## Processing Raman Spectra of High-Pressure Hydrogen Flames

The Raman Code automates the analysis of laser-Raman-spectroscopy data for diagnosis of combustion at high pressure. On the basis of the theory of molecular spectroscopy, the software calculates the rovibrational and pure rotational Raman spectra of $H_2$, $O_2$, $N_2$, and $H_2O$ in hydrogen/air flames at given temperatures and pressures. Given a set of Raman spectral data from measurements on a given flame and results from the aforementioned calculations, the software calculates the thermodynamic temperature and number densities of the aforementioned species. The software accounts for collisional spectral-line-broadening effects at pressures up to 60 bar (6 MPa). The line-broadening effects increase with pressure and thereby complicate the analysis. The software also corrects for spectral interference ("cross-talk") among the various chemical species. In the absence of such correction, the cross-talk is a significant source of error in temperatures and number densities. This is the first known comprehensive computer code that, when used in conjunction with a spectral calibration database, can process Raman-scattering spectral data from high-pressure hydrogen/air flames to obtain temperatures accurate to within ±10 K and chemical-species number densities accurate to within ±2 percent.

*This work was done by Quang-Viet Nguyen of* **Glenn Research Center** *and Jun Kojima of the National Research Council. Further information is contained in a TSP (see page 1).*

*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17769-1.*

## X-Windows Information Sharing Protocol Widget Class

The X-Windows Information Sharing Protocol (ISP) Widget Class ("Class" is used here in the object-oriented-programming sense of the word) was devised to simplify the task of implementing ISP graphical-user-interface (GUI) computer programs. ISP programming tasks require many method calls to identify, query, and interpret the connections and messages exchanged between a client and an ISP server. Most X-Windows GUI programs use widget sets or toolkits to facilitate management of complex objects. The widget standards facilitate construction of toolkits and application programs. The X-Windows Information Sharing Protocol (ISP) Widget Class encapsulates the client side of the ISP programming libraries within the framework of an X-Windows widget. Using the widget framework, X-Windows GUI programs can interact with ISP services in an abstract way and in the same manner as that of other graphical widgets, making it easier to write ISP GUI client programs. Wrapping ISP client services inside a widget framework enables a programmer to treat an ISP server interface as though it were a GUI. Moreover, an alternate subclass could implement another communication protocol in the same sort of widget.

*This program was written by Matthew R. Barry of United Space Alliance for* **Johnson Space Center***. For further information, contact the Johnson Innovative Partnerships Office at (281) 483-3809.*
*MSC-23583*

## Simulating Humans as Integral Parts of Spacecraft Missions

The Collaborative-Virtual Environment Simulation Tool (C-VEST) software was developed for use in a NASA project entitled "3-D Interactive Digital Virtual Human." The project is oriented toward the use of a comprehensive suite of advanced software tools in computational simulations for the purposes of human-centered design of spacecraft missions and of the spacecraft, space suits, and other equipment to be used on the missions. The C-VEST software affords an unprecedented suite of capabilities for three-dimensional virtual-environment simulations with plug-in interfaces for physiological data, haptic interfaces, plug-and-play software, real-time control, and/or playback control. Mathematical models of the mechanics of the human body and of the aforementioned equipment are implemented in software and integrated to simulate forces exerted on and by astronauts as they work. The computational results can then support the iterative processes of design, building, and testing in applied systems engineering and integration. The results of the simulations provide guidance for devising measures to counteract effects of microgravity on the human body and for the rapid development of virtual (that is, simulated) prototypes of advanced space suits, cockpits, and robots to enhance the productivity, comfort, and safety of astronauts. The unique ability to implement human-in-the-loop immersion also makes the C-VEST software potentially valuable for use in commercial and academic settings beyond the original space-mission setting.

*This program was written by Anthony C. Bruins of* **Johnson Space Center***; Robert Rice of Dynoverse Corp.; Lac Nguyen, Heidi Nguyen, and Tim Saito of HPN Software Consultant, Inc.; and Elaine Russell of the Institute of Somatic Sciences. For further information, contact the Johnson Innovative Partnerships Office at (281) 483-3809.*
*MSC-23454*

## Analyzing Power Supply and Demand on the ISS

Station Power and Energy Evaluation Determiner (SPEED) is a Java application program for analyzing the supply and demand aspects of the electrical power system of the International Space Station (ISS). SPEED can be executed on any computer that supports version 1.4 or a subsequent version of the Java Runtime Environment. SPEED includes an analysis module, denoted the Simplified Battery Solar Array Model, which is a simplified engineering model of the ISS primary power system. This simplified model makes it possible to perform analyses quickly. SPEED also includes a user-friendly graphical-interface module, an input file system, a parameter-configuration module, an analysis-configuration-management subsystem, and an output subsystem. SPEED responds to input information on trajectory, shadowing, attitude, and pointing in either a state-of-charge mode or a power-availability mode. In the state-of-charge mode, SPEED calculates battery state-of-charge profiles, given a time-varying power-load profile. In the power-availability mode, SPEED determines the time-varying total available solar array and/or battery power output, given a minimum allowable battery state of charge.

*This work was done by Justin Thomas, Tho Pham, Raymond Halyard, and Steve Conwell of United Space Alliance for* **Johnson Space Center***. For further information, contact the Johnson Innovative Partnerships Office at (281) 483-3809.*
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