2D DATA REDUCTION TECHNIQUE FOR TURBINE BLADE HEAT TRANSFER MEASUREMENTS PERFORMED WITH TWO-LAYERED THIN FILM GAUGES

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The two-layered thin film gauges consist of nickel temperature detectors deposited on a polyamide sheet. Wrapped around a turbine blade in CT3 facility, they are used to measure the temperature evolution in the wall of the body during a blowdown test. The post-processing of the acquired data allows to compute the heat flux around the wall of the turbine blade. Then, the convection coefficient *h* can be determined at each measurement location, and subsequently the Nusselt number distribution is obtained. This is a highly valuable information for gas turbine manufacturers.

Up to now, the thin film layer technique has been applied to the unsteady measurement of temperature in blades of the second stator at the CT3 turbine test rig. The first goal of this project is to extend the technique to rotor blades of the CT3 turbine test rig. To comply with this objective, the twist of the blade must be considered when wrapping a flat surface (the polyamide sheet) onto the 3D curved surface of the rotor blade.

The second goal of the project deals with the extension of the post-processing technique to a 2D approach. To compute the heat flux in the wall of the body, the unsteady heat conduction equation must be solved. In certain regions of the studied cross-sectional area of the blade, nor 1D conduction, neither semi-infinite hypothesis, can be assumed: it occurs at the trailing and leading edge. To accomplish with a rigorous computation of the heat flux in this region, the 2D unsteady heat conduction equation must be solved, using as boundary condition the temperature history provided by the thin film layer in the measurement locations. A Fortran 90 code is developed to solve this equation by the Finite Element Method in domains with two different materials.

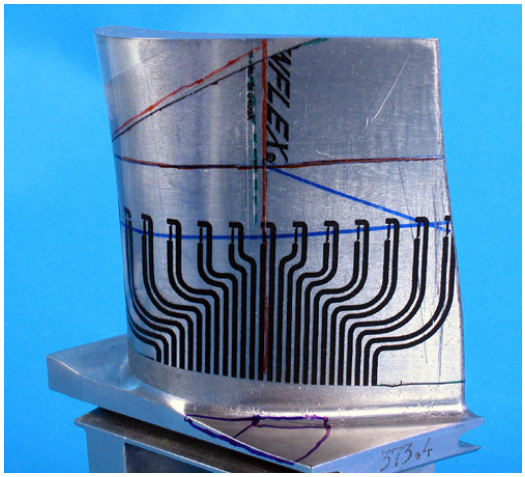

Figure 1. Sketch of the gauges implemented in a rotor blade

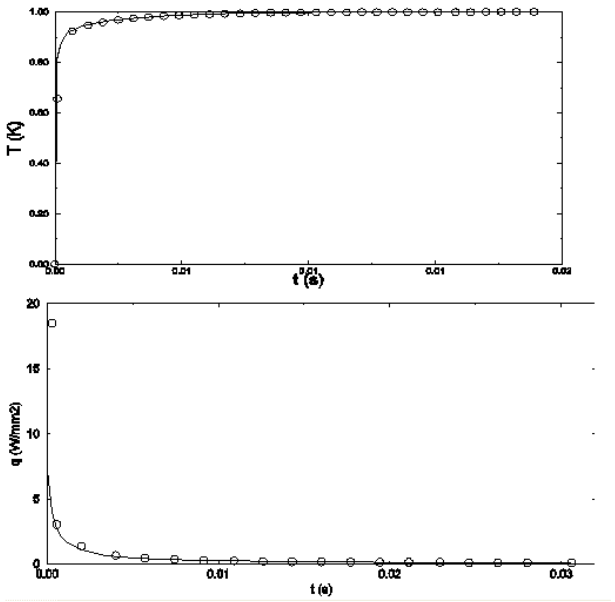

Figure 2. Temperature and heat flux evolution in the wall of a 2D solid body, computed with the developed Fortran 90 code