NASAfacts

Space Technology
Game Changing Development
Human Robotic Systems:
The National Robotics Initiative (NRI)

Overview

The National Robotics Initiative (NRI) is a cross-governmental agency, joint solicitation, which supports a national initiative to accelerate the development of next-generation robots in the U.S. Participating government agencies provide funds for competitive grants to U.S. universities and research labs to conduct robotics research and development, with the goal of bringing robotics and capability back to the U.S., to keep the country competitive in robotics.

Background

The NRI, founded in 2012 by the Office of the Chief Technologist, working in conjunction with the White House, is managed by the National Science Foundation. Current participant agencies include the National Institutes of Health, the U.S. Department of Agriculture, DARPA, the Department of Defense, and NASA, who all share the research results.

NASA Funded Grants

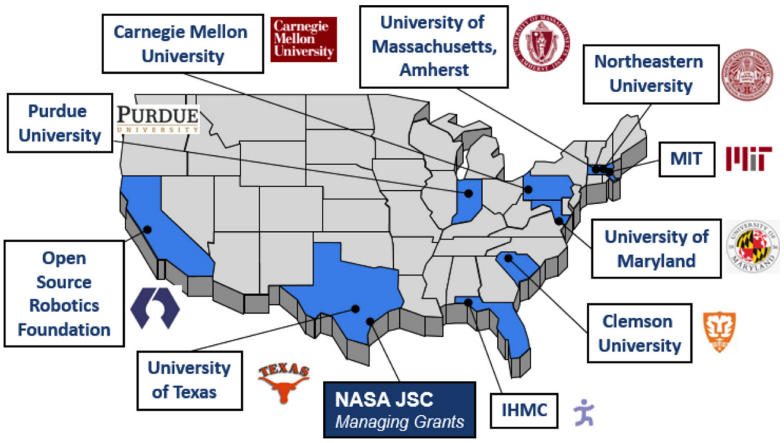
In addition to keeping the U.S. competitive in the emerging robotics markets, NASA's investment in the NRI will ensure top performers in the U.S. robotics research and development community continue to apply their competencies to solving problems relevant to NASA and Space Technology. NASA's grants are provided through the Space Technology Mission Directorate (STMD) and the Game Changing Development (GCD) Program Office, and are managed by the Human Robotic Systems (HRS) project, led from Johnson Space Center.

Though the robotics industry R&D community is going through a revolution, brought on by technology growth in many areas (including computing, algorithms, energy storage, lightweight materials, and ubiquitous communications), little focus has been on solving space-related problems, including limited computing compared to the state of the art, low bandwidth availability, time delay in communications, reliability, flexibility, radiation tolerance, and extended thermal ranges.

NASA robotics subject matter experts review proposals each year in response to the NRI solicitation and pick submissions relevant to Space Technology for funding, which is executed through grants and cooperative agreements. Success is measured on a grant-by-grant basis during annual continuation reviews with panel members from the NASA robotics community, STMD, and other participating agencies.

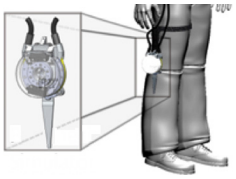
During 2012, NASA approved funding for 10 robotic research tasks under the NRI, all of which had direct infusion paths into current NASA projects. These first-year awardees began research in 2012 and completed the third year in 2015.

During 2015, some of the original nine NASA NRI projects will complete, freeing up funds for new NRI grants beginning in 2015.

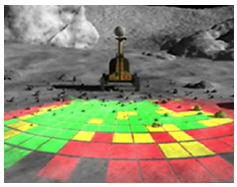


NASA 2015 NRI grant recipients.

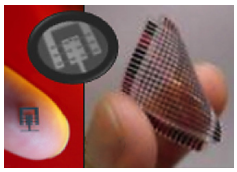
Results to Date



Massachusetts Institute of Technology designed a prosthesis simulator to measure and improve human motion in amputees, which can be used while they are walking on a treadmill with a prosthesis. This will allow prosthesis designers to optimize their prosthesis designs, which can reduce health problems associated with lifelong use, often seen by veterans of war. In addition, MIT developed novel cable routing techniques and materials for their devices. The simulator is of interest to NASA for use in designing better humanoid robot legs, and the flexible cable routing is of interest for exoskeleton cabling.



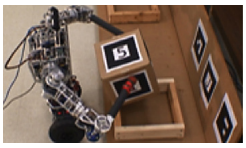
Carnegie Mellon/Astrobotics developed several novel techniques for sensing soft soil conditions ahead of a rover, which could prevent future lunar or Mars rovers from driving into soft soil and becoming stuck.



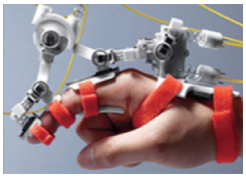
University of Maryland College Park developed revolutionary fabrication methods for creating thin, skin-like, membranes with tiny sensors embedded in them, which are capable of sending tactile feedback to a robot, in effect, giving it a sense of touch. Robots that can "feel" objects (or humans) in the environment will be invaluable in the future when robots are working side by side with humans/astronauts.

Walking algorithms, developed by **Florida Institute for Human and Machine Cognition (IHMC)**, have been loaded on NASA's R5 humanoid robot and have vastly improved its walking and balancing abilities. This software will be useful in the future for planning/executing walking and other motions for humanoid robots in hazardous environments.

Open Source Robotics Foundation (OSRF), improved its Robot Operating System software, which is now on Robonaut 2 (R2), onboard the International Space Station, serves as a key part of the software running R2's zero gravity legs, and is being used on a number of other NASA robots.



University of Massachusetts Amherst is developing methods for dexterous robots to handle objects they have never seen before and "learn" about the object through visual and haptic sensing, thereby improving the ability to pick up, handle, and utilize the object or tool. UMA successfully tested its learning and handling software on an R2 unit at Johnson Space Center in January, 2015.



University of Texas at Austin developed an exoskeleton hand controller that allows users to control a humanoid robot in a unique way, developed algorithms that allow its robot to recover from external forces (such as being accidentally struck by a human) and recover its balance without falling, and developed a software/hardware/sensor system that allows its robot to navigate around unexpected obstacles.

Researchers at **Clemson University** are researching development of long, thin, robotic tendrils for use in zero gravity to access difficult-to-reach areas on spacecraft.

Researchers at **Purdue University** are developing algorithms to facilitate the custom design of electromechanical robotic actuators that are safer, stronger, and more efficient than currently available.

Researchers at **Northeastern University** are developing new methods for robots to manipulate flexible materials, such as protective spacecraft fabrics.

Partnerships

The Human Robotic Systems project is led by NASA'S Johnson Space Center, with many partnerships across the nation at other NASA centers and with numerous industry and academic partners.

The GCD Program is the primary funding source for HRS. Projects under GCD investigate ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about HRS please visit
http://www.nasa.gov/directorates/spacetech/game_changing_development/human-robotic-systems.html

For more information about GCD, please visit:
http://gameon.nasa.gov/

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