



FIGURE 2.3: A schematic description of the Ensemble Kalman Filter. Adapted from [37].

independent. This implies that their parallelization can be trivially carried out. This is one of the reasons for the success and popularity of the EnKF and UKF.

2.6 An algorithm for parameter estimation with data assimilation

The parameter estimation problem tends to improve estimates of a set of poorly known model parameters using DA. Generally, we have observable data for the state, but no direct observable data for the parameters. Parameter estimation can be performed in the same framework as state estimation, by augmenting state vectors by the poorly known parameters that need to be estimated. This framework is referred as joint state-parameter augmented models [65–68]. The augmentation requires a construction of a Kalman filter for the augmented model and parameters is considered as part of the model within the EnKF paradigm, which is updated by the analysis together with the other model’s variables. However, in augmented models, an increase in the number of unknown model states and parameters increases the degree of freedom in the system and can make an estimation unstable through parameter collapse and filter divergence [69, 99]. In a dual state-parameter estimation [69] the EnKF requires two separate