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MODEL REDUCTION, BIG DATA AND DYNAMIC DATA-DRIVEN SYSTEMS

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ABSTRACT

Model Order Reduction (MOR) — or simply, model reduction — is an indispensable tool for many computational engineering applications including, to name only a few, computational-based design and optimization, statistical analysis, uncertainty quantification, embedded computing, and real-time optimal control. It is also an essential paradigm for scenarios where real-time simulation responses are desired. It relies on training procedures that generate large numerical data sets, and projection methods that can learn from these data sets to make fast, data-driven predictions or decisions. Hence, model reduction is related to two other timely research topics, namely, big data and machine learning.

Big Data (BD) challenges include representation, analysis, capture, curation, search, sharing, and storage. The term "big data" also often refers simply to the use advanced data analytics methods that extract value from data. The analysis of data sets can find new correlations to spot useful trends and therefore subspace learning.

Machine Learning (ML) also explores the study and construction of algorithms that can learn from and make predictions on data through building a model from sample inputs. It is however primarily employed in computing tasks where designing and programming explicit algorithms is unfeasible —

for example, data filtering and search engines. It has strong ties to computational statistics and mathematical optimization.

Hence, significant connections exist between model reduction, big data, and machine learning. These include, among others, data classification, regression, clustering, and assimilation, and dimensionality reduction. To this effect, the main objective of this Mini-Symposium (MS) is to explore these connections in view of:

- Advancing the state-of-the-art of model reduction, particularly with respect to data assimilation.
- Enabling the ***Dynamic Data Driven Applications Systems (DDDAS)*** paradigm where the computation and instrumentation aspects of an application system are dynamically integrated in a feed-back control loop, and therefore the computational model is often required to execute in real-time.

Therefore, whereas the MS welcomes papers in classical model reduction approaches, it also encourages papers that explore the synergy and/or technology transfer between MOR, BD, ML, and DDDAS.