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ANALYSIS OF HIGH PRESSURE TURBINE NOZZLE GUIDE VANES CONSIDERING GEOMETRIC VARIATIONS

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Geometric variations caused by manufacturing scatter can influence the aerodynamic performance of turbomachinery components. In case of nozzle guide vanes (NGVs), the capacity is of particular importance due to its influence on the entire engine behaviour, since often the narrowest cross section of the turbine, which limits the capacity, is found in the first NGV stage. Within this scope, the present paper illustrates different methods in order to quantify the impact of geometric variations of high pressure turbine (HPT) NGVs with respect to capacity change during the development process. At first, in the design phase, a parametric CAD model of the NGV can be used to perform an initial assessment of the effect caused by different geometric variations onto capacity. The results of this study can for example be used to set the tolerances for the subsequent manufacturing process.

As soon as the first real hardware components become available, their geometry can nowadays be accurately captured using optical measurement techniques. Consequently, reverse engineering (RE) methods can be used to enable numerical assessment of geometric variability since manufacturing scatter is determined and incorporated into the subsequent CFD analysis. The process to perform this assessment is described in the second part of the paper and its results are compared to the initial CAD-based study. The investigation is conducted using an example of a state-of-the-art NGV stage provided by Rolls-Royce.

Keywords: Capacity, Variations, Uncertainty Quantification