



NASA

Machine Learning Challenges in Mars Rover Traverse Science



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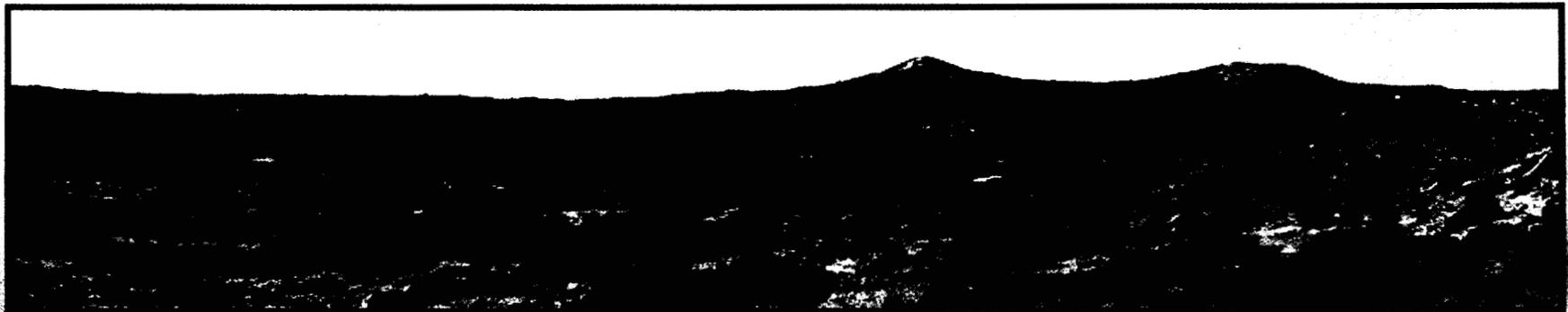


JPL

Outline



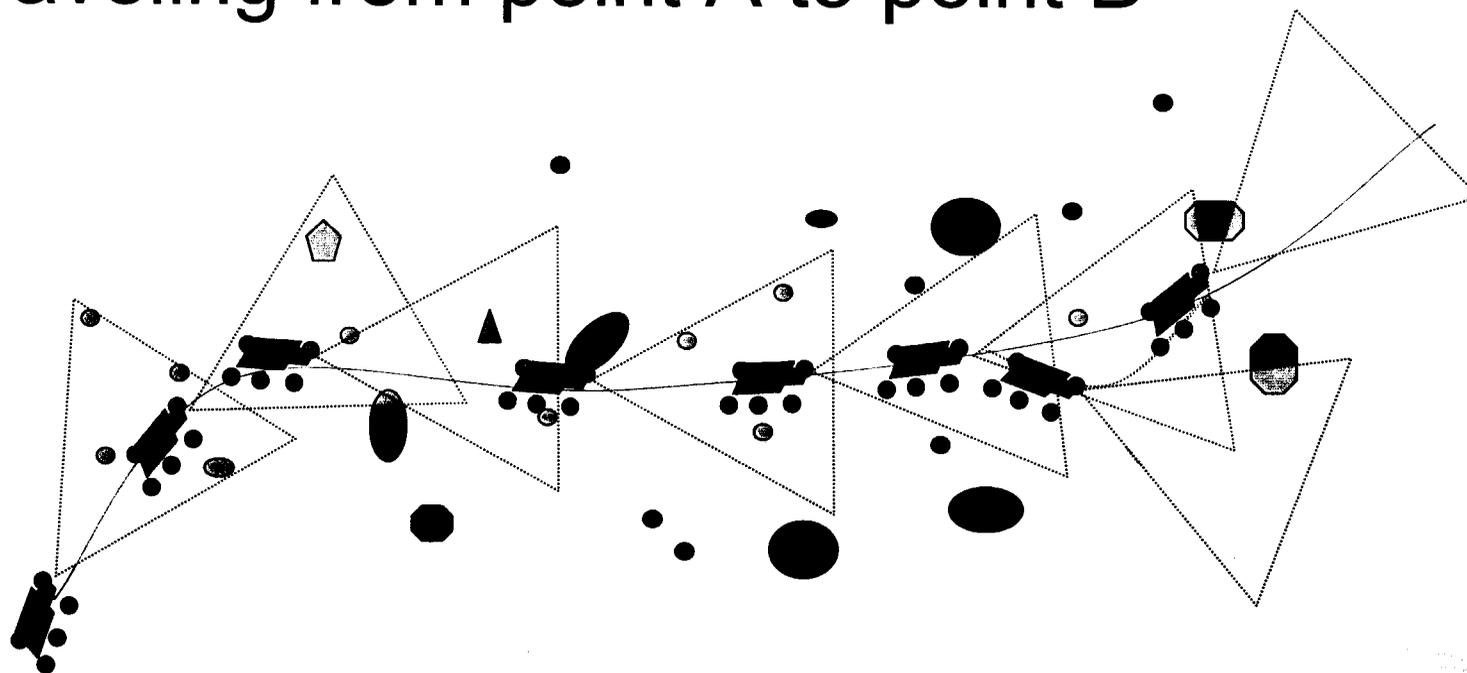
- What is Traverse Science?
- Accurately Identifying the Scientific Opportunity
- Onboard Autonomous Science Investigation System - OASIS
- Verification and Validation
- Integration Plan
- Conclusions



Traverse Science Example



Collecting science information while traveling from point A to point B



Accurately Identifying the Scientific Opportunity

- Onboard data analysis needs the backing of the scientific community
- Historically, scientists want full control over the data collected
- This paradigm will not be possible in the future. As rover traverse distances increase,
 - the bits returned per square meter will decrease
 - scientists will no longer be able to see all of the terrain the rover will traverse in a sol



Traverse Science Goals



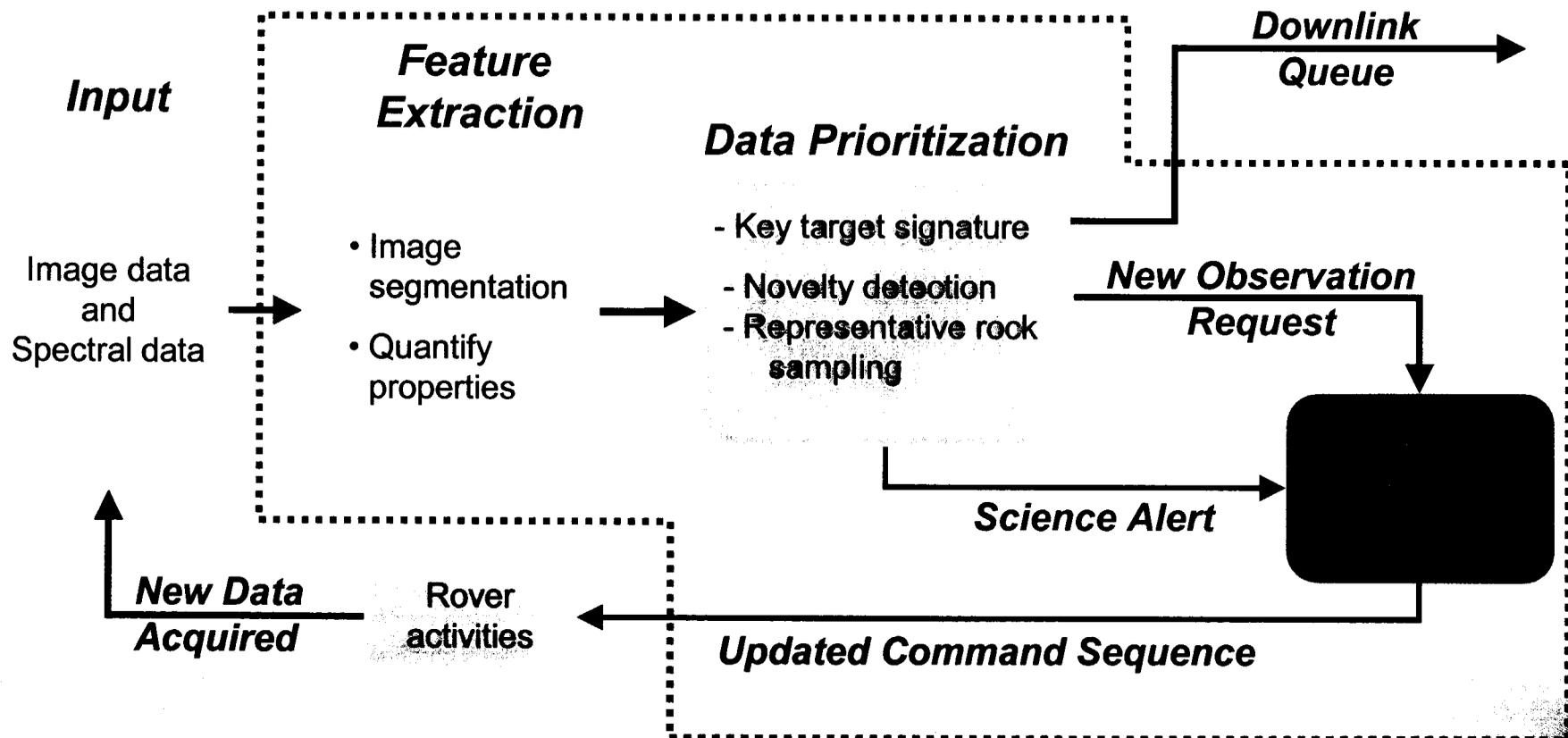
- Identify pre-specified key targets
 - signs of water
- Identify novel, unexpected objects
- Catalog and summarize terrain covered



OASIS



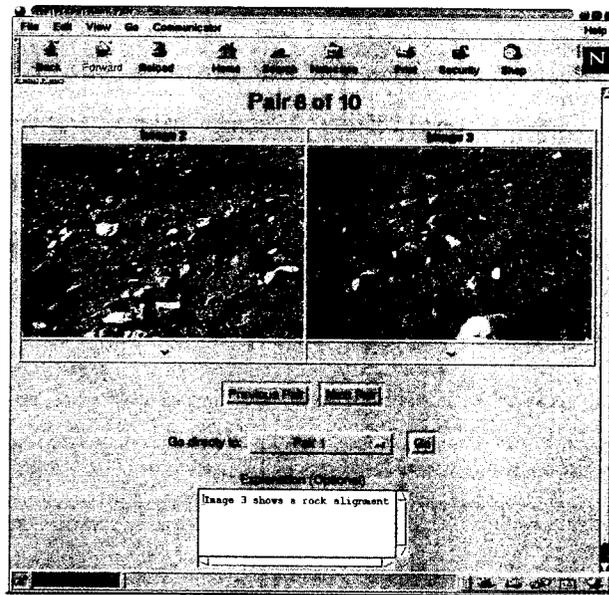
Onboard Autonomous Science Investigation System



Verification and Validation



Prioritization methods can be validated by comparing automated analysis ranking results to ranking of same data by experts



Experts select between two images

Experts see all data before making their top selections



Integration Plan



- Demonstrate algorithms on field test data
- Demonstrate on ground using MER data
- Infuse in extended MSL mission
 - Prioritize images collected during traverse for downlink
 - Collect inexpensive extra data of potentially interesting objects
 - Slightly adjust path to get better view of a very interesting object
 - Approach and take contact measurement of an extremely interesting object
- Early inclusion in future mission designs



Conclusions



- If you want to do onboard science, you must invest the time needed to understand the scientists . . .
 - where they are coming from (attitude)
 - what they say they want
 - what they *really* want
- You need to communicate what you can provide . . .
 - capabilities
 - limitations
- Identify an opportunity that enables more science than a researcher could get otherwise
- **Low risk, incremental infusion plan**

Currently Active Team



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