# 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:** March 5, 2021 (Friday)
**Time:** 10-11am (Hong Kong Time)
**Zoom Link:** https://cuhk.zoom.us/j/92775210812

# Contact Line Dynamics of Droplots with Surfactant: Variational Derivation and Computations
## *Speaker: Professor Jian-guo Liu, Duke University*

**Abstract:** The capillary effect caused by the interfacial energy dominates the dynamics of small droplets, particularly the contact lines (where three phases meet). With insoluble surfactant laden on the capillary surface, the dynamics of droplets to some textured substrates becomes more complicated: (i) insoluble surfactant disperses along the evolutionary capillary surface (ii) the surfactant-dependent surface tension will in turn drive the full dynamics of droplets, particularly the moving contact lines. Using Onsager's principle with different Rayleigh dissipation functionals, we derive and compare both the geometric motion of the droplets and the viscous flow model inside the droplets. To enforce impermeable obstacle constraint, the full dynamics of the droplet can be formulated as a gradient flow on a manifold with boundary, which leads to efficient computations. We propose an unconditionally stable scheme based on explicit moving boundaries and arbitrary Lagrangian Eulerian method. After adapting a projection method for a variational inequality with phase transition information on emerged contact lines, we use those numerical schemes to simulate the contact angle hysteresis, unavoidable splitting of droplets on inclined textured substrates. This is a joint work with Yuan Gao of Duke University

**Bio:** Professor Jian-guo Liu obtained his B.S. and M.S. degrees in Fudan University (China), and a Ph.D in University of California at Los Angeles. He is currently a Professor of Mathematics and Physics at Duke University, as well as a co-director and Professor of Mathematics and Physics at Duke Kunshan University in China. His research interests lie in applied mathematics and numerical analysis, partial differential equations, kinetic theory, computational fluid dynamics, complex fluids, emergent behaviour and self-organization and so on. Prof. Liu is a fellow of American Mathematical Society. He is also serving as co-editor and associate editor for several prestigious journals.