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Preface

Structural health monitoring (SHM) is an emerging engineering discipline that involves fundamental research in mechanics, measurements, signal processing, and data mining. The objective of SHM is to identify the condition of a structure based on *in situ* measurements that are analyzed using engineering models. Vibration and acoustic phenomena are often used in this process to assess structural loads and damage caused by those loads. As SHM methods are applied in aerospace, automotive, naval, and civil structures, new research challenges are being discovered and addressed. This special issue of the Journal of Sound and Vibration was assembled to highlight these research challenges. Each of the papers selected for the special issue develops and then applies in a realistic setting SHM techniques to address one or more challenges dealing with environmental variations, reference measurements, damage localization, or sensing infrastructure for distributed monitoring.

The effects of temperature variations on the performance of SHM damage detection methods are addressed in two papers. The first paper uses guided elastic waves to detect damage despite variations in temperature using physical models whereas the second paper uses impedance measurements and compensates for temperature variations using instrumentation adjustments. The need to use reference measurements for damage detection is also addressed in two papers; these papers use multiple spatial measurements and statistical signal processing techniques, respectively, to detect damage despite variations in the baseline response of the structural component undergoing SHM. The difficulty of locating damage in distributed structural components is addressed in three papers, which apply vibration flexibility formulations, beamforming array signal processing, and spatial restoring force analysis to locate mechanical damage in structures. Finally, the need for distributed actuation and sensing instrumentation for SHM is addressed in two papers that design and then employ wireless transmission nodes.

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