Fixed Rank Kriging for Massive Datasets

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Abstract

Spatial modeling of massive data is challenging. The massiveness causes problems in computing optimal spatial predictors such as kriging, since its computational complexity is cubic in the size of the data. In addition, a large spatial domain is often associated with massive data, so that the spatial process of interest typically exhibits nonstationary behavior over that domain. In this paper, a flexible family of nonstationary covariance functions is constructed using a set of basis functions fixed in number. This approach, which we call Fixed Rank Kriging (FRK), results in computational simplification in deriving the best linear unbiased predictor (BLUP) and its mean squared prediction error for a hidden spatial process. A method is given to find the best estimator from this family of covariance functions, which is then used in the FRK equations. The new methodology is applied to a large dataset of remotely sensed Total Column Ozone (TCO) data, observed over the entire globe. This research is joint with Gardar Johannesson, Lawrence Livermore National Laboratory.

Keywords: best linear unbiased predictor, covariance function, Frobenius norm, geostatistics, mean squared prediction error, remote sensing, total column ozone