Onboard Science Data Processing: ST6 Autonomous Sciencecraft Experiment

Science Data Processing Session

Rebecca Castaño
Jet Propulsion Laboratory
California Institute of Technology
Machine Learning Systems Group

4th Quality Mission Software Workshop
Dana Point, CA, May 7-9 2002

* ASE PI: Steve Chien
Motivation for Onboard Science Data Analysis

- Increases mission value
  - As a result of high data collection rates and limited downlink bandwidth it will not be possible to downlink all data collected on future missions

- Allows quick response time to dynamic events

- Decreases mission costs by reducing necessary ground processing
Autonomy Technology Required

Robust Execution
- perform activities
- automatic mode estimation and recovery

Planning and Scheduling
- select and schedule activities to perform

Science Data Analysis
- determine value of observations for downlink prioritization
- identify new science collection goals
ASE Key Technologies

- Onboard Science (JPL)
  - Feature detection
  - Change detection
  - Enables onboard decision-making based on science
- Onboard Replanning (JPL)
  - Enables onboard development of new plans in response to science events
- Robust Execution (ICS/AFRL)
  - Enables robust plans to deal with run-time uncertainties
ASE Mission Scenario

Cluster
Management
Constellation
Reconfiguration

New Science Images
Utilize Limited Downlink Resource

Old Way:

- Take 200 Images
- Downlink 200 images

New Way:

- Take 2000 Images
- Downlink best 200 images
  - only most scientifically interesting portions
Summary

- Using on-board software for planning, science data analysis, execution, fault detection, and cluster management will increase mission value by:
  - Returning only the most important science data
  - Moving the labor-intensive spacecraft and science data analysis functions onboard the spacecraft
  - Allowing the spacecraft to be commanded with high-level goals
  - Reducing downtime due to anomalies
  - Allowing quick response to opportunistic and dynamic science events

- Challenges
  - validation and testing of autonomy technology
  - processing power (CPU, RAM, disk)