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.

Time: 9am – 10am, July 31, 2020 (Friday) (Hong Kong Time)
Zoom Link: https://cuhk.zoom.us/j/92775210812

A Geometric Understanding of Generative Models
Speaker: Professor David Xianfeng GU

Abstract: This work introduces an optimal transportation (OT) view of generative adversarial networks (GANs). Natural datasets have intrinsic patterns, which can be summarized as the manifold distribution principle: the distribution of a class of data is close to a low-dimensional manifold. GANs mainly accomplish two tasks: manifold learning and probability distribution transformation. The latter can be carried out using the classical OT method. From the OT perspective, the generator computes the OT map, while the discriminator computes the Wasserstein distance between the generated data distribution and the real data distribution; both can be reduced to a convex geometric optimization process. Furthermore, OT theory discovers the intrinsic collaborative—instead of competitive—relation between the generator and the discriminator, and the fundamental reason for mode collapse. We also propose a novel generative model, which uses an autoencoder (AE) for manifold learning and OT map for probability distribution transformation. This AE–OT model improves the theoretical rigor and transparency, as well as the computational stability and efficiency; in particular, it eliminates the mode collapse. The experimental results validate our hypothesis, and demonstrate the advantages of our proposed model.

Bio: Professor David Xianfeng Gu got his bachelor's degree from Tsinghua university, PhD in computer science from Harvard university, supervised by the Fields medalist, Prof. Shing-Tung Yau. Currently, Prof. Gu is a New York State Empire Innovation Professor in the Computer Science Department, Stony Brook university. Prof. Gu's research focuses on applying modern geometry in engineering and medicine fields. Together with Prof. Shing-Tung Yau, Prof. Gu and other collaborators have founded an interdisciplinary field: Computational Conformal Geometry. Prof. Gu has won NSF Career award, Morningside Gold medal in applied Mathematics.