THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

DEPARTMENT OF APPLIED MATHEMATICS
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The Hong Kong Polytechnic University
Department of Applied Mathematics

Seminar

Recent advances in dynamical low-rank approximation for kinetic equations

By

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Abstract

Solving high-dimensional kinetic equations (such as the Vlasov equation or the Boltzmann equations) numerically is extremely challenging. Methods that discretize phase space suffer from the exponential growth of the number of degrees of freedom, the so-called curse of dimensionality, while Monte Carlo methods converge slowly and suffer from numerical noise. In addition, standard complexity reduction techniques (such as sparse grids) usually perform rather poorly due to the lack of smoothness for such problems. Dynamical low-rank techniques approximate the dynamics by a set of lower-dimensional objects. For those low-rank factors, partial differential equations are derived that can then be solved numerically. We will show that such dynamical low-rank approximations work well for a range of kinetic equations due to their capacity to handle non-smooth solutions and the fact that in many situations important physical limit regimes are represented very efficiently by such an approximation (e.g. fluid or diffusive limits in radiation transport or simplified models of shear Alfven waves). Recently, we were able to develop a dynamical low-rank approach that is mass, momentum, and energy conservative. This scheme is based on modifying the Petrov-Galerkin condition in such a way as to ensure the preservation of these important invariants. We will demonstrate that using this approach greatly improves the fidelity of the computed numerical solutions.

Biography

Prof. Lukas Einkemmer received his PhD degree and Habilitation in mathematics from University of Innsbruck in 2014 and 2017, respectively. After his habilitation, he became Associate Professor at the University of Innsbruck and also a scientific staff at the University of Tübingen. He was awarded SciCADE New Talent Award in 2015, and Prize of the State Capital Innsbruck for scientific research in 2017. Prof. Einkemme's research mainly focuses on scientific computing, numerical analysis, and plasma physics, especially the methods that conserve the physical structure of the underlying equation and methods that can utilize modern high-performance computing systems.

Date: 16 November 2022 (Wednesday)
Time: 16:30-17:30 (Hong Kong Standard Time GMT +8)
Venue: Online Talk via Zoom (Meeting ID: 952 8790 0375)
Speaker: Prof. Lukas Einkemmer, University of Innsbruck
Host: Dr. Buyang Li, The Hong Kong Polytechnic University
Click to join:
https://polyu.zoom.us/j/95287900375?pwd=Z3RuTWtNZjM2QmZnRElnTXZMNGVyZz09

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