"Integrating Machine Learning and Multiscale Modeling in Biomedicine"

> Virtual Seminar Wednesday February 3, 2021 3:00 pm



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## Abstract

Machine learning and multiscale modeling complement each other in a unique way, enabling us to seamlessly integrate big data and biophysical pathways and interpret the results while formulating truly predictive and generalizable models, based on both data and physics. In multiscale modeling, I have developed adaptive methods and kinetic models to simulate intracellular polymerization of sickle hemoglobin (HbS) and subsequent interaction with the membrane of a red blood cell (RBC) in sickle cell anemia, which occurs at multispatial scales, ranging from nanometers to micrometers. Machine learning, especially deep learning, usually requires a large amount of data of high accuracy, which is often difficult to obtain in biological and biomedical sciences. I have developed multi-fidelity neural networks, physics-informed neural networks (PINNs), and deep operator network (DeepONets), so that we can learn deep learning models accurately and robustly from even "small" datasets. I will present several examples and discuss further the interaction of both that will lead to a paradigm shift in modeling biomedical systems in the future.

## Bio

Lu Lu is currently an Applied Mathematics Instructor in the Department of Mathematics at the Massachusetts Institute of Technology. He has a multidisciplinary research background with research experience in applied mathematics, physics, computational biology, and computer science. His current research interest lies in physics-informed deep learning, and its applications to engineering, physical, and biological problems. Lu has published 23 papers, with 14 of them as first author, including one in Nature Machine Intelligence, one in Science Advances, and two in PNAS. Lu obtained his Ph.D. degree in Applied Mathematics, master's degrees in Engineering, Applied Mathematics, and Computer Science at Brown University, and bachelor's degrees in Mechanical Engineering, Economics, and Computer Science at Tsinghua University.

## **CBE Faculty Candidate**

