PARAMETRIC DESIGN, ANALYSIS, AND OPTIMIZATION FOR REDUCED ROW INTERACTION OF A TRANSONIC HIGH PRESSURE TURBINE STAGE

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Customer requirements concerning engine weight and cost pose a continuous challenge to design engineers. Turbomachinery design and manufacture is a mature technology, with component reaching efficiencies beyond 90 % for conventional configurations. Complying with specified requirements often means adopting design philosophies that lead astray of optimum performance conditions, such as high load or speed turbomachines, and/or reduced inter-row spacing. Maintaining a reasonable level of efficiency then is a complex task, which will be dealt with by means of computational analysis and design techniques.

In the context of this project, the problem of stator-rotor interaction in a high power turbine stage will be addressed, regarding both the definition of a computational optimization procedure, and understanding of the impact of blade geometry on the physics of the flow field.

A model of rotor forcing is proposed so that the computational domain can be restricted to the stator region and efficiency is assessed by means of a performance prediction method based on loss component analysis. These models define the objective functions for the optimization procedure, which also required of the development, adaptation and modification of analysis tools and technical procedures in order to achieve full 3D design capabilities.

Two resultant geometries have been analyzed, each one achieving the objectives by different mechanisms. Results show a remarkable potential for reduction of rotor forcing without efficiency loss.

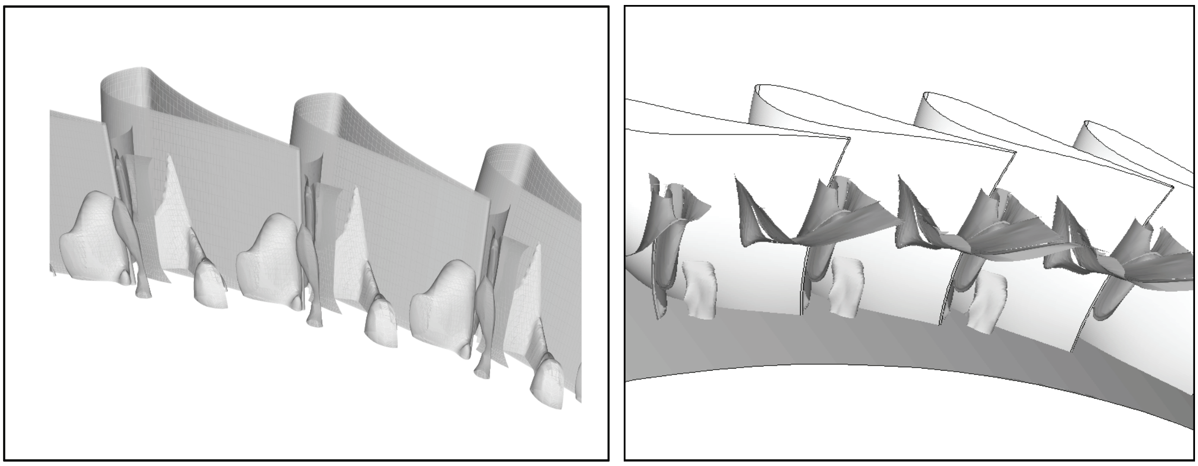

Figure 1: Mach isosurfaces in baseline (left) and optimized (right) configurations