



Special Issue on “Reduced Order Modeling, Generative AI, and SciML in Digital Twins”

The emergence of digital twins facilitates “personalized” control and optimization decisions by taking into account the unique characteristics of individual assets or processes. Two of the most critical aspects of digital twins are (1) real-time updating of a digital model using data collected from the physical system (physical-to-digital) and (2) real-time control, optimization, and decision making of/for the physical twin based on insights from its digital twin (digital-to-physical). While digital twins have great potential to revolutionize design optimization and operation of engineering systems, the real-time coupling and synchronization between a physical system and its digital counterpart—through model updating, control, inference, and optimization—poses significant challenges for the widespread adoption in industry. Reduced-Order Modeling (ROM), generative Artificial Intelligence (AI), and Scientific Machine Learning (SciML) are key enablers that address these challenges. They play a vital role in significantly reducing the time required for the bidirectional coupling between the physical system and its digital model, thereby enabling the potential of digital twins.

This [Special Issue](#) is dedicated to the current state-of-the-art and future directions of ROM, generative AI, and SciML in enabling digital twin technology. It will feature original papers with a clear focus on digital twins of structural systems, manufacturing systems, automotive systems, energy systems, or other important engineering systems, contributed by researchers and practitioners from the fields of computational physics, engineering design, smart manufacturing, structural health monitoring, prognostics and health management, model-based predictive control, computational science, and others.

Topics of Interest to this Special Issue include, but are not limited to, the following:

- Data-driven scientific machine learning ROMs for real-time health monitoring of nonlinear dynamic systems to enable digital twins at scale
- ROM for design optimization and real-time decision making in digital twins
- Enhancing digital twins with generative AI techniques for improved accuracy and efficiency
- ROMs, generative AI, and SciML for real-time model updating and inference
- SciML, such as (1) physics-enhanced or physics-guided machine learning, (2) interpretable machine learning, and (3) uncertainty quantification of machine learning models, for ROM in digital twins
- ROMs, generative AI, and SciML for uncertainty quantification in digital twins
- Generative AI-assisted ROM for prognostics, control, or optimization in digital twins
- Demonstrations of ROM, generative AI, and SciML for real-time model updating, control, inference and optimization (under uncertainty)
- Practical applications of digital twins featuring ROM, generative AI, and SciML

Important Dates

July 31, 2025: Deadline for paper submission

September 15, 2025: Completion of first-round reviews

November 15, 2025: Deadline for revised paper submission

December 15, 2025: Final decision notification (tentative)



Submission Information

During submission, it is important that you select the name of this special issue: **Reduced Order Modeling, Generative AI, and SciML in Digital Twins**. This selection would ensure that your manuscript is correctly identified for further processing as part of this special issue.

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