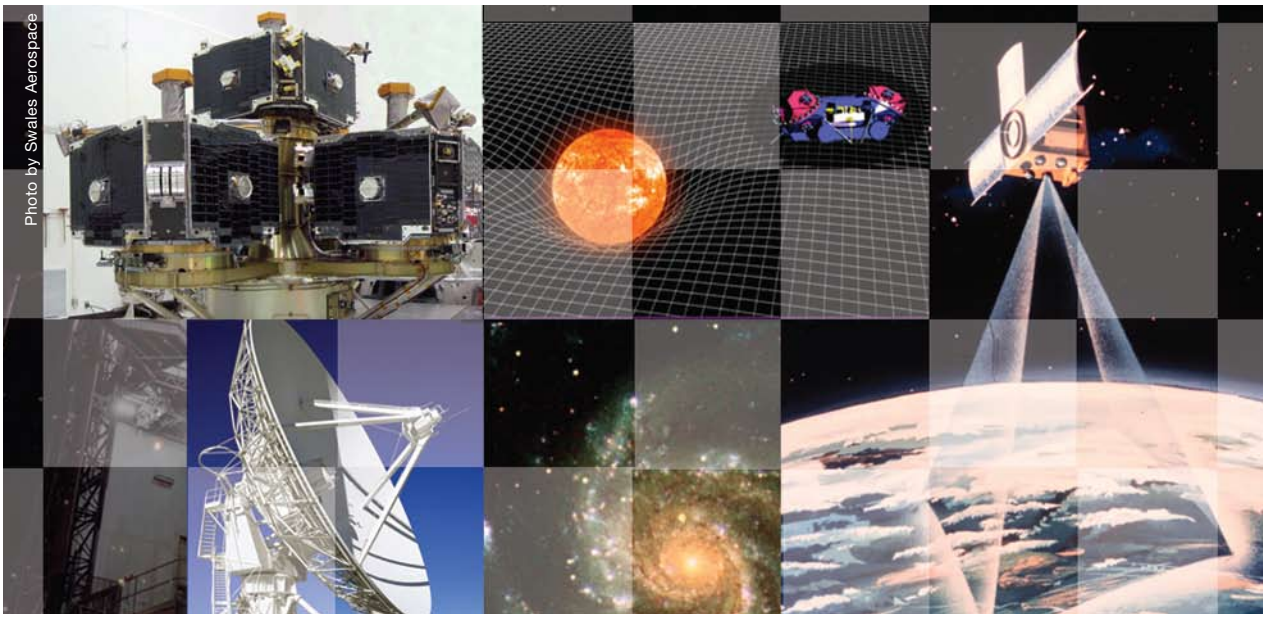
National Aeronautics and Space Administration

Combining Spinoff and SBIR Technologies Yields Cost and Time Savings for NASA Missions



The Hammers Company, Inc. (tHC, Inc.) has successfully combined two technologies—ITOS and the VirtualSat™ system—to yield significant benefits for NASA missions. The ITOS (Integrated Test and Operations System) software offers command and telemetry control of spacecraft during development, test, and on-orbit operations. The VirtualSat system is a satellite simulation tool for flight software development and testing, spacecraft integration and testing, and flight operations training. The company spun-out ITOS from NASA's Goddard Space Flight Center and developed the VirtualSat system under NASA's Small Business Innovation Research (SBIR) program.

VirtualSat is a trademark of the Hammers Company, Inc.

Infusion Success

The following NASA missions are using the ITOS software and/or VirtualSat system:

- Lunar Reconnaissance Orbiter (LRO)
- Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) instruments for the Solar Terrestrial Relations Observatory (STEREO) mission
- Time History of Events and Macroscale Interactions during Substorms (THEMIS)
- Swift Gamma-Ray Burst mission's Burst Alert Telescope (BAT)
- NuSTAR
- Multi-Mission Operations Center (MMOC)
- Earth Observing-1 (EO-1)
- Mars Safe-Hold System Investigation
- ST-7 Disturbance Reduction System
- Living with a Star Space Environment Testbed (SET-1)

success

On the Record

"The SBIR program gives a small company like ours an advantage in our ability to compete in a much larger world. Here we are, a company of 50 employees, and our direct competitors are global corporations like Lockheed and Boeing. It would be impossible to compete otherwise."—*Steve Hammers, co-founder of tHC, Inc.*

"The VirtualSat system and ITOS have been lifesavers in being able to get capabilities to the instrument teams very early on to be interfaced with spacecraft. You can test a board well before you go into production."—*Arlin Bartels, LRO Payload Systems Manager, NASA's Goddard Space Flight Center*

About the Hammers Company, Inc.

Located in Greenbelt, Maryland, tHC, Inc. is a woman-owned, small business, software engineering and development company. tHC, Inc. develops real-time simulation, flight, and ground software systems for numerous NASA scientific satellites, space shuttle payloads, and commercial aerospace customers. Spacecraft flight software includes both attitude determination and control (ACS) and command and data handling (C&DH) real-time systems. Through on-going development in support of commercial and NASA customers, ITOS and the VirtualSat system have created and saved more than a dozen jobs for tHC, Inc.

About ITOS

The Integrated Test and Operations System is a suite of software that controls spacecraft during development, testing, and on-orbit operations. A low-cost, portable, highly configurable system, it runs under a variety of operating systems including Solaris, Linux, and Mac-OS. ITOS can be used for all phases of mission life, and its early use makes spacecraft development more cost effective and reduces risks associated with database conversions, training, validation, and maintenance. tHC has advanced a commercial version of ITOS and now offers a commercial-off-the-shelf (COTS) version, which can support multiple, simultaneous satellite command and telemetry streams. The COTS version of ITOS is being used for several NASA missions, and tHC has sold its ITOS software to the U.S. Naval Research Laboratory, the University of California at Berkeley, and the Canadian Space Agency.

About the VirtualSat System

The VirtualSat system is a satellite simulation tool hosted on a desktop PC for flight software development and testing, spacecraft integration and testing, and flight operations training. The system can be set to run slower or faster than real time, allowing engineers to more easily test all of the critical paths of the software. Spacecraft control analysts and operations teams can understand the behavior of the flight software in different configurations, which is useful in mission planning, training, and testing. When the VirtualSat system is combined with ITOS, commands to spacecraft can be simulated, mitigating some of the risks and costs of maintaining aging hardware on long-term missions. When both are used as a spacecraft simulator for instrument development teams, they can detect interface problems before instruments are integrated into the spacecraft.

The Technology Transfer Process

tHC, Inc. supported the development of ITOS under an engineering support contract with Goddard. In 1999, the company exercised its option to make ITOS software available commercially. Around the same time, tHC, Inc. received funding from NASA's SBIR program to develop the VirtualSat system. The SBIR program, along with its companion Small Business Technology Transfer (STTR) program, provides opportunities for small, high-tech companies to participate in government-sponsored research and development efforts in key technology areas. NASA's Innovative Partnerships Program (IPP) manages the SBIR and STTR programs for the agency (see http://sbir.nasa.gov).

Looking Ahead

The company is pursuing several additional innovations for ITOS and the VirtualSat system. For ITOS, plans include multi-satellite command and control to support future micro-satellite programs, sensor web farms, and combining many older satellite operations systems into a single, cost-effective solution to reduce operations staffing and hardware maintenance costs. Future VirtualSat system development plans include support for formation flying, constellation simulations, and multi-body control.

For More Information

If you would like additional information about NASA's SBIR/STTR programs or other opportunities to work with Goddard technology, please contact:

Innovative Partnerships Program Office
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