Displaying CFD Solution Parameters on Arbitrary Cut Planes

Langley Research Center, Hampton, Virginia

USMC6 is a Fortran 90 computer program for post-processing in support of visualization of flows simulated by computational fluid dynamics (CFD). The name "USMC6" is partly an abbreviation of "TetrUSS — USM3D Solution Cutter," reflecting its origin as a post-processor for use with USM3D — a CFD program that is a component of the Tetrahedral Unstructured Software System and that solves the Navier-Stokes equations on tetrahedral unstructured grids. "Cutter" here refers to a capability to acquire and process solution data on (1) arbitrary planes that cut through grid volumes, or (2) user-selected spheroidal, conical, cylindrical, and/or prismatic domains cut from within grids. Cutting saves time by enabling concentration of post-processing and visualization efforts on smaller solution domains of interest.

The user can select from among more than 40 flow functions. The cut planes can be trimmed to circular or rectangular shape. The user specifies cuts and functions in a free-format input file using simple and easy-to-remember keywords. The USMC6 command line is simple enough that the slicing process can readily be embedded in a shell script for assembly-line post-processing. The output of USMC6 is a data file ready for plotting.

This program was written by S. Paul Pao of Langley Research Center. LAR-17527-1

Flow Solver for Incompressible 2-D Drive Cavity

Goddard Space Flight Center, Greenbelt, Maryland

This software solves the Navier-Stokes equations for the incompressible driven cavity flow problem. The code uses second-order finite differencing on a staggered grid using the Chorin projection method. The resulting intermediate Poisson equation is efficiently solved using the fast Fourier transform.

Time stepping is done using fourth-order Runge-Kutta for stability at high Reynolds numbers. Features include check-pointing, periodic field snapshots, ongoing reporting of kinetic energy and changes between time steps, time histories at selected points, and optional streakline generation.

This program was written by Virginia Kalb of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15107-1

Flow Solver for Incompressible Rectangular Domains

Goddard Space Flight Center, Greenbelt, Maryland

This is an extension of the Flow Solver for Incompressible 2-D Drive Cavity software described in the preceding article. It solves the Navier-Stokes equations for incompressible flow using finite differencing on a uniform, staggered grid. There is a runtime choice of either central differencing or modified upwinding for the convective term. The domain must be rectangular, but may have a rectangular walled region within it. Currently, the position of the interior region and exterior boundary conditions are changed by modifying parameters in the code and recompiling. These features make it possible to solve a variety of classical fluid flow problems such as an L-shaped cavity, channel flow, or wake flow past a square cylinder. The code uses fourth-order Runge-Kutta time-stepping and overall second-order spatial accuracy.

This software permits the walled region to be positioned such that flow past a square cylinder, an L-shaped cavity, and the flow over a back-facing step can all be solved by reconfiguration. Also, this extension has an automatic detection of periodicity, as well as use of specialized data structure for ease of configuring domain decomposition and computing convergence in overlap regions.

This program was written by Virginia L. Kalb of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15111-1

Simulating Avionics Upgrades to the Space Shuttles

Lyndon B. Johnson Space Center, Houston, Texas

Cockpit Avionics Prototyping Environment (CAPE) is a computer program that simulates the functions of proposed upgraded avionics for a space shuttle. In CAPE, pre-existing space-shuttle-simulation programs are merged with a commercial-off-the-shelf (COTS) display-development program, yielding a package of software that enables high-fi-