

Title: Integrating Simulation Modeling, Signal Processing and Machine Learning in the Study of Large Social Systems

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Abstract: The big data about our social systems gathered from the Internet of Things and social media call for new computational tools to study those systems and help people. In this tutorial, I will introduce the stochastic social kinetic model to specify the complex system dynamics of large social systems in terms of how the individuals in the system interact with one another and how the interactions change their states. I will talk about the variational and sampling-based inference algorithms to track and predict the interactions, and the applications of these algorithms in predicting road traffic, urban socio-economical development, epidemic spreading and network formation. I hope to introduce the audience this framework to bring together modelers and data miners by turning the real world into a living lab.

Agenda:

- Section 1: Simulation Modeling of Complex System Dynamics and Large Social Networks [50 minutes + 10 minutes break]
 - Review of simulation modeling in the study of complex social system dynamics
 - Review of probability theory preliminaries
 - Stochastic processes in the field of signal processing and machine learning
- Section 2: Stochastic Process Inferences with Big Data [50 minutes + 10 minutes break]
 - Sampling based inference: particle filter, Gibbs sampling and Metropolis-Hastings sampling
 - Variational Inference: structured mean field and expectation propagation
 - Planning: decentralized partially observed Markov decision process and stochastic game
 - Inferences based on recurrent neural networks
- Section 3: Case studies: data and theories [60 minutes]
 - Social diffusion
 - Social network dynamics
 - Urban dynamics
 - biological networks

Expected audience: I expect two types of audience. The first type of audience is computer science students showing interest in modeling social system dynamics. The second type of audience is social science students showing interest in understanding the machine learning tools to study their social systems. While I will introduce the audience various data sets tracking large social systems and machine learning tools to make stochastic process inferences, I do not require laptop and instead encourage the audience to try our code after the tutorial. The tutorial will be based on my 1-semester course Stochastic Simulation and Inference, and the lecture notes taken by the class is here: ["http://dev.socialcomp.cse.buffalo.edu/wordpress/"](http://dev.socialcomp.cse.buffalo.edu/wordpress/).

Speaker bio: Dr. Wen Dong is an assistant professor of computer science and engineering with a joint appointment at the institute of sustainable transportation and logics at the University at

Buffalo. His research focuses on developing machine learning and signal processing tools to study the dynamics of large social systems in situ. He won the first Best Paper Award at the annual SBP conference with a work on predicting who gets you sniffle from your social network and the volunteer symptoms report. He has a PhD degree from the M.I.T. Media Laboratory.