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Autore	Leeuwen Peter Jan van
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Nota di contenuto	Preface to the Series; Preface; Contents; 1 Nonlinear Data Assimilation for high-dimensional systems; 1 Introduction; 1.1 What is data assimilation?; 1.2 How do inverse methods fit in?; 1.3 Issues in geophysical systems and popular present-day data-assimilation methods; 1.4 Potential nonlinear data-assimilation methods for geophysical systems; 1.5 Organisation of this paper; 2 Nonlinear data-assimilation methods; 2.1 The Gibbs sampler; 2.2 Metropolis-Hastings sampling; 2.2.1 Crank-Nicolson Metropolis Hastings; 2.3 Hybrid Monte-Carlo Sampling; 2.3.1 Dynamical systems; 2.3.2 Hybrid Monte-Carlo 2.4 Langevin Monte-Carlo Sampling2.5 Discussion and preview; 3 A simple Particle filter based on Importance Sampling; 3.1 Importance Sampling; 3.2 Basic Importance Sampling; 4 Reducing the variance in the weights; 4.1 Resampling; 4.2 The Auxiliary Particle Filter; 4.3 Localisation in particle filters; 5 Proposal densities; 5.1 Proposal densities: theory; 5.2 Moving particles at observation time; 5.2.1 The

Ensemble Kalman Filter; 5.2.2 The Ensemble Kalman Filter as proposal density; 6 Changing the model equations; 6.1 The `Optimal' proposal density; 6.2 The Implicit Particle Filter
6.3 Variational methods as proposal densities6.3.1 4DVar as stand-alone method; 6.3.2 What does 4Dvar actually calculate?; 6.3.3 4DVar in a proposal density; 6.4 The Equivalent-Weights Particle Filter; 6.4.1 Convergence of the EWPF; 6.4.2 Simple implementations for high-dimensional systems; 6.4.3 Comparison of nonlinear data assimilation methods; 7 Conclusions; References; 2 Assimilating data into scientific models: An optimal coupling perspective; 1 Introduction; 2 Data assimilation and Feynman-Kac formula; 3 Monte Carlo methods in path space; 3.1 Ensemble prediction and importance sampling
3.2 Markov chain Monte Carlo (MCMC) methods4 McKean optimal transportation approach; 5 Linear ensemble transform methods; 5.1 Sequential Monte Carlo methods (SMCMs); 5.2 Ensemble Kalman filter (EnKF); 5.3 Ensemble transform particle filter (ETPF); 5.4 Quasi-Monte Carlo (QMC) convergence; 6 Spatially extended dynamical systems and localization; 7 Applications; 7.1 Lorenz-63 model; 7.2 Lorenz-96 model; 8 Historical comments; 9 Summary and Outlook; References

Sommario/riassunto

This book contains two review articles on nonlinear data assimilation that deal with closely related topics but were written and can be read independently. Both contributions focus on so-called particle filters. The first contribution by Jan van Leeuwen focuses on the potential of proposal densities. It discusses the issues with present-day particle filters and explorers new ideas for proposal densities to solve them, converging to particle filters that work well in systems of any dimension, closing the contribution with a high-dimensional example. The second contribution by Cheng and Reich discusses a unified framework for ensemble-transform particle filters. This allows one to bridge successful ensemble Kalman filters with fully nonlinear particle filters, and allows a proper introduction of localization in particle filters, which has been lacking up to now.