2027 IWSHM Special Session Request Form

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

Special Session Title**: "Acoustic Emission and Hybrid SHM"**

Organizers: Dr. Zhenhua Tian[1], Dr. Xuan Zhu[2], Dr. Roshan Prakash Joseph[3], and Dr. Victor Giurgiutiu[4]

[1] Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA, 24061, USA; tianz@vt.edu

[2] Department of Civil and Environmental Engineering, University of Utah, Salt Lake City, UT, 84112, USA; xuan.peter.zhu@utah.edu

[2] Department of Mechanical Engineering, University of Alabama, 245 7th Ave, Tuscaloosa, AL 35401, USA; rjoseph4@ua.edu

[3] Department of Mechanical Engineering, University of South Carolina, 300 Main Street, Columbia, SC, 29208, USA; victorg@sc.edu

Key words: acoustic emission, AE signal processing, non-destructive evaluation, NDE, structural health monitoring, SHM, passive detection, active detection, fracture, crack growth, composite, fiber breakage, matrix cracking, damage, artificial intelligence, machine learning

Scope of Session

This special session will address the topic of acoustic emission and hybrid SHM. Acoustic emission (AE) is a passive SHM technique that relies on 'listening' to the elastic waves generated when an incremental crack growth occurs, or impact damage happens in composites. The elastic waves associated with AE events can travel a considerable distance in metallic structures which have a low damping dissipation coefficient. AE waves also travel in composite materials, but their travel distance may be less due to the higher damping dissipation of polymer matrix composites. Hybrid SHM techniques encompass a large class of methods that aim at combining several techniques to increase the probability of damage detection. For example, one may use passive SHM to record a damaging event (such as an impact in a composite structure) and then apply active SHM to try to estimate the magnitude of the resulting damage and its severity. Or one can listen to AE events which indicate that cracks are progressing into the structure and then follow up with the active SHM technique to evaluate the crack size. Or one can use two different active SHM techniques (e.g., pitch-catch wave propagation and electromechanical impedance standing waves) to better detect the damage location and size. But these are just examples. The session is open to

all innovative techniques aimed at enhancing SHM capabilities, including the applications on new engineering materials and structures, data-driven methods, machine learning, artificial intelligence, and autonomous sensing and decision-making frameworks. Emerging topics involving foundation models, large language models, and agentic AI for SHM data interpretation, multimodal information fusion, and autonomous decision support are also encouraged. Contributions that judiciously combine theory and experiments are highly encouraged.