Estimating Parameters In A Gaussian Linear Stochastic Ordinary Differential Equation

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1 Abstract

A stochastic differential equation can be interpreted as a prior distribution on a function space. In this interpretation, the Kalman-Bucy smoother determines the solution of the differential equation that maximizes a posterior distribution corresponding to a set of measurements. Sometimes there are unknown parameters in such a system. For example, the level of the noise in the differential equation and the noise in the measurements. The marginal likelihood is the integral of the posterior distribution with respect to the solution of the differential equation. Optimizing the marginal likelihood reduces the degrees of freedom in the estimation problem to just the system parameters. In this talk we will present a new method for computing the marginal likelihood of the data as a function of the system parameters. With this method, computing the marginal likelihood has the same computational complexity as solving the corresponding Kalman-Bucy smoother problem.

Keywords: marginal likelihood, Kalman-Bucy smoother, stochastic differential equation, parameter estimation