ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

ΤΜΗΜΑ ΦΥΣΙΚΗΣ

ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

Thursday, 14 March 2013

17:00 -18:00

3rd Floor Seminar Room

"Gaussian Field Theory as a Tool for Spatial Data Processing"

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Abstract

This presentation will focus on the interpolation and simulation of scattered spatial observations as well as missing data on regular grids by means of Spartan spatial random fields (SSRFs). It will be shown that SSRFs can be derived from a Gaussian field theory that includes both gradient and curvature terms or, equivalently, from stochastic (Langevin) partial differential equations driven by Gaussian noise. In contrast with field theory, SSRFs focus on short-range correlations important for local structure instead of long-range properties of the covariance near critical points. SSRF covariance models are characterized by sparse precision matrices at least for lattice data. In certain cases, the correlation function in real space can be derived analytically by direct integration of the spectral representation given by the Hankel transform of the spectral density. The availability of explicit, albeit approximate, expressions for both the covariance and the precision matrix helps to reduce the computational cost of numerical procedures such as parameter inference, spatial interpolation and conditional simulation. Applications of SSRFs to real and simulated data sets will be presented. Extension of the SSRF interaction-based concept to data with non-Gaussian probability distributions, using discretized random field models with Ising "spin-type" interactions, will be motivated. Topics for further research and perspectives for the future development of SSRFs will be discussed.