



Humans and Robots Together Mars

Humans to Mars Summit 2022

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05/18/2022

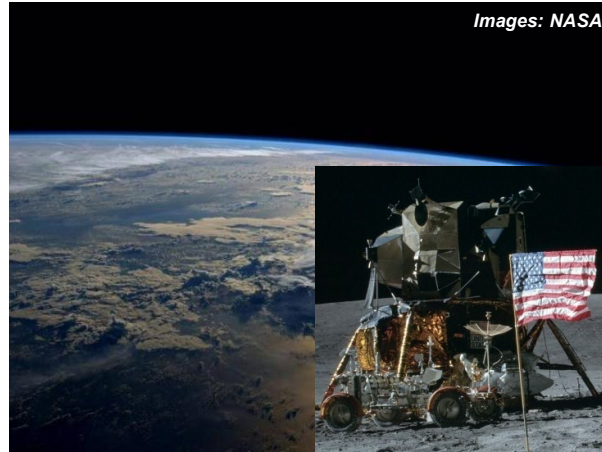
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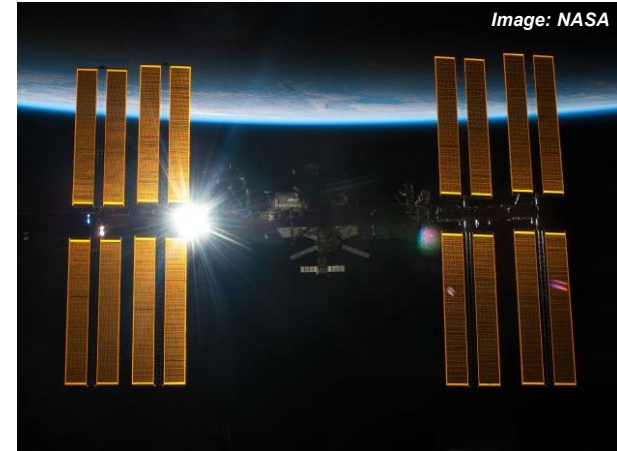
Draper in Space



Human-Systems Engineering

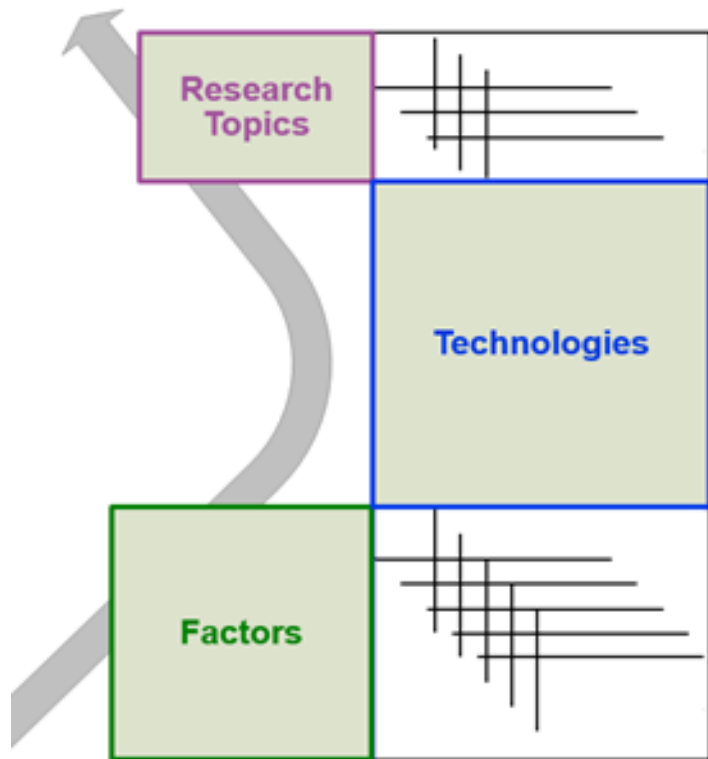


Guidance, Navigation, and Control Systems



Mission Scheduling and Management

Human Automation/Robot Interaction (HARI) Trade Study



Top 3 Technology Development Areas:

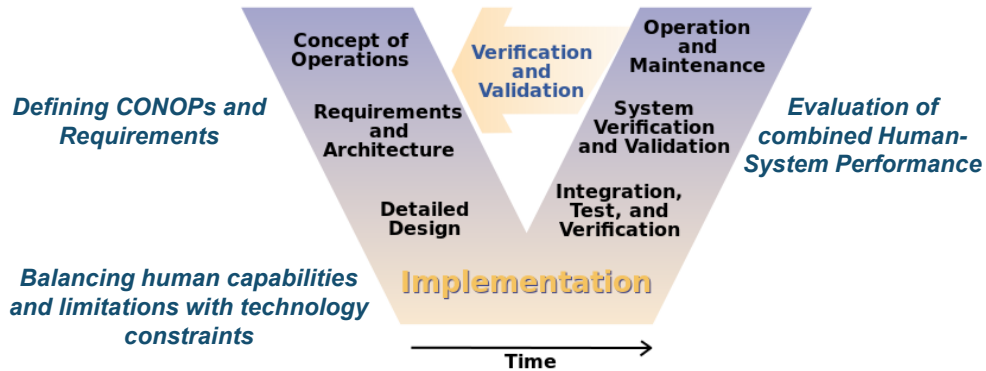
1. Machine Learning
2. Autonomous obstacle detection/imaging
3. Robotic/human information interfaces

Top 3 Research Areas:

1. Improving training for HAR systems and tasks
2. Establishing appropriate trust in automation/robotics systems
3. Understanding human intent

Human System Engineering

Effective teaming with machines requires machines to understand humans, humans to understand the machines, and for humans and machines to adapt to one another and the context of their environments and tasks



HSE Throughout the Design Cycle

	0 Separated Operations	1 Interactive	2 Augmentation, Mutual Support	3 Collaborative Shared Tasks	4 Adaptive Roles	5 Adaptive Team Formation
Interaction	Only at Boundary	Interactive	Augmented Performance	Collaboration	Full Teaming	
Tasks	Individual Task Assignments			Shared Task Assignment		
Roles	Fixed Machine Role Assignments				Interchangeable Human-Machine Roles	
Team Formation	Fixed Team Members					Adaptive

Proposed Levels of Human-Machine Teaming

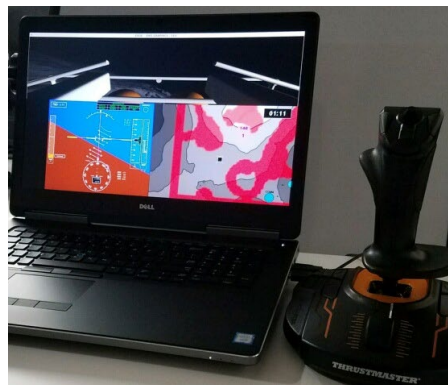
Real-Time Performance Metrics

Non-Intrusive Measurement of Human State

- Measure performance, workload, and SA in manual and semi-autonomous tasks
- Provide real-time feedback for human operators



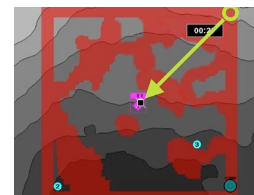
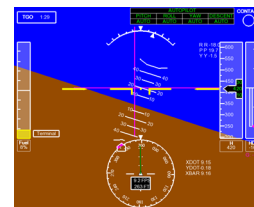
RTPM Simulation for HERA



NEEMO Simulation Laptop

Lunar Landing Task: Land vehicle following autonomous guidance

Flight Displays



Comm Light



Inactive

Blue

Green

Verbal Callouts

Altitude	Fuel Level
450 ft	
400 ft	
350 ft	
300 ft	7% Fuel
250 ft	
225 ft	
200 ft	6% Fuel
175 ft	
150 ft	
140 ft	5% Fuel
130 ft	
120 ft	
110 ft	
100 ft	4% Fuel

Trust in Autonomy Heuristics

