

● SPACE BY JEFF HECHT

Dual threat

ON THE SURFACE, NASA'S Demonstration of Autonomous Rendezvous Technology (DART) mission seemed innocuous. The robotic spacecraft was supposed to locate another satellite and approach it without human control

from the ground—a key step in the plan to develop autonomous robots that could dock with ailing spacecraft to repair or upgrade them. After the 2003 Columbia disaster, NASA considered sending a robot instead of astronauts to upgrade the aging Hubble Space Telescope but decided

High ground: In 2003, an unnamed official acknowledged that the Air Force Research Laboratory's XSS-11 experimental rendezvous satellite (illustrated above and inset) could be used as an antisatellite weapon.

the technology wasn't ready.

Two years later, the technology apparently still wasn't mature. Eleven hours after its April 15, 2005 launch, DART—which was supposed to maneuver around a target satellite—instead bumped into it, then shut itself down a few minutes later. A high-level review panel catalogued an embarrassing list of failures, but its detailed report was never released. Although

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the NASA mission was not classified, security reviewers blocked release of the full report because it described militarily sensitive technology.

The incident highlights the growing dual use of common technology in both military and civilian space systems. Autonomous robots might one day replace fading batteries, creaky gyroscopes, or aging scientific instruments on research or commercial satellites. But Pentagon officials could also use them to take close-up looks at other nations' satellites, and—if they don't like what they see—to sabotage them. A robot able to repair solar panels on U.S. satellites might also be able to cover the solar panels on somebody else's satellite with a black plastic bag, turning its power off. "You can't take all programs at face value," says Matthew Hoey, a research associate at the Institute for Defense and Disarmament Studies in Cambridge, Massachusetts. He warns that some robots could be Trojan horses for weaponizing space.

Antisatellite (ASAT) weapons are not new. Both the United States and the Soviet Union tested them during the Cold War. In 1985, a U.S. interceptor destroyed an aging navy research satellite. But cooler heads prevailed, and Congress banned ASAT tests for a decade. Both sides realized that early warning satellites offered vital reassurance that their opposition was behaving—and that attacking those satellites would be seen as a prelude to a nuclear attack. Moreover, destroying satellites would scatter shrapnel into orbit, potentially creating a debris field that would threaten all nations' space-based assets.

That concern didn't stop development of space weapons, although it did alter their trajectory. In October 1997, after the congressional ASAT test ban expired, the Pentagon fired a 2-million-watt ground-based laser at a U.S. military satellite to probe its vulnerability. In theory, a powerful enough beam could fry a satellite's electronics, but atmospheric interference reduced the power delivered to

the target. The Pentagon still remains interested in lasers—a bit too much, according to some. The Washington, D.C.-based Center for Defense Information (CDI) and the Henry L. Stimson Center released a report earlier this year that identified six high-energy laser research and development programs buried in the fiscal 2007

Rutan's SpaceShipOne when it won the X Prize in 2004. But in the near-term, SpaceDev—whose customers include the Air Force Research Laboratory, the Missile Defense Agency (MDA), and the National Reconnaissance Office—is concentrating heavily on small satellites and propulsion modules. One such project is the Maneuvering and Orbital

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defense budget that the authors believe have potential ASAT applications. (One of the programs, dubbed "advanced weapons technology," explicitly calls for a demonstration of "fully compensated beam propagation to low Earth orbit satellites.") CDI and the Stimson Center discovered other potential dual-use systems, including a maneuvering microsatellite that ostensibly will be used as target practice for ballistic missile interceptors—but would also serve as a de facto test bed for ASAT technology.

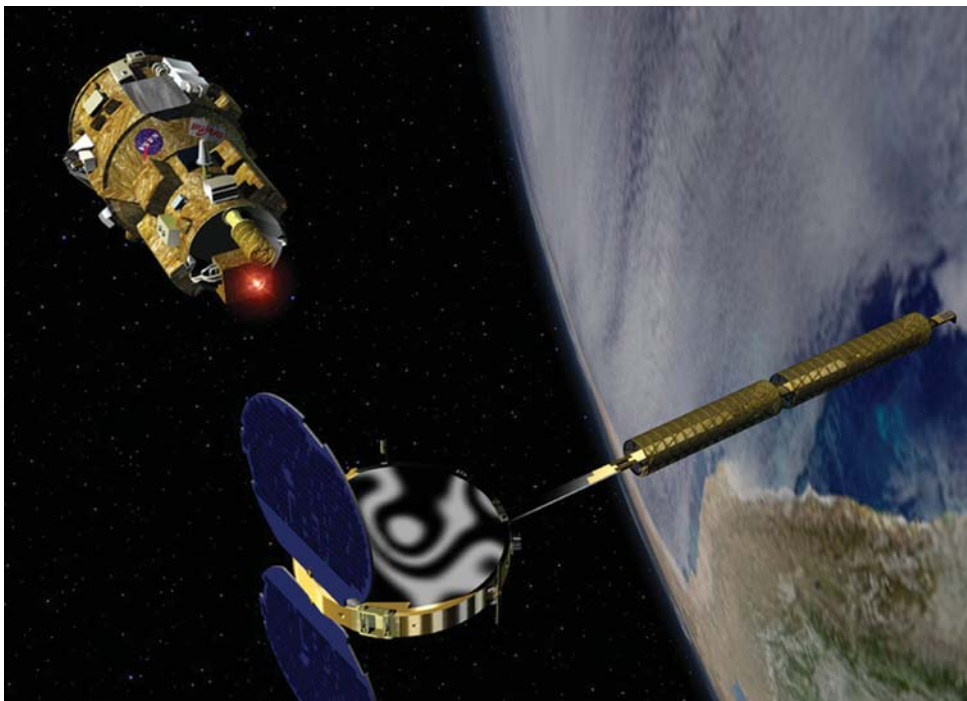
Beyond the Pentagon, another potent driver of dual-use applications is the civilian aerospace sector, where new technology has opened the door to an emerging generation of small, maneuverable satellites and low-cost launchers that could get them into orbit on short notice. This technology "has the potential to revolutionize the space industry, especially military space systems," Hoey wrote earlier this year in the online journal *Space Review*. Instead of blowing up targets, the new generation of ASAT weapons could quietly silence them.

Key innovations are emerging from small companies formed to develop private access to space. The long-term goals of SpaceDev in Poway, California, include a commercial space station and space tourism; it built rocket engines that powered entrepreneur Burt

Transfer Vehicle (MoTV), which delivers a customer-supplied payload to the desired orbit after being launched from a rocket. According to SpaceDev, the MoTV could support "a wide variety of applications," including maneuvering, proximity operations, rendezvous, inspection, docking, and surveillance.

Another small company developing dual-use technology is AeroAstro in Ashburn, Virginia. After the Columbia disaster, the company suggested that its Escort microsatellite could maneuver around a space shuttle or the International Space Station to look for damage such as the hole in the wing that felled Columbia. But a data sheet on the company website says the Escort also can "stealthily inspect and monitor a large satellite to determine its capabilities" and "stealthily attack to permanently or temporarily disable" the satellite. Concealing such an attack, Hoey writes, could fool the satellite operator into thinking it suffered a natural failure.

The smaller the satellite, the stealthier it could be. Self-propelled "cubesats," pioneered at Stanford University and now being studied in a number of university and military labs, are boxes roughly 4–10 inches square that could be carried into orbit by a mother satellite. From there, they would fly individually or in formation to inspect or dock with other satellites. Hoey pos-



Houston, we have a problem: Eleven hours after its April 15, 2005 launch, NASA's DART craft (illustrated above, top left)—which was supposed to maneuver around a target satellite—instead bumped into it.

tulates that a cubesat might “place a black swath of adhesive material over a satellite lens or solar array, and then remove it,” to keep it from seeing secret operations. The cubesat would then return to the mother satellite to recharge, leaving the satellite operators thinking their equipment had suffered a brief glitch.

The most developed satellite systems are considerably larger. DART weighed about 800 pounds when fully fueled and was 6 feet long and 3 feet in diameter. The Air Force Research Laboratory's XSS-11, an experimental rendezvous satellite built by Lockheed Martin and launched just four days before DART on April 11, 2005, weighed about 300 pounds and was the size of a household dishwasher. The XSS-11 also was far more successful than DART. As of December 2005, it had circled the final stage of its launch vehicle more than 75 times and cruised to within 325 meters to 1.5 kilometers of it several times. According to Lockheed Martin, the XSS-11 promises to “advance those capabilities needed

for a satellite to maintain operations on-orbit without intervention from ground-based mission control teams and assets.” The technology could even advance scientific research by aiding NASA's plans to use rendezvousing spacecraft to collect soil samples launched from the surface of Mars and to then return them to Earth. But it's clear there are dual-use worries. In 2003, an unnamed official told the newsletter *Inside the Pentagon*, “XSS-11 can be used as an ASAT weapon.” The satellite could interfere with the operations of another craft or even house a kinetic kill vehicle that could be launched at close range.

Still, despite these concerns, some defense analysts worry less about dual use per se than about how such technology is evolving. “Dual use is great,” says Michael Katz-Hyman, a research associate at the Stimson Center. “NASA should work on how to repair and inspect satellites, but you want to be sure no one misinterprets what you're doing.” If the United States is unclear about its in-

tentions, other nations may assume the worst. Katz-Hyman says an international code of conduct is needed to spell out procedures in space, similar to what the 1972 Incidents at Sea Agreement did for maritime concerns. For example, if a nation wanted to send a robot to inspect another country's spacecraft, it would need to give advance notice and explain its actions.

Dual use also might make it easier for the Pentagon to deploy weapons as “facts in orbit,” says CDI Director Theresa Hitchens. For example, the MDA initially said its ground-based missile defense system would be a test bed but now says it's going to be operational. “You could ostensibly do the same thing

in space,” Hitchens says, by orbiting a robot as experimental and then declaring it operational. The MDA is talking about starting work in 2008 on a fleet of 50–100 space-based missile interceptors to hover over North Korea, Hitchens says. Simultaneously launching a pair of missiles from the ground could easily overcome such a system, she says, “but 50–100 interceptors in space make a heck of an antisatellite system.”

That kind of mission creep is dangerous, Hitchens says. “I think you're harming [your] strategic interests because you're making satellites a target,” she says. The international community, she notes, would see U.S. attacks on satellites as an effort “to prevent other countries' access to space and to keep space for ourselves.” All in all, she says, “It's a strategy that costs you more than it will gain you.” ✽

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