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Modeling of Dynamics of Complex Systems

Shiyan Wang, Research Associate
Davidson School of Chemical Engineering, Purdue University

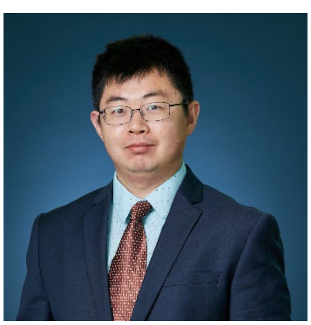
Abstract

A fundamental understanding of transport (e.g. particle, vesicles) and stochastic & reaction engineering is critical for (1) sustainable economy in the 21st century such as efficient biological product processing, and (2) health care sectors. I will discuss two examples of these processes, and then I apply engineering domain knowledge with machine learning to further the discussion related to public health.

Rigid/deformable particle migration in polymeric fluids is essential in many biological and industrial processes such as cells, microfluidic diagnostics, semiconductor cleansing, and enhanced oil recovery. However, the effect of particle shape on this phenomenon is not well understood. Theoretical studies are performed on the dynamics of an arbitrary-shaped particle in a quadratic flow of a general second-order fluid. Key factors are identified, which governs the migration dynamics of the particles in different non-Newtonian fluids (dilute polymer solutions, emulsions, and colloidal dispersions) based on the ratio of normal stress coefficients.

Stochasticity, a fluctuation from mean behavior, sparks many applications ranging from cell self-regulation (antimicrobial drug transfer), microbial processing to material properties predictions. A stochastic bridge, as a control concept, is a continuous random walk that ends in a given region, stays in a region for its entire path, or reaches one region before another region. One can demonstrate that a stochastic bridge can sample conformations that end with a given topology or end with a range of final energies, the latter of which is important for the improvement of sampling computations. On the other hand, by filtering the fluctuation, the mean behavior reflects the physical intuition. The logical implement for COVID-19 transmission control is a large-scale stochastic model with countless parameters lacking robustness and requiring enormous data. A remedy for this vexing problem is proposed when machine learning is employed together with the mechanistic framework, where there can be a considerably enhanced understanding of complex systems.

Bio sketch



Shiyan Wang earned his Ph.D. in mechanical engineering at the University of Notre Dame and is currently an independent research associate at the Chemical Engineering Department, Purdue University. His research interests focus on understanding fluid engineering and chemical physics in nano/micro-scale biological & energy systems using theoretical & computational techniques. He is named as “Early Career Researchers 2020” by American Institute of Physics.

Department of Mechanical Engineering, Edward E. Whitacre Jr. College of Engineering
Friday, Jan 21, 2022
2:00 – 3:00 PM
In person: ME South 205
Online: https://texastech.zoom.us/j/94591486607?pwd=MHhsSnJyM2RJQjl1ZmdsWkZuVExrQT09
Meeting ID: 945 9148 6607
Passcode: 844848