



*AIAA Infotech
Intelligent Systems in Aerospace Workshop*

***Rover Technology Development
and Mission Infusion***

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Outline:

- 1. *Mission Applications***
- 2. *New Mission Regimes and Impacts***
- 3. *Technology Infusion Process***
- 4. *Recent Progress***

Mars Surface Mission Applications:

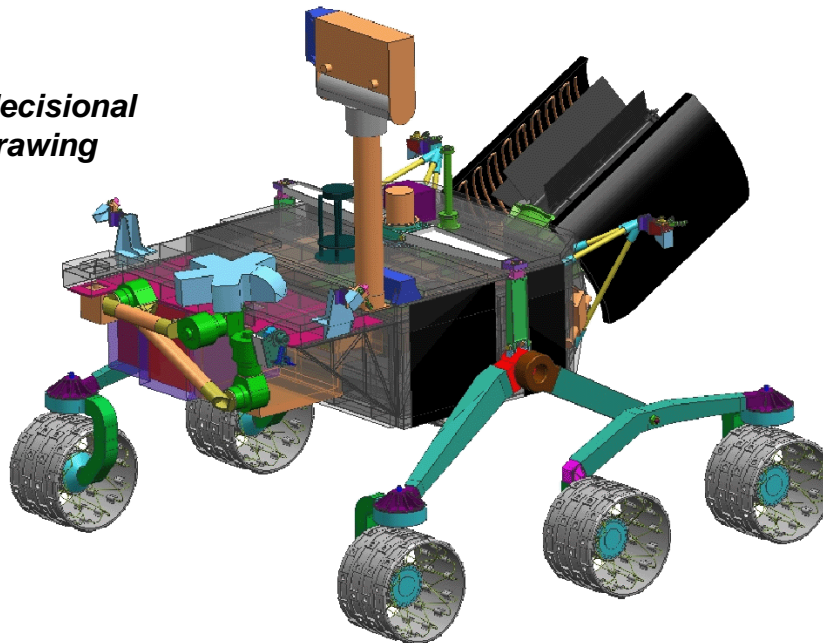
MER: Mars Exploration Rovers (ongoing from 2003)

MSL: Mars Science Laboratory (2009)

Scout: Competed mission concepts (2011?)

AFL: Astrobiology Field Laboratory (2016?)

**MSL pre-decisional
concept drawing**



Titan Atmospheric Mission Application

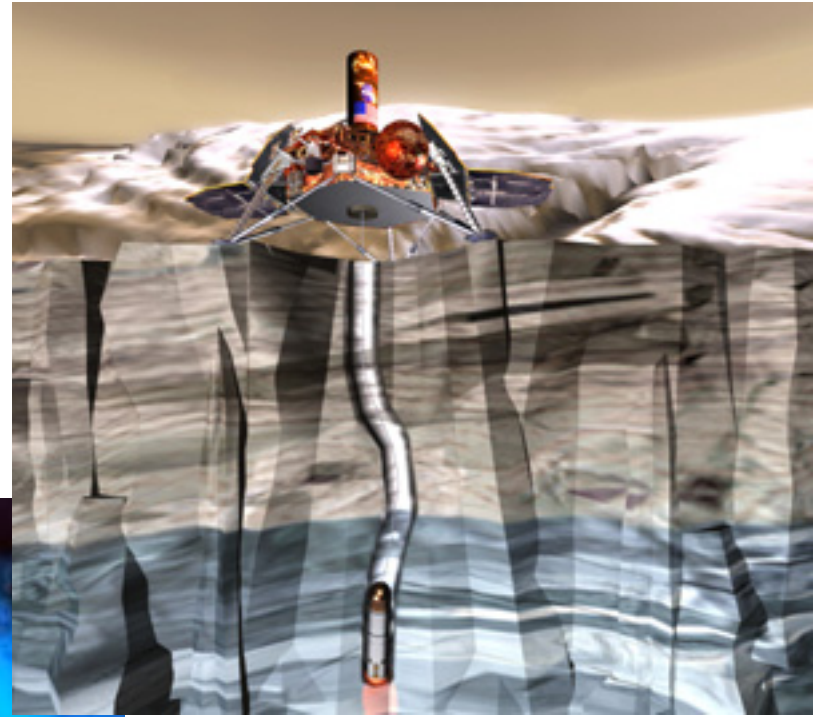
- *long communication delay*
- *occultation by Saturn*
- *continuous motion of airship*
- *challenging surface avoidance or interaction*



JPL Aerobot Testbed

Europa or Mars Polar Ice Penetration Application

- *Possible long communication delay*
- *Possible occultation by Saturn*
- *No ability to backtrack*
- *Need to avoid impenetrable inclusions*



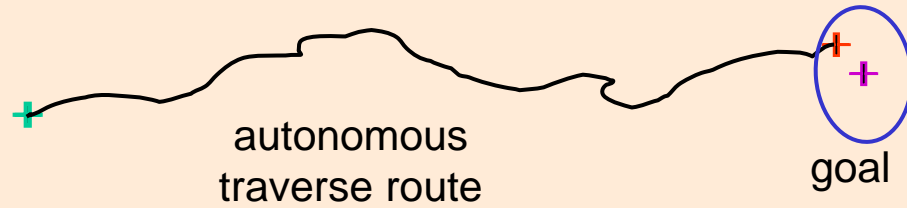
Ice Penetrator Concept

JPL Cryobot

New Mission Regimes and Impacts on Key Factors

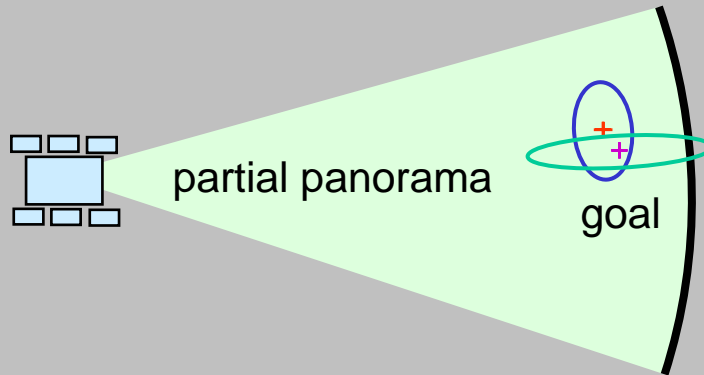
Factors	New Mission Regimes	
	Harsh Environments	Longer Life
1. Dollars	-,0	-,0
2. Time (Pace)	-,0	-
3. Science Quality	+	+
4. Power	-	0
5. Communications	0	0
6. Capabilities	-	-
7. Reliability & Lifetime	-	-
8. Onboard Autonomy	-,+	-,+
9. Operations Autonomy	-	+
10. Public Interest	+	-

Application Scenarios for Validation



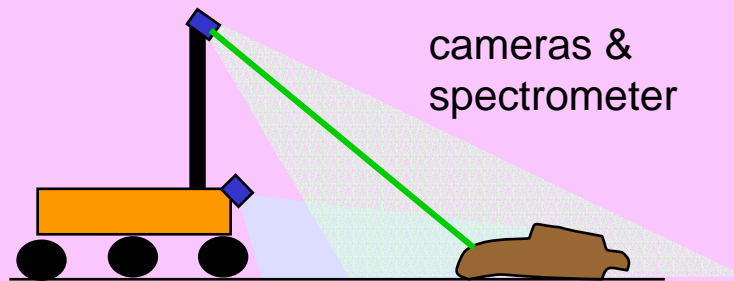
AUTONOMOUS TRAVERSE:

Enable autonomous traverse, obstacle avoidance, and position estimation relative to the starting position.



APPROACH & INSTRUMENT PLACEMENT:

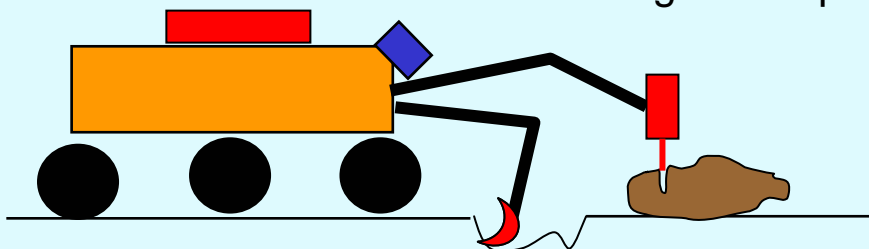
Enable autonomous placement of a science instrument on a designated target, specified in imagery taken from a stand-off distance.



ONBOARD SCIENCE:

Enable autonomous processing of science data onboard the rover system, for intelligent data compression, prioritization, anomaly recognition.

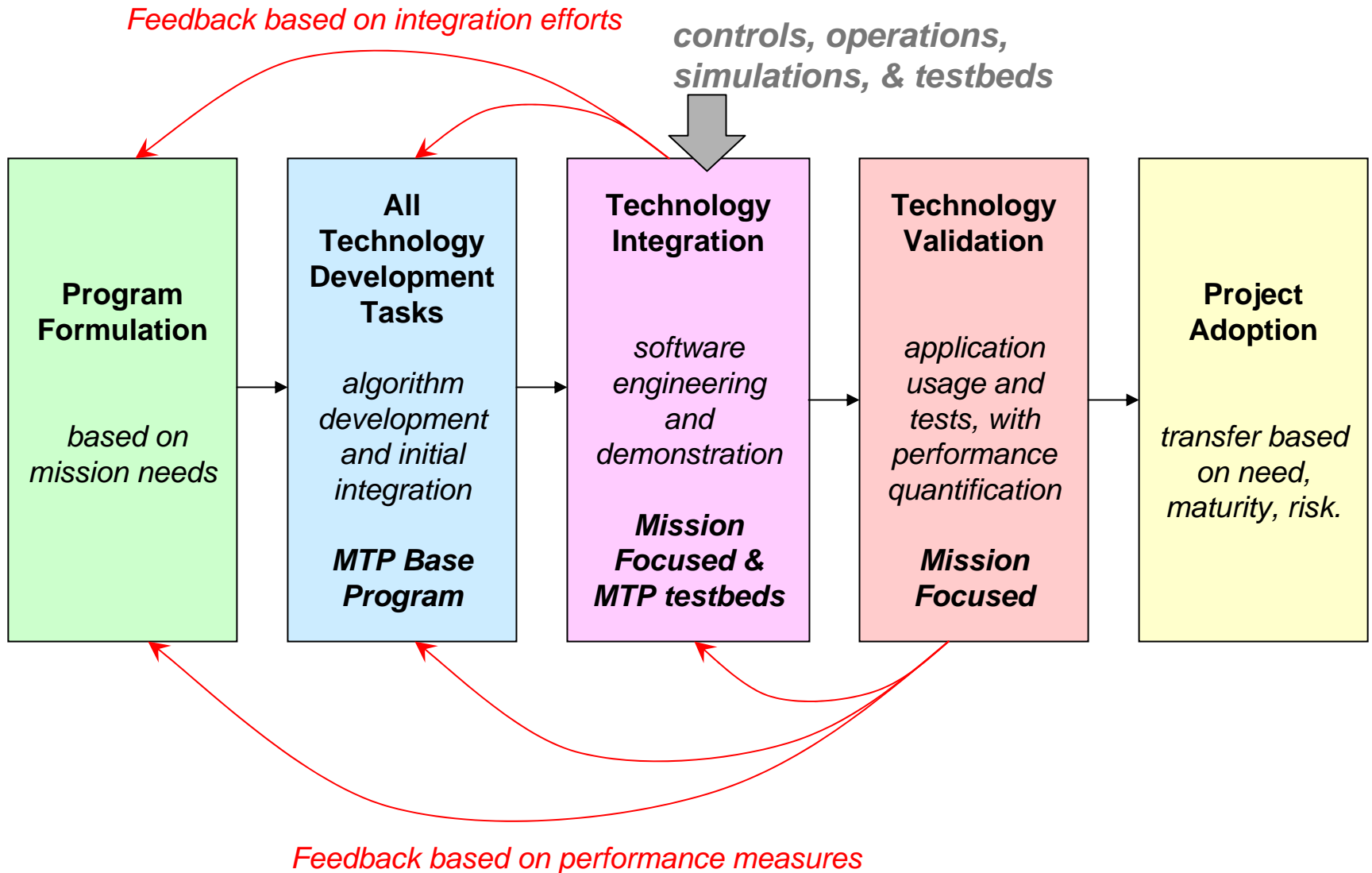
processing and caching drilling & scooping



SAMPLING:

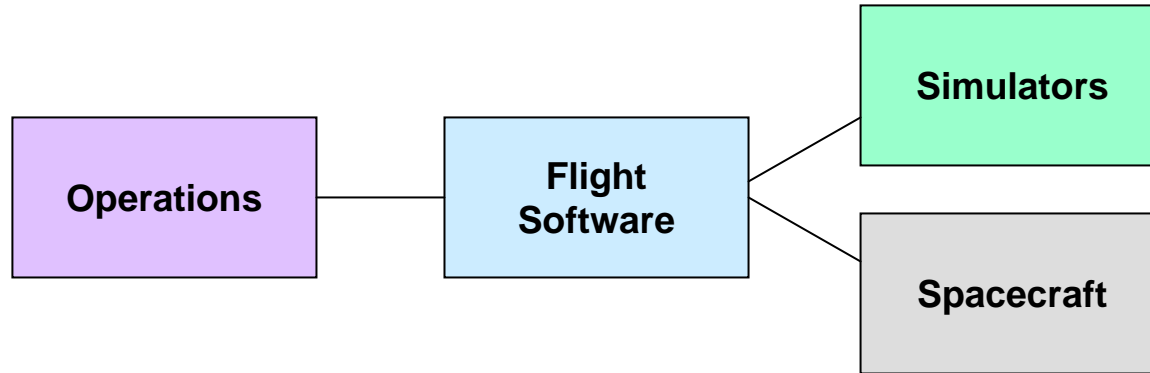
Enable sampling, sample processing, and sample caching through development of controls for new system components.

Technology Infusion Process – Mars Tech Program

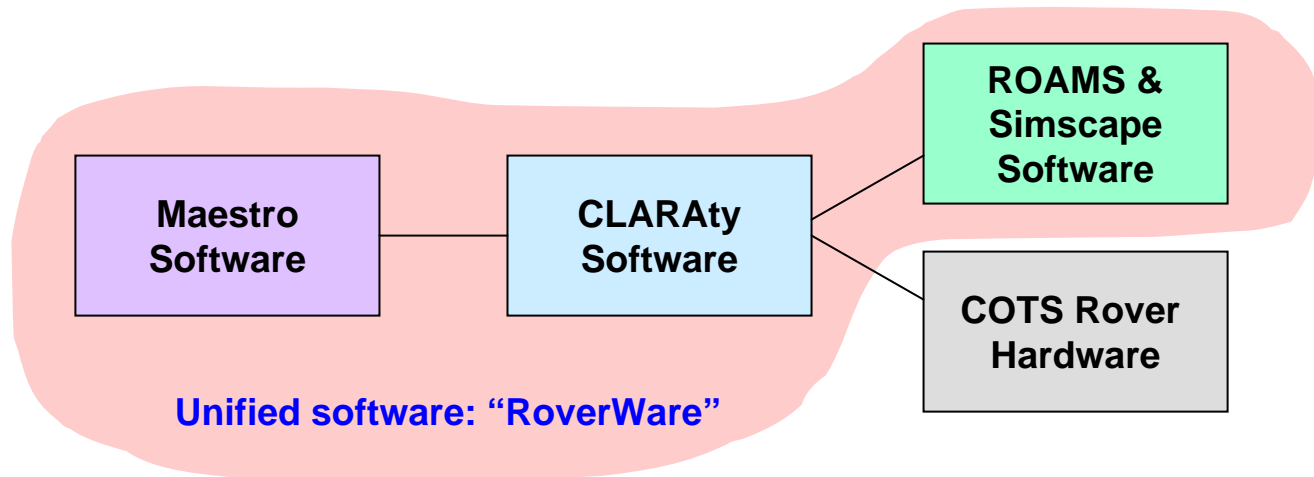


Technology Integration Environment Relative To Flight

**FLIGHT
PROJECT**



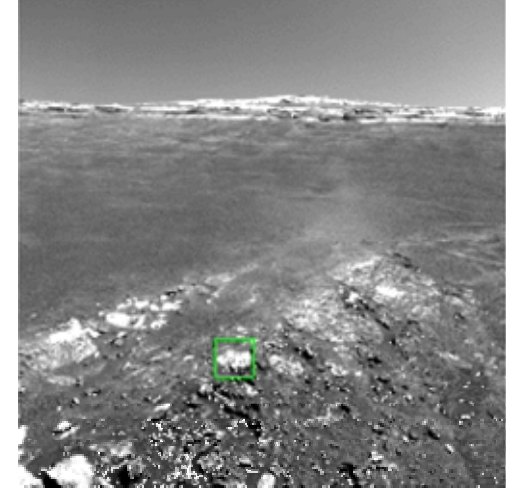
**RESEARCH
PROGRAM**



Unified software: "RoverWare"

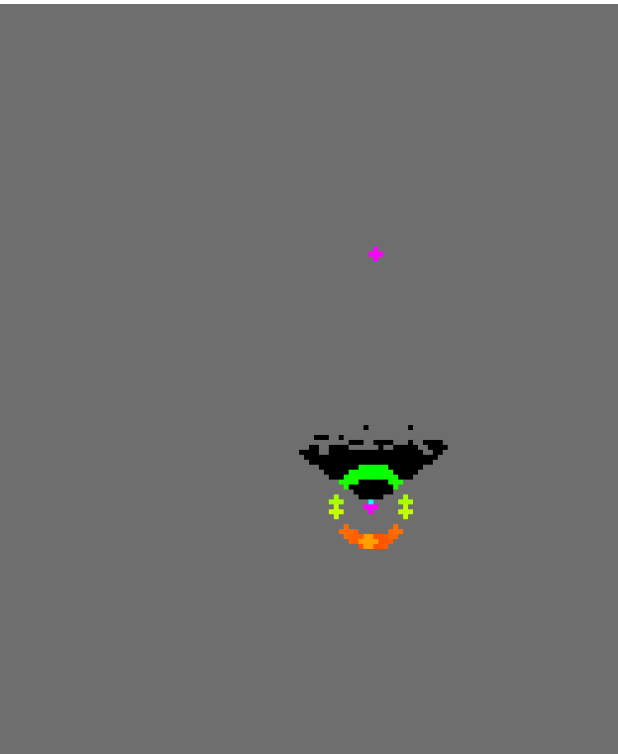
New Technology Infusion into MER Rovers

- Now approaching on full Martian Year on Surface (668 sols or 687 days).
- Previously used new technology has been extremely valuable: DIMES, GESTALT, VO
- New capabilities are incremental improvements from targeted investment by the Mars Technology Program
- Integration on MER should set the bar for future missions such as MSL



Visual Target Tracking
(Nesnas, Bandari, Bajracharya, Kim)

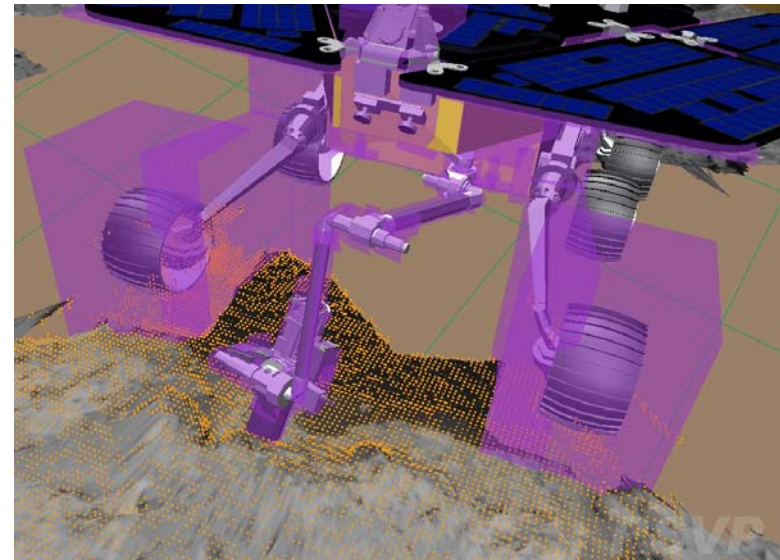
CMU D* with JPL GESTALT
(Stentz, Maimone, Rankin)



Automatic Cloud Detection
(Castano, Chien)



Terrain Collision Prevention
(Leger)



Questions?