THE DESIGN, VALIDATION, AND APPLICATION OF
AN INVERSE HEAT TRANSFER MEASUREMENT TECHNIQUE

Abstract

by

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A heat transfer measurement technique based on the solution of an inverse conduction problem has been developed, validated, and applied in transonic turbine casings with variable surface roughness. A major advantage of the method is that it can be implemented for irregular surface geometries, as opposed to contact sensors which are generally not applicable in these types of situations. Additionally, the presence of contact sensors, *e.g.* heat flux gauges, is known to disturb the near wall flow field and modify thermal boundary conditions in many applications.

The inverse measurement technique requires an array of thermocouples to be embedded in machined holes within metal hardware. An internal sensor spacing criteria, *i.e.* the axial distance separating measurements and the appropriate wall normal distance between a thermocouple and an estimation boundary, is identified and evaluated for accurate inverse solutions. The measurement technique is theoretically and experimentally validated for various boundary conditions. Heat transfer measurements in over-rotor casings of a transonic turbine rig provide a practical demonstration of the method. A commercially available CFD code is validated based on the experimental turbine data and gives added confidence in the measurement technique.