National Aeronautics and Space Administration

# SBIR Recipient Creates Low-Power, Lightweight Controller

Barrett Technology, Inc. has successfully created and commercialized a brushless servo electronics module. The Puck™ module is a powerful universal controller that replaces controller cabinets with a device that weighs 43 grams and can be powered by batteries. The controller increases portability, lowers power consumption, and improves reliability of robotics. Barrett incorporated the technology, which was developed with Small Business Innovation Research (SBIR) funding from NASA's Goddard Space Flight Center (Goddard), into the design of its robotic arms that it has sold for use in surgical robots. The company plans to make the module adaptable to a wide range of brushless servomotor applications.

*Puck and WAM are trademarks of Barrett Technology, Inc.*

**www.nasa.gov**

## Benefits of Technology Transfer

- **Lighter and more portable robotics**: The Puck module makes robots lighter and eliminates the need to tether robots to a bulky controller cabinet. Free of tethering wires, robots can be used in portable settings, such as motorized wheelchairs.
- **Expanded applicability**: The greatly reduced weight requirements could broaden the use of robots on space missions, replacing custom electronics on space-bound robots. The Puck module's design opens the door for researchers looking at power systems for designs incorporating flywheel technology.
- **Increased reliability**: With dramatically fewer parts, there is less chance of a part being jolted loose–whether on Earth or in space. In space, the smaller size decreases the risk of a motor getting knocked out by high-speed particles.
- **Enhanced innovation**: The SBIR program allowed Barrett to research a concept that it would not otherwise been able to afford.

success

### On the Record

"If it weren't for the SBIR, we couldn't have made progress on the Puck module. With long-term research like this, you need to keep a researcher working on it continuously. If you don't have the funding and lose your researcher, you lose your core competency." — *Bill Townsend, Barrett Technology Founder and CEO*

## About Barrett Technology

Barrett Technology of Cambridge, MA, provides flexible, machine-intelligent robotic arms and hands. The company was spun out of the Artificial Laboratory at the Massachusetts Institute of Technology in 1990 to bring a haptic robot arm, named the WAM™ arm, to market. Because the market did not yet exist for haptic devices, Barrett honed the technology during the 1990s with grants from the Department of Energy, NASA, and the National Science Foundation (NSF). Today, the company has commercial customers and sells to advanced robotics laboratories all over the world.

## Addressing a Technology Need

Barrett had grappled with the issue of power control for robots for several years. Robots could never be used beyond controlled industrial settings unless they could be made light, portable, and able to sense human touch to be safe for use around people. Haptic robotics enhanced safety but were still encumbered by the need for as much as 10 pounds of wire inside the robot arm itself. NASA, meanwhile, was looking for a way to power microsatellites, and thus funded Barrett's research into developing a lightweight servo-electronics module through its SBIR program. Barrett worked at minimizing the components necessary—eventually eliminating 90 percent of the traditional parts in a servo-electronics module and cooling the remaining components using conduction, rather than convection, technology. The Puck innovation also integrates precise rotor-position sensing and has its own 32-bit CPU, eliminating most of the wiring normally associated with brushless applications. The device requires so little power that a set can drive a WAM robotic arm from only five 9-volt batteries for 18 minutes.

This technology could be applied to flywheel technology for use on microsatellites or as a low-energy means of powering devices on Earth. NASA's Jet Propulsion Laboratory and Carnegie Mellon University have expressed interest in the technology, as have NASA scientists working on the Mars Rover and Moon Rover projects.

## Finding Other Uses

Nearly all industrial precision machines rely on brushless servomotors that must be housed in a large separate controller cabinet. An NSF grant is enabling Barrett to develop features to make the Puck module universally adaptable to a wide range of brushless servomotor applications. In addition, Barrett was able to integrate the technology into its own robotic arms, which have been sold to MAKO Surgical, a company that provides robotics to surgeons. General Motors is using the portable arm system mounted on an autonomous mobile platform to perform complex assembly tasks on the assembly line. Puck-enabled force control is essential in this task.

## The Transfer Process

The SBIR program is a highly competitive three-phase program that reserves a specific percentage of federal research and development (R&D) funding for award to small businesses to move ideas from the laboratory to the marketplace, foster high-tech economic development, and to address the technological needs of the federal government. Barrett developed the Puck module under a Phase 1 SBIR program award from Goddard in 2002.

## Looking Ahead

By creating lighter, more portable robots, Barrett's technology can drive innovation in the use of sophisticated robots. The greatly reduced weight requirements could broaden the use of robots on space missions. Barrett's next step is to make the controller even smaller. The company recently received a Phase II grant from the NSF to pursue that work.

### For More Information

If you would like additional information about Goddard's partnership with Barrett Technology or other technology transfer opportunities, please contact:

Innovative Partnerships Program Office
NASA's Goddard Space Flight Center
techtransfer@gsfc.nasa.gov
http://ipp.gsfc.nasa.gov