STANFORD UNIVERSITY

DEPARTMENT OF STATISTICS

DEPARTMENTAL SEMINAR

4:15 p.m., Tuesday, January 23, 2007
Sequoia Hall Room 200
(Cookies at 3:45 in 1st Floor Lounge)

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Nonlinear filtering in the presence of long-memory noise

A typical estimation problem, arising in many engineering and physical systems evolving in time and space, is that of nonlinear filtering. Namely, one wishes to estimate a trajectory of a signal process (X(t)), which is unobserved directly, from a given path of an observation process (Y(t)), where the latter is an absolutely continuous (nonlinear) functional of the signal plus an additive noise. In the classical framework, parameter 't' is interpreted as time, the observation noise is represented by a Brownian motion, and the desired optimal filter, which is the best mean-square estimate of the signal given the information provided by the observation process, has a number of useful representations and satisfies the well-known Kushner and Zakai evolution equations. However, many processes arising in nature have long-memory or long-range dependence structure. One of the most popular self-similar long-memory processes is given by a persistent fractional Brownian motion, and its use has been advocated in a number of telecommunications/internet traffic, financial and geophysical applications. Thus, in this talk we will focus on the nonlinear filtering theory for the case when the observation noise is a fractional Brownian motion with Hurst index in (0.5,1). Moreover, motivated in part by potential applications to problems of denoising of images and video-streams with self-similar long-memory spatial observation noise, we study a class of best mean-square estimators of noisy random fields. Specifically, when the observation noise is represented by a persistent fractional Brownian sheet we develop stochastic evolution equations governing the behavior of the optimal filter.