PARAMETRIC MODEL ORDER REDUCTION AND SENSITIVITY ANALYSIS

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The modelling of physical processes or mechatronic systems can lead to high order mathematical models including numerous uncertain parameters. Such models are generally hardly tractable for real-time applications. It appears a trade-off between the accuracy of the model and the computational constraints. Therefore, it is desirable to approximate such systems by reduced-order models obtained through a Model Order Reduction (MOR) [1]. Several criteria can be found to identify the system parameters and classically the mean square criterion is used which is depending on quality of measurements, number of parameters and measurements.

Sensitivity analysis (SA) [2,7] allows us to determine the most influent parameters that strongly contribute to the system behaviour. Based on this sensitivity analysis, a weighted criterion, linked to the degrees of influence of each parameter, can be introduced. The combination of MOR with SA helps, on the one hand, to simplify the model order, and on the other hand, to preserve the sensitivity indices of the parameters, thus preserving the influence of the most significant parameters of the system. This also allows the formulation, within a single framework, of both model order reduction and identification problems. Furthermore, this new formulation allows the inclusion of the concept of parameter within the reduction criteria, thus making the model reduction more closely related to the impact of the parameters on the system's behaviour.

This project represents a natural advance on previous works done by the MIAM team on order reduction [3,4] on one hand and on analysis of parametric uncertainty or perturbation [5,6] on the other hand. After having reviewed the main order reduction methods for parametric uncertain model, the aim of this project is to study and compare the identification of the reduced-order model with respect to the full-order model. This comparison may be performed using the sensitivity analysis tools.

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