

# VELOCITY MEASUREMENTS BEHIND A COMPRESSOR CASCADE EQUIPPED WITH PASSIVE VORTEX GENERATORS

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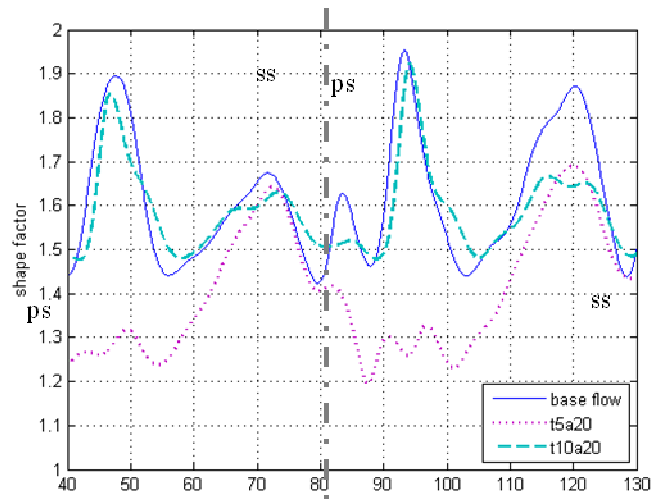
## **ABSTRACT**

In a turbomachinery application, the design condition at blade mid-span cannot be sustained on the span-wise extremes of the blade. Especially in a high pressure passage, which has a low aspect ratio, the secondary flow developing on the hub and the tip of the blade are the source of losses and since those 3-D flow losses do not mainly depend on the varying tangential velocity, they cannot be compensated with any severe blade incidence variation. Hence, precautions should be taken to avoid separation from the hub or shroud i.e. secondary flow control is the main interest.

The current study is based on experimental investigations in a linear cascade of compressor blades. Aft control is intended by triangular vane type VGs implemented between two blades according to flow visualisation tests on the facility. Although alternation of flow momentum by means of an obstacle dates decades ago, neither the geometry nor the orientation of a control obstacle is universal. That is why each new case has to be well investigated to optimize the control methodology. An accurate definition of passive control location provides minimum cost of disturbances in the core flow. Besides a purely numerical guidance, a qualitative experimental data leads to a control point physically more relevant.

In an adverse pressure gradient, which is observed through compressor blades, spaced vane type VGs are suggested to provide the maximum improvement in the shape factor. The experimental investigations of the current study are pneumatic measurements via 5-hole pressure probe which measures the stagnation pressure behind the cascade as well as the correct direction of the flow. The results of 5-hole probe measurements can be analysed in terms of a total pressure distribution or the loss in the total pressure through the passage and the flow angles on the measurement plane which quantifies the blade turning. The flow angle on two planes provide the 3-D velocity vector field and the shape factor of the boundary layer developing on the end-walls is also available to be processed from the raw data of 5-hole probe.

The measurements prove that certain VG cases are effective in dropping the shape factor level between the blades. Stabilizing effect of the VG is supported by the decreased level of absolute value span-wise vorticity between the blades. The available 3-D field of data will provide different components of vortices although the literature mostly deals with only one component of it.



**Figure 1 Comparison of the shape factor on the end-wall for the base flow and the controlled cases.**