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Collana	Advances in Geographic Information Science, , 1867-2434
Disciplina	519.23
Soggetti	Sociophysics Econophysics Geophysics Statistics Applied mathematics Engineering mathematics Statistical physics Data-driven Science, Modeling and Theory Building Geophysics/Geodesy Statistics for Engineering, Physics, Computer Science, Chemistry and Earth Sciences Geophysics and Environmental Physics Mathematical and Computational Engineering Statistical Physics and Dynamical Systems
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Introduction -- Preliminary Remarks -- Why Random Fields? -- Notation and Definitions -- Noise and Errors -- Spatial Data and Basic Processing Procedures -- A Personal Selection of Relevant Books -- Trend Models and Estimation -- Empirical Trend Estimation -- Regression Analysis -- Global Trend Models -- Local Trend Models -- Trend Estimation based on Physical Information -- Trend Based on the Laplace Equation -- Basic Notions of Random Fields -- Introduction -- Single-Point Description -- Stationarity and Statistical Homogeneity --

Variogram versus Covariance -- Permissibility of Covariance Functions
 -- Permissibility of Variogram Functions -- Additional Topics of
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 Anisotropy -- Anisotropic Spectral Densities -- Multipoint Description
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 Dimension -- Long-Range Dependence -- Intrinsic Random Fields --
 Fractional Brownian Motion -- Classification of Random Fields --
 Gaussian Random Fields -- Multivariate Normal Distribution -- Field
 Integral Formulation -- Useful Properties of Gaussian Random Fields --
 Perturbation Theory for Non-Gaussian Probability Densities -- Non-
 stationary Covariance Functions -- Further Reading -- Random Fields
 based on Local Interactions -- Spartan Spatial Random Fields -- Two-
 point Functions and Realizations -- Statistical and Geometric Properties
 -- Bessel-Lommel Covariance Functions -- Lattice Representations of
 Spartan Random Fields -- Introduction to Gauss-Markov Random Fields
 -- From Spartan Random Fields to Gauss-Markov Random Fields --
 Lattice Spectral Density -- SSRF Lattice Moments -- SSRF Inverse
 Covariance Operator on Lattices -- Spartan Random Fields and
 Langevin Equations -- Introduction to Stochastic Differential Equations
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 Equations -- Spartan Random Fields and Stochastic Partial Differential
 Equations -- Covariance and Green's functions -- Whittle-Matérn
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 Fast-Fourier-Transform Simulation -- Randomized Spectral Sampling
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Sommario/riassunto

This book provides an inter-disciplinary introduction to the theory of
 random fields and its applications. Spatial models and spatial data
 analysis are integral parts of many scientific and engineering

disciplines. Random fields provide a general theoretical framework for the development of spatial models and their applications in data analysis. The contents of the book include topics from classical statistics and random field theory (regression models, Gaussian random fields, stationarity, correlation functions) spatial statistics (variogram estimation, model inference, kriging-based prediction) and statistical physics (fractals, Ising model, simulated annealing, maximum entropy, functional integral representations, perturbation and variational methods). The book also explores links between random fields, Gaussian processes and neural networks used in machine learning. Connections with applied mathematics are highlighted by means of models based on stochastic partial differential equations. An interlude on autoregressive time series provides useful lower-dimensional analogies and a connection with the classical linear harmonic oscillator. Other chapters focus on non-Gaussian random fields and stochastic simulation methods. The book also presents results based on the author's research on Spartan random fields that were inspired by statistical field theories originating in physics. The equivalence of the one-dimensional Spartan random field model with the classical, linear, damped harmonic oscillator driven by white noise is highlighted. Ideas with potentially significant computational gains for the processing of big spatial data are presented and discussed. The final chapter concludes with a description of the Karhunen-Loève expansion of the Spartan model. The book will appeal to engineers, physicists, and geoscientists whose research involves spatial models or spatial data analysis. Anyone with background in probability and statistics can read at least parts of the book. Some chapters will be easier to understand by readers familiar with differential equations and Fourier transforms.
