



MATH-IMS Joint Applied Mathematics Colloquium Series The Chinese University of Hong Kong

This MATH-IMS Joint Colloquium Series is organized by Center for Mathematical Artificial Intelligence (CMAI), under Department of Mathematics and Institute of Mathematical Sciences (IMS) at The Chinese University of Hong Kong. The colloquium series focuses on mathematics and applications of artificial intelligence, big data and related topics.

Date: November 20, 2020 (Friday)

Time: 10am – 11am (Hong Kong Time)

Zoom Link: <https://cuhk.zoom.us/j/92775210812>

Random Batch Methods for classical and quantum N-body problems

Speaker: Professor Shi Jin
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Abstract: We first develop random batch methods for classical interacting particle systems with large number of particles. These methods use small but random batches for particle interactions, thus the computational cost is reduced from $O(N^2)$ per time step to $O(N)$, for a system with N particles with binary interactions. For one of the methods, we give a particle number independent error estimate under some special interactions.

This method is also extended to molecular dynamics with Coulomb interactions, in the framework of Ewald summation, and to quantum Monte-Carlo methods for the N -body Schrodinger equation. In each case we will show its superior performance compared to the current state-of-the-art methods for the corresponding problems, in the computational efficiency and parallelizability.

For quantum N -body Schrodinger equation, we also obtain, for pair-wise random interactions, a convergence estimate for the Wigner transform of the single-particle reduced density matrix of the particle system at time t that is uniform in $N > 1$ and independent of the Planck constant \hbar . To this goal we need to introduce a new metric specially tailored to handle at the same time the difficulties pertaining to the small \hbar regime (classical limit), and those pertaining to the large N regime (mean-field limit).

Bio: Prof. Shi Jin is the Director of 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. He obtained his BS degree from Peking University and his Ph.D. from University of Arizona. He was a postdoc at Courant Institute, New York University, an assistant and associate professors at Georgia Institute of Technology, and a full professor, department chair and Vilas Distinguished Achievement Professor at University of Wisconsin-Madison, Chair of Department of Mathematics at Shanghai Jiao Tong University.

He 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 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.