Software

Computing Isentropic Flow Properties of Air/R-134a Mixtures

MACHRK is a computer program that calculates isentropic flow properties of mixtures of air and refrigerant R-134a (tetrafluoroethane), which are used in transonic aerodynamic testing in a wind tunnel at Langley Research Center. Given the total temperature, total pressure, static pressure, and mole fraction of R-134a in a mixture, MACHRK calculates the Mach number and the following associated flow properties: dynamic pressure, velocity, density, static temperature, speed of sound, viscosity, ratio of specific heats, Reynolds number, and Prandtl number. Real-gas effects are taken into account by treating the gases comprising the mixture as both thermally and calorically imperfect. The Redlich-Kwong equation of state for mixtures and the constant-pressure ideal heat-capacity equation for the mixture are used in combination with the departure-function approach of thermodynamics to obtain the equations for computing the flow properties. In addition to the aforementioned calculations for air/R-134a mixtures, a research version of MACHRK can perform the corresponding calculations for mixtures of air and R-12 (dichlorodifluoromethane) and for air/SF_6 mixtures. [R-12 was replaced by R-134a because of environmental concerns. SF_6 has been considered for use in increasing the Reynolds-number range.]

This program was written by Ray Kvaternik of **Langley Research Center**. *Further information is contained in a TSP (see page 1).*
LAR-17095-1

Java Mission Evaluation Workstation System

The Java Mission Evaluation Workstation System (JMEWS) is a collection of applications designed to retrieve, display, and analyze both real-time and recorded telemetry data. This software is currently being used by both the Space Shuttle Program (SSP) and the International Space Station (ISS) program. JMEWS was written in the Java programming language to satisfy the requirement of platform independence.

An object-oriented design was used to satisfy additional requirements and to make the software easily extendable. By virtue of its platform independence, JMEWS can be used on the UNIX workstations in the Mission Control Center (MCC) and on office computers. JMEWS includes an interactive editor that allows users to easily develop displays that meet their specific needs. The displays can be developed and modified while viewing data. By simply selecting a data source, the user can view real-time, recorded, or test data.

This program was written by Ross Pettinger, Tim Watlington, Richard Ryley, and Jeff Harbour of Lockheed Martin Corp. for **Johnson Space Center**. *For further information, contact the Johnson Innovative Partnerships Office at (281) 483-3809.*
MSC-23665

Using a Quadtree Algorithm To Assess Line of Sight

A matched pair of computer algorithms determines whether line of sight (LOS) is obstructed by terrain. These algorithms were originally designed for use in conjunction with combat-simulation software in military training exercises, but could also be used for such commercial purposes as evaluating lines of sight for antennas or determining what can be seen from a "room with a view." The quadtree preparation algorithm operates on an array of digital elevation data and only needs to be run once for a terrain region, which can be quite large. Relatively little computation time is needed, as each elevation value is considered only one and one-third times. The LOS assessment algorithm uses that quadtree to answer LOS queries. To determine whether LOS is obstructed, a piecewise-planar (or higher-order) terrain skin is computationally draped over the digital elevation data. Adjustments are made to compensate for curvature of the Earth and for refraction of the LOS by the atmosphere. Average computing time appears to be proportional to the number of queries times the logarithm of the number of elevation data points. Accuracy is as high as is possible for the available elevation data, and symmetric results are assured. In the simulation, the LOS query program runs as a separate process, thereby making more random-access memory available for other computations.

These programs were written by Joseph Gonzalez, Robert Chamberlain, Eric Tailor, and Gary Gutt of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-40596.

Software for Automated Generation of Cartesian Meshes

Cart3D is a collection of computer programs for generating Cartesian meshes [for computational fluid dynamics (CFD) and other applications] in volumes bounded by solid objects. Aspects of Cart3D at earlier stages of development were reported in "Robust and Efficient Generation of Cartesian Meshes for CFD" (ARC-14275), *NASA Tech Briefs,* Vol. 23, No. 8 (August 1999), page 30. The geometric input to Cart3D comprises surface triangulations like those commonly generated by computer-aided-design programs. Complexly shaped objects can be represented as assemblies of simpler ones. Cart3D deletes all portions of such an assembled object that are not on the exterior surface. Intersections between components are preserved in the resulting triangulation. A tie-breaking routine unambiguously resolves geometric degeneracies. Then taking the intersected surface triangulation as input, the volume mesh is generated through division of cells of an initially coarse hexahedral grid. Cells are subdivided to refine the grid in regions of increased surface curvature and/or increased flow gradients. Cells that become split into multiple unconnected regions by thin pieces of surface are identified.

These programs were written by Michael J. Aftosmis and John E. Melton of **Ames Research Center** *and Marsha J. Berger of the Courant Institute of Mathematics at New York University. Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Technology Partnerships Division, Ames Research Center, (650) 604-2954. Refer to ARC-14275-1.