

HIGH FREQUENCY GAS TEMPERATURE AND SURFACE HEAT FLUX MEASUREMENTS

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Further improvements of the thermal efficiency of gas turbine cycle are closely coupled to the increase of turbine inlet temperature. This requires intensive and efficient cooling of the blades. In this perspective, experimental investigations of the gas temperature and heat transfer distribution around the airfoil are of primary importance.

The present work aims at the development of two measurement techniques based on applications of the thin film sensors: the two-layer gauge for the wall heat transfer determination and the dual thin film probe for flow temperature measurements. Both techniques are used in short duration tunnels of the von Karman Institute (VKI) under engine representative conditions and are able to resolve both time-averaged component and time-resolved component i.e. periodic blade passing events at ~5-7 kHz with harmonics up to 50 kHz.

In order to derive the wall heat flux with the two-layer gauge, the unsteady conduction equation is solved in the two-layer substrate using the measured value of the wall temperature as a boundary condition. The gauges are extensively calibrated and the data reduction method is validated on a blade of the second stator of the VKI turbine. A very good repeatability is achieved. Measurements are also performed on the complex geometry of a blade tip in a cascade configuration revealing the high three dimensionality of the flow.

The dual thin film probe combines the operation of two thin films and determines the flow temperature from two independent heat flux measurements. The probe is calibrated and then validated with measurements downstream a cascade. The robustness and the reliability of the probe are also demonstrated by measurements downstream of the rotor and the second stator of the VKI turbine.