PRINCETON UNIVERSITY
OPERATIONS RESEARCH & FINANCIAL ENGINEERING SEMINAR

Hidden Markov Models, Markov Chains in Random Environments, and Systems Theory

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Abstract

An essential ingredient of the statistical inference theory for hidden Markov models is the nonlinear filter. The asymptotic properties of nonlinear filters have received particular attention in recent years, and their characterization has significant implications for topics such as the convergence of approximate filtering algorithms, maximum likelihood estimation, and stochastic control. Despite much progress in specific models, however, most of the general asymptotic theory of nonlinear filters has suffered from a recently discovered gap in the fundamental work of H. Kunita (1971). In this talk, I will show that this gap can be resolved in the general setting of weakly ergodic signals with nondegenerate observations by exploiting a surprising connection with the theory of Markov chains in random environments. These results hold for both discrete and continuous time models in Polish state spaces, and shed new light on the filter stability problem. In the non-ergodic setting I will argue that a general theory can be built around systems theoretic notions of observability and detectability, and I will outline the connection with the ergodic case.

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11:00 am