Title of Investigation:

Conformal Gripper

Principal Investigator:

John M. Vranish (Code 544)

Other In-House Members of Team:

Mathew Chen (Student Intern)

Other External Collaborators:

Roopnarine and Saase Singe (Honeybee Robotics)

Initiation Year:

FY 2004

Aggregate Amount of Funding Authorized in FY 2004 and Earlier Years:

$25,000 in FY 2004

Funding Authorized for FY 2005:

$40,000

Actual or Expected Expenditure of FY 2005 Funding:

In-House: TBD; Contracts: $40,000 to Honeybee Robotics, Inc.

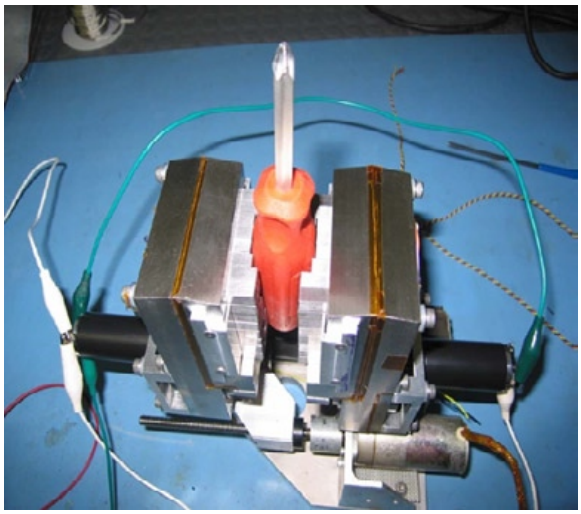
Status of Investigation at End of FY 2005:

To be continued in FY 2006, with funds remaining from FY 2005 and earlier years

Expected Completion Date:

December 30, 2006

DDF annual report



Purpose of Investigation:

Typically, robots use tools and materials to perform useful work. To carry out their work, they use different types of special purpose end-effectors, tools, wrist change-out mechanisms for end-effectors, and a storage system for each of the end-effectors. The "Conformal Gripping System" makes robotic tool and materials handling significantly more efficient, safe, effective, and compact. The Conformal Gripper can perform many tasks directly and can hold and manipulate tools without separate end-effectors. This eliminates the need for a wrist change-out mechanism as well as most special purpose end-effectors and their storage means. While it has long been recognized that Conformal Gripping is a superior approach to robotic tool and materials handling and that a conformal surface based on individual moving pins is the logical way to proceed, practical attempts to create hardware based on this approach have failed because the conformal shape could not be switched from soft and compliant to fixed and unyielding without transferring force to the object being held. The purpose of the investigation was to prove a new approach to switching a conformal shape, from soft and compliant to hard and unyielding without transferring force to the object being held. The work has been successful. Follow-on work will seek to simplify the approach so conformal gripping will be normal practice for both NASA and industry.

Accomplishments to Date:

A prototype has been constructed and demonstrated. At the request of a private company that specializes in robotic hardware, the Conformal Gripper prototype will be exhibited at robot/automation shows to solicit development partners and licensees. The company will seek customers, license the technology from NASA, and supply hardware to the customers. Goddard will have a representative at the show to ensure proper procedures are followed.

Patents:

An invention disclosure for the Conformal Gripping System was submitted in 2005. The Goddard Patent Office is currently processing the application and expects to submit it to the U.S. Office of Patents and Trademarks shortly.

Planned Future Work:

The method of keeping finger position unchanged under load has been rethought and will be reworked to simplify the system and make it perform better in a more compact package. There

also will be an innovative tool-set architecture, which will leverage the Conformal Gripper's capabilities. The sensing system will be simplified and improved to include pin-position sensing and "Virtual Feel" for whatever tool the Gripper is holding.

Key Points Summary:

Project's innovative features: The surface shape management concept for the "Conformal Gripper" is new. (There will be several different methods for how to perform the surface shape management and all will be new innovative.) The "Conformal Gripper Tool Set System" also is new. The "Pin Position Sensing System" is new. Actuation techniques used in the surface shape management system will be new. (Some will also be useful in other space applications.)

Potential payoff to Goddard/NASA: The Conformal Gripping System will significantly and fundamentally enhance Goddard/NASA robotic capabilities to carry out servicing and construction tasks. Tool and end-effector management will be significantly more capable and, at the same time, simpler, stronger, and more compact. These new, enhanced capabilities will apply both for on-orbit servicing and for construction on the Moon. Already we have indications that industry will adapt the technological. This would lead to industry development and price reductions for NASA.

The criteria for success: If the conformal shape can be fixed and relaxed on command without transferring loads to the object being held, the work will be successful. Later, the performance must be improved, simplified, reduced in cost, and made more compact.

Technical risk factors: The approach is straightforward and will work, but it must be simple, compact, low cost, and reliable to be universally adapted for NASA and industry operations.