

# Digital Twins through Reduced Order Models and Machine Learning

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The vision of building digital twins for complex infrastructure and systems is old. However, realizing it remains very challenging due to the need to combine advanced computational modeling, reduced order models, data infusion for calibration, updating and uncertainty management, and sensor integration to obtain models with true predictive value for decision support. Nevertheless, the perspectives of using digital twins for predictive maintenance, operational optimization, and risk analysis are very substantial and the potential for impact significant, from safety, planning, and financial points of view. In this talk we shall first discuss the importance of reduced models in the development of digital twin technologies and continue by discussing different aspects of the challenges associated with developing digital twins through a few examples, combining advanced model and data driven technologies, e.g., classifiers, Gaussian regression and neural networks, to enable failure analysis, optimal sensor placement and, time permitting, multi-fidelity methods and risk analysis for rare events.

These are all elements of the workflow that needs to be realized to address the challenge of building predictive digital twins and we shall demonstrated the value of such technologies through a number of different examples of increasing complexity.