

We present a new method for estimating multivariate, second-order stationary Gaussian Random Field (GRF) models based on the Sparse Precision matrix Selection (SPS) algorithm, proposed by \cite{SPSarxiv} for estimating scalar GRF models.} Theoretical convergence rates for the estimated between-response covariance matrix and for the estimated parameters of the underlying spatial correlation function are established. Numerical tests using simulated and real datasets validate our theoretical findings. Data segmentation is used to handle large data sets.

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