National Aeronautics and
Space Administration

Robotics

Johnson Space Center (JSC) provides research, engineering, development, integration, and testing of robotic hardware and software technologies for robotic systems applications in support of human spaceflight. Advanced robotic systems technology efforts include both remotely controlled robots for space and terrestrial application and intelligent robotics for high value functionality. JSC technology development laboratories have produced the Robonaut, an anthropomorphic robot with dexterity close to that of humans, and the Lunar Electric Rover, which was on display in the 2009 Presidential Inaugural Parade.

Services Provided

- Design and development of highly dexterous manipulators
  - Force-controlled manipulation
  - Variable stiffness joints
  - Human-like end effectors
  - Integrated machine vision
  - Human-compatible robot operations
- Design and development of electric vehicles for extra-planetary or terrestrial off-road use in extreme environments
  - Active suspension systems
  - Efficient transmissions
  - Vehicle autonomy and navigation
  - Efficient motor control
  - High voltage DC systems
- Design and development of robotic interfaces
- Design and development of free-flying robotic micro/nanosatellite-class platforms
- Robotic interface and system requirements definition and verification
- Robotic capture and berthing analysis of free-flying vehicles
- Simulation and verification of robotic workstation interfaces
- Physical emulation of robotic devices with motion platforms

Robotics Technology Development

JSC offers expertise in design, development, and testing of robotic technology. Services include the capability to develop highly advanced robotics systems, such as Robonaut; development of advanced perception, machine vision, and sensing capabilities; and assembly and test mobility system technologies, such as the Space Exploration Vehicle.

Dynamic Test Facilities

Robotic Motion Platform (RMP)

The RMP is a very large model-following motion-base simulator that is hydraulically actuated, computer-controlled, and designed to maneuver payloads of up to 500 lb at the end of its 60-foot-long robotic arm. A model following, closed loop control system allows the RMP to emulate any simulated system as long as the desired motions are within its rate and travel limits.

RMP Specifications	
Parameter	**Value**
End effector translational velocity	14 in/s
End effector rotational velocity	10 d/s
Degree-of-freedom	8
Number of joints	7
Joint velocity	0.08 – 5 d/s
Joint reach limits	± 270 degrees
Arm reach limits	100 ft Dia hemisphere
Payload capacity	500 lb
Absolute POR linear position accuracy	± 3.04 in

Dexterous Manipulator Testbed (DMT)

The DMT provides two six-joint, hydraulic manipulators, with model-following control systems, mounted on a 7-foot-high pedestal, designed to precisely position small payloads of up to 240 lb for close-in worksite operations concentrating on hardware contact.

DMT Specifications	
Parameter	**Value**
Arm reach limit	72 in.
Arm lift capacity	240 lb
Degree-of-freedom	6
Joint velocity	0.08—5 d/s

Active Response Gravity Offload System (ARGOS)

ARGOS is designed to simulate reduced gravity environments, including lunar, Martian, and microgravity. A continuous vertical offload of a portion of a subject's weight is maintained by a motion control system that follows the subject's motion within the facility's operational volume. The facility is capable of offloading the weight of people (both in shirtsleeves and space suits), rovers, and robots for testing in simulated reduced gravity environments.

We have developed customer-friendly agreements to streamline business relationships and are eager to share our unique facilities and expertise with new customers. We invite your inquiries regarding application or adaptation of our capabilities to satisfy your special requirements. Briefings on general or specific subjects of mutual interest can be arranged at JSC or at your business site.

Facility Testing Information
http://jsceng.nasa.gov

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