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Digital Twins and Their Enabling Technologies

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Digital twins map physical objects, processes, and further entities from the real (physical) world into digital space. In their coexistence, the digital twin and its physical counterpart are able to exchange information bidirectionally [1]. Successful digital twinning allows to investigate incidents, new regimes and treatments, and supports decision making and control of the physical system.

While the term digital twin was coined in the context of manufacturing, the concept is also explored in various other fields such as health care, education, meteorology and construction [2]. In particular, digital twins have great potential in structural health monitoring and predictive maintenance of engineering systems. Further important application examples in the field of civil engineering include the protection of critical infrastructure, such as road systems, water treatment facilities and energy networks.

Enabling technologies – required for establishing and operating digital twins – include high fidelity numerical simulators, e.g., finite element solvers, data-driven modeling, and reduced-order modeling [2], all of which are core topics in the field of computational mechanics. However, a reliable digital twin often requires the coupling of thorough mathematical models encoding domain knowledge and sophisticated data science and machine learning techniques [1].

To this end, our minisymposium brings together experts in the field of digital twins and their enabling technologies to foster scientific exchange and collaboration in innovative research. Topics of interest include, but are not limited to:

- Numerical solvers for partial differential equations in the context of digital twins
- Reduced-order modeling and multifidelity approaches
- Scientific machine learning for digital twins, e.g., physics-informed neural networks
- Hybrid digital twins combining physics- and data-based modeling approaches

References

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