NMST611 *Advanced Statistics Seminar*

Optimal parameter estimation for linear SPDEs

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Abstract

The problem of parameter estimation in a general second order linear stochastic partial differential equation (SPDE) is considered. One trajectory of the solution to the SPDE is observed continuously in time and averaged in space over a small window at multiple locations. Estimators for the diffusivity, transport and reaction coefficients are constructed. These estimators are shown to be minimax rate optimal by proving an explicit lower bound in the asymptotic regime where the spatial window shrinks to zero and with a growing number of observations. Interestingly, the rate of convergence depends on the differential order in which the respective coefficient appears, with the fastest rate achieved for the diffusivity coefficient and the slowest rate for the reaction terms. The proof for the lower bounds relies on an explicit analysis of the reproducing kernel Hilbert spaces for the observed Gaussian processes, which we derive here, and which may be of independent interest.