HEAT TRANSFER MEASUREMENTS USING MULTI-LAYER THIN FILM GAUGES

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The purpose of this project is to perform heat transfer measurements using nickel thin-film gauges deposited on a 50µm Upilex array. This instrumented gauge can be implemented on any kind of substrate with a double-sided adhesive. It is more flexible than the ceramic inserts used up to now at the VKI.

The first part of the work is dedicated to the implementation of these gauges with good quality of roughness and a low thickness modification of the test piece. This implementation has been done on a blade of the second stator of the CT3 turbine test rig.

The second part concerns the calibration of the thermal properties of the multi-layer thin-film gauges. The use of a jet of hot air as a heat source, impinging suddenly thanks to a shutter on flat plate instrumented with these gauges, allows to determine these thermal properties. Moreover, the application of an optimization algorithm allows to obtain accurate value of the thermal properties of the Upilex $\left(\sqrt{\rho\, C\, k} = 715\ J/m^2Ks^{0.5}\right)$, thanks to the modelization of the multi-layer 1D conduction with a Crank-Nicholson scheme.

The last part is dedicated to the use of these thin-film gauges to perform heat transfer measurement on a blade in the CT3 turbine test rig. The measurements, done for several clocking positions of the stator, allow to see the effects of this clocking on the steady heat transfer.

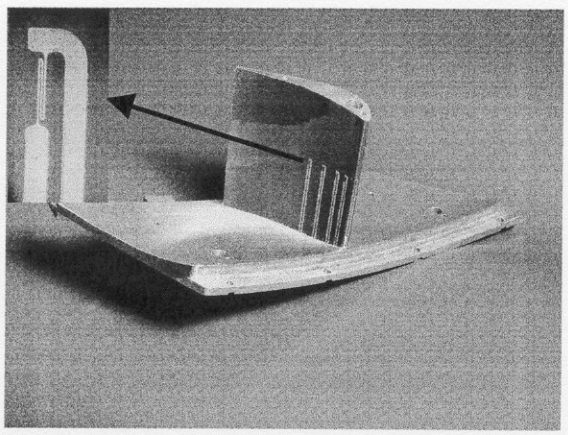

Figure 1: Instrumented sheet implemented on the second stator measurement cassette

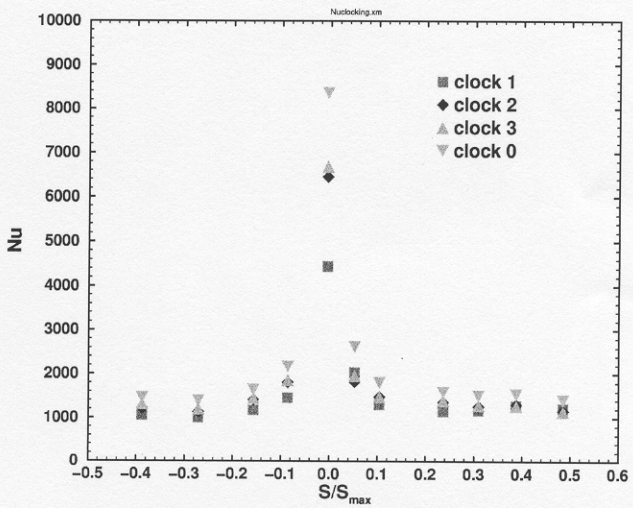

Figure 2: Average heat flux on the second stator at several clocking position