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Model Order Reduction in Experimental Mechanics

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Model Order Reduction (MOR) has been widely developed in simulation over the past 15 years. Various approaches like projection based methods (RB, POD...) or variable separation techniques (PGD...) have been proposed to allow solving simulations that were out of reach of classical tools, because prohibitive computational costs.

Experimental Mechanics has undergone a revolution with the generalization of images. Today, even simple quasi-static experiments may yield tremendous amounts of experimental data, that classic procedures does not manage efficiently. In this talk, we will review some recent studies where Reduced Order Model was advantageously used in experimental mechanics.

In addition to computational costs savings (which is the reason why it was introduced in simulation), ROM has generally a second very important advantage when applied to experimental mechanics. Indeed, by reducing the dimension of the approximation subspace (e.g. from FE to a reduced basis), it is shown that the uncertainties and noise sensitivities may be significantly reduced. Many recent applications of ROM in Digital Image Correlation will be presented, among which:

- projection based methods for the measurement of consistent boundary conditions with application to structural tests performed on composite plates [1,2]
- variable separation techniques for the fast measurement of 2D/3D displacement fields [3,4], for the noise robust measurement of vibration modes [5] and for the fast identification of mechanical properties from non-intrusive PGD vademecums [6].

Bibliography

- [1] J. Serra, J.-E. Pierré, J.-C. Passieux, J.-N. Périé, C. Bouvet and B. Castanié. Validation and Modeling of Aeronautical Composite Structures Subjected to Combined Loadings: the VERTEX Project. Part 1: Experimental Setup, FE-DIC Instrumentation and Procedures. *Composite Structures*. 179, 224-244. 2017
- [2] J.-E. Pierré, J.-C. Passieux and J.-N. Périé. Finite Element Stereo Digital Image Correlation: framework and mechanical regularization. *Experimental Mechanics*. 53(7)443-456. 2017
- [3] J.-C. Passieux and J.-N. Périé. High resolution digital image correlation using proper generalized decomposition: PGD-DIC. *International Journal for Numerical Methods in Engineering*. 92(6)531-550. 2012
- [4] L.A. Gomes Perini, J.-C. Passieux and J.-N. Périé. A multigrid PGD-based algorithm for volumetric displacement fields measurements. *Strain*. 50(4)355-367. 2014
- [5] J.-C. Passieux, J.-N. Périé and R. Bouclier. Space-time FE-DIC for vibration measurement. iDICs 2016 Conference and Workshop SEM Fall Conference, Philadelphia, PA, USA 2016
- [6] X. Zou, J.-C. Passieux, M. Conti, P. Diez and F. Auricchio. NURBS-Enhanced Reduced Order Modelling with PGD. 5th International Conference on Isogeometric Analysis - IGA 2017 2017