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ADVANCED REDUCED-ORDER MODELING STRATEGIES FOR PARAMETRIZED PDES AND APPLICATIONS

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ABSTRACT

This proposed minisymposium will consider a range of reduced-order models with applications in real-time computing and optimization. The increasing complexity of mathematical models used to predict real-world systems, such as climate or the human cardiovascular system, has led in the last decade to develop systematic algorithms for replacing complex models with far simpler ones, allowing to capture the most important features of the modelled phenomena in a rapid and reliable way.

The minisymposium will emphasize model reduction topics in several themes: 1. design, optimization, and control theory in real-time with applications in science and engineering; 2. data assimilation, efficient geometry representation/registration, and parameter estimation with a special attention to real-time computing in computational mechanics; 3. real-time visualization of physics-based simulations in computer science; 4. treatment of high-dimensional problems in state space, physical space, or parameter space, with a special accent on reduced basis methods and proper orthogonal decomposition; 5 reliability of reduced order models compared with classical discretization techniques and methodologies.

A strong attention is on mathematical models based on parametrized ordinary and partial differential equations. We will emphasize engineering and life-sciences applications, including continuum mechanics, fluid dynamics, and transport problems. Other mathematical frameworks and application domains may also be considered to provide perspective and opportunity for "technology transfer" and interdisciplinary exchanges.

Even if the focus of the minisymposium is methodological, we expect a wide range of both academic and industrial problems of high complexity to motivate, stimulate, and ultimately demonstrate the computational challenges addressed by the proposed approaches. The emphasis on real-time computing applications can be seen as a new frontier in scientific computing to assist scientists and engineers during design, construction, manufacturing or production phases, and even medical doctors during

surgery or diagnosis.

The increasing popularity of reduced-order modeling is underscored by the many minisymposia at conferences such as ICOSAHOM, ECCOMAS (Congress, CFD and thematic workshop), SIAM CSE and ICIAM in the last few years.

The aim of this minisymposium is to discuss the leading-edge developmentsin this field and to identify new directions and perspectives. For this reason, we plan to invite up to 15-17 speakers from several Universities and Research Groups around the world with strong expertise in these fields (MIT, Brown University, Paris VI, EPFL, Stanford, Sandia Labs, Rice University, etc). We would plan at least two sessions, maybe a third one, with a couple of keynote lecturers.

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