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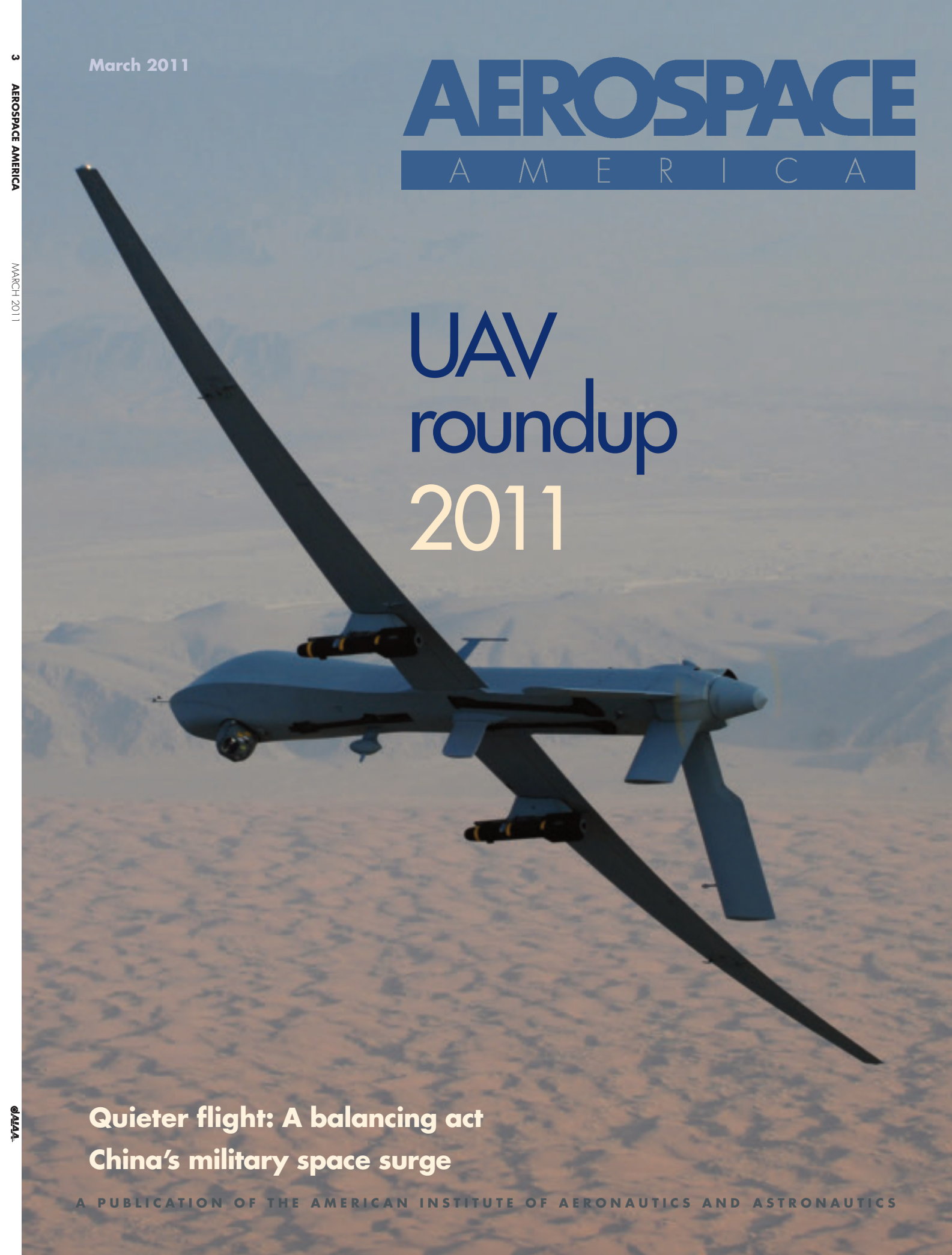

UAV roundup 2011

Quieter flight: A balancing act

China's military space surge

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China's MILITARY SPACE SURGE

China's surging military space program is poised to challenge U.S. aircraft carrier operations in the Pacific, as Chinese military spacecraft already gather significant new radar, electro-optical imaging, and signal intelligence data globally.

During 2010, China more than doubled its military satellite launch rate to 12. This compares with three to five military missions launched each year between 2006 and 2009. Since 2006, China has launched about 30 military related spacecraft. Its total of 15 launches in 2010 set a new record for China and for the first time equaled the U.S. flight rate for a given year.

Most U.S. public and media attention has focused on China's occasional manned flights and its maturing unmanned lunar program. But China's military space surge reveals a program where more than half of its spacecraft are like 'wolves in sheep's clothing,' posing a growing threat to U.S. Navy operations in the Pacific. India's navy is also concerned.

Expert analysts say China is accelerating its military space program to target U.S. aircraft carriers. The surge in development and launch activities has caught the attention of the U.S. secretary of defense and has begun to affect DOD planning. Yet very little U.S. or political and media attention has focused on this trend, which some are calling "a new space race with only one participant."

First liftoff from Jiuquan Gobi Desert launch site of the Long March 4C with restartable third stage in late 2010 also marked first launch of three co-orbital Yaogan spacecraft, 9A/B/C, that maneuvered into an ocean surveillance constellation to track U.S. carrier battle groups. Credit: U.S. Naval Institute.

"This is a really big deal. These military spacecraft are being launched at a very rapid pace" says Andrew S. Erickson, a Naval War College expert on China's naval and space forces. China is becoming a military space power within a global context."

At least three or four different Chinese military satellite systems are being networked to support China's 1,500 km+ range DF-21D antiship ballistic missile (ASBM) program, say U.S. analysts. The DF-21D is being designed to force U.S. Navy aircraft carrier battle groups and other large U.S. allied warships to operate hundreds of miles farther away from China or North Korea than they do today.

The ASBM "has undergone repeated tests and has reached initial operational capability," Adm. Robert Willard, commander of the U.S. Pacific Command said recently in Tokyo. The new Chinese space capabilities, combined with development of the DF-21D, are already having an effect on the planning of future operations in the Pacific, says Secretary of Defense Robert Gates.

"I'm trying to get people to think about how do we use aircraft carriers in a world environment where other countries [China specifically] will have the capability, between their missile and satellite capabilities, to knock out a carrier," Gates said recently at Duke University. "How do you use carriers differently in the future than we've used them in the past?" he asked.

The space arena

Some analysts say the basic DF-21 two-stage solid propellant ballistic missile could also play a role in Chinese antisatellite development. As former Director of National Intelligence Adm. Dennis Blair testified before Congress in 2009, "counter command, control, and sensor systems, to include communications satellite jammers, are among Beijing's highest military priorities. China continues to pursue a long-term program to develop a capability to disrupt and damage critical foreign space systems. Counterspace systems, including antisatellite weapons, also rank among the country's highest military priorities."

Detailed analyses of China's military space program have been done by Erickson at Harvard University, where he is com-

by Craig Covault
Contributing writer

A mobile version of the DF-21 missile is being tested as a fixed DF-21D version of aircraft carrier killer ballistic missile, linked to multiple Chinese military satellites to track and target U.S. carriers hundreds of miles farther away from China than in the past.

pleting a book entitled *Great Power Aerospace Development, China's Quest for the Highest High Ground*.

Grandson of the late Joe Gavin, who led Apollo lunar module development at Grumman, Erickson has also written for the U.S. Naval Institute at Annapolis, where his piece "Eyes in the Sky" in the institute's *Proceedings* lays out a detailed picture of China's growing military space program. Work from Erickson's research is included in this analysis, as are his findings from another major research project on Chinese military small satellites and microsats.

"An emerging network of space-based sensors promises to radically improve the targeting capabilities of China's Navy and other services," says Erickson. This is also giving the country a major new capability to image and eavesdrop on U.S. aircraft and ships basing at key Pacific locations like Guam and Japan.

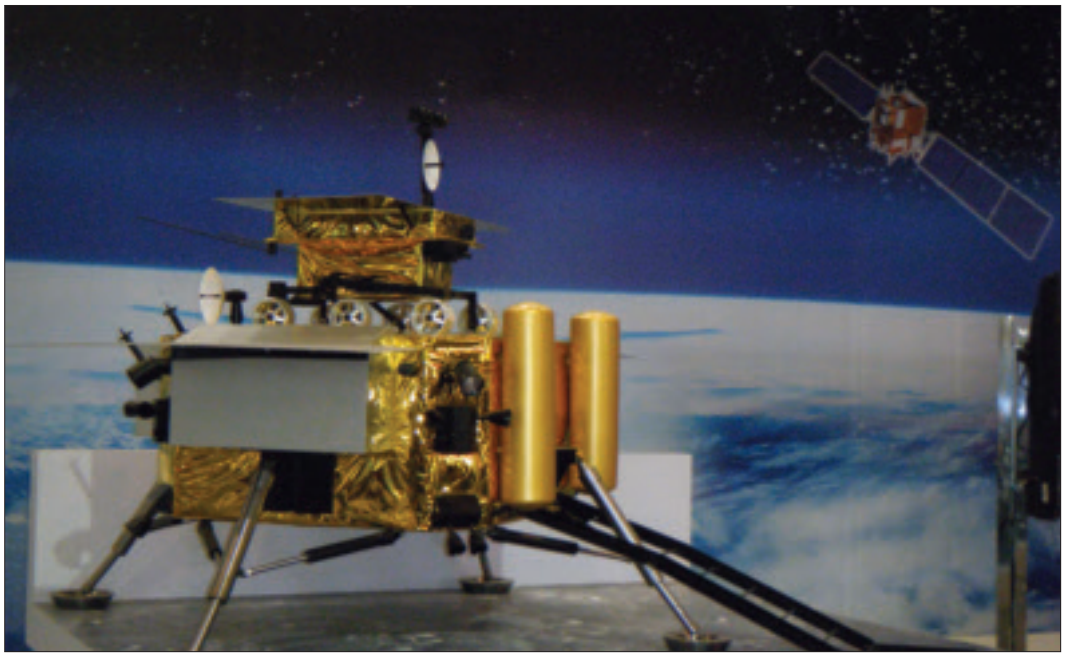
Racing alone

China is accelerating its military satellite launch and networking operations so rapidly that personnel at U.S. Strategic Command (STRATCOM), Offutt AFB, Neb., refer to "the new space race that seems to have only one participant." Sources say that is not a criticism of U.S. space capabilities, but rather a comment by Air Force officers on how little media and political attention there is about China's military space surge. STRATCOM oversees U.S. military space operations as well as its strategic deterrent.

"China's military space program is moving at a rapid pace and has to be taken very seriously," says Erickson.

Yaogan spacecraft form the core of Chinese military space operations. But this designation is a cover to maintain secrecy for at least four different military designs, including satellites with electrooptical digital imaging cameras, a totally different spacecraft with synthetic aperture radar imaging, a third type with signal intercept, and a fourth with electronic eavesdropping capability. A fifth version is for formation flight and has ocean surveillance sensors.

Thirteen Yaogan satellites launched since 2006 are engaged in military space activity, and most remain operational, says Erickson. Only Yaogan 1 has expired. This first Chinese imaging radar satellite appears to have exploded in orbit in February 2010 after four years of service. Four digital imaging Yaogans and four imaging radar satellites have been launched.



By mid-decade, China plans to launch a small nuclear-powered lander carrying a 'pathfinder' Moon rover that will descend to the surface, then periodically plug in to recharge, along with also using a small solar array. Missions like this are showing other countries China's growing high-technology leadership.

"This is the most rapid launch sequence of anything I have yet seen. It is particularly significant because [although they clearly have military missions] they are officially billed as satellites for civilian applications like crop monitoring."

Analysts ask which People's Liberation Army entity is managing the multimillion-dollar military satellite development and launch capability and the daily operation of these spacecraft. One says "there is an ongoing struggle for control of the new military space assets, with perhaps the PLA air force in the lead." He muses that there appears to be "a big food fight" in the PLA over the new military space capability.

Most Yaogans fly in 400-mi. orbits inclined about 98.8 deg. These high inclination orbits involve ground tracks that fly from south to north. The orbits have been used since the cold war by the U.S. and Soviet Union because spacecraft eventually pass over every point on Earth as the planet rotates east to west under the polar orbit satellites' ground tracks.

Quality and quantity

China appears to have very advanced capabilities in both electrooptical and radar imaging, with very high resolution," Erickson points out. "These seem to be exactly the type of capabilities for which to further develop space-based information, surveillance and reconnaissance to support precision weapons."

Two large spacecraft developed by China and Brazil under the China Brazil Earth Resources Satellite (CBERS) program also provide a diverse array of imaging products for both military and civil applications. Two spacecraft are operational and a third is planned. All have advanced cameras and other imaging scanners. Erickson says that, as a whole, China has about 15 reconnaissance-relevant imaging spacecraft, spread between the Yaogans, CBERS, and numerous small satellites. In fact, China has launched some 40 small satellites (weighing 500 kg or less) to date, he says.

Coorbital choreography

Such satellites have been involved in coorbital spacecraft formations like triangles or echelons that can detect ships and calculate location, speed, and direction of travel. Acquisition of such constantly updated positions can give the Chinese navy extremely accurate information as to the actions and intensions of U.S. warships and allied ships.

A small man-tended Salyut-type spacecraft will be used to explore Chinese military space technologies, as well as minor science projects. They will lead to a larger station, and are being used to inspire China's youth to pursue math and science for space-related careers.

Ian Easton, a research fellow at the Arlington, Va.-based Project 2049 Institute, has studied these coorbital missions. The institute is a think tank dedicated to studying Chinese national security issues. Easton writes in the "Asia Eye" blog that the first (and perhaps most strategically significant) of the coorbital satellite constellations to form in 2010 was launched in March. One constellation makes use of three Yaogan radar and eavesdropping spacecraft.

"Unlike previous electrooptical and radar imagery satellites deployed in the series, the Yaogan 9 launch positioned three satellites [A/B/C] orbiting in a highly choreographed triangular formation, suggesting that China had deployed a dedicated Naval Ocean Surveillance Satellite system to bolster the ASBM program. Space-based surveillance and cueing capabilities represent an essential (and previously underdeveloped) element of the ASBM program," Easton writes.

The next coorbital development came in August 2010 when China's Shi Jian-12 satellite conducted a series of sophisticated maneuvers to rendezvous with Shi Jian 6F, one of several suspected electronic intelligence satellites. But the rendezvous ended in a collision. Whether deliberate or accidental, the Chinese remained mum on the incident," Easton says. However, the dean of China satellite analysts, Joan Johnson Freese at the Naval War College, does not believe it was an ASAT test.

"More recently, the September 2010 launch of the three-satellite Yaogan 11 constellation and the October 2010 launch of the two-satellite Shi Jian-6 Group-04 constellation have expanded China's coorbital portfolio," Easton says. His sources believe that Yaogan-11A/B/C are radar imagery satellites with all-weather, day/night capability and can play a role in tracking carrier strike groups. Likewise, the Shi Jian-6 group

launched in October were reported to be intended for an electronic intelligence role, also perhaps as part of China's ASBM program," he says. Easton says key personnel like Li Yandong have been involved in several of the coorbital flights.

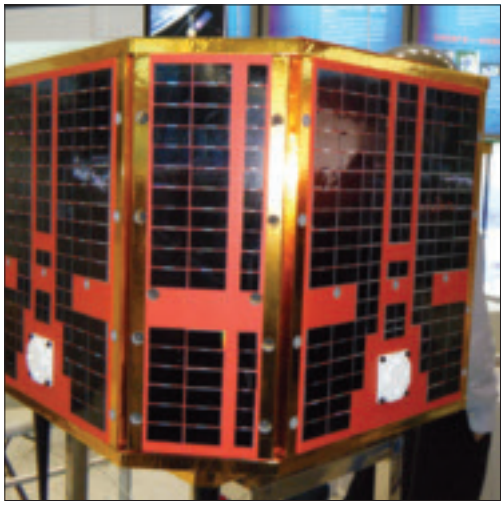
"Ultimately, it appears that these coorbital programs, when viewed in the context of their underlying military missions, have worrisome security implications for both the space and the maritime segments of the global commons in the coming years," he points out.

Ocean monitoring

In addition to intelligence and targeting formations, China is also moving aggressively with ocean monitoring satellites that provide militarily important coastal and sea condition data.

Among the spacecraft planned are 15 additional Haiyang satellites, in three sets, over the next decade. The initial HY-1 series will monitor ocean color using an optical radiometer and sea-surface temperature with a medium spatial-resolution optical sensor. Erickson says a total of eight satellites, designated HY-1C-J, will be launched every three years, in pairs, between 2010 and 2019. The HY-2 series will then introduce a Ku/C dual-frequency radar altimeter, a tri-frequency radiometer, a Ku-band scan radar scatterometer, and a microwave imager to monitor sea surface wave field, height, and temperature.

Four additional satellites, HY-2A-D, will be launched every three years over the same period. In addition, the coming HY-3 series will use SAR sensors with 1-10-m resolution and X-band radar to monitor maritime resources, pollution, and coastal zones.



The Hope 1 communications relay satellite also has an imaging system. Such spacecraft are becoming a key element of the China military space program.

Three satellites will be launched in 2012, 2017, and 2022, according to an analysis by Eric Hagt and Matthew Durnin, "China's Antiship Ballistic Missile: Developments and Missing Links."

And an analysis published by Taiwan's navy says the Haiyang satellites are part of an "ocean monitoring system that has strengthened the PRC military's knowledge of a potential Pacific Ocean battlefield."

Also relevant to maritime surveillance will be the eight-satellite Huanjing disaster/environmental-monitoring constellation. It is envisioned to contain satellites capable of visible, infrared, multispectral, and SAR imaging. Two initial satellites in the series, Huanjing-1A and -1B, will provide real-time multi- and hyperspectral imaging, respectively, at 30-m resolution.

Small size, big payoff

China is especially pursuing constellations of relatively small but high-resolution electrooptical and imaging radar spacecraft, as well as electronic intelligence constellations, says Easton. Erickson has also conducted a detailed study of Chinese military small sats and microsats, both of which may aid China's intelligence gathering.

"What is especially intriguing is that by employing diverse small satellite designs based on common buses, or standardized platforms, China may not need to develop superior heavy spacecraft technologies, but end up with military space capabilities greater than the sum of its parts," Erickson says. "That may suit their purposes quite effectively, although quite differently from the U.S. military space program, which uses larger individual spacecraft."

China may have discovered very sweet 'knees on the curve' (points of maximum benefit) in terms of capability versus cost. Looking forward, if they are able to continue to develop and succeed with reasonably priced satellites updated with the latest off-the-shelf technologies, they may have a potent modular, affordable, adaptable, and replenishable military satellite nucleus the U.S. will not have, Erickson says.

"With this strategy, China may be able to come up with something that is increasingly more than the sum of its parts," Erickson says. He points out that Chinese specialists almost uniformly view microsatellite technology as essential for 21st century military development.

In the assessment of one major Chinese aerospace journal, "The successful develop-

ment of reconnaissance, monitoring, surveying and mapping, communications, and other satellite systems can provide comprehensive, accurate and timely strategic and tactical information for high technology warfare." Another argues that "microsatellites will play an indispensable role in future information warfare," which reflects a view widespread in China's defense industrial sector. Having recognized that "space control provides the key to military victories in modern warfare, Chinese defense analysts are focusing on developing improved methods for entering space, using space, and controlling space."

They already credit indigenously developed satellites for substantially improving the nation's military communications. Erickson points out that "Chinese researchers are studying not only how to attack other nations' satellites, but also how to defend their own." He says a detailed study of satellite defense methods by researchers at the Shijiazuang School of Ordnance Engineering predicts that, "As microsatellite technology advances, small high-energy lasers or high-power microwave systems may be incorporated for self-defense or satellite protection."

Protecting assets

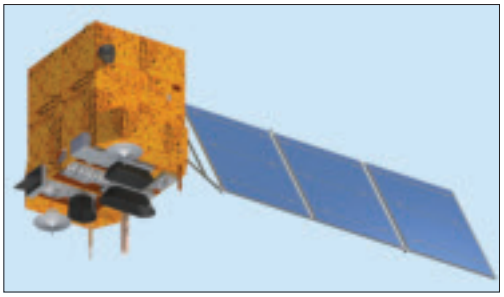
The study further noted that, "at the present moment, we should significantly reinforce the top level design of satellite protection to address specifically the status of satellite protection in China. By combining countermeasures against 'soft kill' and 'hard destruction,' the concept of 'system-based countermeasures' should be practiced by taking a variety of measures. We should actively engage in the development of all kinds of protection technology and initiate preliminary research on low cost, novel protection technology.

"On the other hand, we also must closely monitor progress made by foreign militaries in satellite protection technology in order to adjust and alter our focus and direction of our countermeasure technology correspondingly.

"We have to know ourselves as well as our enemy in order to win every battle," says the Chinese internal assessment.

Navigation and communications

In satellite navigation, China's 2007-era Beidou 1 four-satellite constellation has its capability limited by its latitude and longitude area of service. To improve on that, China is deploying a 35-satellite Beidou 2/compass navigation satellite system that will have five spacecraft in geosynchronous orbit and 30 medium-altitude spacecraft. It should achieve global coverage capability in 2015-2020, Erickson predicts.



Spacecraft developed by China and Brazil under the China Brazil Earth Resources Satellite [CBERS] program provide imaging products for both military and civil applications.

Chinese military satellite communications has been hampered in recent years with failures in the DFH-4 bus. But overall, several other geosynchronous orbit designs are providing China with reliable encrypted communications. According to the authoritative Global Security.org, China's most advanced military satcom series is the Feng Huo-1 (FH-1) satellite, the country's first space-based communications platform to provide military units with both C-band and UHF communications.

First launched in 2000, it is the first of several military communications satellites for the Qu Dian C4I system, China's first integrated command, control, communications, computer, and intelligence system. The new system gives the PLA new capabilities for coordinating and supporting its growing terrestrial forces. The PLA describes the new Tactical Information System as similar to the American Joint Tactical Information Distribution System, or JTIDS. When fully deployed, the Qu Dian system will allow theater commanders to communicate with and share data with all forces under a joint Chinese command.

China launched a smaller military comsat in November 2010. A Long March 3A launched the Zhongxing-20A military communications satellite from Xichang. A new navigation satellite followed in mid-December as the 15th and final mission of the year and the 12th with military capability.

As China continues to keep its three existing launch sites busy, huge construction crews continue to work at the giant new Wenchang Satellite Launch Center on Hainan Island, scheduled for completion in 2013. It will launch the new oxygen/hydrogen-powered Long March 5, similar to the American Delta IV.