The 3rd CAS SIAM Student Chapter Annual Meeting

June 13th, 2015, Beijing

The 3rd CAS SIAM Student Chapter Annual Meeting will take place on Saturday, 13th June 2015 at Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, China.

The purpose of the meeting is to bring graduate students, young re-searchers and faculty together to share their works, exchange ideas and promote potential cooperation in computational mathematics, applied mathematics and their application in industry and real problems.

Committee

Faculty Advisor

Yaxiang Yuan (Chinese Academy of Sciences, China)

Officers

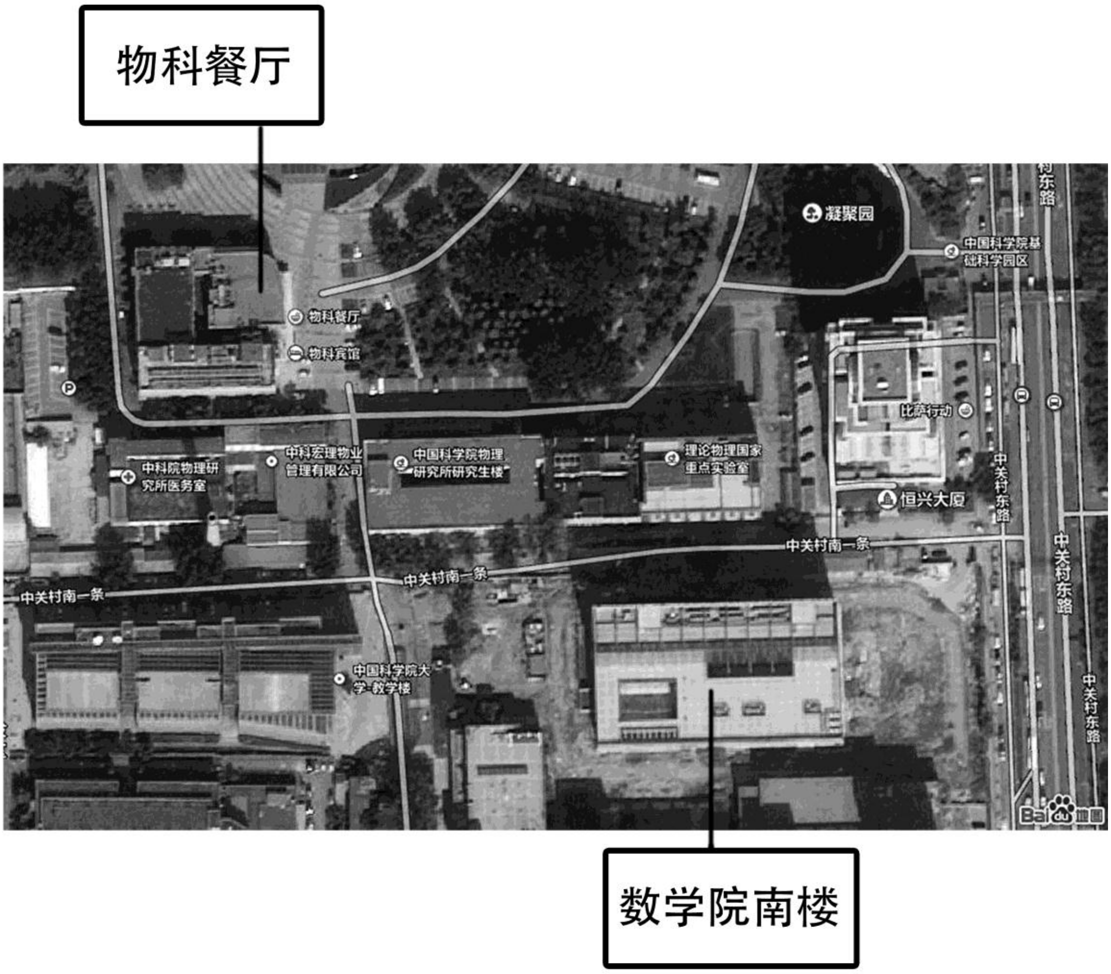
Ran Gu (Chinese Academy of Sciences, China)
Beibei Zhu (Chinese Academy of Sciences, China)
Manting Xie (Chinese Academy of Sciences, China)
Zhiyu Tan (Chinese Academy of Sciences, China)

Sponsor

Society for Industrial and Applied Mathematics (SIAM)
Institute of Computational Mathematics and
Scientific/Engineering Computing of Chinese Academy of Sciences

Contact Information

Email: siamstuch@lsec.cc.ac.cn
Zhiyu Tan: +86 15652766050



Schedule

Venue: N204 South Building, AMSS, CAS

07:50-08:10 **Registration**

08:10-08:30 **Opening Ceremony**

08:30-09:20 **Plenary Talk: Song Jiang**
An Asymptotic Preserving Unified Gas Kinetic Scheme for Grey Radiative Transfer Equations

09:20-10:00 **Hui Xie**
Mass Conservative Domain Decomposition for Multiscale PDEs

10:00-10:30 **Coffee Break &Conference Photography**

10:30-11:20 **Plenary Talk: Hehu Xie**
Aubin-Nitsche 技巧及其应用

11:20-12:00 **Xue Peng**
与保正型相联系的伪马氏过程

12:00-13:30 **Lunch: The 2nd floor, Wu-Ke Restaurant**

14:30-15:20 **Plenary Talk: Ruo Li**
在一些问题上的私下尝试

15:20-16:00 **Jie Zhang**
Coarse-to-Fine Auto-Encoder Networks (CFAN) for Real-Time Face Alignment

16:00-16:20 **Coffee Break**

16:20-17:00 **Wei Su**
博弈观点下的种群方程

17:00-17:40 **Zhenli Sheng**
Geometric Buildup-based Error Minimization Algorithms for Distance Geometry Problem with Sparse Large-noise Data

Abstract

An Asymptotic Preserving Unified Gas Kinetic Scheme
for Grey Radiative Transfer Equations

Song Jiang
Institute of Applied Physics and Computational Mathematics, Beijing

The solutions of radiative transport equations can cover both optical thin and optical thick regimes due to the large variation of photon's mean free path and its interaction with the material. In the small mean free path limit, the nonlinear time-ependent radiative transfer equations can converge to an equilibrium diffusion equation due to the intensive interaction among radiation and material. In the optical thin limit, the photon free transport mechanism will emerge. In this paper, we are going to develop an accurate and robust asymptotic preserving unified gas kinetic scheme (AP-UGKS) for the grey radiative transfer equations, where the radiation transport equation is coupled with the material thermal energy equation. The current work is based on the UGKS framework for the rarefied gas dynamics [K. Xu and J.C. Huang, J. Comput. Phys. 229 (2010), 7747-7764], and is an extension of a recent work [L. Mieussens, J. Comput. Phys. 253(2013), 138-156] from a one-dimensional linear radiation transport equation to a nonlinear two-dimensional grey radiative system. The newly developed scheme has the asymptotic preserving (AP) property in the optically thick regime in the capturing of diffusive solution without using a cell size being smaller than the photon's mean free path and time step being less than the photon collision time. Besides the diffusion limit, the scheme can capture the exact solution in the optical thin regime as well. The current scheme is a finite volume method. Due to the direct modeling for the time evolution solution of the interface radiative intensity, a smooth transition of the transport physics from optical thin to optical thick can be accurately recovered. Many numerical examples are included to validate the current approach. Finally, an extension of the proposed AP UGKS scheme to the frequency-dependent radiative transfer system will be discussed. (joint work with Wenjun Sun and Kun Xu)

Mass Conservative Domain Decomposition for Multiscale PDEs

Hui Xie
AMSS, Chinese Academy of Sciences

In this talk, we give some new coarse correction matrices to design domain decomposition (DD) preconditioners for solving multiscale finite volume algebraic system. The key ingredients of our coarse correction matrices are based on several operators, which are prolongation, restriction and correction operators. Using the coarse correction matrices, together with one-level additive Schwarz method as a local solver, we may get several efficient preconditioners for the fine-scale finite volume linear system. Techniques used in some well-known multiscale methods are important and inspire us to combine them to generate different kinds of these operators. A variety of numerical examples are presented to confirm the validity and robustness of our coarse correction matrices.

Aubin-Nitsche 技巧及其应用

Hehu Xie
AMSS, Chinese Academy of Sciences

本报告将从有限元方法中的 Aubin-Nitsche 技巧出发，在新的情况下如何得到 Aubin-Nitsche 技巧类似的结果。然后慢慢递进，讨论这种方法在求解一些偏微分方程和特征值问题中的应用。

与保正型相联系的伪马氏过程

Xue Peng
AMSS, Chinese Academy of Sciences

狄氏型理论在解析位势论与马氏过程理论之间架起了一座桥梁。该理论的进一步发展包括了保正型理论及其应用。保正型由于其对应的半群仅仅具有保正性，所以需要运用 h-变换才能建立与马氏过程的对应关系。本次报告主要围绕对同一个保正型，经过不同 h-变换得到的不同马氏过程具有哪些不变量这个问题展开，得到的结论是构造了与 h-变换的选择无关的伪马氏过程。

在一些问题上的私下尝试

Ruo Li
School of Mathematical Sciences, Peking University

我自己私下在几个比较干净而困难的问题上做过一些尝试，当然总体上来说是很失败的，基本上没有有用的结果，但是其中一些细节的计算过程也给人以希望。我以一种很非正式地方式将我自己所做的这些尝试共享给各位同学，希望能够引起同学们对这些问题的关注，激起同学们在这些问题进行一些尝试的兴趣。我预计谈到的内容主要会涉及到湍流和多体问题等，但是不需要有任何相关的背景知识。

Coarse-to-Fine Auto-Encoder Networks (CFAN) for Real-Time Face Alignment

Jie Zhang
Institute of Computing Technology, Chinese Academy of Sciences

Accurate face alignment is a vital prerequisite step for most face perception tasks such as face recognition, facial expression analysis and non-realistic face re-rendering. It can be formulated as the nonlinear inference of the facial landmarks from the detected face region. Deep network seems a good choice to model the nonlinearity, but it is nontrivial to apply it directly. Instead of a straightforward application of deep network, we propose a Coarse-to-Fine Auto-encoder Networks (CFAN) approach, which cascades a few successive Stacked Auto-encoder Networks (SANs). Specifically, the first SAN predicts the landmarks quickly but accurately enough as a preliminary, by taking as input a low-resolution version of the detected face holistically. The following SANs then progressively refine the landmark by taking as input the local features extracted around the current landmarks (output of the previous SAN) with higher and higher resolution. Extensive experiments conducted on challenging datasets demonstrate that our CFAN outperforms the state-of-the-art methods and performs in real-time.

博弈观点下的种群方程

Wei Su

AMSS, Chinese Academy of Sciences

对已有的种群方程，探索用博弈的观点，将它们重新推导出来。首先，寻找到一个泛函量，使得单种群系统模型是该泛函对应的 Euler-Lagrange 方程，并证明了渐近稳定的单种群模型使得该泛函在某个无限函数集合上取得最大值。对于两个物种相互作用形成的两种群系统,构造了一个博弈，把每个物种的动力学看作自己的策略，泛函量看作各自的支付函数，导出经典的两种群模型—Lotka-Volterra 方程，并证明了渐近稳定的两种群方程是该博弈的广义纳什均衡。两物种系统采用的泛函量及极值解与单物种系统的泛函量及极值解具有形式上的一致性，说明种群在演化过程中，每个物种的动力学机制保持不变的形式。

Geometric Buildup-based Error Minimization Algorithms for Distance Geometry Problem with Sparse Large-noise Data

Zhenli Sheng

AMSS, Chinese Academy of Sciences

Distance Geometry Problem has attracted a great deal attentions in recent years due to its wide applications in biology, environmental monitor and sensor-based applications, etc. Based on the fast Geometric Buildup algorithms developed by Wu and his coauthors, we propose enhanced Geometric Buildup algorithms (GBEM-LLS and GBEM-NLS). Our main contribution is two-fold. First, we analysis the importance of computation order and carefully design a buildup sequence to make our algorithms much more stable than before. Second, a novel framework is proposed such that error minimization technique is integrated in every buildup process to control error accumulation effectively, which is a dominant disadvantage of the original algorithms. Extensive numerical experiments show that our algorithms can give reasonably good results in short computation time. For instance, given inter-atomic distances which are less than 6Å and are corrupted with 10% multiplicative noise, a 5681-atom can be

realized within 3 minutes with a root-mean-square-deviation (RMSD) of 0.24Å. The former state-of-the-art Geometric Buildup methods can only handle at most 0.01% noise with distances under 6Å, our novel algorithms can deal with 10% noises, which makes the Geometric Buildup methods practical, hence can be applied in real problems.