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ADVANCED TECHNIQUES FOR DATA ASSIMILATION AND DATA-BASED ADAPTATION OF SIMULATION MODELS

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ABSTRACT

The use of experimental data in combination with simulation models has become a very active research topic. Indeed, new sensing facilities (such as those related to image-based or optic fiber-based technologies) now enable to collect a large and diversified amount of data from a physical system. Such data may be used to identify and validate complex models, or to build hybrid models in which machine learning components enhance the predictions of a physics-based simulator. This represents the "physical-to-virtual" leg of the digital twin framework. However, many challenges dealing with data selection/filtering, uncertainty quantification, management of computational cost, or numerical robustness, need to be addressed in order to incorporate data efficiently in practical applications.

The goal of this mini-symposium is to bring together recent fundamental advances in data assimilation, inverse methods, and hybrid modeling, in both deterministic and stochastic (Bayesian) settings. With regards to innovative and powerful numerical approaches which emerged recently, we anticipate contributions on the following topics:

- use of model reduction or adaptive/multi-fidelity strategies for high dimensional parameter/state spaces;
- offline operator/surrogate learning, subsequently updated online, versus all-at-once formulations in which state and parameters are inferred simultaneously;
- real-time sequential model updating for DDDAS (Dynamic Data-Driven Application Systems), requiring fast inference algorithms;
- physics-informed and physics-augmented algorithms for deep learning from data;
- analysis of full-field measurements and large data sets, together with the representation and propagation of modeling and measurement errors from the raw signal up to the identified quantities;
- goal-oriented ("fit-for-purpose") model updating;
- optimal experimental design for informative data acquisition;
- applications in multiscale or multi-physics contexts.