Autonomous Science on the EO 1 Spacecraft

The Autonomous Sciencecraft Experiment will fly in 2003 on the EO 1 Spacecraft and uses AI software to autonomously detect and respond to science events. ASE use several science algorithms to analyze science data including: onboard event detection, feature detection, change detection, and unusualness detection. These algorithms will be used to trigger responses (such as re-observation of high priority targets) and will detect features of scientific interest such as volcanic eruptions, sand dune migration, growth and retreat of ice caps.

The autonomy software on EO-1 is organized into a traditional three-layer architecture. At the highest level of abstraction, the Continuous Activity Scheduling Planning Execution and Replanning (CASPER) system is responsible for mission planning functions. CASPER schedules science activities while respecting spacecraft operations and resource constraints. For EO-1, CASPER operates on the tens of minutes timescale. CASPER scheduled activities are inputs to the Spacecraft Command Language (SCL) system, which is responsible for the detailed sequence commands corresponding to CASPER scheduled activities.

SCL operates on the several second timescale. Below SCL the EO-1 flight software is responsible for lower level control of the spacecraft and also operates a full layer of independent fault protection. The interface from SCL to the EO-1 flight software is at the same level as ground generated command sequences. The science analysis software is scheduled by CASPER and executed by SCL in batch mode. The results from the science analysis software result in new observation requests presented to the CASPER system for integration in the mission plan.

We will demonstrate our software on a typical EO 1 Autonomous Science operations scenario, highlighting the science event detection, onboard replanning, and execution.

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