Model Reduction Methods for Data Assimilation and for the Approximation Of the Solution to Parameter Dependent PDE's

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Abstract

In order to construct physical or mechanical functional quantities such as fluid velocity, pressure field or concentration of some constituants…, one generally refers to two different approaches sketched as follows : i) the explicit construction based on data, i.e. some measurements and then inter- and extrapolation to fill the gap between the point where the data have been acquired, ii) the implicit construction where, thanks to the understanding of the background phenomenon, a mathematical model is provided where the functional quantity of interest is solution of.

The first approach suffers from errors in the measurement, the second suffers from bias between the model and the truth. Very often, the model takes the form of a parameter dependent partial differential equation where the parameters have to be fitted to the practical situation that is faced. In this case, the set of all solutions when the parameter varies, constitutes a manifold, the structure of which can be used so as to provide some knowledge that, combined with measurements, even polluted with errors, can correct the defects of both approaches and take the best of each.