First Pan American Congress on Computational Mechanics
PANACM 2015
April 27-29, 2015, Buenos Aires, Argentina

MODEL ORDER REDUCTION OF LARGE-SCALE DYNAMICAL SYSTEMS

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Key words: Model reduction, dimensionality reduction, real-time predictions.

ABSTRACT

The discretization of physical equations in complex three-dimensional domains typically leads to the solution of large-scale systems of equations. The goal of model reduction is to replace these sets of large-scale equations by an alternative set of equations of much smaller dimension that nevertheless retains the main characteristics of the original equations. Reducing the dimensionality and complexity of a given large-scale system then typically leads to a much faster solution time. Therefore, it enables routine analysis, model predictive control, data-driven systems, embedded and real-time computing, and faster design optimization, statistical studies, and uncertainty quantification.

Many of the aforementioned applications involve variations in the physical parameters and operating conditions, and therefore variations in the reduced-order models. This typically leads to an expensive offline phase in which these are trained in order to be accurate in the online phase over the entire parametric domain of interest.

Model reduction has been successfully applied in the last decade to a variety of computational mechanics applications ranging from aerodynamics and structural mechanics to fluid/structure interaction and micro machined devices. Current research efforts focus on the application of model reduction to many areas of computational mechanics including multi-scale mechanical systems, structural systems with large-deformations, compressible fluid mechanics and multi-phase flows, to name just a few.

The goal of this mini-symposium is two-fold: to present challenging applications that can be tackled by using reduced-order models instead of high-dimensional models, and to feature innovative methods that enable these applications. A particular emphasis will be put on the reduction of nonlinear mechanical systems, for which problem-specific techniques are often required in order to achieve large online speedups.