World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:10, No:06, 2016

Bayesian Inference for High Dimensional Dynamic Spatio-Temporal Models

Authors : Sofia M. Karadimitriou, Kostas Triantafyllopoulos, Timothy Heaton

Abstract : Reduced dimension Dynamic Spatio-Temporal Models (DSTMs) jointly describe the spatial and temporal evolution of a function observed subject to noise. A basic state space model is adopted for the discrete temporal variation, while a continuous autoregressive structure describes the continuous spatial evolution. Application of such a DSTM relies upon the pre-selection of a suitable reduced set of basic functions and this can present a challenge in practice. In this talk, we propose an online estimation method for high dimensional spatio-temporal data based upon DSTM and we attempt to resolve this issue by allowing the basis to adapt to the observed data. Specifically, we present a wavelet decomposition in order to obtain a parsimonious approximation of the spatial continuous process. This parsimony can be achieved by placing a Laplace prior distribution on the wavelet coefficients. The aim of using the Laplace prior, is to filter wavelet coefficients with low contribution, and thus achieve the dimension reduction with significant computation savings. We then propose a Hierarchical Bayesian State Space model, for the estimation of which we offer an appropriate particle filter algorithm. The proposed methodology is illustrated using real environmental data.

Keywords : multidimensional Laplace prior, particle filtering, spatio-temporal modelling, wavelets
Conference Title : ICSSG 2016 : International Conference on Spatial Statistics and Geostatistics
Conference Location : New York, United States
Conference Dates : June 06-07, 2016