Final Report

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JAMES LOELLBACH

Research Area: 3D Structured Grid Generation Codes for Turbomachinery

Mr. Loellbach's research tasks during the past year were mainly in the area of computational grid generation in support of CFD analyses of turbomachinery components. This work was performed in cooperation with Dr. Chunill Hah of NASA Lewis Research Center and Fu-Lin Tsung of ICOMP. In addition to the grid generation work, he obtained a numerical simulation for the flow through a centrifugal gas compressor using an unstructured Navier-Stokes solver.

The work with Dr. Hah involves many different turbomachinery component analyses. These analyses were performed for NASA projects or for industrial applications. The work includes both centrifugal and axial machines, single and multiple blade rows, and steady and unsteady analyses. Over the past five years, a set of structured grid generation codes were deveoped by Mr. Loellbach that allow grids to be obtained fairly quickly for the large majority of configurations we encounter. These codes do not comprise a generalized grid generation package; they are noninteractive codes specifically designed for turbomachinery blade row geometries. But because of this limited scope, the codes are small, fast, and portable, and they can be run in the batch mode on small workstations.

During the past year, these programs were used to generate computational grids for a wide variety of configurations. In particular, Mr. Loellbach modified the codes or wrote supplementary codes to improve our grid generation capabilities for multiple blade row configurations. This involves generating separate grids for each blade row, and then making them match and overlap by a few grid points at their common interface so that fluid properties are communicated across the interface. Unsteady rotor/stator analyses were performed for an axial turbine, a centrifugal compressor, and a centrifugal pump. Steady-state single-blade-row analyses were made for a study of blade sweep in transonic compressors.

Mr. Loellbach also cooperated with Fu-Lin Tsung on the application of an unstructured Navier-Stokes solver for turbomachinery flow simulations. In particular, the unstructured solver was used to analyze the flow through a centrifugal compressor impeller.