Math Geosci (2010) 42: 1001–1002
DOI 10.1007/s11004-010-9313-6

BOOK REVIEW

Geir Evensen: Data Assimilation—The Ensemble Kalman Filter, 2nd edn

Springer, Berlin, 2009. 307 pp., 130 Euros, hardcover, ISBN 978-3-642-03710-8

Hans Wackernagel

Received: 3 September 2010 / Accepted: 5 September 2010 / Published online: 5 October 2010

Operational forecasting systems, as being widely used in meteorology and oceanography, rely on high-resolution dynamical models coupled with very large data sets of observations. The methodology used to merge the numerical model with these observations has been termed "data assimilation." A fair amount of research is currently being devoted to adapting data assimilation methods to the history-matching problem in petroleum reservoir engineering.

Data assimilation, as defined by Geir Evensen, refers to the computation of the conditional probability distribution function of the output of a numerical model describing a dynamical process, conditioned by observations. The probabilistic approach is justified by the various sources of uncertainty about the initial and the boundary conditions, by the fact that the mathematical model does not integrate all aspects of the physical process, and, last but not least, by the observational errors occurring in the process. The Ensemble Kalman filter (EnKF), an algorithm that has proven to be very successful in many applications since it was proposed by Geir Evensen in 1994, provides a solution to the data assimilation problem. It is, moreover, fairly simple to implement.

The present second edition of the book is subdivided into seventeen chapters, which progressively introduce different aspects of data assimilation with Kalman filters. As a rule, they contain applications to numerical data as well as careful discussions of the results. The book follows a three-part structure. The first part is a basic introduction (Chapters 1 to 6) which acquaints the reader with basic statistical concepts, linear and nonlinear Kalman filters, and variational methods. The second part (Chapters 7 to 15) addresses more advanced material, offering an exposition of

H. Wackernagel (✉)
MINES ParisTech, Centre de Géosciences, Geostatistics Group, 35 rue Saint Honoré,
77305 Fontainebleau, France
e-mail: hans.wackernagel@mines-paristech.fr

contemporary research topics around ensemble Kalman methods, such as sampling strategies for the EnKF, how to deal with model errors, square root analysis schemes, rank issues, spurious correlations, localization and inflation. In the second edition, the first part has remained unchanged, while the second part has been thoroughly updated due to the intense recent research activity around ensemble Kalman methods. The third part of the book (Chapters 16 and 17) provides two detailed case studies: firstly, of an ocean prediction system, and secondly, of the petroleum history-matching problem.

Furthermore, the Appendix section contains a comprehensive discussion of the literature on the ensemble Kalman methods in geoscience applications up to the publication date of this second edition, together with an extensive reference list.

The book primarily addresses researchers in the field of data assimilation, for whom it represents a basic reference text. The text is very carefully written and is intended to be self-contained. In my opinion, this book is not immediately accessible to newcomers in the field, who will prefer to start with shorter review papers on data assimilation and Kalman filtering, which are widely available in different application journals.