures around solitons including soliton resolution, center-stable manifolds, blow-up dynamics. This is joint with Thomas Duyckaerts (Sorbonne Paris Nord).

骆泳铭　深圳北理莫斯科大学

题目: Scattering of the focusing energy-critical NLS on waveguide manifold

摘要: In this talk, we introduce how the framework of the semiviral-vanishing geometry can be applied for the focusing energy-critical NLS model on waveguide manifold, in order to establish large data scattering results. In particular, we reveal the interesting fact that despite the semiviral-vanishing geometry is of energy-subcritical nature at the first glance, it will indeed encode all the useful energy-critical features such as the Aubin-Talenti bubble solution.

邓杨肯迪 北京理工大学

题目: 波导流形上薛定谔方程的双线性估计

摘要: 本报告主要介绍两类波导流形上薛定谔方程的双线性估计及其相关的应用.其中一类被称为双线性 Strichartz 估计, 本报告主题之一是在波导流形上建立的比环群上更好的双线性 Strichartz 估计.另一类被称为双线性限制性估计,这一部分主要与 Tao 在 2003 年建立的欧式空间上的双线性估计作对比,我们也得到了波导流形上几乎最佳的结果。

吕勇 南京大学

题目: Nonrelativistic limit of the Klein-Gordon equations: convergence rates and long time approximations

摘要: We study the nonrelativistic limit of the cubic Klein-Gordon equations. We show the cubic Klein-Gordon equation converges to the cubic Schr\"odinger equation with a convergence rate of order ϵ^{2}. In particular for the defocusing case, for `smooth' initial data, we show error estimates of the form $(1+t)\epsilon^{2}$ at time $t$ which is valid up to long time of order $\epsilon^{-1}$; while for `nonsmooth' initial data, we show error estimates of the form $(1+t)\epsilon$ at time t which is valid up to long time of order $\epsilon^{-\frac{1}{2}}$. These specific forms of error estimates coincide with the numerical results.

刘爽 北京理工大学

题目: On principal eigenvalues for elliptic operators with shear flow

摘要: In this talk, we will discuss the recent progress on principal eigenvalues of second order elliptic operators with shear flow. Some monotonicity and asymptotic behaviors of principal eigenvalues, with respect to diffusion rate and flow amplitude, are established. These local asymptotic analysis can help us find some global information on the principal eigenvalue, i.e. the classification of topological structures of the level sets as a function of multiple parameters. This enables us to better understand qualitative properties of the principal eigenvalues. This is a joint work with Professor Yuan Lou.

唐修棣 北京理工大学

题目: Symplectic classification of compact almost-toric systems of dimension four

摘要: Almost-toric systems are important in mirror symmetry. We give a classification of 4-dimensional compact almost-toric systems up to fiber-preserving symplecctomorphisms. This

generalizes the classification by Pelayo--Vu Ngoc on simple semitoric systems and that by the speaker together with Pelayo and Palmer on semitoric systems, both in dimension four. The extra difficulty for almost-toric systems is the lack of a global circle action. The polygon invariant is replaced by an almost-toric closed disk, and we give appropriate notions of focus-focus label and twisting indices in the almost-toric case.

概率分会场

李向东 中国科学院数学与系统科学研究院
题目: 随机矩阵、统计力学与随机分析
摘要: 在本报告中，我们将探讨随机矩阵、统计力学与随机分析之间的深刻联系。

朱湘禅 中国科学院数学与系统科学研究院
题 目 : Non-unique ergodicity for the 2d stochastic Navier-Stokes equations with derivative of space-time white noise
摘 要 : We prove existence of infinitely many stationary solutions as well as ergodic stationary solutions for the stochastic Navier-Stokes equations on T2du + div(u⊗u)dt + ∇pdt = Δudt + (−Δ)a/2dBt, divu = 0,driven by derivative of space-time white noise, where a ∈ [0, 1/3). In this setting, the solutions are not function valued and probabilistic renormalization is required to give a meaning to the equations. Finally, we show that the stationary distributions are not Gaussian distribution N (0, 1/2(−Δ)a-1). The proof relies on a time-dependent decomposition and a stochastic version of the convex integration method which provides uniform moment bounds in some function spaces.

曾强 中国科学院数学与系统科学研究院
题目: Large deviations for the extremal eigenvalues of Ginibre ensembles
摘 要 : Consider the Ginibre matrix ensemble, i.e., ξn\times nξ matrices with independent and identically distributed Gaussian entries. I will present large deviation principles for the spectral radius and the rightmost eigenvalue for such matrices. The proof relies on the one point correlation functions for the eigenvalues which was known from the representation of correlation functions via determinantal point processes for the complex case and was given by Edelman, Kostlan and Shub in 1994 for the real case. Based on Joint work with Yuanyuan Xu (AMSS CAS).

孙振尧 北京理工大学
题目: On the subcritical self-catalytic branching Brownian motions
摘 要 : Self-catalytic branching Brownian motions (SBBM) are a class of one-dimensional branching Brownian motions that incorporate pairwise catalytic branchings, triggered by the

intersection local times of particle pairs. These processes naturally arise as the moment duals of certain reaction-diffusion equations perturbed by multiplicative space-time white noise. For the subcritical case of the catalytic branching mechanism, we construct the SBBM allowing an infinite number of initial particles. Additionally, we establish the coming down from infinity (CDI) property for these systems and characterize their CDI rates. This is based on ongoing joint research with Haojie Hou.

郑家愉 深圳北理莫斯科大学

题目: On mean-field super Brownian motions

摘要: The mean-field stochastic partial differential equation (SPDE) corresponding to a mean-field super-Brownian motion (sBm) is obtained and studied.In this mean-field sBm, the branching-particle lifetime is allowed to depend upon the probability distribution of the sBm itself, producing an SPDE whose space-time white noise coefficient has, in addition to the typical sBm square root, an extra factor that is a function of the probability law of the density of the mean-field sBm. This novel mean-field SPDE is thus motivated by population models where things like overcrowding and isolation can affect growth. A two step approximation method is employed to show the existence for this SPDE under general conditions. Then, mild moment conditions are imposed to get uniqueness. Finally, smoothness of the SPDE solution is established under a further simplifying condition.

白天衣 中国科学院数学与系统科学研究院

题目: On CLT for range of critical branching random walk in high dimensions

摘要: We present recent progress on central limit theorem for the range of a critical branching random walk (CBRW) in Zd conditioned to be large. Law of large number for range of CBRW was given by Le Gall and Lin in 2016, and we aim at strengthening the result to a central limit theorem, based on general theory for stationary process and relation between height process of CBRW and random walk excursions. This talk is based on an ongoing joint work with Yueyun Hu.

Grégoire Véchambre 中国科学院数学与系统科学研究院

题目: The Leftmost particle of branching subordinators

摘要: In this talk we consider continuous-time particle systems on the non-negative real line, called branching subordinators, where particles move as independent subordinators. Each particle can also split (at possibly infinite rate) into several children (possibly infinitely many) whose positions relative to the position of the parent are random. These particle systems are in the continuity of branching Lévy processes introduced by Bertoin and Mallein arXiv:1703.08078 as a tool to study fragmentation processes, but the case of subordinators allows us to get rid of some classical exponential integrability assumptions. We pay a particular attention to the asymptotic behavior of the leftmost particle of branching subordinators. It turns out that, under some assumptions, the rate

of growth of the position of the leftmost particle is of order t^{γ} where $\gamma \in (0,1)$ depends explicitly on the parameters. This sub-linear growth is significantly different from the classical linear growth observed for regular branching random walks. This talk is based on arXiv:2409.16617, it is joint work with Alexis Kagan (University of Auckland).

应用数学分会场

王国亮　北京理工大学

题目: The composition method for the e-positivity of graphs

摘要: Motivated by the study of the e-positivity of graphs proposed by Richard Stanley at MIT, we develop a composition method to confirm the e-positivity. The idea comes from a collaboration with Professor Thibon on the Schur positivity of graphs in 2023. The first paper describing this method was accepted by Advances in Applied Mathematics, in which we established the e-positivity of hats as applications. In the subsequent journey of exploring the power of the composition method, we established the e-positivity of cycle-chords which contains crocodiles and alligators, and that of clocks, bicycles and a special family of spiders of 3 legs which supports a more general conjecture. We proposed an e-positivity conjecture for hat-chains in June and it was confirmed by Tom from MIT in late October.

朱天琪　中国科学院数学与系统科学研究院

题目: Complexity of the simplest species tree problem

摘要: The multispecies coalescent model provides a natural framework for species tree estimation accounting for gene-tree conflicts. Although a number of species tree methods under the multispecies coalescent have been suggested and evaluated using simulation, their statistical properties remain poorly understood. Here, we use mathematical analysis aided by computer simulation to examine the identifiability, consistency, and efficiency of different species tree methods in the case of three species and three sequences under the molecular clock. We consider four major species-treemethods including concatenation, two-step, independent-sites maximum likelihood, and maximum likelihood. We develop approximations that predict that the probit transform of the species tree estimation error decreases linearly with the square root of the number of loci. Even in this simplest case, major differences exist among the methods. Full-likelihood methods are considerably more efficient than summary methods such as concatenation and two-step. They also provide estimates of important parameters such as species divergence times and ancestral population sizes,whereas these parameters are not identifiable by summary methods.Our results highlight the need to improve the statistical efficiency of summary methods and the computational efficiency of full likelihood methods of species tree estimation.

Chaikovskii Dmitrii 深圳北理莫斯科大学

题目: Asymptotic methods for solving source identification problems in nonlinear 3D partial differential equations

摘要: Reaction-diffusion-advection equations are fundamental for modeling complex physical processes, including the development of autowave models. To address both direct and inverse problems involving singularly perturbed equations of this type, we employ asymptotic expansion techniques. By formulating conditions for smooth solutions and accurately characterizing the transitional layer within the domain, we achieve precise mathematical descriptions. A local coordinate system is introduced near the transitional layer to pinpoint its location with high accuracy. The theoretical framework is further reinforced by proving the existence and uniqueness of the derived solution. For the inverse problem of identifying the source function, the asymptotic approach simplifies the complexity of the original system. This reduction enables the derivation of accurate solutions throughout the domain, except within the transitional layer. By filtering noisy data within the transitional layer and applying smoothing techniques to the remaining data, the reduced model provides reliable solutions to the inverse problem. The methodology is validated through numerical experiments, demonstrating its robustness and precision.

胡煜成 首都师范大学

题目: 白癜风进展过程的数学模拟

摘要: 通过数学建模研究免疫细胞杀伤黑色素细胞的白癜风致病过程, 主要运用微分方程和数值模拟等数学工具, 揭示免疫细胞杀伤动力学背后的双稳态机制, 模拟白癜风患者皮肤白斑的进展过程。

洪一平 北京理工大学

题目: On spatio-temporal autocorrelation models for space-time data

摘要: In the fields of meteorology, ecology, and epidemiology, the analysis of spatio-temporal datasets with discrete values and nonstationary characteristics is a common challenge. Most existing nonstationary models are based on Gaussian random fields, which can be computationally intensive. In this presentation, I will introduce recent progress in the development of nonstationary spatio-temporal autocorrelation models for discrete value spatiotemporal data, mainly on the nonstationary autologistic model, and also involves nonstationary binomial and Poisson models. The ability of the autocorrelation parameter to be linked to additional covariates enhances the model's suitability for describing nonstationary data. We will demonstrate the practical application of our proposed models through simulations and the analysis of fine particulate matter (PM 2.5) concentration data from the Community Multiscale Air Quality (CMAQ) data for the continental US.

季丽娜 深圳北理莫斯科大学

题目: Exponential ergodicity of CBIRE-processes with competition and catastrophes

摘 要 : We establish the exponential ergodic property in a weighted total variation distance of continuous-state branching processes with immigration in random environments with competition and catastrophes, under a Lyapunov-type condition and other mild assumptions. The proof is based on a Markov coupling process along with some delicate estimates for the associated coupling generator. In particular, the main result indicates whether and how the competition mechanism, the environment and the catastrophe could balance the branching mechanism respectively to guarantee the exponential ergodicity of the process.

李国鹏 北京理工大学

题目: Nonlinear PDEs with modulated dispersion – regularization by noise

摘要: We study dispersive equations with a time non-homogeneous modulation acting on the linear dispersion term. In this talk, we consider the Korteweg-de Vries equation (KdV) and related equations such as the Benjamin-Ono equation (BO) and the intermediate long wave equation (ILW). By imposing irregularity conditions on the modulation, we demonstrate phenomena known as regularization by noise in the following three ways: (i) For sufficiently irregular modulation, we establish local well-posedness of the modulated KdV on both the circle and real line in settings where the unmodulated KdV is ill-posed. In particular, we show that the modulated KdV on the circle with a sufficiently irregular modulation is locally well-posed in Sobolev spaces of arbitrarily low regularity. By combining the -method (from dispersive PDEs) and the sewing lemma (controlled rough paths), we also prove global well-posedness in negative Sobolev spaces. (ii) While equations like BO and ILW exhibit quasilinear behavior, we show that sufficiently irregular modulations semilinearize these equations by proving their local well-posedness via a contraction argument. (iii) Finally, we show nonlinear smoothing for these modulated equations, where we show that a gain of regularity of the nonlinear part becomes (arbitrarily) larger for more irregular modulations. This talk is based on joint work with Khalil Chouk (formerly UoE), Massimiliano Gubinelli (Oxford), Tadahiro Oh (UoE), and Jiawei Li (UoE).

计算与控制分会场

Krainiukov Nikolai 深圳北理莫斯科大学

题目: On some systems of word equations for automata

摘 要 : We use some programing tools and algorithms for solving system of word equation for regular languages. There are many possibilities for presenta-tion of regular languages such as grammars, finite automata, rewriting systems and so on. Some of these systems is presented by system of computational discrete algebra GAP and the possibilities of presentation now in some

systems interactive theorem provers (Isabelle, Coq). This computer system can give to detailed understanding of solution of system of word equation, compared the languages and regular expressions of the languages.

Melnikov Boris 深圳北理莫斯科大学

题目: On the non-existence of a simple version of the polynomial algorithm extracting the root from the language

摘要: For the standard word concatenation operation, considered as multiplication, the concatenation of languages is naturally determined, and based on the last operation, the degree of the language and, if available, the root of a given degree. When describing algorithms for constructing a language that is the root of degree M from a given language, the so-called potential roots are of great importance: these are such words (not languages), the considered mth degree of which is included in a given language. It is easy to show that all potential roots for a given language are constructed using a polynomial algorithm. This task does not seem to be simplified when considering words and languages over a 1-letter alphabet - which is what is being done in this work. A taboo pair of potential roots is a pair whose word concatenation is not included in the language. In previous publications on the topic of describing algorithms for extracting roots from a language, a hypothesis arose that a polynomial algorithm for extracting a root from a language can be described based on considering only a set of taboo pairs — by iterating through specially described subsets of a set of potential roots. In this work, it is shown that such an algorithm (called "simple") is impossible, i.e. if there is a polynomial algorithm for extracting the root from the language, then it (the algorithm) must use some additional information.

季霞 北京理工大学

题目: A holomorphic operator function approach for the transmission eigenvalue problem of elastic waves

摘要: The talk presents a new proof of the C0IPG method (C0 interior penalty Galerkin method) the transmission eigenvalue problem of elastic waves. Instead of using the proof following the structure of discontinuous Galerkin method, we rewrite the problem as the eigenvalue problem of a holomorphic Fredholm operator function of index zero. The convergence for C0IPG is proved using the abstract approximation theory for holomorphic operator functions. We employ the spectral indicator method which is easy in coding to compute the eigenvalues. Numerical examples are presented to validate the theory.

Abramyan Mikhail 深圳北理莫斯科大学

题目: On the study of the Waterloo automaton and Waterloo-like automata

摘要: We study semilattices containing covering automata for the Waterloo automaton, which plays an important role in vertex minimization algorithms for nondeterministic finite automata. We give a

complete description of the obtained semilattices in terms of the equivalence of the covering automata they contain to the Waterloo automaton. Three classes of semilattices are considered, and several representations for each class are constructed. We also consider algorithms for generating nondeterministic finite automata possessing the Waterloo automaton property (the “Waterloo-like badness” property, or walibad property), namely: among their covering automata, there exist automata which are not equivalent to the original automaton. Two algorithms are described: the first one is based on recursive analysis of covering automata for automata with the walibad property, the second one uses non-equivalent transformations of a complete automaton created on the basis of an automaton with the walibad property. Examples of application of both algorithms to the Waterloo automaton are given, and some interesting features of the resulting sets of new walibad automata are described.

Kamzolkin Dmitrii　深圳北理莫斯科大学

题目: Time-optimal control of a harmonic oscillator with viscous friction

摘要: This report considers the problem of optimal control of an oscillatory process in a medium with viscous friction. In contrast to classical optimal control problems, the frequency of oscillations was chosen as the control parameter rather than the force of external influence. It was required to move the controlled system from a given initial state to the final state in the least time. The Pontryagin maximum principle and the Bellman optimality principle were applied to solve this problem. The existence conditions and the general form of optimal control are obtained, and some of its properties are studied.

Ilyutko Victor　深圳北理莫斯科大学

题目: Optimal control of a harmonic oscillator with parametric excitation

摘要: This report investigates the optimal control of a harmonic oscillator governed by the second-order bilinear equation. The primary objective is to determine the minimal time required for the system to transition from an arbitrary initial state to a final state under constrained frequency as a control function. The main challenge involves identifying the optimal control switching times while satisfying all boundary conditions. Various boundary scenarios were analyzed, and the reachable set of all trajectories was constructed. Analytical techniques, combined with control theory and a proven theorem, were utilized to solve this problem. This study is particularly relevant for applications requiring time-optimal control, such as mechanical vibration systems or signal processing, where rapid state transitions are crucial. The methods developed provide a robust framework for time-optimal control in oscillatory systems and are adaptable to other systems facing similar control challenges.

康文　北京理工大学

题目: Stabilization of PDE systems and its application in multi-agent systems

摘要: Many important plants (e.g. flexible manipulators or chemical reactors) are governed by PDEs and are often described by models with a significant degree of uncertainty. Stabilization for infinite-dimensional PDE systems is a challenging problem. We aim to provide efficient methods for stabilization of PDEs and for PDE-based multi-agent deployment.

优化与算法分会场

Ingtem Jennie 深圳北理莫斯科大学

题目: Use of spline function in numerical differentiation of electroprospecting data for resolution enhancement

摘要: Differential electroprospecting methods provide an efficient technique to search for mineral deposits, but technical difficulties have so far prevented their widespread use. A stable method is available for numerical differentiation of functions defined by tabular data with errors. The method relies on integral splines. The present article applies the integral spline method to process electromagnetic sounding data. The efficiency of the numerical method is analyzed by modeling magnetotelluric fields in twodimensional nonhomogeneous media. The results show that numerical differentiation of profile curves can be efficiently applied for resolution enhancement in magnetotelluric sounding with the purpose of identifying structural features of the medium longitudinally to the Earth's surface.

孟琪 中国科学院数学与系统科学研究院

题目: Towards universal physics-informed neural operator

摘要: AI-powered scientific computing represents a paradigm shift in the realm of scientific research and computation that integrates artificial intelligence into traditional scientific computing, offering unprecedented opportunities for enhanced efficiency and accelerated scientific discovery. As the AI foundation models have achieved success in language or vision tasks, we seek the opportunity on solving partial differential equations. In this talk, we will introduce several designs of AI approaches towards universal neural operator that incorporate the physical knowledge into the AI models to enhance the efficiency and accuracy in evolving the dynamic systems governed by the partial differential equations.

张晔 深圳北理莫斯科大学

题目: Generalized asymptotic regularization methods for inverse and ill-posed problems

摘要: In this talk, I will introduce the framework of generalized asymptotic regularization for efficiently solving ill-posed operator equations. Specifically, I will introduce the stochastic asymptotic regularization method. In addition to the classical regularization theory, I will demonstrate the advantages of this method through numerical examples: uncertainty quantification,

capturing multiple solutions of the inverse problem, and escaping local minima.

Demin Aleksei 深圳北理莫斯科大学

题目: How many neurons are required to win the tic-tac-toe game?

摘 要 : This report focuses on optimizing neural network structure to improve the operation efficiency using the tic-tac-toe game as an example.

In order to improve the operation efficiency of neural network in tic-tac-toe game, the research focuses on optimizing the network structure. By reducing the number of network layers and nodes, a lightweight neural network model is going to be constructed. Experiments are conducted in order to demonstrate whether optimizing the network structure can significantly reduce the computational overhead and speed up the problem solving.

李庆娜 北京理工大学

题目: Bilevel optimization methods and theory in machine learning

摘要: Bilevel optimization is an important tool to deal with hyperparameter selection in machine learning. In this talk, we will address typical models and classical approaches to deal with the bilevel optimization model in machine learning. We will also report some of our recent work in theory and algorithms in solving bilevel optimization models arising from machine learning.

王超 深圳北理莫斯科大学

题目: Error estimates for a mixed finite element method for the Maxwell's transmission eigenvalue problem

摘 要 : In this talk, we analyze a numerical method combining the Ciarlet-Raviart mixed finite element formulation and an iterative algorithm for the Maxwell's transmission eigenvalue problem. The eigenvalue problem is first written as a nonlinear quad-curl eigenvalue problem. Then the real transmission eigenvalues are proved to be the roots of a non-linear function. They are the generalized eigenvalues of a related linear self-adjoint quad-curl eigenvalue problem. These generalized eigenvalues are computed by a mixed finite element method. We derive the error estimates using the spectral approximation of compact operators, the theory of mixed finite element method for quad-curl problems, and the derivatives of eigenvalues.

李春 深圳北理莫斯科大学

题目: Uncertainty quantification for incomplete multi-view data using divergence measures

摘要: Existing multi-view classification and clustering methods typically improve task accuracy by leveraging and fusing information from different views. However, ensuring the reliability of multi-view integration and final decisions is crucial, particularly when dealing with noisy or corrupted data. Current methods often rely on Kullback-Leibler (KL) divergence to estimate uncertainty of network predictions, ignoring domain gaps between different modalities. To address

this issue, KPHD-Net, based on Hölder divergence, is proposed for multi-view classification and clustering tasks. Generally, our KPHD-Net employs a variational Dirichlet distribution to represent class probability distributions, models evidences from different views, and then integrates it with Dempster-Shafer theory (DST) to improve uncertainty estimation effects. Our theoretical analysis demonstrates that Proper Hölder divergence offers a more effective measure of distribution discrepancies, ensuring enhanced performance in multi-view learning. Moreover, Dempster-Shafer evidence theory, recognized for its superior performance in multi-view fusion tasks, is introduced and combined with the Kalman filter to provide future state estimations. This integration further enhances the reliability of the final fusion results. Extensive experiments show that the proposed KPHD-Net outperforms the current state-of-the-art methods in both classification and clustering tasks regarding accuracy, robustness, and reliability, with theoretical guarantees.