

REDUCED ORDER MODELS AND ARTIFICIAL INTELLIGENCE FOR INDUSTRIAL APPLICATIONS

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ABSTRACT

Reduced Order Models (ROMs) and Artificial Intelligence (AI) have gained significant attention in industrial applications thanks to their ability to reduce the computational cost and time of physics-based computational methods, while still maintaining a sufficient degree of accuracy, which enables the time-effective completion of decision-making processes. On the one hand, ROMs reduce the dimensionality of high-fidelity models while retaining essential features for faster and still accurate modelling of complex physical and engineering systems. On the other hand, AI extracts relevant features from available data to develop (1) effective Machine Learning (ML) surrogate models that temporarily replace expensive calculations and (2) generative models (GMs) that judiciously guide the exploration of physical parameter spaces for effective design and calibration of complex systems.

The goal of the minisymposium is to bring together recent scientific advances in ROMs, ML surrogate models and GMs, from both academia and industry, in the most diverse tasks regarding industrial production. Key applications and areas of interest where ROMs and AI are particularly relevant include i) manufacturing process optimization; ii) structural analysis and design, particularly in industries such as aerospace and automotive, for virtual testing and predictions on structural responses; iii) energy systems and grid optimization for managing power generation, transmission and distribution; iv) fluid dynamics and aerodynamics such as airfoil design, flow control and turbulence modelling in the areas of aircraft and turbines production; v) robotics, for the reduction of complex engineering processes and advanced control strategies; up to vi) smart predictive maintenance and supply chain optimization.

This minisymposium is thought as a mathematical interdisciplinary platform for the discussion on the state-of-the-art concerning a smarter industry with a lighter impact on computational costs and times. As far as the numerical mathematical modelling is concerned, we encourage the dissemination of works both methodologically and more application-oriented related - and not limited – to artificial intelligence, deep and reinforcement learning, data-driven (reduced order) models and computational sciences.