Abstract

The aim of the present work is to evaluate the aerodynamic forces coefficients, lift and drag coefficients experimentally and numerically of gas turbine cascade blades, with and without film cooling. The flow field parameters of the gas turbine cascade passage are also predicted numerically.

For this purpose, the interaction between a two-dimensional inclined injected (jet angle) and the cross-flow is simulated by employing different two-equation eddy-viscosity turbulence models, such as (standard (k-ε), RNG (k-ε), standard (k-ω), and SST (k-ω)). The governing equations include the filtered time dependent Navier Stokes equations under the conditions of incompressible and constant properties. The present numerical simulation is based on the use of the finite volume method.

The experimental work was introduced to validate the numerical results of lift and drag coefficients. This was done by manufacturing five linear cascade blades (of first stage rotor of engine F-100-PW-220 turbofan) in an open jet type low-speed subsonic wind tunnel. The lift and drag coefficients were calculated by measured inlet and outlet stagnation pressures, inlet flow velocity, and flow deflection angle by using a five-hole probe and a Pitot-static tube. The Mach number distributions outside the boundary layer on both blade sides are compared with the results of a well known CFD code (Fine/Turbo) for a rotor stage identical gas turbine.

The computation shows that the Mach number distribution along the both blade sides in the subsonic region for the rotor stage is higher than that for the cascade by 10 %- 20 %. The gas temperature close to the blade pressure side surface does not exceed 1150 °K, i.e., it drops from 1509 °K to 1150 °K (23 %), while at the leading edge and on the suction side, the temperature drops only from 1509 °K to 1300 °K (13 %).