2025 IWSHM Special Session Request Form

Dear Organizers, please follow the following template to create a Special Session outline:

Special Session Title**: "SHM-Enhanced Digital Twins for Infrastructure Condition Assessment, Prediction, and Management"**

Organizers: Chongjie Kang[1], Steffen Marx[2], Michael Todd[3]

[1]Institute of Concrete Structures, TUD Dresden University of Technology, Dresden, Saxony,

(Dr.-Ing., chongjie.kang@tu-dresden.de).

[2]Institute of Concrete Structures, TUD Dresden University of Technology, Dresden, Saxony,

(Prof. Dr.-Ing., steffen.marx@tu-dresden.de).

[3]Lyles School of Civil and Construction Engineering, Purdue University, West Lafayette, USA

(Bob Bowen Head and Professor, Ph.D., F.ASME, F.SEM, todd153@purdue.edu)

Key words: digital twin, condition assessment, condition prediction, maintenance management

Scope of Session

The condition of civil infrastructure is characterized by increasingly rapid degradation as it ages. Preventive measures against aging are most effective when implemented early. Extending the service life of complex structures—such as bridges, Water Gate Structures, Tunnels and network systems—requires significantly more detailed information at an earlier stage than is typically available today. To bridge this gap and advance towards predictive maintenance and lifecycle asset management, fundamental research is needed to develop methods for collecting, linking, and evaluating data related to geometry, materials, stress, and aging.

In this context, digitization, particularly the concept of the structural health monitoring (SHM)-enhanced digital twin, takes on a transformative role. This approach enables the integration and collaborative real-time monitoring, evaluation, and management of all data essential for the operation and maintenance of structures.

This session aims to bring together researchers exploring the latest advances in SHM-enhanced infrastructure digital twins. Topics include, but are not limited to:

- The automated digitalization and geometric modeling of civil structures, particular but not limited to bridges, water gate structures
- Data-driven and physics-informed methods for damage and mode identification
- Advanced condition assessment and remaining useful life prediction
- The integration of heterogeneous SHM systems and multi-sensor data fusion
- The incorporation of data, risk analysis, and uncertainty quantification into digital twins for strategic decision-making and intelligent infrastructure management.
- SHM supported numerical and AI simulations