Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Aero-thermal optimization of film cooling flow parameters on the suction surface of a high pressure turbine blade CAROLE EL AYOUBI, IBRAHIM HASSAN, WAHID GHALY, Concordia University — This paper aims to optimize film coolant flow parameters on the suction surface of a high-pressure gas turbine blade in order to obtain an optimum compromise between a superior cooling performance and a minimum aerodynamic penalty. An optimization algorithm coupled with three-dimensional Reynolds-averaged Navier Stokes analysis is used to determine the optimum film cooling configuration. The VKI blade with two staggered rows of axially oriented, conically flared, film cooling holes on its suction surface is considered. Two design variables are selected; the coolant to mainstream temperature ratio and total pressure ratio. The optimization objective consists of maximizing the spatially averaged film cooling effectiveness and minimizing the aerodynamic penalty produced by film cooling. The effect of varying the coolant flow parameters on the film cooling effectiveness and the aerodynamic loss is analyzed using an optimization method and three dimensional steady CFD simulations. The optimization process consists of a genetic algorithm and a response surface approximation of the artificial neural network type to provide low-fidelity predictions of the objective function. The CFD simulations are performed using the commercial software CFX. The numerical predictions of the aero-thermal performance is validated against a well-established experimental database.

Carole El Ayoubi
Concordia University

Date submitted: 03 Aug 2012 Electronic form version 1.4