



Unsteady, Cooled Turbine Simulation Using a PC-Linux Analysis System

Michael G. List and Mark G. Turner
University of Cincinnati, Cincinnati, Ohio

JenPing Chen and Michael G. Remotigue
Mississippi State University, Starkville, Mississippi

Joseph P. Veres
Glenn Research Center, Cleveland, Ohio

Unsteady Cooled Turbine Simulation Using A Pc Linux Analysis System

Rémy Fransen



Unsteady Cooled Turbine Simulation Using A Pc Linux Analysis System:

Unsteady, Cooled Turbine Simulation Using a Pc-Linux Analysis System National Aeronautics and Space Administration (NASA), 2018-06-21 The first stage of the high pressure turbine HPT of the GE90 engine was simulated with a three dimensional unsteady Navier Stokes solver MSU Turbo which uses source terms to simulate the cooling flows In addition to the solver its pre processor GUMBO and a post processing and visualization tool Turbomachinery Visual3 TV3 were run in a Linux environment to carry out the simulation and analysis The solver was run both with and without cooling The introduction of cooling flow on the blade surfaces case and hub and its effects on both rotor vane interaction as well the effects on the blades themselves were the principle motivations for this study The studies of the cooling flow show the large amount of unsteadiness in the turbine and the corresponding hot streak migration phenomenon This research on the GE90 turbomachinery has also led to a procedure for running unsteady cooled turbine analysis on commodity PC s running the Linux operating system List Michael G and Turner Mark G and Chen Jen Pimg and Remotigue Michael G and Veres Joseph P Glenn Research Center NASA TM 2004 212976 E 14449 AIAA Paper 2004 0370 **AIAA Aerospace Sciences Meeting and Exhibit, 42nd**, 2004 *Aerospace America*, 2003 **Government Reports Announcements & Index**, 1996 *LES Based Aerothermal Modeling of Turbine Blade Cooling Systems* Rémy Fransen, 2013 This PhD dissertation conducted as part of a CIFRE research project between TURBOMECA and CERFACS in partnership with the VKI deals with improving performance of axial turbines from helicopter engines One of the most critical design points of such engines is the control of the high pressure turbine blade lifetime which face the high temperatures from the combustor Today industrial numerical aerothermal predictions of the flows around the blade in the vein and in its cooling system are performed with the Reynolds Averaged Navier Stokes RANS Thanks to the increasing computational power Large Eddy Simulation LES becomes affordable to offer further flow predictions Therefore this thesis focuses on the capabilities of the LES to estimate the flow in turbine blade internal cooling channels To simplify this analysis where several physical phenomenon are present the problem is described in three parts with increasing complexity The first part addresses simplified typical geometries of cooling channel U bend and ribbed channel in a static configuration Considering the flow regime a wall resolved approach using a hybrid unstructured mesh is proposed in view of the application on an industrial case The second part extends the study of the ribbed channel in rotation using an inertial reference frame LES provides mean and unsteady results in good agreement with the available experimental data and previous works for the flow dynamic and the heat transfer Finally the third part presents the application of the method to an industrial case with conjugate heat transfer between a complex cooling channel and the blade This last section is not present in the public manuscript for confidential reasons Results of the use of the wall resolved approach in rotation in an inertial frame of reference are compared to RANS predictions and show the potential of the method with high local differences *Unsteady High Turbulence Effects on Turbine Blade Film Cooling Heat Transfer*

Performance Using a Transient Liquid Crystal Technique National Aeronautics and Space Administration (NASA), 2018-06-27

Unsteady wake effect with and without trailing edge ejection on detailed heat transfer coefficient and film cooling effectiveness distributions is presented for a downstream film cooled gas turbine blade. Tests were performed on a five blade linear cascade at an exit Reynolds number of 5.3×10^5 . Upstream unsteady wakes were simulated using a spoke wheel type wake generator. Coolant blowing ratio was varied from 0.4 to 1.2. Air and CO₂ were used as coolants to simulate different density ratios. Surface heat transfer and film effectiveness distributions were obtained using a transient liquid crystal technique. Coolant temperature profiles were determined with a cold wire technique. Results show that Nusselt numbers for a film cooled blade are much higher compared to a blade without film injection. Unsteady wake slightly enhances Nusselt numbers but significantly reduces film effectiveness versus no wake cases. Nusselt numbers increase only slightly but film cooling effectiveness increases significantly with increasing blowing ratio. Higher density coolant CO₂ provides higher effectiveness at higher blowing ratios $M = 1.2$ whereas lower density coolant Air provides higher effectiveness at lower blowing ratios $M = 0.8$. Trailing edge ejection generally has more effect on film effectiveness than on the heat transfer, typically reducing film effectiveness and enhancing heat transfer. Similar data is also presented for a film cooled cylindrical leading edge model. Han J. C. and Ekkad S. V. and Du H. and Teng S. Glenn Research Center NAG3 1656 RTOP 714 01 4A **A**

Computer Program for the Transient Thermal Analysis of an Impingement Cooled Turbine Blade Raymond E. Gaugler, 1977 **Gas Turbine Cooling Modeling - Thermodynamic Analysis and Cycle Simulations** Kristin Jordal, 1999 *The Unsteady Temperature Field in a Turbine Blade Cooling Channel* T. Arts, 2001 Computational Simulation and Analysis of Film Cooling for the Leading-edge Model of a Turbine Blade, 2007

The application of interest is the cooling of turbine blades in large gas combustion engines where hot gases from the combustor cause thermal deterioration of the metal turbine blades. A thin film of coolant flow buffers the hottest parts of the blade surface. Heat transfer on a bluff body and subsequently a single hole cooling problem is solved numerically in two dimensions. The flow is assumed to be incompressible and the laminar steady Navier Stokes equations are used to obtain the flow solution. Results for the bluff body heat transfer agree very well with experimental data up to the separation point and are within 20% of the data thereafter. The film cooling simulation yielded higher cooling effectiveness due in large part to the use of the two dimensional model which treats the hole as a slot with higher coolant mass. Results from the simulations indicate that the Cobalt flow solver is capable of solving complex heat transfer problems.

Unveiling the Magic of Words: A Overview of "**Unsteady Cooled Turbine Simulation Using A Pc Linux Analysis System**"

In some sort of defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their power to kindle emotions, provoke contemplation, and ignite transformative change is actually awe-inspiring. Enter the realm of "**Unsteady Cooled Turbine Simulation Using A Pc Linux Analysis System**," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve in to the book is central themes, examine its distinctive writing style, and assess its profound affect the souls of its readers.

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