Software

MIRO Computational Model

A computational model calculates the excitation of water rotational levels and emission-line spectra in a cometary coma with applications for the Microwave Instrument for Rosetta Orbiter (MIRO). MIRO is a millimeter-submillimeter spectrometer that will be used to study the nature of cometary nuclei, the physical processes of outgassing, and the formation of the head region of a comet (coma). The computational model is a means to interpret the data measured by MIRO.

The model is based on the accelerated Monte Carlo method, which performs a random angular, spatial, and frequency sampling of the radiation field to calculate the local average intensity of the field. With the model, the water rotational level populations in the cometary coma and the line profiles for the emission from the water molecules as a function of cometary parameters (such as outgassing rate, gas temperature, and gas and electron density) and observation parameters (such as distance to the comet and beam width) are calculated.

This work was done by Paul A. Von Allmen and Seungwon Lee 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-46508.

Team Collaboration Software

The Ground Resource Allocation and Planning Environment (GRAPE 1.0) is a Web-based, collaborative team environment based on the Microsoft SharePoint platform, which provides Deep Space Network (DSN) resource planners' tools and services for sharing information and performing analysis. The foundation platform for GRAPE provides a number of communication and data-management mechanisms, which help planners communicate scheduling issues, including document management, security schemes, calendars, wikis, blogs, lists, issue tracking, discussion forums, workflow management, alerts/notifications, and configuration management.

Additionally, a set of "web parts" has been developed for DSN resource-allocation-specific analysis, including tools for managing ground asset and mission information; finding configuration codes; displaying, querying, and comparing schedules; analyzing mission coverage; checking for schedule conflicts; creating and submitting schedule change requests; and viewing and validating mission view periods. The methodology of web parts allows individual users to compose their own Web pages by picking the web parts they want to use on a Web page, rather than developers designing Web pages for users. This allows developers to focus more on functionality and less on appearance and integration, while users are empowered to compose Web pages for their immediate analysis and collaboration needs rather than waiting for another long development cycle for some new capability. GRAPE web parts, which connect to existing DSN middle-tier Web services for many computation and data access activities, support Service Oriented Architecture (SOA), and component-style development.

This work was done by Yeou-Fang Wang, Mitchell Schrock, John R. Baldwin, and Chester S. Borden 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-45988.

Comet Gas and Dust Dynamics Modeling

This software models the gas and dust dynamics of comet coma (the head region of a comet) in order to support the Microwave Instrument for Rosetta Orbiter (MIRO) project. MIRO will study the evolution of the comet 67P/Churyumov-Gerasimenko's coma system. The instrument will measure surface temperature, gas-production rates and relative abundances, and velocity and excitation temperatures of each species along with their spatial temporal variability. This software will use these measurements to improve the understanding of coma dynamics.

The modeling tool solves the equation of motion of a dust particle, the energy balance equation of the dust particle, the continuity equation for the dust and gas flow, and the dust and gas mixture energy equation. By solving these equations numerically, the software calculates the temperature and velocity of gas and dust as a function of time for a given initial gas and dust production rate, and a dust characteristic parameter that measures the ability of a dust particle to adjust its velocity to the local gas velocity.

The software is written in a modular manner, thereby allowing the addition of more dynamics equations as needed. All of the numerical algorithms are added in-house and no third-party libraries are used.

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Online Planning Algorithm

AVA v2 software selects goals for execution from a set of goals that oversubscribe shared resources. The term "goal" refers to a science or engineering request to execute a possibly complex command sequence, such as image targets or ground-station downlinks.

Developed as an extension to the Virtual Machine Language (VML) execution system, the software enables onboard and remote goal triggering through the use of an embedded, dynamic goal set that can oversubscribe resources. From the set of conflicting goals, a subset must be chosen that maximizes a given quality metric, which in this case is strict priority selection. A goal can never be preempted by a lower priority goal, and high-level goals can be added, removed, or updated at any time, and the "best" goals will be selected for execution.

The software addresses the issue of re-planning that must be performed in a short time frame by the embedded system where computational resources are constrained. In particular, the algorithm addresses problems with well-defined goal requests without temporal flexibility that oversubscribes