北京国际数学研究中心
BEIJING INTERNATIONAL CENTER FOR MATHEMATICAL RESEARCH

The 2nd International Conference on Mathematical Modeling and Numerical Methods

Time: June 1 - June 3, 2024

Venue: Lecture Hall, Jiayibing Building, Jingchunyuan 82

Beijing International Center for Mathematical Research (BICMR),

Peking University

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Accommodation

All invited speakers will be accommodated in Building 1 of Zhongguanyuan Global Village PKU. The hotel is located opposite the Southeast gate of the Peking University campus.

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Schedule

Friday, May 31st

Time	
15:00 - 18:00	Conference Check-in (Lobby, Building No.1, Zhongguanyuan Global Village)
18:00 -	Welcome Dinner (Yi Yuan Restaurant (中关新园怡园中餐厅))

Saturday, June 1st

Time	Speaker	Title	Host
8:45 - 9:00		Welcome Speech	Lei Zhang
9:00 - 9:40	Qiang Du	Nonlocal Problems on Bounded Domains with Local Boundary Conditions	
9:40 - 10:20	Rémi Abgrall	A New Kinetic Scheme for Compressible Navier-Stokes Equations	
10:20 - 10:40		Group Photo, Tea Break	
10:40 - 11:20	Jan S. Hesthevan	Time Domain Reduced Order Models Through the Laplace Transform	Jun Hu
11:20 - 12:00	Zhiming Chen	An Adaptive High Order Finite Element Methods for Arbitrarily Shaped Domains with Automatic Mesh Generation	
12:00 - 14:00		Lunch (Shao Yuan Restaurant (勺园中餐厅))	
14:00 - 14:40	Chun Liu	Energetic Variational Approaches in Active Materials and Reactive Fluids	Huazhong Tang
14:40 - 15:20	Lei Zhang	Construction of Solution Landscape for Complex Systems	
15:20 - 15:40		Tea Break	
15:40 - 16:20	Xiaoping Wang	Topology Optimization Using Generative Models	Sihong Shao
16:20 - 17:00	Apala Majumdar	Solution Landscapes in the Landau-de Gennes Theory for Nematic Liquid Crystals: Analysis, Computations, and Applications (Online)	

Sunday, June 2nd

Time	Speaker	Title	Host
9:00 - 9:40	Chi-Wang Shu	Bound-Preserving High Order Schemes for Hyperbolic Equations: Survey and Recent Developments	Tiejun Li
9:40 - 10:20	Alexander Ostermann	Accelerating Exponential Integrators	
10:20 - 10:40	Tea Break		
10:40 - 11:20	Jie Shen	Structure-Preserving Schemes Using the Lagrange Multiplier Approach	Zaiwen Wen
11:20 - 12:00	Weizhu Bao	Modeling, Analysis, and Simulation for Degenerate Dipolar Quantum Gas	
12:00 - 14:00	Lunch (Shao Yuan Restaurant (勺园中餐厅))		
14:00 - 14:40	Kui Ren	Inverse Problems to Mean Field Game Systems: Analysis and Computation	Ruo Li
14:40 - 15:20	Zhonghua Qiao	Maximum Bound Principle and Non-negativity Preserving ETD Schemes for a Phase Field Model of Prostate Cancer Growth with Treatment	
15:20 - 15:40	Tea Break		
15:40 - 16:20	Bin Dong	PDEformer: Towards a Foundation Model for Solving Parametric PDEs and Beyond	Zhonghua Qiao
16:20 - 17:00	Xiaochuan Tian	A Model-Based Approach for Continuous-Time Policy Evaluation with Unknown Lévy Process Dynamics	

Monday, June 3rd

Time	Speaker	Title	Host
9:00 - 9:40	Shi Jin	Dimension Lifting for Quantum Computation of Partial Differential Equations and Related Problems	Zhengyu Huang
9:40 - 10:20	Lili Ju	Energy-Dissipative Spectral Renormalization Exponential Integrator Method for Gradient Flow Problems	
10:20 - 10:40	Tea Break		
10:40 - 11:20	Hongkai Zhao	Numerical Understanding of Neural Networks: from Representation to Learning Dynamics	Lili Ju
11:20 - 12:00	Maria Emelianenko	The Role of Centroidal Voronoi Tessellations in Data Science and Applications	
12:00 - 13:00	Lunch (Shao Yuan Restaurant (勺园中餐厅))		
Afternoon: Free discussion			

Abstracts of Talks

Nonlocal Problems on Bounded Domains with Local Boundary Conditions

Qiang Du
Columbia University

We consider nonlocal integro-differential equations on bounded domains with nonlocal interactions of a finite range. Such problems have received much attention in various applications. We begin with a review of earlier works on problems involving nonlocal boundary conditions. We then present more recent studies of problems using only local boundary conditions. In particular, we discuss the design of boundary localization and properties of the boundary localized convolutions. We show that they lead to desired nonlocal Green's identity, well-posed nonlocal variational problems, and coupled local and nonlocal models via local interface conditions for more effective nonlocal modeling and simulations.

Bio: Qiang Du is the Fu Foundation Professor of Applied Mathematics at Columbia University, where he is also affiliated with the Data Science Institute and co-chairs the Center of Computing Systems for Data-driven Science. He is currently the EIC of the SIAM Journal on Applied Mathematics (SIAP) and the founding co-EIC of Communications of the American Mathematical Society (CAMS).

A New Kinetic Scheme for Compressible Navier-Stokes Equations

Rémi Abgrall
University of Zurich

In this talk, I will first review kinetic method proposed by Shi Jin and Zhouping Xin. After the work of Jin and Xin, there has been a considerable interest for nonlinear hyperbolic problem because there was no need of using Riemann Solver. Extensions have been provided for some parabolic problems. The problem is that the time step depends on the inverse of a relaxation parameter which is assumed to tend to zero, hence implicit schemes become a must. We show how to construct kinetic schemes written in the spirit of Jin and Xin that are able to approximate parabolic problems with a time step that is independent of the relaxation parameter while staying explicit.

The fundamental principles are: (1) rather than aiming for the desired equations in the strict limit of a vanishing relaxation parameter, as is commonly done in the diffusion limit of kinetic methods, diffusion terms are sought as a first-order correction of this limit in a Chapman-Enskog expansion, (2) introducing a coupling between the conserved variables within the relaxation process by a specifically designed collision matrix makes it possible to systematically match a desired diffusion. Extending this strategy to multi-dimensions cannot, however, be achieved through simple directional splitting, as diffusion is likely to couple space directions with each other, such as with shear viscosity in the Navier-Stokes equations.

In this work, we show how rewriting the collision matrix in terms of moments can address this issue, regardless of the number of kinetic waves, while ensuring conservation systematically. This rewriting allows for introducing a new class of kinetic models called regularized models, simplifying the numerical methods and establishing connections with Jin-Xin models. Subsequently, new explicit arbitrary high-order kinetic schemes are formulated and validated on standard two-dimensional cases from the literature. Excellent results are obtained in the simulation of a shock-boundary layer interaction, validating their ability to approximate the Navier-Stokes equations with kinetic speeds obeying nothing but a sub-characteristic condition along with a hyperbolic constraint on the time step.

References

[1] Shi Jin and Zhouping Xin. The relaxation schemes for systems of conservation laws in arbitrary space dimensions. Commun. Pure Appl. Math., 48(3):235–276, 1995.

[2] R. Natalini. A discrete kinetic approximation of entropy solution to multi-dimensional scalar conservation laws. Journal of differential equations, 148:292–317, 1998.

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[4] F. Bouchut. Construction of BGK models with a family of kinetic entropies for a given system of conservation laws. Journal of Statistical Physics, 95(1/2), 1999.

[5] S. Boscarino, L. Pareschi, and G. Russo. Implicit-explicit Runge-Kutta schemes for hyperbolic systems and kinetic equations in the diffusion limit. SIAM J. Sci. Comput.,35(1):A22–A51, 2013.1

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[7] R. Abgrall and D. Torlo. Some preliminary results on a high order asymptotic preserving computationally explicit kinetic scheme. Communications in Mathematical Sciences, 20(2): 297–326, 2022.

[8] G. Wissocq and R. Abgrall. A new local and explicit kinetic method for linear and nonlinear convectiondiffusion problems with finite kinetic speeds: I. one-dimensional case, 2023. arXiv.2310.08356.

[9] Gauthier Wissocq and Rémi Abgrall. A new local and explicit kinetic method for linear and non-linear convection-diffusion problems with finite kinetic speeds: II. multidimensional case, 2023. arXiv.2312.16323.

Bio: Prof. Rémi Abgrall received his PhD in 1988 from the University of Paris (now Sorbonne University). He got his first research position at ONERA, the French Aerospace Lab, and worked as a research scientist at INRIA, the National Institute for Research in Digital Science and Technology in France, from 1989 to 1996. He became an associate professor at the University of Bordeaux in 1996 and a full professor in 2001. Funded by the Advanced Grant(2008-2013) from the European Research Council (ERC), he was on leave at INRIA (Bordeaux) from 2008-2013. Then, he moved to the University of Zurich as a full professor in January 2014.

Prof. Rémi Abgrall is well known for his pioneering work in designing schemes for multicomponent and multiphase flows and high-order methods on unstructured meshes. He has sat on several editorial boards, and he is currently the editor-in-chief of the Journal of Computational Physics.

Prof. Rémi Abgrall is a SIAM fellow and was an ICM speaker in 2014.

Time Domain Reduced Order Models Through the Laplace Transform

Jan S. Hesthevan (Joint work with Fernando Hernandez)
École Polytechnique Fédérale de Lausanne

With the need for accurate and efficient ways of simulating complex systems under parametric variations, the development of reduced-order models remains an area of significant interest. While these developments have matured for steady problems, the extension to time-dependent problems remains a challenge. In the talk, we introduce a novel reduced-order model based on the transformation of the original problem to the Laplace domain, resulting in stationary boundary value problems with a Laplace parameter. During the offline stage, one can then sample the Laplace domain to recover a basis. While such ideas have been pursued in the past, this previous work relies on the use of an inverse Laplace transform in the online stage – an approach that is known to be numerically sensitive, in particular for wave-dominated problems. We pursue the development of the reduced basis in the Laplace domain but then proceed with a Galerkin projection of the time-dependent problem, resulting in a small timedependent problem that can be integrated using standard methods during the online stage. While it is far from obvious that such a basis leads to an accurate formulation, we shall demonstrate that it is indeed a good basis with a rapidly decaying Kolmogorov-n width and a resulting exponentially accurate reduced model. The accuracy and efficiency of the approach are demonstrated for parabolic and hyperbolic problems.

Bio: After receiving his PhD in 1995 from the Technical University of Denmark, Professor Hesthaven joined Brown University, USA, where he became Professor of Applied Mathematics in 2005. In 2013, he joined EPFL as Chair of Computational Mathematics and Simulation Science and, from 2017-2020, served as Dean of the School of Basic Sciences. Since 2021, he has served as Provost of EPFL.

His research interests focus on the development, analysis, and application of high-order accurate methods for the solution of complex time-dependent problems described by nonlinear partial differential equations that often require high-performance computing. A particular focus of his research has been on the development of computational methods for linear and nonlinear wave problems, with recent emphasis on reduced order modeling and the combination of traditional methods with machine learning and neural networks with broad applications.

Jan S Hesthaven's contributions to the field have been recognized with numerous prestigious awards. His dedication to teaching and research is evident in his 4 monographs and over 175 research papers. His expertise has earned him the honor of being an elected member of the Royal Danish Academy of Sciences and Letters, the European Academy of Sciences, and a Fellow of the American Mathematical Society (AMS) and the Society for Industrial and Applied Mathematics (SIAM).

An Adaptive High Order Finite Element Methods for Arbitrarily Shaped Domains with Automatic Mesh Generation

Zhiming Chen
Chinese Academy of Sciences

We consider high-order unfitted finite element methods on Cartesian meshes with hanging nodes for elliptic interface problems, which release the work of body-fitted mesh generation and allow us to design adaptive finite element methods for solving curved geometric singularities. We introduce new concepts of the large element and interface deviation to solve the small cut cell problem of unfitted finite element methods. We consider the reliable implementation of the adaptive method, which extends our previous work on the reliable cell merging algorithm for smooth interfaces to automatically generate the induced mesh for piecewise smooth interfaces. An hp a posteriori error estimate is derived for a new unfitted finite element method whose finite element functions are conforming in each subdomain. Numerical examples illustrate the competitive performance of the method. This talk is based on joint works with Ke Li, Yong Liu, and Xueshuang Xiang.

Bio: Prof. Zhiming Chen is a Professor of Mathematics at the Academy of Mathematics and Systems Science of the Chinese Academy of Sciences. His research focuses on developing numerical methods for solving partial differential equations with particular applications in computational electromagnetism and seismic imaging. He was an invited speaker of ICM in 2006 and an elected member of the Chinese Academy of Sciences.

Energetic Variational Approaches in Active Materials and Reactive Fluids

Chun Liu
Illinois Institute of Technology

I will present a general theory for active fluids that convert chemical energy into various types of mechanical energy. This is the extension of the classical energetic variational approaches for mechanical systems. The methods will cover a range of both chemical reaction kinetics and mechanical processes. This is a joint project with many collaborators, in particular Bob Eisenberg, Yiwei Wang, and Tengfei Zhang.

Bio: Prof. Chun Liu is the Chair and Professor in the Department of Applied Mathematics at the Illinois Institute of Technology in Chicago. Before coming to Illinois Tech, Liu was in the Department of Mathematics at Pennsylvania State University, where he had served since 1998. Prof. Liu also served a term as associate director for the Institute for Mathematics and Its Applications (IMA) at the University of Minnesota and has held positions at many institutions, such as the University of Wuerzburg, the University of Tokyo, the University of Georgia, and Carnegie Mellon University. He received his Ph.D. in 1995 from the Courant Institute of Mathematical Sciences at New York University.

Prof. Liu's research is in nonlinear partial differential equations and applications in complex fluids, such as liquid crystal growth, polymers, and ion channels in cell membranes. He developed a general framework of energetic variational approaches (EnVarA) to study various problems arising from physical and biological applications. Prof. Liu's research has been supported by various federal and international funding agencies.

Construction of Solution Landscape for Complex Systems

Lei Zhang
Peking University

The energy landscape has been widely applied to many physical and biological systems. A long-standing problem in computational mathematics and physics is how to search for the entire family tree of possible stationary states on the energy landscape without unwanted random guesses. Here, we introduce a novel concept, "Solution Landscape," which is a pathway map consisting of all stationary points and their connections. We develop a generic and efficient saddle dynamics method to construct the solution landscape, which not only identifies all possible minima but also advances our understanding of how a complex system moves on the energy landscape. We then apply the solution landscape approach to target several problems, including the defect landscapes of nematic liquid crystals, the transition pathways connecting crystalline and quasicrystalline phases, and the excited states of rotational Bose-Einstein condensates.

Bio: Lei Zhang is Boya Distinguished Professor at Beijing International Center for Mathematical Research, Peking University. He is also a Principle Investigator at the Center for Quantitative Biology, and Center for Machine Learning Research. He obtained his Ph.D in Mathematics at Penn State University in 2009. His research is in the area of computational and applied mathematics and interdisciplinary science in biology, materials, and machine learning. He has published the papers in Phys. Rev. Lett., PNAS, Acta Numerica, Science journals, Cell journals, SIAM journals. He was awarded/funded by the NSFC Innovation Research Group, the NSFC Outstanding Youth Award, the National Key Research and Development Program of China, the NSFC Excellent Youth Award, the Royal Society Newton Advanced Fellowship, etc. He serves as an Associate Editor for SIAM J. Appl. Math, Science China Mathematics, CSIAM Trans. Appl. Math, DCDS-B, The Innovation, and Mathematica Numerica Sinica.

Topology Optimization Using Generative Models

Xiaoping Wang
The Chinese University of Hong Kong, Shenzhen

Topology optimization, which aims to find the optimal physical structure that maximizes mechanical performance, is vital in engineering design applications in aerospace, mechanical, and civil engineering. We introduce a deep generative model based on diffusion models to address the structure optimization problem. Combined with the threshold dynamics method, we present a successful framework for topology optimization.

Bio: Prof. Wang received his BSc Degree in mathematics from Peking University in 1984 and his PhD Degree in mathematics from Courant Institute (NYU) in 1990. He was a postdoctoral at MSRI in Berkeley, University of Colorado in Boulder before he moved to the Hong Kong University of Science and Technology (HKUST) in 1994. He was the Head and Chair Professor of the Mathematics Department at HKUST. Prof. Wang is currently a Presidential Chair Professor at SSE/CUHKSZ. Prof. Wang's current research interests are: Modeling and Simulations of Interface Problems and Multi-phase Flow, Topology Optimization, and Numerical Methods for Micro-magnetics Simulations. He received the Feng Kang Prize for Scientific Computing in 2007. He was a plenary speaker at the SIAM conference on mathematical aspects of materials science (2016) and a plenary speaker at the International Congress of Industrial and Applied Mathematics (2019).

Solution Landscapes in the Landau-de Gennes Theory for Nematic Liquid Crystals: Analysis, Computations, and Applications

Apala Majumdar
University of Strathclyde

Nematic liquid crystals are classical examples of partially ordered materials that combine fluidity with the order of crystalline solids. They are the working material of a range of electro-optic devices, i.e., in the liquid crystal display industry, and more recently, they are used in sensors, actuators, elastomers, security applications, and pathological studies. We review the celebrated Landau-de Gennes theory for nematic liquid crystals and focus on the modeling of nematics confined to thin quasi-2D systems, with reference to 2D polygons. We perform asymptotic analysis in certain distinguished limits, encoded in terms of geometrical, material, and temperature-dependent parameters, accompanied by exhaustive numerical studies of solution landscapes that include stable and unstable solution branches for these systems. There are several numerical challenges associated with the numerical computation of the unstable solution branches and their unstable directions, for which we use the powerful High-Index Shrinking Optimisation Dimer Method. In the last leg of the talk, we discuss the mathematical modeling of some recent experiments on nematic shells to illustrate the synergistic links between theory, experiment, and novel applications.

It is collaborative work with Professor Lei Zhang, Professor Jan Lagerwall, and his group members, Dr. Yucen Han, Dr. Yiwei Wang, and Mr. Baoming Shi. All collaborations will be acknowledged during the talk.

Bio: Apala Majumdar is an internationally known expert in the mathematics and modeling of liquid crystals and their applications. She is a Full Professor of Applied Mathematics at the University of Strathclyde. Prof. Apala Majumdar received her PhD in applied mathematics from the University of Bristol in 2006, where she was also a CASE student with Hewlett Packard laboratories. She worked in Oxford as a research fellow, was appointed as a faculty member at the University of Bath in 2012, and moved to Strathclyde in 2019. Apala's research program is strongly interdisciplinary, and her scientific achievements and service to the community have been recognized by several national prizes - a London Mathematical Society Anne Bennett Prize in 2015, two prizes from the British Liquid Crystal Society in 2012 and 2020, respectively, an Academic Leader award from the FDM Everywoman in Technology Awards and a Suffrage Science Award for inspirational women in STEM in 2020, and an international Humboldt Foundation Friedrich Wilhelm Bessel Award in 2022. Apala was elected a Fellow of the Royal Society of Edinburgh in 2024. Apala has worked extensively with researchers around the world - UK, Europe, Asia, North and South America, and is also the Associate Dean for International Research for the Faculty of Science at the University of Strathclyde. More details about her research and activities can be found at https://www.strath.ac.uk/staff/majumdarapalaprofessor.

Bound-Preserving High Order Schemes for Hyperbolic Equations: Survey and Recent Developments

Chi-Wang Shu
Brown University

Solutions to many hyperbolic equations have convex invariant regions, for example, solutions to scalar conservation laws satisfy maximum principle, solutions to compressible Euler equations satisfy positivity-preserving property for density and internal energy, etc. It is, however, a challenge to design schemes whose solutions also honor such invariant regions. This is especially the case for high-order accurate schemes. In this talk, we will first survey strategies in the literature to design high-order bound-preserving schemes, including the general framework in constructing high-order bound-preserving finite volume and discontinuous Galerkin schemes for scalar and systems of hyperbolic equations through a simple scaling limiter and a convex combination argument based on first order boundpreserving building blocks, and various flux limiters to design high order bound-preserving finite difference schemes. We will then discuss a few recent developments, including high-order bound-preserving schemes for relativistic hydrodynamics, high-order discontinuous Galerkin Lagrangian schemes, high-order discontinuous Galerkin methods for radiative transfer equations, high-order discontinuous Galerkin methods for MHD, and implicit bound-preserving schemes. Numerical tests demonstrating the good performance of these schemes will be reported.

Bio: Prof. Chi-Wang Shu obtained his BS degree from the University of Science and Technology of China in 1982 and his PhD degree from UCLA in 1986. He has been at Brown University since 1987 as the Chair of the Division of Applied Mathematics between 1999 and 2005 and from 2023 until now. He is the Theodore B. Stowell University Professor of Applied Mathematics. His research interest includes high-order numerical methods for solving hyperbolic and other convection dominated PDEs, with applications in CFD and other areas. He is the Chief Editor of the Journal of Scientific Computing and Communications on Applied Mathematics and Computation. He serves on the editorial boards of several other journals, including the Journal of Computational Physics. He is an SIAM Fellow, an AMS Fellow, and an AWM Fellow, and received the First Feng Kang Prize of Scientific Computing in 1995, the SIAM/ACM Prize in Computational Science and Engineering in 2007, and the SIAM John von Neumann Prize in 2021.

Accelerating Exponential Integrators

Alexander Ostermann
University of Innsbruck

Exponential integrators are a well-established class of time integration schemes for the numerical solution of large systems of evolution equations. Unlike other time integration schemes, they solve the linear part of the problem exactly and discretize the nonlinearity with an explicit scheme. In situations where the nonlinearity is small, this results in very accurate schemes with good stability properties. Nowadays, exponential integrators are widely used for the integration of stiff problems resulting from the spatial discretization of semilinear parabolic problems or for highly oscillatory problems resulting from wave equations or dispersive problems such as Schrödinger-type equations.

The implementation of exponential integrators relies on computing the action of certain matrix functions (exponential, trigonometric, and related functions) on vectors. For small problems, these matrix functions are computed explicitly, but for large problems, the action has to be computed by iterative methods such as Krylov subspace methods or Lagrange interpolation at Leja points. In situations where these actions can be computed reliably and efficiently, exponential integrators will show their advantages. Note that some acceleration techniques work very well with modern HPC installations. In this talk, I will discuss two new approaches: μ-mode integrators for evolution equations in Kronecker form and accelerated methods that make use of simplified linearizations.

The μ-mode integrator is related to splitting methods and is based on one-dimensional precomputed exponentials. This technique can also be used to efficiently compute the spectral transform when a fast transform is not available. The accelerated integrator uses matrix functions from a related (but simpler) problem that can be computed cheaply. Numerical experiments in two and three dimensions demonstrate the effectiveness of these two new approaches.

Bio: Alexander Ostermann is a Professor of Numerical Analysis and Scientific Computing at the University of Innsbruck, Austria. He received his Ph.D. in Innsbruck and was a postdoctoral fellow at the University of Geneva, Switzerland. His research focuses on the numerical solution of partial differential equations. In particular, he has worked on implicit and linearly implicit Runge-Kutta methods (with Christian Lubich), on the development of exponential integrators and their stiff order conditions (with Marlis Hochbruck), on the correct treatment of nontrivial boundary conditions in splitting methods (with Lukas Einkemmer), and numerical integrators for dispersive equations with extremely rough initial data (with Katharina Schratz).

Alexander Ostermann is a board member of ICIAM, the International Council for Industrial and Applied Mathematics. He was also Dean of the School of Mathematics, Computer Science and Physics at the University of Innsbruck for eight years and a member of several scientific societies and boards.

Structure Preserving Schemes Using the Lagrange Multiplier Approach

Jie Shen
Eastern Institute of Technology, Ningbo

I will present a Lagrange multiplier approach to construct highly efficient and accurate structure-preserving schemes for a class of complex nonlinear systems with global (e.g., energy dissipation) and/or local (e.g., positivity or length preserving) constraints. I shall also present some recent advances in the error analysis of this approach in some special cases.

Bio: Professor Jie Shen received his B.S. in Computational Mathematics from Peking University in 1982, and his Ph.D in Numerical Analysis from Universite de Paris-Sud (currently Paris Saclay) at Orsay in 1987. He worked at Indiana University (1987-1991), Penn State University (1991-2001), University of Central Florida (2001-2002) and Purdue University (2002-2023). He served as the Director of the Center for Computational and Applied Mathematics at Purdue University from 2012 to 2022 and was ratified as Distinguished Professor of Mathematics at Purdue University in 2023. In May 2023, he joined the Eastern Institute of Technology, Ningbo, China, as a Chair Professor and Dean of the School of Mathematical Science.

He received the Fulbright "Research Chair" Award in 2008, and the Inaugural Research Award of the College of Science at Purdue University in 2013, and he is an elected Fellow of AMS and SIAM.

Modeling, Analysis, and Simulation for Degenerate Dipolar Quantum Gas

Weizhu Bao
National University of Singapore

In this talk, I will present our recent work on mathematical models, asymptotic analysis, and numerical simulation for degenerate dipolar quantum gas. As preparatory steps, I begin with the three-dimensional Gross-Pitaevskii equation with a long-range dipolar interaction potential, which is used to model the degenerate dipolar quantum gas and reformulate it as a Gross-Pitaevskii-Poisson type system by decoupling the two-body dipolar interaction potential which is highly singular into short-range (or local) and long-range interactions (or repulsive and attractive interactions). Based on this new mathematical formulation, we rigorously prove the existence and uniqueness, as well as the nonexistence of the ground states, and discuss the existence of a weak global solution and finite time blowup of the dynamics in different parameter regimes of the dipolar quantum gas.

In addition, a backward Euler sine pseudospectral method is presented for computing the ground states, and a time-splitting sine pseudospectral method is proposed to compute the dynamics of dipolar BECs. Due to the adoption of a new mathematical formulation, our new numerical methods avoid evaluating integrals with high singularity, and thus, they are more efficient and accurate than the numerical methods currently used in the literature for solving the problem. In addition, new mathematical formulations in two dimensions and one dimension for dipolar quantum gas are obtained when the external trapping potential is highly confined in one or two directions. Numerical results are presented to confirm our analytical results and demonstrate the efficiency and accuracy of our numerical methods. Some interesting physical phenomena are discussed as well.

Bio: Weizhu BAO is a Professor at the Department of Mathematics, National University of Singapore (NUS). He got his PhD from Tsinghua University in 1995. Afterward, he had postdoc and faculty positions at Tsinghua University, Imperial College, Georgia Institute of Technology, and the University of Wisconsin at Madison. His research interests include numerical methods for partial differential equations, scientific computing/numerical analysis, and analysis and computation for problems from physics, chemistry, biology, and engineering sciences. He has made significant contributions to the modeling and simulation of Bose-Einstein condensation, solid-state dewetting, and geometric PDEs, as well as in multiscale methods and analysis for highly oscillatory PDEs. He was on the Editorial Board of the SIAM Journal on Scientific Computing from 2009 to 2014 and is currently on the Editorial Board of the SIAM Journal on Numerical Analysis. He was awarded the Feng Kang Prize in Scientific Computing by the Chinese Computational Mathematics Society in 2013. Weizhu Bao was an invited speaker at the ICM 2014 in Seoul. He is a Fellow of the American Mathematical Society, the Society of Industrial and Applied Mathematics, and the Singapore National Academy of Science.

Inverse Problems to Mean Field Game Systems: Analysis and Computation

Kui Ren
Columbia University

Mean field game models have been developed in different application areas. We will provide an overview of recent developments in inverse problems to mean field game models where we are interested in reconstructing missing information from observed data. We present a few different scenarios where differential data allows for the unique identification of model parameters in various forms, as well as numerical methods for computing the inverse solutions.

Bio: Kui Ren received his B.S. from Nanjing University in China and obtained his Ph.D. from the Applied Mathematics program in the APAM Department at Columbia University in May 2006. Following his Ph.D., he moved to the University of Chicago in 2007 where he worked as the L. E. Dickson instructor. In Fall, 2008, Ren joined the University of Texas at Austin as an assistant professor in the Department of Mathematics and the Institute for Computational Sciences, Engineering and Mathematics (ICES) and was promoted to Associate Professor in 2014.

Prof. Ren's research involves several aspects of applied and computational mathematics. His recent work includes theoretical and numerical analysis of inverse problems related to partial differential equations with applications in biomedical imaging, mathematical modeling and computation of the propagation of high frequency acoustic/electromagnetic waves in random media, numerical and mathematical studies of random graphs and networks, as well as numerical algorithms for kinetic modeling of electrostatics and charge transport in semiconductor devices.

Maximum Bound Principle and Non-negativity Preserving ETD Schemes for a Phase Field Model of Prostate Cancer Growth with Treatment

Zhonghua Qiao
The Hong Kong Polytechnic University

Prostate cancer (PCa) is a significant global health concern that affects the male population. In this study, we present a numerical approach to simulate the growth of PCa tumors and their response to drug therapy. The approach is based on a previously developed model, which consists of a coupled system comprising one phase field equation and two reactiondiffusion equations. To solve this system, we employ the fast second-order exponential time differencing Runge-Kutta (ETDRK2) method with stabilizing terms. This method is a decoupled linear numerical algorithm that preserves three crucial physical properties of the model: a maximum bound principle (MBP) on the order parameter and non-negativity of the two concentration variables. Our simulations allow us to predict tumor growth patterns and outcomes of drug therapy over extended periods, offering valuable insights for both basic research and clinical treatments.

Bio: Dr. Qiao Received his PhD at Hong Kong Baptist University in 2006. He worked as a postdoctoral research fellow at North Carolina State University from 2006 to 2008. After that, he worked as a research assistant professor at Hong Kong Baptist University from 2008 to 20011. In December 2011, he joined the Department of Applied Mathematics at the Hong Kong Polytechnic University as an Assistant Professor and was promoted to Associate Professor in 2017 and Professor in 2021.

Dr. Qiao’s research concentrates on the numerical investigation of nonlinear mathematical models in phase transition simulations, e.g., multiphase flow problems, material science, biology, etc. He has published several high-quality papers in prestigious journals, including SIAM Review. In 2013, he attained the 2013-2014 Early Career Award from the Research Grants Council (RGC) of Hong Kong. He won the Hong Kong Mathematical Society Award for Young Scholars in 2018. In 2020, he was conferred the title “RGC Research Fellow” by the RGC of Hong Kong.

PDEformer: Towards a Foundation Model for Solving Parametric PDEs and Beyond

Bin Dong
Peking University

Deep learning has emerged as a dominant approach in machine learning and has achieved remarkable success in various domains such as computer vision and natural language processing. Its influence has progressively extended to numerous research areas within the fields of science and engineering. In this presentation, I will outline our work on the design and training of a foundation model, named PDEformer, which aims to serve as a flexible and efficient solver across a spectrum of parametric PDEs. PDEformer is specifically engineered to facilitate a range of downstream tasks, including but not limited to parameter estimation and system identification. Its design is tailored to accommodate applications necessitating repetitive solving of PDEs, where a balance between efficiency and accuracy is sought.

Bio: Bin Dong is a faculty member of the Beijing International Center for Mathematical Research at Peking University. He is also the assocaite director of the Center for Machine Learning Research at Peking University and an affiliated faculty member of the National Biomedical Imaging Center and the National Engineering Laboratory for Big Data Analysis and Applications. He received his B.S. from Peking University in 2003, M.Sc from the National University of Singapore in 2005, and Ph.D. from the University of California Los Angeles in 2009. Bin Dong's research interests are mathematical analysis, modeling, and computations in computational imaging, scientific computing, and machine learning. He currently serves on the editorial board of Inverse Problems and Imaging, CSIAM Transactions on Applied Mathematics, Journal of Computational Mathematics, and Journal of Machine Learning. He received the Qiu Shi Outstanding Young Scholar Award in 2014 and was invited to deliver a 45-minute sectional lecture at the International Congress of Mathematicians (ICM) 2022.

A Model-Based Approach for Continuous-Time Policy Evaluation with Unknown Lévy Process Dynamics

Xiaochuan Tian
University of California, San Diego

Reinforcement learning (RL) is an active branch of machine learning focused on learning optimal policies to maximize cumulative rewards through interaction with the environment. While traditional RL research primarily deals with Markov decision processes in discrete time and space, we explore RL in a continuous-time framework, which is essential for high-frequency interactions such as stock trading and autonomous driving. Our research introduces a PDE-based framework for policy evaluation in continuous-time environments, where dynamics are modeled by Lévy processes. We also formulate the Hamilton-Jacobi-Bellman (HJB) equation for the corresponding stochastic optimal control problem governed by Lévy dynamics. Our approach includes two primary components: 1) Estimating parameters of Lévy processes from observed data and 2) Evaluating policies by solving the associated integro-PDEs. In the first step, we use a fast solver for the fractional Fokker-Planck equation to accurately approximate transition probabilities. We demonstrate that combining this method with importance sampling techniques is vital for parameter recovery in heavy-tailed data distributions. In the second step, we offer a theoretical guarantee on the accuracy of policy evaluation considering modeling error. Our work establishes a foundation for continuous-time RL in environments characterized by complex, heavy-tailed dynamics.

Bio: Prof. Xiaochuan Tian is an Assistant Professor of Mathematics at the University of California, San Diego. She received her Ph.D. from Columbia University and was a Bing Instructor in the Department of Mathematics at the University of Texas, Austin. Her areas of research interest include numerical PDEs, nonlocal integral models, multiscale and stochastic modeling, and most recently, intersections of PDEs and data analysis. Her research is partially funded by the National Science Foundation CAREER grant and the Alfred P. Sloan Fellowship.

Dimension Lifting for Quantum Computation of partial differential equations and related problems

Shi Jin
Shanghai Jiao Tong University

Quantum computers have the potential to gain algebraic and even up to exponential speed compared with their classical counterparts and can lead to a technology revolution in the 21st century. Since quantum computers are designed based on the quantum mechanics principle, they are most suitable for solving the Schrodinger equation and linear PDEs (and ODEs) evolved by unitary operators. The most efficient quantum PDE solver is a quantum simulation based on solving the Schrodinger equation. It will be interesting to explore what other problems in scientific computing, such as ODEs, PDEs, and linear algebra arising in both classical and quantum systems, can be handled by quantum simulation.

We will present a novel and systematic approach to developing quantum simulation algorithms for general differential equations. Our innovative framework, dimension lifting, transfers nonlinear PDEs to linear ones, and linear ones to Schrodinger type PDEs. For nonautonomous PDEs and ODEs, or Hamiltonian systems with time-dependent Hamiltonians, we also add an extra dimension to transform them into autonomous PDEs that have only time-independent coefficients. This allows quantum simulations to be done without using the cumbersome Dyson's series and time-ordering operators. Our formulation allows both qubit and qumode (continuous-variable) formulations, and their hybridizations, and provides the foundation for analog quantum computing.

Bio: Shi Jin is the Director of the Institute of Natural Sciences and Chair Professor of Mathematics at Shanghai Jiao Tong University. He is also a co-director of the Shanghai Center of Applied Mathematics. Shi Jin obtained his B.S. degree from Peking University and his Ph.D. from the University of Arizona. He was a postdoc at Courant Institute, New York University, an assistant and associate professor at Georgia Institute of Technology, and a full professor, department chair and Vilas Distinguished Achievement Professor at University of WisconsinMadison, Chair of Department of Mathematics at Shanghai Jiao Tong University. Shi Jin received a Feng Kang Prize of Scientific Computing in 2001 and a Morningside Silver Medal of Mathematics at the International Congress of Chinese Mathematicians in 2007. He is an inaugural Fellow of the American Mathematical Society (AMS) (2012), a Fellow of the Society of Industrial and Applied Mathematics (SIAM) (2013), an inaugural Fellow of the China Society for Industrial and Applied Mathematics (CSIAM) (2020), and an Invited Speaker at the International Congress of Mathematicians in 2018.

Energy-Dissipative Spectral Renormalization Exponential Integrator Method for Gradient Flow Problems

Lili Ju
University of South Carolina

In this talk, we present a novel spectral renormalization exponential integrator method for solving gradient flow problems. Our method is specifically designed to simultaneously satisfy discrete analogs of the energy dissipation laws and achieve high-order accuracy in time. Our method first incorporates the energy dissipation law into the target gradient flow equation by introducing a time-dependent spectral renormalization (TDSR) factor. Then, the coupled equations are discretized using the spectral approximation in space and the exponential time differencing (ETD) in time. Finally, the resulting fully discrete nonlinear system is decoupled and solved using the Picard iteration at each time step. Furthermore, we introduce an extra enforcing term into the system for updating the TDSR factor, which greatly improves the solvability and the time step size restriction of the proposed method and enhances its computational efficiency. Extensive numerical tests with various gradient flows are presented to demonstrate the accuracy and effectiveness of our method as well as its high efficiency when combined with an adaptive time-stepping strategy for long-term simulations.

Bio: Dr. Lili Ju earned a B.S. degree in Mathematics from Wuhan University, China, in 1995, an M.S. degree in Computational Mathematics from the Chinese Academy of Sciences in 1998, and a Ph.D. degree in Applied Mathematics from Iowa State University in 2002. He completed two years of postdoctoral training at the Institute for Mathematics and its Applications at the University of Minnesota before joining the University of South Carolina as an Assistant Professor of Mathematics in 2004. He was then promoted to Associate Professor in 2008 and Full Professor in 2013. Dr. Ju's research interests include numerical PDEs, nonlocal modeling and computation, deep learning methods, computer vision, high-performance computing, and their applications to computational geoscience and materials science. He has published over 150 papers in academic journals and conference proceedings, with a Google Scholar record of over 6,000 citations. Since 2006, Dr. Ju's research has been continuously supported by many grants from the U.S. National Science Foundation and the U.S. Department of Energy. From 2012 to 2017, Dr. Ju served as an Associate Editor for SIAM J. Numer. Anal., and currently, he serves as an Associate Editor for several journals in the field of computational and applied mathematics, including Math. Comp., J. Sci. Comput., Numer. Meths. PDEs, and so on.

Numerical Understanding of Neural Networks: from Representation to Learning Dynamics

Hongkai Zhao
Duke University

In this talk I will present both numerical analysis and experiments to understand a few basic computational issues in using neural network to approximate functions: (1) the numerical error that can be achieved given a finite machine precision, (2) the learning dynamics and computation cost to achieve certain accuracy, and (3) structured and balanced approximation. These issues are studied for both approximation and optimization in asymptotic and non-asymptotic regimes.

Bio: Prior to joining Duke, Zhao was the Chancellor's Professor of Mathematics and Computer Science at the University of California, Irvine (UCI). He earned his B.S. from Peking University (China), his M.S. from University of Southern California and his Ph.D. from UCLA, all in mathematics. He was also the Gábor Szegő Assistant Professor at Stanford University before joining UCI, and has received the Sloan Research Fellowship (2002–2004), Feng Kang Prize for Scientific Computing in 2007 and Chang-Jiang Guest Professorship at Peking University in 2009.

Much of Zhao's recent work has focused on inverse and imaging problems, which have direct applications for medical technologies such as CT scans, MRI scans, ultrasound, optical tomography, and radar imaging. Based on different physical models and imaging modalities, the goal is to construct images or infer desired biomedical information from the obtained measurements.

One of Zhao's focuses is developing, improving, and analyzing the algorithms involved in the imaging pipeline. In practice, small perturbations in measurement can lead to large differences in the imaging results. By making more efficient algorithms and exploiting redundancy in the measurements, Zhao's work can lead to more accurate images in less time, reducing radiation doses and exposure. Another of Zhao's specialties is numerical methods for partial differential equations, which are essential to mathematical modeling in the physical sciences. Their applications in material science, quantum chemistry, climate modeling, and geophysical explorations offer exciting possibilities. One of Zhao's algorithms for calculating distance functions, the fast sweeping method, is already being used in VLSI integrated circuit design.

Zhao has also done work on 3-D shape modeling and analysis, which has applications in constructing, recognizing, and comparing objects. One challenge for shape recognition and comparison is that two intrinsically identical shapes can be represented or embedded in 3-D space in various ways, making them look completely different, like the same person in different poses, for example. An important task is to resolve ambiguities and align the objects under a non-rigid transformation. Zhao's recent work proposed efficient algorithms based on mathematical models of isometric transformation, which keeps the distance on the surface of the objects the same and novel feature space for non-rigid shape matching. In harmony with this work, Zhao has recently been exploring the fundamental complexity and limits of extracting information from high-dimensional data and signals. Combining insight from multiscale physical computation, inverse problems around imaging, and ideas from machine learning, he has informed questions in astrophysics and learning in physical systems.

The Role of Centroidal Voronoi Tessellations in Data Science and Applications

Maria Emelianenko
George Mason University

The notion of centroidal Voronoi tessellation (CVT) has been gaining popularity in recent decades in many application areas, ranging from biology and physics to finance, economics, and social science. The flexibility of the formulation and solid theoretical foundation afforded through the CVT energy minimization provide a fertile ground for developing a wide range of numerical tools and automation techniques impacting a wide range of scientific domains. It is particularly well studied in the context of mesh generation, clustering, quantization, imaging, reduced order modeling, and partial differential equations applications, where a number of theoretical results have been obtained attesting to its superior qualities compared to other competing methodologies. This presentation will provide a brief overview of some recent results in this area, focusing on new CVT-based algorithms related to optimal rain gauge location prediction and a new adaptive CVOD (centroidal Voronoi orthogonal decomposition)-based matrix column subset selection framework for interpretable dimension reduction in data-intensive applications.

Bio: Maria Emelianenko is a Professor and Chair of the Department of Mathematical Science at George Mason University. She graduated with a PhD in Mathematics from Pennsylvania State University. She held a postdoctoral research associate position at the Center for Nonlinear Analysis of Carnegie Mellon University before joining Mason faculty. Her work lies at the interface between mathematics and other areas of science and engineering, such as materials science, chemistry, and biology. Emelianenko's work has been supported by a number of National Science Foundation (NSF) grants, including the 2011 NSF CAREER award. She is a recipient of the 2009 ORAU Ralph E. Powe Junior Faculty Enhancement Award and the 2008 MAA Project NExT Fellowship. She served as an Associate Director of the Quantum Science and Engineering Center and co-directed several outreach and undergraduate research programs, including the first NSF-funded REU SITE at Mason. She has held multiple appointments in professional societies, including Vice Chair of the SIAM Activity Group in Materials Science and a SIAM representative to the US National Committee for Theoretical and Applied Mechanics.

Peking University Map

北京大学校园图
MAP
PKU
蔚秀园
Wei Xiu Yuan
承泽园
Cheng Ze Yuan
畅春园
Chang Chun Yuan
畅春新园
Chang Chun Xin Yuan
鸣鹤园
Ming He Garden
镜春园
勺园
Shao Yuan
静园
Jing Yuan
燕南园
Yan Nan Yuan
国家发展研究院
National School of Development
绣花楼
Xiuhua Building
北大西门站
Peking University West Gate Station
西门
West Gate
西侧门
West Side Gate
西南门
Southwest Gate
燕园街道办事处
Yan Yuan Community Administration Office
北京大学附属幼儿园
The Affiliated Kindergarten of Peking University
畅春园食堂
Chang Chun Yuan Dining Hall
北京大学附属中学北校区
The North Campus of The Affiliated Middle School of Peking University
实验动物中心
Laboratory Animal Center
荷花池
Lotus Pond
考古文博学院
School of Archaeology and Museology
生物技术楼
Biotechnology Building
赛克勒考古与艺术博物馆
Arthur M.Sackler Museum of Art and Archaeology
红湖
Red Lake
校景亭
Campus Scenery Pavilion
北京国际数学研究中心
Beijing International Center for Mathematical Research
红一楼至红六楼
Red Mansion No.1-6
德斋
De Hall
才斋
Cai Hall
均斋
Jun Hall
备斋
Bei Hall
民主楼
Democracy Building
外文楼
Foreign Languages Building
华表
Ornamental Columns
办公楼
Administrative Building
蔡元培像
Statue of the Former President Cai Yuanpei
钟亭
Bell Pavilion
翻尾石鱼
Stone Fish
化学北楼
North Chemistry Building
葛利普墓
Tomb of Grabau
档案馆
The Archives
化学南楼
South Chemistry Building
西南联大纪念碑
The Monument of National Southwestern Associated University
北阁
North Pavilion
临湖轩
Lin Hu Xuan
俄文楼
Russian Building
校史馆
Museum of University History
塞万提斯像
Statue of Cervantes
南阁
South Pavilion
李大钊像
Statue of Professor Li Dazhao
北京大学革命烈士纪念碑
Monument of Peking University Martyrs
一院
Courtyard No.1
二院
Courtyard No.2
三院
Courtyard No.3
四院
Courtyard No.4
五院
Courtyard No.5
六院
Courtyard No.6
国际关系学院
School of International Studies
勺园食堂
Shao Yuan Dining Hall
佟园餐厅(清真)
Tong Yuan Halal Restaurant
勺海
Shao Hai
网球场
Tennis Court
第二体育馆
Gymnasium No.2
篮球场
Basketball Court
正大国际中心
Chaitai International Center
核磁中心
Beijing Nuclear Magnetic Resonance Center
综合科研1号楼
Integrated Science Research Center No.1
综合科研2号楼
Integrated Science Research Center No.2
学五食堂
Student Dining Hall No.5
艺园餐厅
Yi Yuan Dining Hall
餐饮综合楼
Catering Building
松林餐厅
Song Lin Restaurant
学一食堂
Students' Dining Hall No.1
43楼
Building No.43
资源宾馆
Resource Hotel
海淀桥北站
Haidian Bridge North Station
花房
Greenhouse
北大—港理工中国社会工作研究中心（思鲁苑）
PKU-HK PolyU China Social Work Research Center
中国画法研究院
The Institute of Art of Chinese Painting


北
North
圆明园南门
Yuanmingyuan South Gate Station
圆明园站 地铁4号线
Yuan Ming Yuan Subway Line 4
科维理天文与天体物理研究所
Kavli Institute for Astronomy and Astrophysics
朗润湖
Lang Run Lake
国家发展研究院
National School of Development
中国古代史研究中心
Research on Ancient Chinese History
朗润园
Lang Run Yuan
斯坦福中心
PKU-Stanford Center
中国诗歌研究所
The Institute of Poetry Studies
外国语学院
School of Foreign Languages
北大博雅国际酒店
The Lakeview Hotel
北大科技园
University Science Park
成府园
Cheng Fu Yuan
清华西门站
Tsinghua University West Gate Station
小东门
Small East Gate
李兆基人文学苑
Lee Shao Kee Humanities Building
教育基金会
Peking University Education Foundation
经济学院(孝义金晖楼)
School of Economics
北京大学医院
University Hospital
全斋
Quan Hall
体斋、健斋
Ti & Jian Hall
帕卡德公寓
Packard Apartment
未名湖
Wei Ming Lake
东操场
East Playground
光华管理学院2号楼
Bldg No.2, Guanghua School of Management
政府管理学院(廖凯原楼)
School of Government
法学院(陈明楼)
Law School
中关园北站
Zhongguanyuan North Station
第一体育馆
Gymnasium No.1
鲁斯亭
Luce Pavilion
石舫
Marble Boat
花神庙
Temple of Flower Goddess
斯诺墓
Tomb of Mr. Edgar Snow
博雅塔
Boya Tower
方楼
Fang Building
微纳电子大厦
Micro & Nanoelectronics Building
法学院(凯原楼)
Law School
环境科学与工程学院(刘水楼)
School of Environmental Sciences and Engineering
陈守仁国际研究中心
Tan Siu Lin Center for International Studies
遥感楼
Remote Sensing Building
电话室
Office of Telephone Exchange
第一教学楼
Teaching Building No.1
生物标本馆
Museum of Biology
老生物楼
Old Biology Building
东侧门
Side East Gate
物理大楼
Physics Building
青鸟集团
Bei Da Jade Bird Group
出版大楼
Building of Peking University Press
加速器大楼
Accelerator Building
燕东园
Yan Dong Yuan
力学大院
Mechanics House
北大附小
Affiliated Primary School of Peking University
燕东幼儿园
Yan Dong Kindergarten
吕志和楼
Lui Che Woo Building
金光生命科学大楼
Sinar Mas Life Sciences Building
北京大学东门 地铁4号线
East Gate of Peking University Subway Line 4
东门
East Gate
文史楼
Chinese and History Building
图书馆
University Library
地学楼
Geology Building
老化学楼
Old Chemistry Building
招生办公室
理科教学楼(黄廷方楼)
Sciences Teaching Building
理科三号楼(曙东楼)
Sciences Building No.3
化学楼
Chemistry Building
方正大厦
Founder Science and Technology Building
燕园派出所
Yhao Yuan Police Station
中关园
Zhong Guan Yuan
哲学楼
Philosophy Building
燕南美食餐厅
Yan Nan Dining Hall
光华管理学院1号楼
Bldg No.1, Guanghua School of Management
理科一号楼
Natural Sciences Building No.1
理科二号楼(逸夫苑)
Natural Sciences Building No.2
英杰交流中心
Ho Ying Chie Overseas Exchange Center
东南门
Southeast Gate
百周年纪念讲堂
University Hall
电化教学楼(智华楼)
Audio-Visual Teaching Building
第二教学楼
Classroom Building No.2
第四教学楼
Classroom Building No.4
理科五号楼
Natural Science Building No.5
中关园站
Zhongguanyuan Station
中关新园
Zhongguanyuan Global Village
三角地
Triangle Area
农园餐厅
Nong Yuan Restaurant
第三教学楼
Classroom Building No.3
新太阳学生中心
New Sun Student Center
教育学院
Graduate School of Education
治贝子园
Zhibeizi Garden
对外汉语学院(方李邦琴楼)
School of Chinese as a Second Language
篮球场
Basketball Court
邱德拔体育馆
Khoo Teck Puat Gymnasium
信息管理系(方李邦琴楼)
Department of Information Management
五四运动场
May 4th Playground
五四体育中心
May 4th Sports Center
燕园大厦
Yan Yuan Building
新闻与传播学院(蒙民伟楼)
School of Journalism and Communication
王克桢楼
Wang ko Chiang Building
中关村北站
Zhongguancun North Station
资源西楼
West Resources Building
资源东楼
East Resources Building
南门
South Gate
POLICE 派出所 Police
宿舍 Residence
超市 Store
公交站 Bus
餐饮 Canteen
地铁 Subway
洗手间 Toilet
医院 Hospital

北京国际数学研究中心
BEIJING INTERNATIONAL CENTER FOR MATHEMATICAL RESEARCH