

Speaker: Hugo TOUCHETTE (Stellenbosch University, South Africa)

Title: **Machine learning of large deviations**

Abstract

Many works have looked recently at describing the steady state and fluctuations of nonequilibrium systems using ideas from large deviation theory, leading to new insights into the physics of these systems and to new results such as the thermodynamic uncertainty relation. The likelihood of rare, nonequilibrium fluctuations is described within this theory by the rate function, which is notoriously difficult to calculate analytically or numerically. In this talk, I will describe recent work on learning and representing this function using neural networks and stochastic optimisation. Using one long trajectory of a stochastic process, I will show how the rate function can be estimated reliably by iteratively solving an optimal control problem in which control forces, representing physically the forces needed to generate rare fluctuations, are represented by a neural network. I will compare this approach with other works done recently, merging machine learning and large deviations, and will present applications for a simple diffusion and an interacting system of active particles. This is joint work with Grant Rotskoff and Jiawei Yan (Stanford University).