

Introduction

For almost 50 years, Johnson Space Center (JSC) has played a vital role in our nation's space exploration initiatives. JSC has been NASA's lead center for human space flight for over 4 decades. From Mercury, Gemini, and Apollo to Skylab, space shuttle, and the International Space Station, JSC has achieved excellence in engineering, mission operations, space life sciences and astromaterials, and sample return science. With the completion of the spectacular last mission of the space shuttle and new direction for NASA, JSC is in the process of inventing a new future for our nation's next bold steps in space exploration. We are transforming our center to meet the exciting challenges of the future exploration missions, and to keep the core capabilities of our center functional to accomplish the next generation of human space flight. With this focus in mind, JSC's leadership is fostering a new, open collaboration and partnership environment at the center. As a first step, the center has established a "Strategic Opportunities and Partnership Development" office (page xxii).

This office enables NASA's missions toward Human Space Exploration by successfully pursuing and maintaining strategic collaboration opportunities and partnerships for JSC that maintain, enhance, or develop key competencies and technologies required for future space exploration. It also plans to leverage other resources to maintain NASA's objectives for space exploration, and to strategically position JSC for future opportunities. These steps include establishing JSC as a global innovation leader in Human Space Exploration by bringing the best minds from universities to collaborate with the best minds of JSC to conduct research, and by reaching out to new partners to ensure that we take advantage of the best fresh ideas and viewpoints. The office provides a clear entry point for external aerospace, non-aerospace, international and academic entities, and other government agencies, and seeks to establish new partnerships, collaborations, and alliances that achieve the center's business objectives.

JSC's Robonaut 2 is an excellent example of our collaboration with industry, academia, and other federal agencies. It is a human-safe robotic assistant endowed with triple redundant-force control software. Early development included collaboration with the Defense Advanced Research Projects Agency, and later with automotive industry. Robonaut 2 was launched on STS-133 with the intravehicular activity task board. The desired outcome is to support extravehicular activities and minimize the risks to human flight crews. The center will continue to seek those technical collaborations that advance technologies for our mission while providing societal benefits.

JSC is fully engaged with universities in both research and educational endeavors. From fabricating cubesats and modeling orbital debris to developing engineering curriculum to teach systems engineering to undergraduate students, we work with our academic partners on wide range of challenges.

The purpose of this *Biennial Research and Technology Development Report* is to highlight the diverse technical, scientific, and engineering research and technology developments under way at our center. To make this report relevant to our readers, we have organized the contents into the categories listed here. These categories are also related to the NASA "Space Technology Roadmaps," developed by the Office of the Chief Technologist at NASA (page xxii).

- *Human Health, Life Support and Habitation Systems, and Space Medicine*
- *Human Exploration Systems, Technologies for Extravehicular Activity and Harsh Environments*
- *Environmental Technologies*
- *Materials, Structures, Development and Testing*
- *Space Power, Energy Storage, and Propulsion*
- *Robotics, Tele-Robotics, Autonomous Systems, and Software*

- *Exploration, Planetary Science, and Sensor Systems*
- *Flammability and Explosive Technologies*
- *Space and Ground Operations*
- *Inspiring Future Generations: Education and Outreach*

At JSC, we are interested in partnering in research and technology development areas of mutual interest and benefit. Our engineers and scientists are well positioned to collaborate in a wide array of technical disciplines. We believe our skills, facilities, and research and technology expertise will allow us to make significant contributions to non-aerospace and aerospace sectors.

Let us invent our futures together.

Kamlesh Lulla, Ph.D.

*University Research, Collaboration and Partnership Office
External Relations Office*

Collaborating with Johnson Space Center

NASA and JSC have a long history of working with colleges and universities, industry, federal laboratories, and other research and technology development organizations. Several vehicles are available to accomplish the collaboration and partnership objectives. Collaborative agreements, both reimbursable and non-reimbursable, can be used to provide mutual leverage of government, university, and industry resources in the cooperative pursuit of joint-interest research and technology development efforts. We look forward to hearing from you.

The electronic version of the 2011 *Biennial Research and Technology Development Report* can be found at <http://research.jsc.nasa.gov>.