Autonomous Satellite Docking System and 3-D Docking Sensor Algorithms

Technologies Extend the Life and Function of Our Satellites

Technology and Innovation

Satellite technology is fulfilling an ever-increasing number of critical military and civilian uses, but their expense makes it imperative that their usable life be extended as long as possible. Thus, efficient satellite operation, routine servicing and repair is increasingly important. Recognizing this need, DARPA set up the Orbital Express Advanced Technology Demonstration to develop and test an autonomous satellite servicing system. Although the Michigan Aerospace Corporation docking mechanism is not on board the Orbital Express mission, the company is developing sensors and algorithms to enable autonomous docking and repair of satellites on orbit along with a compliant, lightweight capture mechanism for future missions.

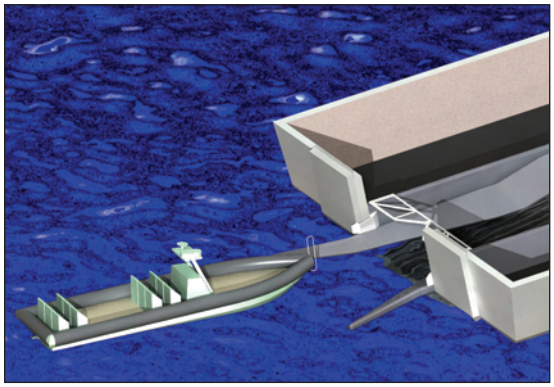
3-D Docking Sensor Algorithms are being developed, under an SBIR contract, to extract information about a target spacecraft's position, orientation, and spin rates from 3-D long-range data. MAC's software is robust, even with low signal-to-noise data, and is capable of running in real time for on-orbit rendezvous and docking operations. Software previously available for this purpose was developed by sensor manufacturers specifically for their own sensors. MAC's software is completely sensor independent.

The Autonomous Satellite Docking System (ASDS) is a compliant, lightweight docking mechanism that enables soft docking of two space assets, such as satellites, and subsequent establishment of a rigid connection for resupply or repair operations. ASDS employs an integral cable-cone latching mechanism, which is scalable from nano- or micro-satellites to large space assets, making the system versatile. ASDS's latching technology can be used in a wide range of vehicle capture applications. For example, the technology has been tested in a Phase II Navy SBIR to replace more labor-intensive and hazardous methods of launching and recovering unmanned vehicles.

The flight crew from the Autonomous Satellite Docking System testing aboard the KC-135 microgravity aircraft in 2002

Joint Collaborations

As a result of DARPA SBIRs, MAC has collaborated directly with two NASA centers—the Johnson Space Center and Marshall Space Flight Center—and has formed numerous other partnerships with companies. MAC has teamed with several



This latch mechanism is based on technology developed during the ASDS program, and is used to capture surface vehicles for a Navy launch and retrieval system

companies to optimize the ASDS design and used dynamic simulation to address docking requirements for various types of military, civil, and commercial space assets. MAC frequently teams with large aerospace companies for platform development, integration, and testing in a relevant ground, marine, airborne, or spaceborne implementation environment. The company has teaming agreements with three prime aerospace companies and alliances with several more.

Lessons Learned

- Establish formal teaming agreements with the primes in the early stages of development to accomplish final product integration and testing.
- Communicate with the sponsoring agency's program manager. This person is the best source of information on transitioning to the military and finding appropriate partners.
- Make technology easily compatible with existing or planned systems by understanding the technical needs of both the program office and corporate partners. Finding the ideal niche for your technology is critical to commercialization success.

Economic Impact

MAC has received DARPA SBIR contracts from Phase I and II development of the algorithm and latching enabling technologies for support of satellite programs. SBIR programs have provided needed funds for product development and have opened doors for teaming relationships with several prime defense contractors that has led to additional funding opportunities.

Since 1997, MAC's revenue has grown from $497,000 to over $5.5 million (estimated for 2007). This growth is based largely on commercialization success fueled by the SBIR program and mutually beneficial corporate partnerships to transition this technology to the market. To support growth, MAC recently expanded its Ann Arbor facilities by adding high-bay assembly and manufacturing space and opened three new offices. MAC has obtained one patent (and another is pending) related to mechanisms for spacecraft and other vehicles.

About the Company

Michigan Aerospace Corporation has its headquarters and a manufacturing facility in Ann Arbor, MI. They also have offices in Berkeley and Los Angeles, CA and Phoenix, AZ. The company is an advanced engineering and products company that provides a broad spectrum of services, from initial concept design and research and development through production and support. ■

Company Information

Michigan Aerospace Corporation
1777 Highland Drive, Suite B
Ann Arbor, MI 48108
Phone: 734.975.8777
Fax: 734.975.0239
www.MichiganAero.com

Peter Tchoryk, Jr., CEO
Founded: 1997
Annual revenue: $5.5 million (estimated FY 2007)
Revenue growth: 49%
Number of employees: 30