World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:10, No:02, 2016

One-Dimensional Performance Improvement of a Single-Stage Transonic Compressor

Authors : A. Shahsavari, M. Nili-Ahmadabadi

Abstract : This paper presents an innovative one-dimensional optimization of a transonic compressor based on the radial equilibrium theory by means of increasing blade loading. Firstly, the rotor blade of the transonic compressor is redesigned based on the constant span-wise deHaller number and diffusion. The code is applied to extract compressor meridional plane and blade to blade geometry containing rotor and stator in order to design blade three-dimensional view. A structured grid is generated for the numerical domain of fluid. Finer grids are used for regions near walls to capture boundary layer effects and behavior. RANS equations are solved by finite volume method for rotating zones (rotor) and stationary zones (stator). The experimental data, available for the performance map of NASA Rotor67, is used to validate the results of simulations. Then, the capability of the design method is validated by CFD that is capable of predicting the performance map. The numerical results of new geometry show about 19% increase in pressure ratio and 11% improvement in overall efficiency of the transonic stage; however, the design point mass flow rate of the new compressor is 5.7% less than that of the original compressor.

Keywords : deHaller number, one dimensional design, radial equilibrium, transonic compressor
Conference Title : ICAMME 2016 : International Conference on Applied Mechanics and Mechanical Engineering
Conference Location : Melbourne, Australia
Conference Dates : February 04-05, 2016