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PHYSICAL MODELS AND REDUCED ORDER MODELS AUGMENTATION WITH DATA FOR PHYSICS-INFORMED MACHINE LEARNING IN REAL-WORLD APPLICATIONS

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MINISYMPOSIUM

Novel machine learning algorithms are being used in combination with physics-based modeling in engineering to tackle traditionally intractable problems. For example, dynamic applications requiring fast and reliable feedback, ultimately in real-time, or highly complex systems involving intractable transformations. Many advances have been made in this field with multiple researchers incorporating scientific machine learning to solve different numerical tasks in computational science and engineering. Recent works tackle the developments in the models addressing physics-based machine learning techniques and applications related to industrial systems and processes, as well as model augmentation with data. However, many challenges remain in incorporating scientific knowledge into black-box machine learning techniques, in a robust and reliable way. For example, the black-box surrogate model's stability is to be guaranteed before any real-life application of surrogate models. Stability is particularly important for dynamic applications involving an additional layer of complexity, like when creating an integrator, without accessing the correct outputs of the physical system at previous time steps.
We propose a minisymposium focusing on the use of model augmentation with machine learning tools for the simulation, optimization, and control of real-time industrial processes. This minisymposium aims to bring together researchers from diverse backgrounds to exchange novel ideas and initiate new lines of research addressing the challenges hindering the efficient and robust use of surrogate modeling, enhancing therefore classical models in engineering and industrial applications. Particular focus is placed on addressing major challenges in physical models and model order reduction augmentation for complex problems and digital twinning applications, in particular:

- Nonlinear surrogate modeling
- High dimensional parameter space
- Surrogate modeling of real-world and industrial applications
- Augmented physical models with data
- Physics-informed, data-based, machine learning models
- Stability and control issue in surrogate models
- Integrators construction and optimization