# Preface

*Residual Stress, Thermomechanics & Infrared Imaging, Hybrid Techniques and Inverse Problems* represents one of nine volumes of technical papers presented at the 2017 SEM Annual Conference & Exposition on Experimental and Applied Mechanics organized by the Society for Experimental Mechanics and held in Indianapolis, IN, June 12–15, 2017. The complete Proceedings also includes volumes on: *Dynamic Behavior of Materials; Challenges In Mechanics of Time-Dependent Materials; Advancement of Optical Methods in Experimental Mechanics; Mechanics of Biological Systems, Materials and other topics in Experimental and Applied Mechanics; Micro-and Nanomechanics; Mechanics of Composite, Hybrid & Multifunctional Materials; Fracture, Fatigue, Failure and Damage Evolution; and Mechanics of Additive and Advanced Manufacturing.*

Each collection presents early findings from experimental and computational investigations on an important area within Experimental Mechanics; Residual Stress, Thermomechanics & Infrared Imaging, Hybrid Techniques and Inverse Problems being three of these areas.

Residual stresses are self-balanced stress fields induced during most materials processing procedures, for example, welding/joining, casting, thermal conditioning, and forming. Their hidden character often causes them to be underrated or overlooked. However, they profoundly influence structural design and substantially affect strength, fatigue life, and dimensional stability. Thus, they must be taken seriously and included in practical applications.

In recent years the applications of infrared imaging techniques to the mechanics of materials and structures has grown considerably. The expansion is marked by the increased spatial and temporal resolution of the infrared detectors, faster processing times and much greater temperature resolution. The improved sensitivity and more reliable temperature calibrations of the devices have meant that more accurate data can be obtained than were previously available.

Advances in inverse identification have been coupled with optical methods that provide surface deformation measurements and volumetric measurements of materials. In particular, inverse methodology was developed to more fully use the dense spatial data provided by optical methods to identify mechanical constitutive parameters of materials. Since its beginnings during the 1980s, creativity in inverse methods has led to applications in a wide range of materials, with many different constitutive relationships, across material heterogeneous interfaces. Complex test fixtures have been implemented to produce the necessary strain fields for identification. Force reconstruction has been developed for high strain rate testing. As developments in optical methods improve for both very large and very small length scales, applications of inverse identification have expanded to include geological and atomistic events. Researchers have used in-situ 3D imaging to examine microscale expansion and contraction and used inverse methodologies to quantify constitutive property changes in biological materials.

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