Semi-Blind Deconvolution

Gianluigi Pillonetto, University of Padova
giapi@dei.unipd.it

Bradley M. Bell, University of Washington
bradbell@washington.edu

Abstract

We consider the semi-blind deconvolution problem; i.e., estimating an unknown input function to a linear dynamical system using a finite set of linearly related measurements where the dynamical system is known up to some system parameters. Without further assumptions, this problem is often ill-posed and ill-conditioned. We overcome this difficulty by modeling the unknown input as a realization of a stochastic process with a covariance that is known up to some finite set of covariance parameters. We first present an empirical Bayes method where the unknown parameters are estimated by maximizing the marginal likelihood/posterior and subsequently the input is reconstructed via a Tikhonov estimator (with the parameters set to their point estimates). Next, we introduce a Bayesian method that recovers the posterior probability distribution, and hence the minimum variance estimates, for both the unknown parameters and the unknown input function. Both of these methods use the eigenfunctions of the random process covariance to obtain an efficient representation of the unknown input function and its probability distributions. Simulated case studies are used to test the two methods and compare their relative performance.