



NASA's
Game Changing Technology
Industry Day
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Human Robotic Systems

Presented by

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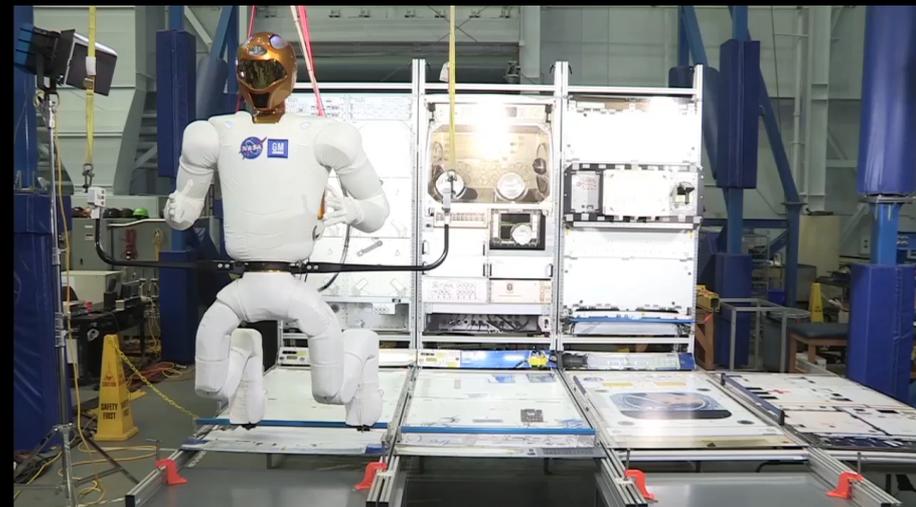
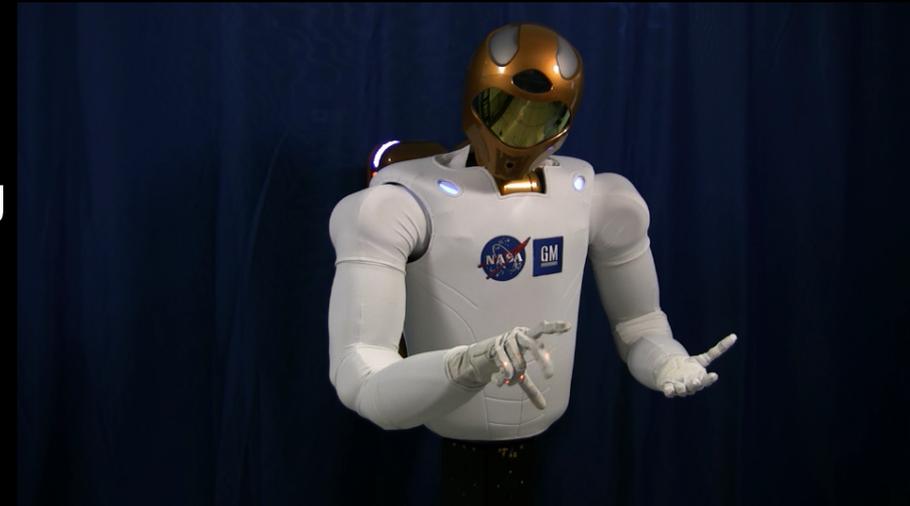
TECHNOLOGY DRIVES EXPLORATION



Robonaut



- Humanoid astronaut assistant currently on ISS
- Co-developed with General Motors
 - ~50 patented and patent pending technologies
- Space Applications
 - Spacecraft caretaking, servicing, maintenance, assembly, inspection
- Sample Terrestrial Applications
 - Manufacturing, general assembly, plant maintenance
- Component technologies
 - Compact series elastic actuation, tendon force sensing, safe operation in proximity to humans

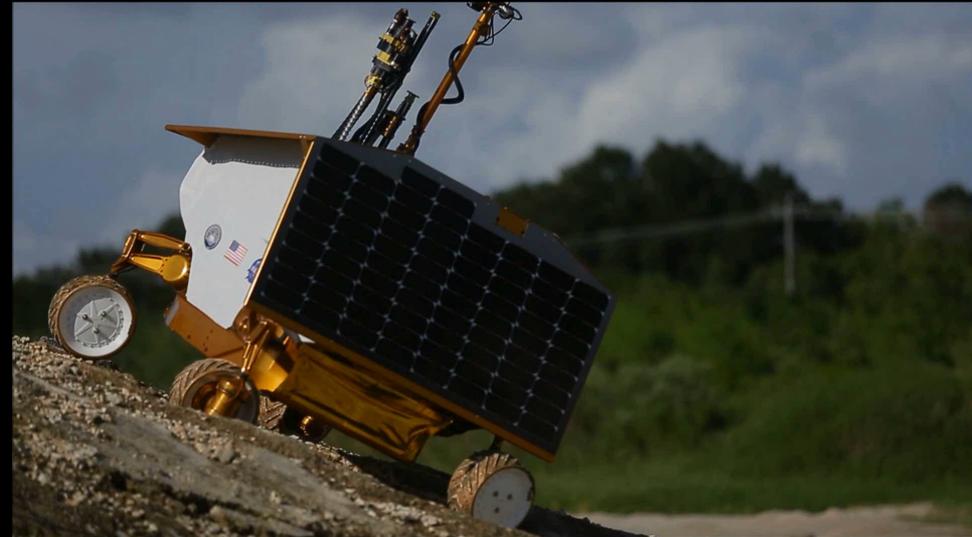




Rover Technologies



- Developing rover technologies for low cost surface missions
- Key technologies
 - Advanced mobility systems
 - Tools for time delay operation
 - Rover navigation
- Prototype build, with tvac, vibrate and radiation testing, TRL 5
- Sample space applications
 - In situ resource utilization, low cost surface missions, component technologies
- Sample terrestrial Applications
 - Extreme mobility, compact actuation, safeguarding, rover operations software, high energy density batteries





Modular Robotic Vehicle



- Drive-by-wire electric vehicle
- Evolution of crew rover technologies to urban vehicle application
- Co-developed with an automotive partner
 - 5 patent pending technologies
- Sample space applications
 - Crew rovers, fail operational systems, liquid cooled actuators
- Sample terrestrial applications
 - Robotic vehicles, entertainment, motorized wheelchairs





X1 Exoskeleton



- Wearable robot based on Robonaut arm technologies
- Co-developed with Florida Institute for Human and Machine Cognition
- Sample space applications
 - Crew exercise, strength and endurance augmentation, dynamometry
- Sample terrestrial applications
 - Strength and endurance, augmentation, rehabilitation, exercise

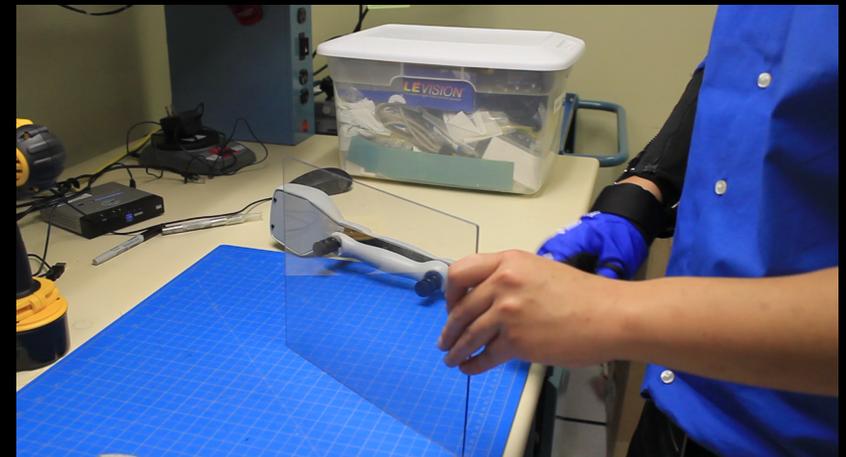
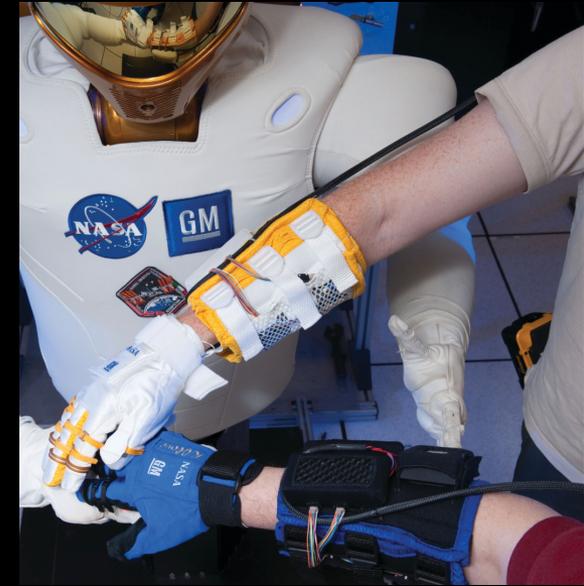




Roboglove



- Hand exoskeleton based on Robonaut hand technologies
- Co-developed with General Motors
- Sample space applications
 - Space suit glove enhancements, strength and endurance augmentation
- Sample terrestrial applications
 - Rehabilitation, exercise, assembly, tool use, fatigue reduction during repetitive task

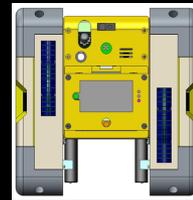




Other Robotic Technologies



- Space Exploration Vehicles
- Dynamic Tensegrity Robotics
- ATHLETE
- Astrobee
- Force Shoes
- Gravity offload testing
- Compliant wheel designs
- Compact exercise devices





Partnerships



- Our robotics community has a strong history with partnering with industry
 - All technologies highlighted today are in a functional prototype (or beyond) state
- Industry benefits by leveraging significant government investment in both systems and component technologies

Next Steps

- Robonaut
 - Continued preparation for caretaking in future missions
 - Seeking partnerships
- Rover Technologies
 - Focused on infusion into Resource Prospector mission
- Modular Robotic Vehicle
 - Looking for new partnerships
- X1 Exoskeleton
 - Just wrapping a project with another government agency
 - Seeking new partnerships
- Roboglove exoskeleton
 - Integrating prototype into suit
 - Seeking new partnerships



Contact Information



For more information about these technologies or to discuss potential collaboration efforts:



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