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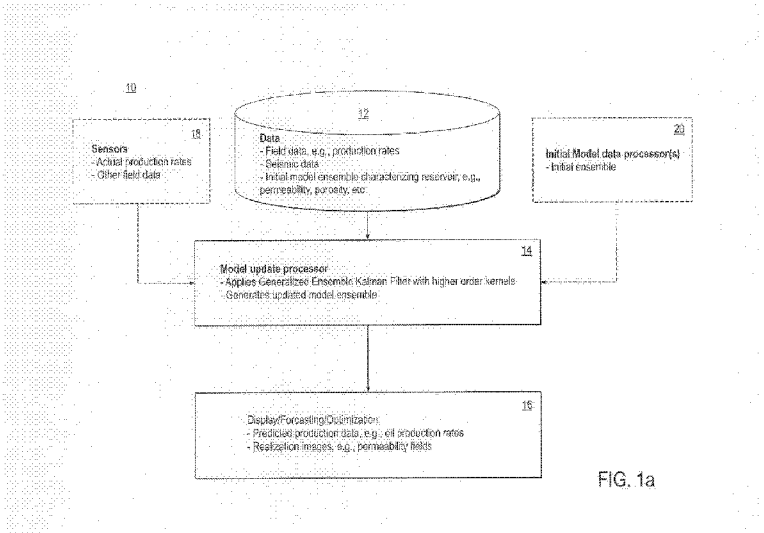

FIG. 1a

(57) Abstract: A reservoir prediction system and method are provided that use generalized EnKF using kernels, capable of representing non-Gaussian random fields characterized by multi-point geostatistics. The main drawback of the standard EnKF is that the Kalman update essentially results in a linear combination of the forecasted ensemble, and the EnKF only uses the covariance and cross-covariance between the random fields (to be updated) and observations, thereby only preserving two-point statistics. Kernel methods allow the creation of nonlinear generalizations of linear algorithms that can be exclusively written in terms of dot products. By deriving the EnKF in a high-dimensional feature space implicitly defined using kernels, both the Kalman gain and update equations are nonlinearized, thus providing a completely general nonlinear set of EnKF equations, the nonlinearity being controlled by the kernel. By choosing high order polynomial kernels, multi-point statistics and therefore geological realism of the updated random fields can be preserved. The method is applied to two non-limiting examples where permeability is updated using production data as obserations, and is shown to better reproduce complex geology compared to the standard EnKF, while providing reasonable match to the production data.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

F15D 1/00(2006.01)i, G06F 19/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F15D 1/00; E21B 34/16; E21B 43/12; F04D 27/00; G01N 11/00; G01N 19/00; G01V 1/28; G06G 7/48; G06T 7/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: program, predict, non-gaussian, kalman

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X Y	KR 10-2005-0037342 A (smitomo gomu co.) 21 April 2005 See Abstract, Fig. 1, 2, P3-5	1,7,8,9 2-6,10-15
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A	US 4969130 A1 (WASON; CAMERON B. et al.) 06 November 1990 See Abstract	1-15
A	US 5992519 A1 (RAMAKRISHNAN; TERIZHANDUR S. et al.) 30 November 1999 See Abstract	1-15
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☒ See patent family annex.

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