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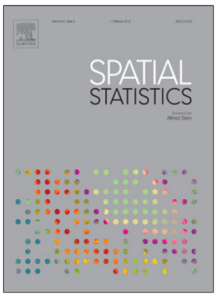

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PII: S2211-6753(17)30167-7
DOI: https://doi.org/10.1016/j.spasta.2018.01.003
Reference: SPASTA 281

To appear in: *Spatial Statistics*

Received date : 20 June 2017
Accepted date : 23 January 2018

Please cite this article as: Xu H., Gardoni P., Improved latent space approach for modelling non-stationary spatial–temporal random fields. *Spatial Statistics* (2018), https://doi.org/10.1016/j.spasta.2018.01.003

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Improved Latent Space Approach for Modelling Non-stationary Spatial-temporal Random Fields

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Abstract

This paper proposes an improved latent space approach for modelling non-stationary spatial and spatial-temporal random fields. For the non-stationary spatial random fields, the paper proposes a general formulation of the spatial covariance. Building on the latent space approach, the proposed formulation considers regressors as latent dimensions, and characterizes the non-stationarity in the spatial covariance using a regressor-based standard deviation and correlation. For the non-stationary spatial-temporal random fields, the paper proposes general formulations for the spatial-temporal covariance structure used in a dynamic approach.

The proposed formulations are more flexible than the current ones by considering the possible effects of spatial distance, time, and regressors on the statistics of a random field. Two examples are considered in the paper. The first one considers the modelling and prediction of a spatial random field and the second one considers a spatial-temporal random field. The proposed formulations demonstrate better performance for both examples compared with the current formulations, and can better describe the dependencies of the quantities of interest on the regressors.

Key Words: Covariance function; Spatial-temporal random fields; Non-stationarity; Latent space approach; Dynamic approach

1. Introduction

The modelling of a covariance function is a key step in the simulation of a non-stationary random field (Risser and Calder 2015). Most existing work on the

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