Mathematics > Statistics Theory

# Besov priors for Bayesian inverse problems

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We consider the inverse problem of estimating a function $u$ from noisy, possibly nonlinear, observations. We adopt a Bayesian approach to the problem. This approach has a long history for inversion, dating back to 1970, and has, over the last decade, gained importance as a practical tool. However most of the existing theory has been developed for Gaussian prior measures. Recently Lassas, Saksman and Siltanen (Inv. Prob. Imag. 2009) showed how to construct Besov prior measures, based on wavelet expansions with random coefficients, and used these prior measures to study linear inverse problems. In this paper we build on this development of Besov priors to include the case of nonlinear measurements. In doing so a key technical tool, established here, is a Fernique-like theorem for Besov measures. This theorem enables us to identify appropriate conditions on the forward solution operator which, when matched to properties of the prior Besov measure, imply the well-definedness and well-posedness of the posterior measure. We then consider the application of these results to the inverse problem of finding the diffusion coefficient of an elliptic partial differential equation, given noisy measurements of its solution.

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