Determining Atmospheric-Density Profile of Titan

NASA's Jet Propulsion Laboratory, Pasadena, California

A method was developed for measuring the atmospheric density of Titan, the largest moon of Saturn, to create an accurate density profile as a function of altitude. This will allow mission planners to select safe flyby altitudes, and for navigation engineers to accurately predict the delta-v associated with those flybys.

The spacecraft angular rate vector profile as a function of time is collected via telemetry from the onboard attitude estimator once every 2 seconds. The telemetry for thruster times, as a function of time, for eight Reaction Control System (RCS) thrusters is gathered, once a second, from the Propulsion Manager algorithm of the Cassini onboard attitude-control flight software. Using these data, the ground software computes the angular momentum vector profile and the per-axis external torque as a function of time imparted from the spacecraft only due to the atmospheric drag. The software can then determine the Titan atmospheric density profile as a function of time and altitude with the known values of spacecraft center of mass, the Titan-relative range and velocity data, the projected area, and the aerocenter, along with the estimated drag coefficient in a free molecular flow field.

This work was done by Siamak Sarani of Caltech for NASA's Jet Propulsion Laboratory.

The software used in this innovation is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-44707.