National Aeronautics and
Space Administration

NASA's
Game Changing Technology
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Human Robotic Systems

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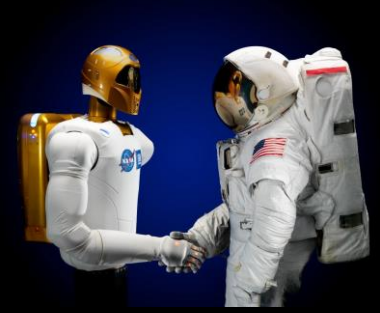
TECHNOLOGY DRIVES EXPLORATION

Presentation Overview

- Representing a diverse portfolio of robot technologies
- Humanoid/Dexterous Robots
  - Robonaut
- Mobile Robots
  - Rover Technologies
  - Modular Robotic Vehicle
- Wearable Robotics
  - X1 exoskeleton
  - Roboglove exoskeleton
- Other robotic technologies

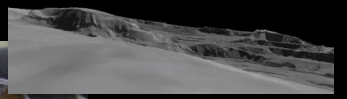






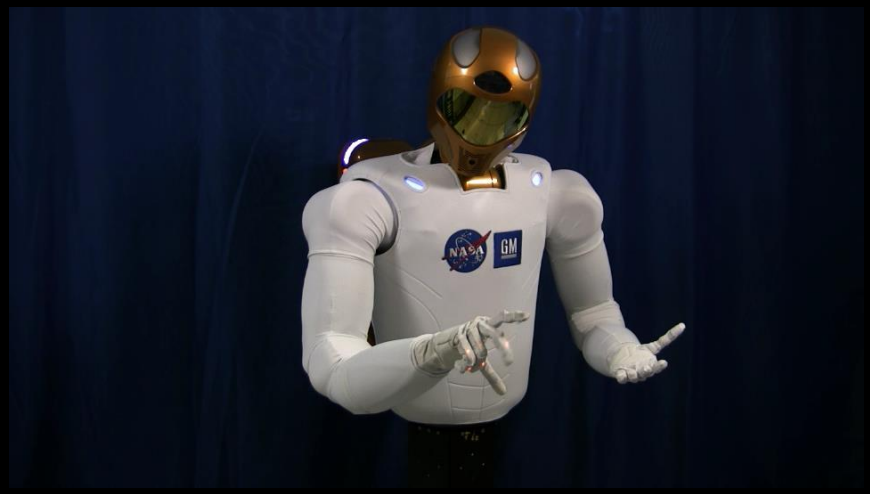


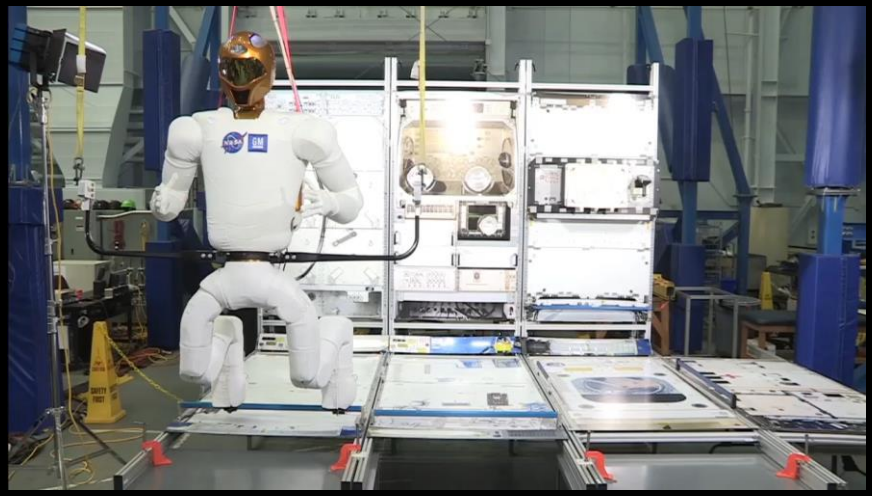



Robonaut

- 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, vibe and radiation testing, TRL 5
- 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

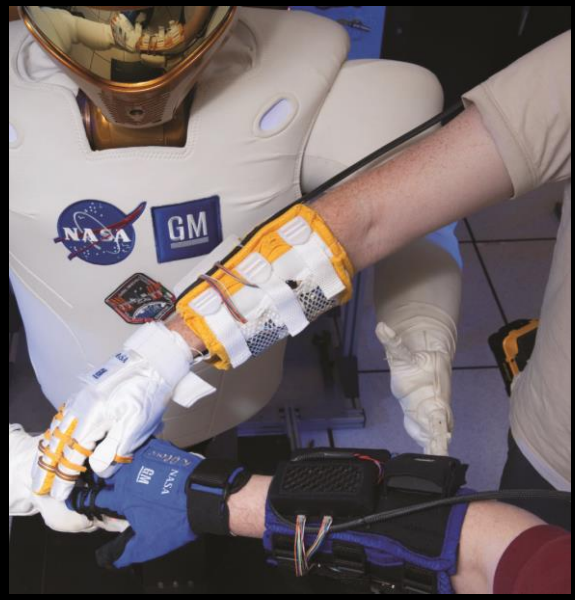
- Drive-by-wire electric vehicle
- Evolution of crew rover technologies to urban vehicle application
- Co-developed with an automotive partner
  - 5 patent pending technologies
- Space applications
  - Crew rovers, fail operational systems, liquid cooled actuators
- Sample terrestrial applications
 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

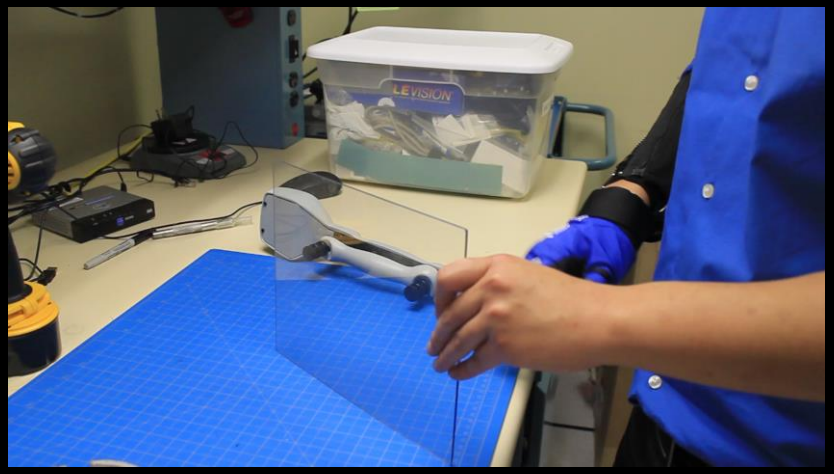
X1 Lower Body Exoskeleton

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

X1 Lower Body Exoskeleton

- Hand exoskeleton based on Robonaut hand technologies
- Co-developed with General Motors
- 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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