

PART 7. SENSOR WEB/TESTBED INITIATIVES

3. AUTONOMOUS SCIENCECRAFT EXPERIMENT

NASA is successfully using onboard autonomous decision-making software, known as Autonomous Sciencecraft Experiment (ASE), to change a science satellite's priorities without the involvement, or even knowledge, of ground controllers so it can observe unexpected phenomena in its path such as an active volcano. Normally, an ongoing event such as an eruption might be missed because of the time required for the spacecraft to send its data to ground controllers, who have to process and study the data and then send commands back to the spacecraft to make further observations. On future interplanetary space missions, ASE software will enable onboard capture of short-lived science phenomena at the finest time-scales without overwhelming onboard memory or downlink capacities. Examples include: eruption of volcanoes on Io, formation of jets on comets, and phase transitions in ring systems. The approach can cut lengthy time lags inherent to taking an observation, transmitting it to the ground for study, and later decisions by scientists to direct the satellite to take further measurements.

The ASE onboard flight software consists of the following three main software components that work together to spot science targets autonomously:

- Image processing algorithms that analyze onboard data to detect dynamic events such as volcano eruptions and flooding and autonomously request updates to the mission operations plan.
- Robust execution software using the Spacecraft Command Language (SCL) to enable spacecraft telemetry processing and event-driven commanding.
- Planning and scheduling software using the Continuous Activity Scheduling Planning Execution and Re-planning (CASPER) software to schedule science observations, ground contacts, and re-plan based on requests from onboard image processing.

Documentation of efforts to demonstrate an above described on-board autonomous decision-making software system, using EO-1 as a testbed, can be obtained from the links contained in the Table of Contents for Part 7, Section 3.