

guides for others outside the current organization to use the system.

*This program was written by Cecilia S. Cheng, Rajesh R. Patel, Elias M. Sayfi, and Hyun H. Lee of Caltech for NASA's Jet Propulsion Laboratory.*

*This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-45630.*

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### **Autonomously Calibrating a Quadrupole Mass Spectrometer**

A computer program autonomously manages the calibration of a quadrupole ion mass spectrometer intended for use in monitoring concentrations and changes in concentrations of organic chemicals in the cabin air of the International Space Station. The instrument parameters calibrated include the voltage on a channel electron multiplier, a discriminator threshold, and an ionizer current. Calibration is achieved by analyzing the mass spectrum obtained while sweeping the parameter ranges in a heuristic procedure, developed by mass-spectrometer experts, that involves detection of changes in signal trends that humans can easily recognize but cannot necessarily be straightforwardly codified in an algorithm.

The procedure includes calculation of signal-to-noise ratios, signal-increase

rates, and background-noise-increase rates; finding signal peaks; and identifying peak patterns. The software provides for several recovery-from-error scenarios and error-handling schemes. The software detects trace amounts of contaminant gases in the mass spectrometer and notifies associated command-and-data-handling software to schedule a cleaning. Furthermore, the software autonomously analyzes the mass spectrum to determine whether the parameters of a radio-frequency ramp waveform are set properly so that the peaks of the mass spectrum are at expected locations.

*This work was done by Seungwon Lee and Benjamin J. Bornstein 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 (626) 395-2322. Refer to NPO-45364.*

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### **Determining Spacecraft Reaction Wheel Friction Parameters**

Software was developed to characterize the drag in each of the Cassini spacecraft's Reaction Wheel Assemblies (RWAs) to determine the RWA friction parameters. This tool measures the drag torque of RWAs for not only the

high spin rates (>250 RPM), but also the low spin rates (<250 RPM) where there is a lack of an elasto-hydrodynamic boundary layer in the bearings. RWA rate and drag torque profiles as functions of time are collected via telemetry once every 4 seconds and once every 8 seconds, respectively. Intermediate processing steps single-out the coast-down regions.

A nonlinear model for the drag torque as a function of RWA spin rate is incorporated in order to characterize the low spin rate regime. The tool then uses a nonlinear parameter optimization algorithm based on the Nelder-Mead simplex method to determine the viscous coefficient, the Dahl friction, and the two parameters that account for the low spin-rate behavior.

*This program was written by Siamak Sarani of Caltech for NASA's Jet Propulsion Laboratory.*

*In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:*

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*Refer to NPO-44712, volume and number of this NASA Tech Briefs issue, and the page number.*