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## State, global and local parameter estimation using local ensemble Kalman filters: applications to online machine learning of chaotic dynamics

**Quentin Malartic**, Marc Bocquet, and Alban Farchi

Ecole des Ponts ParisTech, CEREAs, France ([quentin.malartic@enpc.fr](mailto:quentin.malartic@enpc.fr))

In a recent methodological paper, we have shown how a (local) ensemble Kalman filter can be used to learn both the state and the dynamics of a system in an online framework. The surrogate model is fully parametrised (for example, this could be a neural network) and the update is a two-step process: (i) a state update, possibly localised, and (ii) a parameter update consistent with the state update. In this framework, the parameters of the surrogate model are assumed to be global.

In this presentation, we show how to extend the method to the case where the surrogate model, still fully parametrised, admits both global and local parameters (typically forcing parameters). In this case, localisation can be applied not only to the state update, but also to the local parameters update. This results in a collection of new algorithms, depending on the localisation method (covariance localisation or domain localisation) and on whether localisation is applied to the state update, or to both the state and local parameter update. The algorithms are implemented and tested with success on the 40-variable Lorenz model. Finally, we show a two-dimensional illustration of the method using a multi-layer Lorenz model with radiance-like non-local observations.