Digital Twins in Engineering, DTE 2027
March 8-12, 2027, Yokohama, Japan

SHAPE INTELLIGENCE: DIGITAL TWINS FOR EXPLICIT GEOMETRY AND MULTIPHYSICS DESIGN OPTIMIZATION

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ABSTRACT

Digital twin technologies are undergoing a significant transition from passive system representation and predictive monitoring toward active engineering frameworks capable of supporting design generation, geometry adaptation, and intelligent decision making. Simultaneously, recent advances in explicit geometry representation, non-parametric optimization, artificial intelligence, and multiphysics simulation have created new opportunities for accelerating engineering design while improving manufacturability and real-world applicability.

This minisymposium aims to establish an interdisciplinary forum for researchers and engineers working at the convergence of digital twins, geometry driven optimization, and advanced computational engineering. The session seeks to explore how digital twins may evolve into active design environments capable of continuously interacting with simulation models, updating geometry, and guiding engineering performance throughout the product lifecycle.

Particular emphasis will be placed on explicit geometry-based methodologies and optimization approaches that directly manipulate engineering representations while integrating physical modelling with data driven techniques. The minisymposium welcomes contributions spanning fundamental developments, computational methodologies, and industrial applications.

Topics of interest include, but are not limited to: explicit geometry and shape optimization; thermofluid, thermal, and structural design optimization; topology and non-parametric optimization; reduced order and surrogate modelling; digital twin enabled design updates; artificial intelligence assisted engineering design; physics informed machine learning; uncertainty quantification and verification; manufacturability aware optimization; computational infrastructure; and industrial deployment.

The objective of this minisymposium is to stimulate discussion on the next generation of digital twins as intelligent design systems capable of linking simulation, optimization, artificial intelligence, and engineering implementation toward faster, more adaptive, and more reliable multiphysics design workflows.