Numerical Simulation of Flow Through Cascade in Wind Tunnel Test Section and Stand Alone Configurations

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Abstract

The work deals with the numerical simulation of flows through turbine cascade composed of a low-pressure rotor blade tip profiles. The aim of the work is to investigate two setups: the configuration corresponding to real experiments and the configuration corresponding to annular cascade. The experimental configuration is characterized by finite number of blades located in complicated geometry of wind tunnel test section. The annular configuration leads to blade to blade periodicity, which is not guaranteed in experimental configuration. The tip section cascade consists of very thin profiles with very high stagger angle. The flow field is thus very sensitive on incidence angle, the inlet Mach number varies in range 0.8 - 2.2. There is a complex flow with interaction of strong shock waves, shear layers and shock reflections. These simulations can explain how to interpret the experimental data for annular blade design. Another contribution is better understanding of complex phenomena in wind tunnel, which cannot be observed experimentally. The mathematical model is based on Favre-averaged Navier-Stokes equations with SST k-omega turbulence model. The in-house implicit finite volume solvers based on AUSM-type discretization are used. One approach uses unstructured grids, the other one structured multi-block grids. The results are obtained for several regimes for both configurations.

References

1. F. R. Menter. Two-equation eddy-viscosity turbulence models for engineering applications. AIAA Journal 32 (8) (1994) 1598–1605.