Software Modules for the Proximity-1 Space Link Interleaved Time Synchronization (PITS) Protocol

The Proximity-1 Space Link Interleaved Time Synchronization (PITS) protocol provides time distribution and synchronization services for space systems. A software prototype implementation of the PITS algorithm has been developed that also provides the test harness to evaluate the key functionalities of PITS with simulated data source and sink.

PITS integrates time synchronization functionality into the link layer of the CCSDS Proximity-1 Space Link Protocol. The software prototype implements the network packet format, data structures, and transmit- and receive-timestamp function for a time server and a client. The software also simulates the transmit- and receive-time stamp exchanges via UDP (User Datagram Protocol) socket between a time server and a time client, and produces relative time offsets and delay estimates.

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This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47704.

AdapChem

AdapChem software enables high efficiency, low computational cost, and enhanced accuracy on computational fluid dynamics (CFD) numerical simulations used for combustion studies. The software dynamically allocates smaller, reduced chemical models instead of the larger, full chemistry models to evolve the calculation while ensuring the same accuracy to be obtained for steady-state CFD reacting flow simulations.

The software enables detailed chemical kinetic modeling in combustion CFD simulations. AdapChem adapts the reaction mechanism used in the CFD to the local reaction conditions. Instead of a single, comprehensive reaction mechanism throughout the computation, a dynamic distribution of smaller, reduced models is used to capture accurately the chemical kinetics at a fraction of the cost of the traditional “single-mechanism” approach.

This work was done by Dmitry V. Strekalov, Gerhard L. Kruizinga, Moongeong Paik, Dah-Ning Yuan, and Sami W. Asmar of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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Mars Relay Lander and Orbiter Overflight Profile Estimation

This software allows science and mission operations to view graphs of geometric overflights of satellites and landers within the Mars (or other planetary) networks. It improves on the MaROS Web interface within any modern Web browser, in that it adds new capabilities to the MaROS suite. The profile for an overflight is an important element for selecting communication/overflight opportunities between the landers and orbiters within the Mars network. Unfortunately, determining these estimates is very computationally expensive and difficult to compute by hand. This software allows the user to select different overflights (via the existing MaROS Web interface) and specify the smoothness of the estimation.

Estimates for the geometric relationship between a lander and an orbiter are determined based upon the orbital conditions of the orbiter at the moment the orbiter rises above the horizon from the perspective of the lander. It utilizes 2-body orbital equations to propagate the trajectory through the duration of the view period, and returns profiles that represent the range between the two vehicles, and the elevation and azimuth angles of the orbiter as measured from the lander’s position. The algorithms assume a 2-body relationship with an ideal, spherical planetary body, so therefore can see errors less than 2% at polar landing sites on Mars. These algorithms are being implemented to provide rough estimates rapidly for the geometry of a geometric view period where more complete data is unavailable, such as for