2027 IWSHM Special Session Request Form

Special Session Title**:**

Physics-Based Data-Driven Digital Twins for SHM

Organizers: Yang Wang[1], Haeyoung Noh[2], Babak Moaveni[3], Hamed Ebrahimian[4]

[1] Georgia Institute of Technology, USA yang.wang@ce.gatech.edu

[2] Stanford University, USA noh@stanford.edu

[3] Tufts University, USA babak.moaveni@tufts.edu

[4] University of Nevada, Reno, USA hebrahimian@unr.edu

Key words: digital twins; Bayesian inference; state, parameter, and input estimation; model updating; data assimilation; information fusion; model inversion; Bayesian inference; uncertainty quantification

Scope of Session

The goal of this special session is to bring together researchers and practitioners developing physics-based, data-driven digital twin frameworks for structural health monitoring (SHM), with particular emphasis on model updating, system identification, state estimation, prognosis, uncertainty quantification, and decision support. Physics-based models provide a powerful foundation for understanding structural behavior but are often subject to uncertainties associated with model form, material properties, boundary conditions, and other modeling assumptions. Integrating these models with measurement data from sensing systems enables the estimation of unknown model parameters, improves predictive accuracy, and provides rigorous quantification of associated uncertainties.

This session seeks contributions from a diverse community of researchers and stakeholders, including application practitioners, sensing and instrumentation experts, data scientists, and computational mechanics researchers. We welcome both methodological developments and application-driven studies that demonstrate the integration of physics-based modeling and data analytics for monitoring, diagnosing, and managing engineered systems. Experimental studies and field applications that validate theoretical developments or analytical methodologies are particularly encouraged.

Topics of interest include, but are not limited to:

- Digital twins and model updating
- Data fusion
- Physics-informed machine learning
- Inverse modeling
- Model parameter estimation
- Data assimilation
- Bayesian inference
- Damage diagnosis and prognosis
- System identification
- Uncertainty quantification
- Service life prediction