



Goddard

NASA



Onboard Science Data Processing: ST6 Autonomous Sciencecraft Experiment*

Science Data Processing Session

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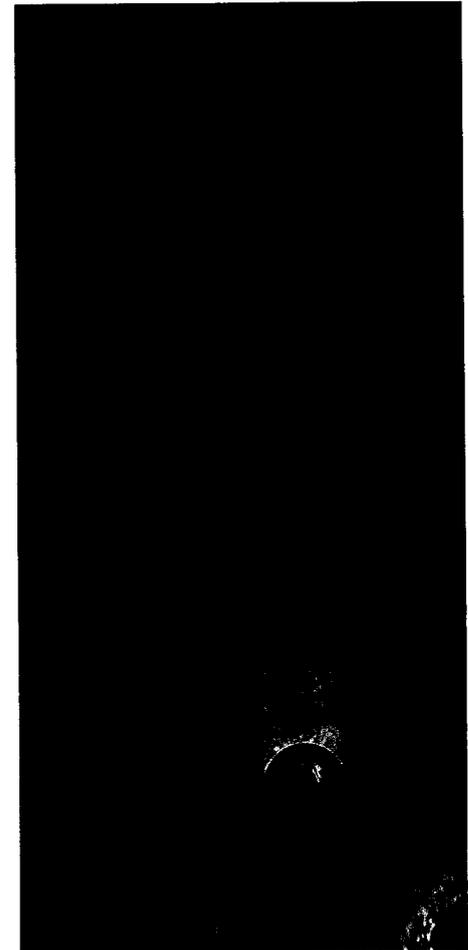
Jet Propulsion Laboratory
California Institute of Technology
Machine Learning Systems Group

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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

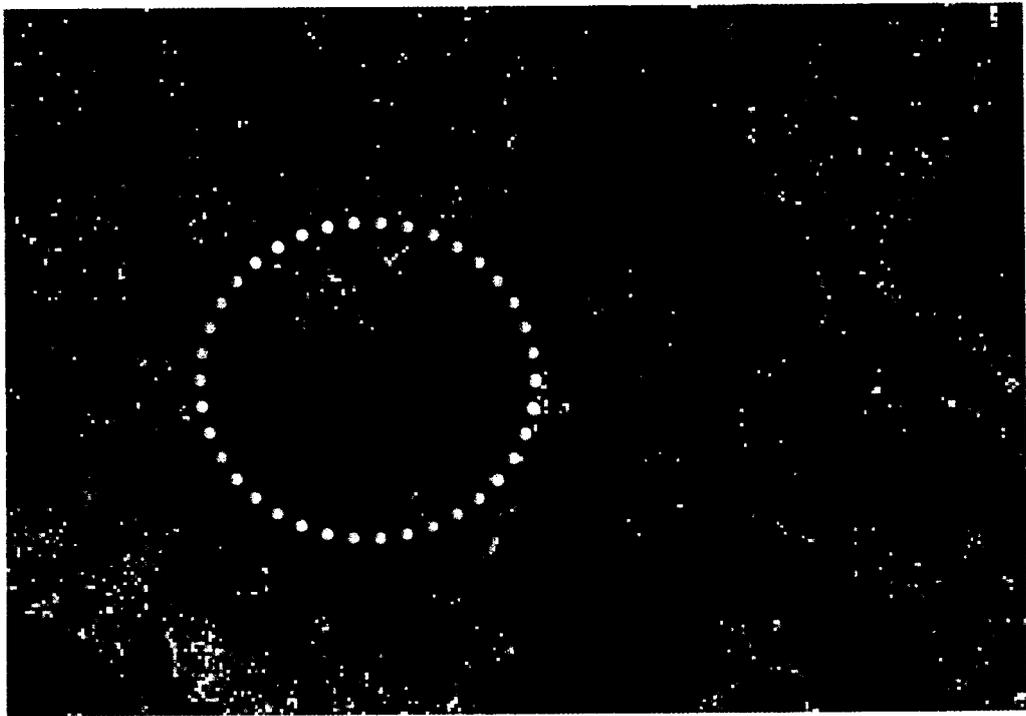
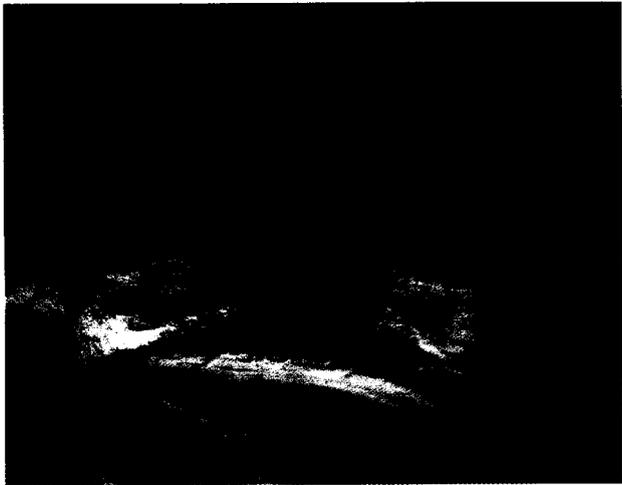
- Onboard Science (JPL)
 - Feature detection
 - Change detection
 - Enables onboard decision-making based on science
- Onboard Replanning (JPL)
 - Enables onboard development of new plans in response to science events
- Robust Execution (ICS/AFRL)
 - Enables robust plans to deal with run-time uncertainties



ASE Mission Scenario

Cluster
Management
Constellation
Reconfiguration

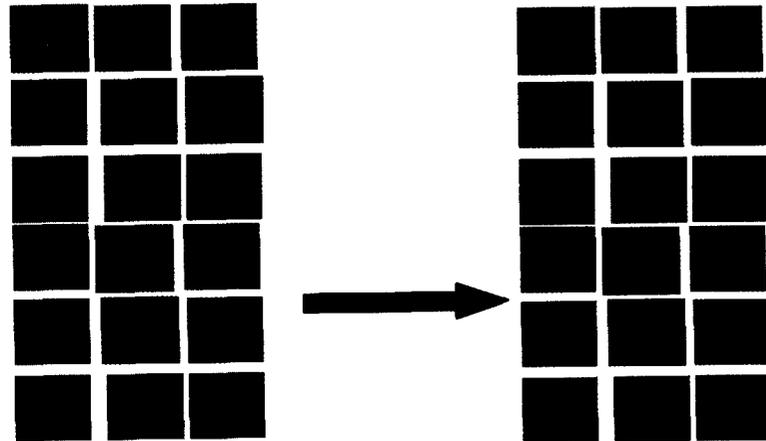
New Science Images



Utilize Limited Downlink Resource

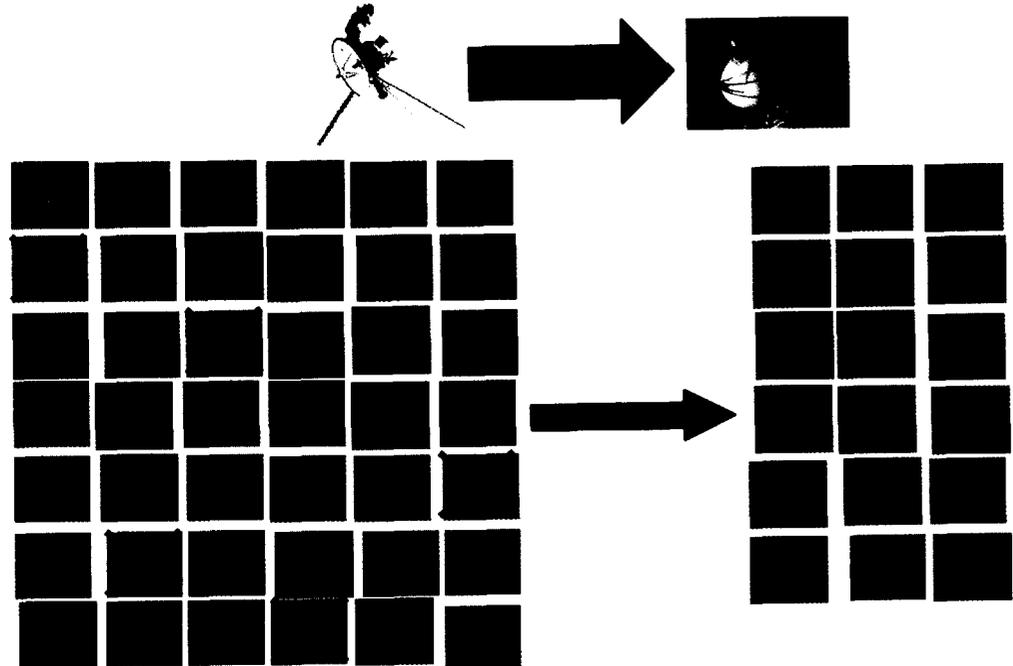
Old Way:

- 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)

