

Ensemble Kalman Control

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Abstract

Although data assimilation originates from control theory, the relationship between modern data assimilation methods in geoscience and model predictive control has not been extensively explored. In the present paper, I discuss that the modern data assimilation methods in geoscience and model predictive control essentially minimize the similar quadratic cost functions. Inspired by this similarity, I propose a new ensemble Kalman filter (EnKF)-based method, called Ensemble Kalman Control (EnKC), for controlling spatio-temporally chaotic systems, which can readily be applied to high-dimensional and nonlinear Earth systems. In this method, the reference vector, which serves as the control target, is assimilated into the state space as a pseudo-observation by ensemble Kalman smoother to obtain the appropriate perturbation to be added to a system. Proof-of-concept experiments using the Lorenz 63 & 96 models and an atmospheric model with idealized tropical cyclone cases will be presented. I will thoroughly discuss the potential and limitation of EnKC toward an efficient mathematical and computational method to explore an appropriate actuator for extreme weather modifications.