EGU21-9566
https://doi.org/10.5194/egusphere-egu21-9566
EGU General Assembly 2021

Machine learning based conditional mean filter: a non-linear extension of the ensemble Kalman filter

Truong-Vinh Hoang, Sebastian Krumscheid, and Raul Tempone
RWTH-AAchen University, Chair of Mathematics for Uncertainty Quantification, Department of Mathematics, Germany
(hoang@uq.rwth-aachen.de)

Filtering is an uncertainty quantification technique that refers to the inference of the states of dynamical systems from noisy observations. This work proposes a machine learning-based filtering method for tracking the high-dimensional non-Gaussian state-space models with non-linear dynamics and sparse observations. Our filter method is based on the conditional expectation mean filter and uses machine-learning techniques to approximate the conditional mean (CM). The contribution of this work is twofolds: (i) we demonstrate theoretically that the assimilated ensembles obtained using the ensemble conditional mean filter (EnCMF) provide a correct prediction of the posterior mean and have the optimal variance, and (ii) we implement the EnCMF using artificial neural networks, which has a significant advantage in representing non-linear functions that map between high-dimensionality domains, such as the CM. We implement the machine learning-based EnCMF for tracking the states of the Lorenz-63 and 96 systems under the chaotic regime. Numerical results show that the EnCMF outperforms the ensemble Kalman filter.