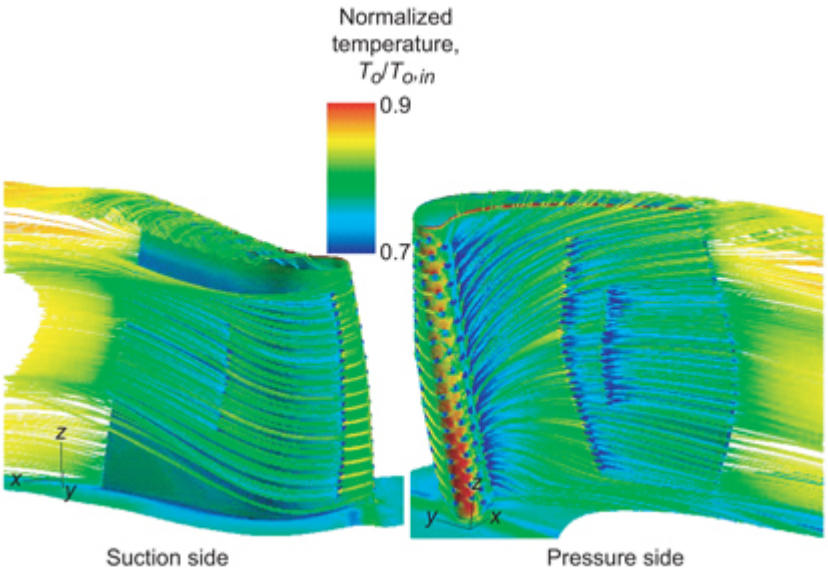
Object-Oriented Version of Glenn-HT Code Released: Glenn-HT2000

NASA Glenn Research Center's General Multi-Block Navier-Stokes Convective Heat Transfer Code (Glenn-HT) has been used extensively to predict heat transfer and fluid flow for a variety of steady gas turbine engine problems. Efforts have focused on turbine heat transfer, where computations have modeled tip clearance, internal coolant, and film cooling flows. Excellent agreement has been achieved for a variety of experimental test cases, and results have been published in over 40 technical publications. The code is available to U.S. industry and has been used by several domestic gas turbine engine companies. The following figure shows a typical flow solution from the Glenn-HT code for a film-cooled turbine blade.



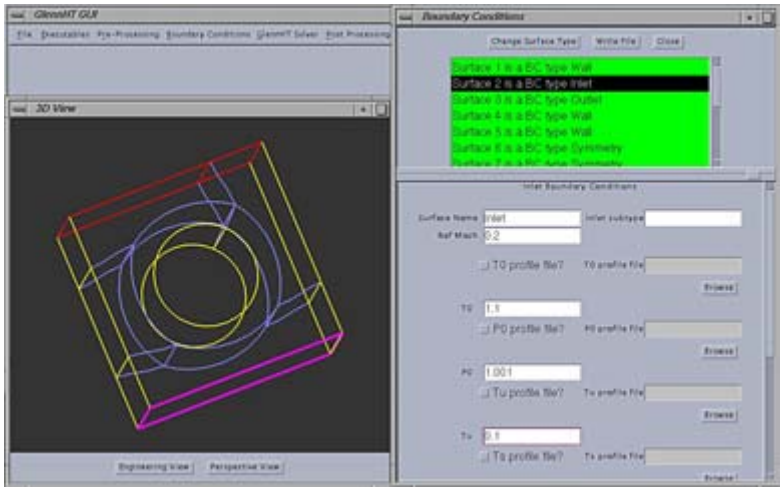
Glenn-HT solution for a film-cooled turbine blade. Streamlines, colored by temperature, emanate from holes over the cooled blade surface with a distribution of h.

Originally, the Glenn-HT code was written in the Fortran 77 programming language. However, limitations in Fortran 77 restrict the generality of the code. Fortran 90/95 is a more object-oriented language and allows programmers to create code that is more modular and that makes more efficient use of data structures. Recently, the Glenn-HT code was completely rewritten using all the capabilities of the Fortran 90/95 programming language. The result, Glenn-HT2000, provides dynamic memory allocation, a modular design, unsteady flow capability, and the ability to more easily implement new models and equations into the code.

In an effort to improve computational turnaround time and cost, Glenn's Turbine Branch purchased a 96-processor Linux-based personal-computer cluster to run the Glenn-HT2000 code. As a part of this effort, the Message Passing Interface (MPI) will have to be implemented in the code. MPI will allow the code to run on multiple processors on a

distributed memory system, such as the Turbine Branch cluster. Since the trend is toward larger computational problems, the use of many processors, and thus MPI, is very important. The MPI implementation effort is underway, and testing has begun.

In addition to the object-oriented capabilities in the Glenn-HT2000 code, a graphical user interface (GUI) has been produced that allows a user to more easily set up a case. Previously, users had to manually create and edit the various input files necessary for code execution. Although this is generally sufficient for an expert user, it makes the process somewhat susceptible to errors. Furthermore, it is quite intimidating to new users of the code. The GUI allows users to set up a case by entering information about the case as prompted by the GUI, and it allows some graphical manipulation of the input information. In addition, a saved case can very easily be modified and rerun. The GUI also provides runtime convergence histories and comes packaged with the Java Runtime Environment for Linux and Unix systems. The following figure shows a screen shot from the GUI.



Screen shot from the Glenn-HT graphical user interface.

Future plans call for the application of the new Glenn-HT2000 code to a range of gas turbine engine problems of current interest to the heat transfer community. The new unsteady flow capability will allow researchers to predict the effect of unsteady flow phenomena on the convective heat transfer of turbine blades and vanes. Work also will continue on the development of conjugate heat transfer capability in the code, where convective and conductive heat transfer domains can be solved simultaneously. Finally, advanced turbulence and fluid flow models and automatic gridding techniques being developed within Glenn's Turbine Branch will be applied to the Glenn-HT2000 code and solution process.

Find out more about this research at
http://www.grc.nasa.gov/WWW/TURBINE/Turbine.htm

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