"Multiscale Patient-Specific Systems Biology"

Scott L. Diamond, PhD
Professor and Chair, Department of Chemical and Biomolecular Engineering
Institute for Medicine and Engineering
University of Pennsylvania

Predicting tissue function based upon an individual's unique cells requires a multiscale Systems Biology approach to understand the coupling of intracellular signaling with spatiotemporal gradients of extracellular biochemicals. In the cardiovasculature, extracellular species are also controlled by convective-diffusive transport. Using high throughput experimentation, we obtained a large set of platelet responses to combinatorial activators in order to train a neural network (NN) model of platelet activation for several individuals. Each NN model was then embedded into a kinetic Monte Carlo/finite element/lattice Boltzmann simulation of stochastic platelet deposition under flow. In silico representations of an individual's platelet phenotype allowed prediction of blood function under flow, essential to prioritizing patient-specific cardiovascular risk and drug response or to identify unsuspected gene mutations.

Chatterjee MS, et al. Nature Biotechnology 28:727 (2010)
Flamm MH, et al. Blood 120:190 (2012)