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QUANTIFICATION OF X-RAY MEASUREMENT UNCERTAINTY BASED ON OPTICAL MEASUREMENT DATA OF TURBINE BLADES

Lars Högner, Sebastian Knebel,
Matthias Voigt, Ronald Mailach
Technische Universität Dresden
Institute of Fluid Mechanics
Chair of Turbomachinery and Flight Propulsion
D-01062 Dresden, Germany
Email: Lars.Hoegner@tu-dresden.de

Marcus Meyer
Rolls-Royce Deutschland Ldt & Co KG
CFD Methods
D-15827 Blankenfelde-Mahlow, Germany
Email: Marcus.Meyer@Rolls-Royce.com

Probabilistic design approaches taking geometric variation due to manufacturing scatter or wear into account reflect a relevant part of today's design process in turbomachinery. This process is characterized by a high degree of multidisciplinarity involving complex geometric features, which demands high standards to incorporate geometric variability. The significance of the employed probabilistic approaches considering real geometry effects is based on the information about the existing variability including distributions, correlations as well as the respective uncertainty of employed measurement techniques.

Within the scope of mechanical probabilistic analysis of cooled turbine blades, the variability of the internal geometry is of particular interest since this in combination with the external geometry variation leads to a change in wall thickness, which may influence stress and life significantly. Computed tomography represents a non-destructive technology that enables the detection of internal geometric features.

The present paper address the uncertainty quantification of computed tomography for a high-pressure turbine blade. Measurement data derived by optical techniques are used by way of comparison. A parametric turbine blade model is employed to quantify the deviations between optical and tomographic measurement data. Furthermore, five blades were cut open by wire erosion, which enables a comparative investigation in terms of wall thickness. The observed deviations are related to inherent sources of uncertainties in CT.

Keywords: X-Ray, optical measurement, measurement uncertainty, manufacturing variation