TRANSONIC HIGH PRESSURE TURBINE INTERFERENCE EFFECTS ON A MULTI-SPLITTER LOW PRESSURE VANE

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Ultra high bypass ratio turbofan engines allow substantial reductions in Specific Fuel Consumption and noise. This design trend has a strong influence on the low pressure turbine performance since the rotational speed needs to be lower. A higher LPT efficiency can be preserved by increasing the turbine disc radius, which necessitates a curved transition duct between the HP and LP turbines. Such ducts are big, heavy and require mechanical supports, resulting in an undesired weight. In this perspective the present project addresses the use of a multi-splitter architecture within a "swan necked" transition duct. The large structural vanes provide the mechanical support while small aero vanes, in between structural vanes, guide the flow to the next LP rotor.

The current research aims to analyze the interaction between the high pressure stage and the innovative low pressure vane. Experiments are carried out on the VKI compression tube test rig where a 1.5 turbine stage is installed. The facility allows testing turbines at engine-like representative conditions, reproducing the correct Reynolds number, Mach number and temperature ratios. The performance of the LP stator will be characterized by means of downstream measurements of pressure, Mach number and flow angles.

A 5-hole rake probe delivers information about the 2D distribution of pressure, flow angles and Mach number (see Figure 1) downstream of the LP stator. Particular attention will be devoted to develop appropriate instrumentation to investigate the rotor tip leakage flow. The coupling with tip clearance measurements will enhance our knowledge of the interaction of the tip leakage flow with the core flow, pointing out the effects of centrifugal forces on the corresponding vortex, together with that coming from the pressure gradients on the blade shroud and the relative motion between the blades and the casing.

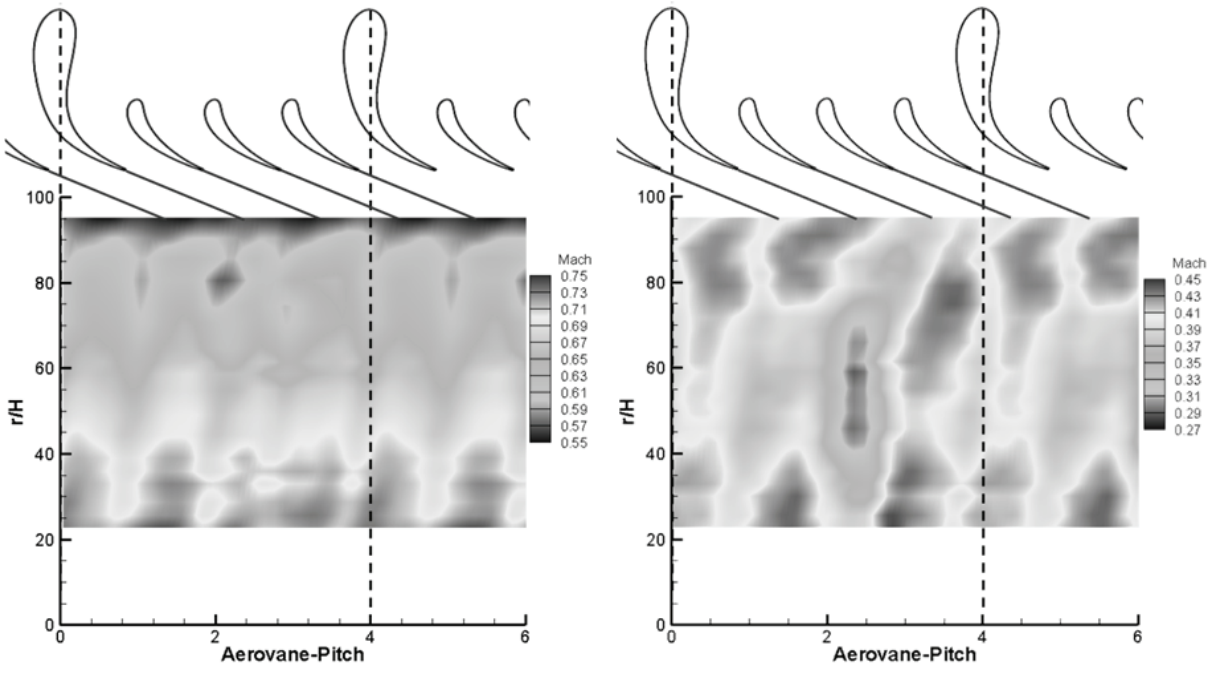

Figure 1: LP vane downstream Mach distribution at design (left) and off design conditions (right)