Inference of Dynamic Systems from Noisy and Sparse Data via Manifold-constrained Gaussian Processes

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Ordinary differential equations are widely used as models for dynamic systems in science and engineering, such as gene regulation, epidemics, and ecology. An important problem is to infer and characterize the uncertainty of parameters that govern the equations, based on the data that can be observed from the system. In this talk, I will present an accurate and fast inference method using manifold-constrained Gaussian processes, such that the derivatives of the Gaussian process must satisfy the dynamics of the differential equations. Our method completely avoids the use of numerical integration and is thus fast to compute. Our construction is embedded in a principled statistical framework and is demonstrated to yield fast and reliable inference in a variety of practical problems, including when a system component is unobserved.

This is joint work with Shihao Yang (Georgia Tech) and Samuel Kou (Harvard).

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