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AI-ENABLED DIGITAL TWINS FOR LIFECYCLE-AWARE RESILIENT INFRASTRUCTURE SYSTEMS

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ABSTRACT

The increasing complexity of infrastructure systems and their exposure to uncertain, evolving environments call for integrated, lifecycle-aware approaches to enhance resilience and sustainability. Recent advances in data-centric engineering and artificial intelligence have enabled new possibilities for developing digital twins that connect physical systems with their virtual counterparts across different stages of the lifecycle. This minisymposium aims to bring together contributions focused on methodologies for developing digital twins for infrastructure systems. Such developments may involve model formulation, data integration, simulation, validation, deployment, and continuous updating. The scope includes approaches applicable to various lifecycle stages, such as design, construction, operation, monitoring, and post-disaster response, without requiring full lifecycle coverage. Emphasis is placed on methods that enhance system understanding, predictive capability, and decision-making under uncertainty.

Topics of interest include, but are not limited to: data-driven and hybrid modeling approaches, sensing and monitoring techniques, model updating and data integration, predictive analysis, and decision-support methodologies for resilient infrastructure systems. Contributions addressing the interaction between physical models and data, as well as approaches enabling real-time or near-real-time system representation, are particularly encouraged. This minisymposium seeks to foster exchange across disciplines, including computational mechanics, data-centric engineering, and infrastructure applications. It aims to advance lifecycle-aware digital twin frameworks for resilient and intelligent infrastructure systems.