QUASI-3D UNSTEADY NUMERICAL INVESTIGATION OF CLOCKING EFFECTS IN 1&1/2 STAGE TRANSONIC TURBINE

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Description of the project

In a transonic high-pressure turbine stage, the rotor traverses periodically the shocks and wakes emanating from the stator trailing edge. In a one and a half stage configuration with equal number of vanes in the two stators, there is also a stator/stator interaction i.e. the flow field depends on the relative position of the second stator with respect to the first stator (the so-called 'clocking').

This project investigates numerically the effect of clocking with a quasi 3D Navier&Stokes unsteady code on a domain composed of 2 vane passages and 3 rotor passages. The computational domain is three-dimensional but there is only one-cell in the radial direction. The cell-height is then adjusted to simulate the stream-tube area variation along the machine.

Accomplishments.

The parallel version of the Quasi-3D Navier-Stokes code has been successfully implemented on the VKI cluster. A program that allows interfacing between the mesh generator Gambit and the current solver was developed as well as a number of small program that ease the post processing. The influence of the stream-tube height on the operating point has been investigated. A perfect match with the experimental results could not be achieved. The numerical results of three different stream-tube configurations in the four different clocking positions are presented. The stator-rotor interaction was successfully reproduced and compared with the experimental data (see figure 1). The stator-stator interaction shows significant effects on the time-averaged and time-resolved flow field of the downstream stator but also on the rotor. A first attempt of mesh refinement shows that grid independence is not yet achieved on the second stator. For this reason, it is proposed to refine further the mesh until a stable solution is reached.

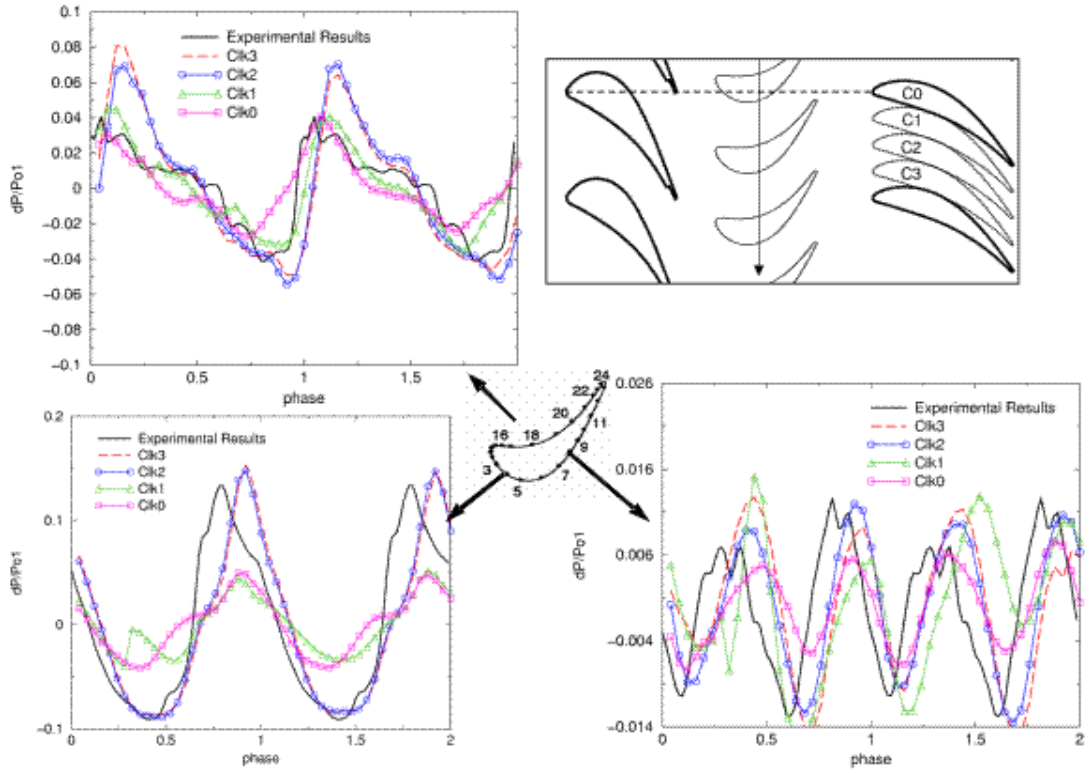

Figure 1: Time resolved pressure fluctuations in different clocking positions, rotor blade.