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Testimony before the U.S.-China Economic and Security Review Commission Hearing on "China in Space: Strategic Competition"

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This research represents the author's own personal views.

Introduction

The Chinese military has embarked on a series of organizational and doctrinal reforms to improve its ability to fight modern war. Prominent among these reforms is a growing emphasis on space and counterspace operations to enable long-range precision strikes and deny adversary space capabilities. The People's Liberation Army (PLA) has officially designated space as a new domain and established an organization to command space forces. With this increased focus on space, the PLA may begin to develop a doctrine to govern the use of space in military operations.

Chinese analysts writing on space make the oft-repeated statement that "whoever controls space will control the Earth" and argue that outer space is the new high ground of military operations. They assert that the center of gravity in military operations is now transitioning to space. Explicit in these arguments is the assumption that space has become so vital to fighting modern war that no military can do without the benefits of space-based capabilities. At the same time, Chinese military analysts regard space as a great vulnerability that, if denied, can debilitate an enemy and secure victory.[1]

According to Chinese sources, the goal of space operations is to achieve space superiority (*zhitianquan*; 制天权), defined as "ensuring one's ability to fully use space while at the same time limiting, weakening, and destroying an adversary's space forces."[2] Space operations play a key role in the PLA's ability to conduct asymmetric strikes against the US military, enabling long-range precision strikes against land, air, and naval targets and denying adversaries the use of space assets.

This paper argues that China is taking a dual-use approach to its space program that integrates military and civilian capabilities to pursue national security and economic goals. China is developing a space-based command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR) network to extend the PLA's power projection capabilities while promoting its economic interests. China's counterspace efforts appear to be directed toward developing an operational capability to threaten an adversary's space assets from the ground to geosynchronous orbit (GEO). The PLA's priority on space, especially space control, increases the possibility of warfare in space, the risk of escalation, and the risk that efforts to deter Chinese counterspace actions may have little chance of success.

[1] Jiang Lianju and Wang Liwen, eds., *Textbook for the Study of Space Operations* (*空间作战学教程*), (Beijing: Military Science Publishing House, 2013), 44.

[2] Ibid., 14.

China's Space Capabilities

The Chinese military is developing three broad capabilities that either have direct military application or are inherently dual-use in nature: operationally responsive space launch capabilities, space-based C4ISR, and counterspace capabilities.

Operationally responsive launch capabilities

China can launch satellites into all orbits and is developing the ability to rapidly reconstitute or augment satellite constellations. It has a new generation of liquid-fueled launch vehicles that can launch bigger and more capable satellites as well as smaller, solid-fueled, road-mobile launch vehicles that can conduct launches within shorter timelines. The new generation of liquid-fueled rockets is divided into light, medium, and heavy-lift versions that can send 1 to 25-metric-ton-payloads into low Earth orbit and 1 to 14-metric-t on-payloads into GEO orbit.[3] The addition of heavier lift capacity facilitates the orbiting of China's long-term space station and robotic missions to the moon. China can also use these new rockets to launch heavier satellites, such as larger remote sensing satellites with better imagery resolutions.

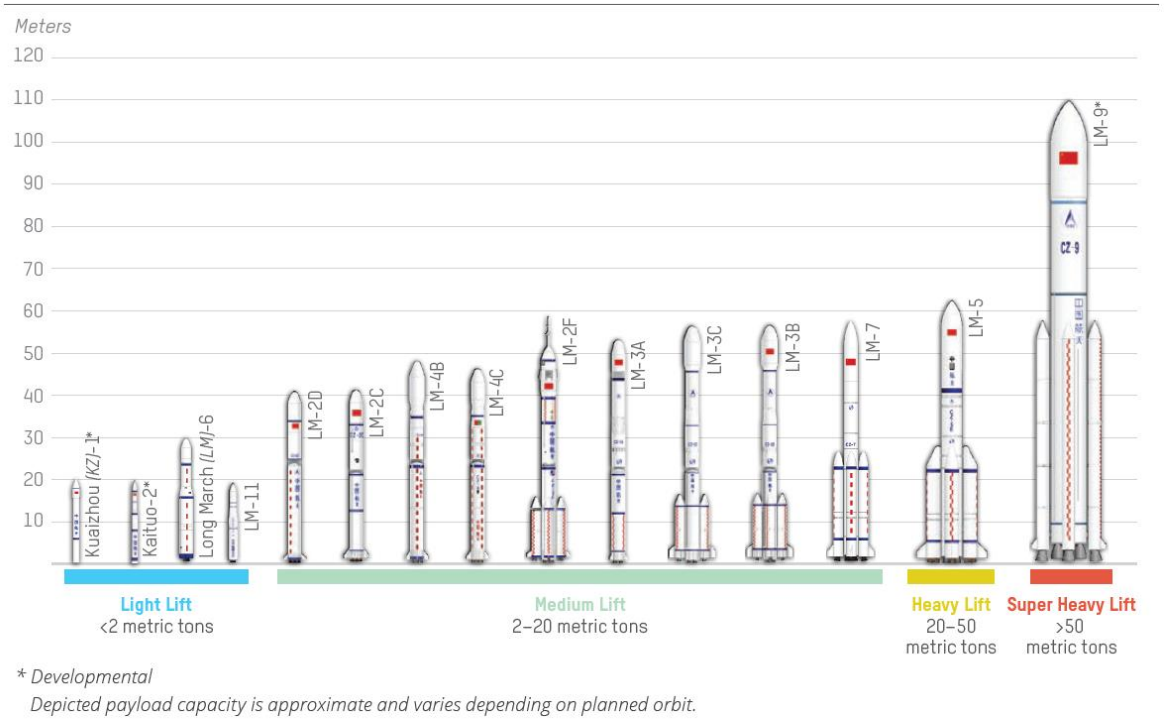
China has also developed solid-fueled rockets that provide launch capabilities at the lower end of the lift spectrum. Solid-fueled rockets do not require fueling before launch and can be transported by ground vehicles, enhancing responsiveness and survivability. The Long March 11, reportedly based on the DF-31 ICBM, can carry a payload of 700 kilograms into orbit.[4] The Kuaizhou launch vehicle, reportedly based on the DF-21 medium-range ballistic missile, is advertised as being capable of launching 300 kg into orbit with just four hours of preparation.[5]

[3] Zhang Feng, "China's Long March 5 Launch Vehicle" (中国的长征五号运载火箭), *Satellite Application* (卫星应用), 2012/5, 29.

[4] "Long March 11" (长征十一号), China Academy of Launch Vehicle Technology, May 12, 2016, http://www.calt.com/n482/n498/c4962/content.html.

[5] "Guancha Net on the Frontlines of the Zhuhai Airshow: Feitian-1 Triggers Attention That it Can Launch in Four Hours," (观察者网珠海航展前线：飞天一号火箭引发关注 4 小时即可"飞天), http://m.guancha.cn/military-affairs/2014_11_12_285792.

Figure 1. Chinese space launch vehicles



Source: Defense Intelligence Agency, "Challenges to Security in Space," 16.

Space-based C4ISR capabilities

PLA analysts describe space-based C4ISR systems as a critical part of a modern military's sensor-to-shooter network. The PLA's development of long-range precision-strike capabilities requires a robust space-based C4ISR network to locate, track, and target enemy installations and ships hundreds of kilometers from Chinese territory and coordinate forces from multiple services in joint operations. Space-based C4ISR supports these operations through the application of reconnaissance, meteorology, missile early warning, communication, and navigation capabilities that can help monitor the activities of potential adversaries, enable communication between friendly units, and provide positioning, navigation, and timing data.

According to the Union of Concerned Scientists Satellite Database, as of November 2018, China had 284 operational satellites. These included 134 remote sensing satellites, 41 communication satellites, and 40 navigation satellites.

Remote sensing satellites

China plans to establish a high-resolution Earth observation system capable of stable all-weather, 24-hour, multi-spectral, various-resolution observation by 2020. China operates 28 different types of ISR satellites. These include satellites with electro-optical (EO) sensors for remote sensing during daylight and moderate weather conditions, synthetic aperture radar (SAR) for observations at night or during inclement weather, and video cameras to capture movement. China's remote sensing satellites also feature a variety of resolutions, from sub-meter for discrete imagery to 800 meters for imaging broad swaths of territory. China also has a number of satellites that are apparently equipped with electronic intelligence (ELINT) payloads to collect electronic transmissions.[6]

China plans to deploy remote sensing constellations that will add redundancy, flexibility, and timeliness to its remote sensing capabilities. The Superview series of satellites is planned to form a 24-satellite constellation made up EO and SAR satellites and several mini-satellites by 2022.[7] A second constellation made up of the Jilin-series of satellites is planned to consist of 60 satellites by 2020 and 138 satellites by 2030. The constellation consists of satellites with EO and video payloads and, by 2030, will have a revisit rate of 10 minutes.[8]

Communication satellites

China owns and operates over 40 communications satellites, with four dedicated to military use. According to the Defense Intelligence Agency (DIA), "China produces its military-dedicated satellites domestically and its civil communications satellites incorporate off-the-shelf commercially manufactured components." [9] China is planning two large communication satellite constellations. The Hongyun constellation, built by the China Aerospace Science and Industry Corporations, will consist of 156 satellites and is planned to be operational in 2020.[10] The Hongyan constellation, built by the China Aerospace Science and Technology Corporation,

[6] "China Adds to Yaogan-30 Reconnaissance Constellation via Successful Long March 2C Launch," *Spaceflight 101*, January 25, 2018, http://spaceflight101.com/yaogan-30-04-launch/.

[7] Zhao Lei, "High-resolution satellites begin operation," *China Daily*, January 13, 2017, http://www.chinadaily.com.cn/china/2017-01/13/content_27943139.htm.

[8] Ma Si and Liu Mingtai, "Jilin group sets goal of putting 60 satellites in orbit by 2020," *China Daily*, March 28, 2017, http://www.chinadaily.com.cn/business/2017-03/28/content_28700107.htm.

[9] Defense Intelligence Agency, "Challenges to Security in Space," 2019, 19.

[10] Andrew Jones, "China to Launch First Hongyun Low Earth Orbit Communication Satellite Late on Friday," *GBtimes*, December 21, 2018, https://gbtimes.com/china-to-launch-first-hongyun-low-earth-orbit-communication-satellite-late-on-friday.

will consist of around 320 satellites.[11] Both constellations will provide global communications and internet connectivity, especially to underserved regions. According to Yao Fahai, vice president of China Satcom, China is pursuing communication satellite constellations at this time in order to claim orbital slots in the already crowded low Earth orbit.[12]

Navigation

China has launched 47 navigation satellites since 2000. At the end of 2018, China had 33 operational navigation satellites in orbit—18 third-generation satellites and 15 second-generation satellites. The third-generation satellites offer better accuracy and stability than the second-generation satellites. In 2018, the Beidou program started to provide global service for the first time, covering 50 countries with 10-meter accuracy globally and 5-meter accuracy in the Asia-Pacific.[13] When fully deployed, the Beidou program will consist of 35 satellites.[14]

Counterspace

Counterspace operations are conducted to deny, degrade, disable, or destroy an opposing side's space capabilities. This can include attacks against ground-based and space-based space assets with kinetic and non-kinetic means. Counterspace operations not only include offensive and defensive operations in space against an adversary's space forces, but also air, ground, and naval operations against space assets.[15] Although Chinese strategic writings indicate a cautious

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[11] Andrew Jones, "China to Launch First Hongyan LEO Communications Constellation Soon," *GBtimes*, November 13, 2018, https://gbtimes.com/china-to-launch-first-hongyan-leo-communications-constellation-satellite-soon and Zhao Lei, China begins space-based broadband project, *China Daily*, December 22, 2018, http://www.chinadaily.com.cn/a/201812/22/WS5c1d82d6a3107d4c3a002337.html

[12] Caleb Henry, "China Satcom's LEO, HTS projects driven by desire not to fall behind foreign counterparts," *Space News*, July 11, 2018, https://spacenews.com/china-satcoms-leo-hts-projects-driven-by-desire-not-to-fall-behind-foreign-counterparts/

[13] Zhao Lei, "Beidou Navigation System Begins Global Operations," *China Daily*, December 28, 2018, http://www.chinadaily.com.cn/a/201812/28/WS5c247a52a310d912140514b9.html and "BDS to Provide Navigation Services to BRI Countries from Next Month," China Space Navigation Office, November 19, 2018, http://en.beidou.gov.cn/WHATNEWS/201811/t2018112316656.html.

[14] Stephen Clark, "Expansion of China's Beidou Satellite Fleet Continues with Successful Launch," *Spaceflight Now*, September 20, 2018, https://spaceflightnow.com/2018/09/20/expansion-of-chinas-beidou-satellite-fleet-continues-with-successful-launch/.

[15] Jiang and Wang, *Textbook for the Study of Space Operations*, 14.

approach to space warfare,[16] writings on the operational level of war suggest a predilection for strong offensive actions at the beginning of a conflict. The authors of the *Study of Space Operations*, for example, conclude that China will "do all it can at the strategic level to avoid firing the first shot,"[17] but recommend that China should "strive to attack first at the campaign and tactical levels in order to maintain the space battlefield initiative,"[18] and that the PLA should "conceal the concentration of its forces and make a decisive large-scale first strike."[19]

According to the US Defense Department, China is developing a number of counterspace and counterspace-related technologies. These include direct-ascent kinetic-kill vehicles, co-orbital satellites, and directed-energy weapons and jammers.[20] China's development of counterspace technologies appears to be aimed at developing the capability to put at risk adversary satellites from earth's surface to GEO.

Table 1. Counterspace-related testing and operations

Type	Year	Description	Comments
Direct Ascent			
	2007	**KKV test**	
	2010	**Mid-course ballistic missile defense test**	
	2013	**Mid-course ballistic missile defense test**	
	2013	**KKV test**	**Test to GEO. China called it "high altitude science mission"**
	2014	**KKV test**	**China called it ballistic missile defense test. US called it ASAT test.**
	2015	**Unknown test**	
	2017	**Unknown test**	

[16] China Academy of Military Science Military Strategy Studies Department, *Science of Military Strategy* (战略学), Beijing: Military Science Press December 2013), 92.

[17] Jiang and Wang, *Textbook for the Study of Space Operations*, 42.

[18] Ibid., 52.

[19] Ibid., 142-143.

[20] Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2016*, 37.

Type	Year	Description	Comments
	2018	Mid-course ballistic missile defense test	
Co-orbital			
	2010	Two Shijian satellites involved in close proximity operation, causing slight change in one satellite's orbit	
	2013	Three satellites involved in close proximity operation to test space debris removal and robotic arm technologies	
	2016	Aolong-1 tested robotic arm to remove space debris	
	2016	Shijian-17 rendezvous with ChinaSat-5A	
	2019	TJS-3 satellite released probable subsatellite	
Cyber			
	2012	Computer network attack against Jet Propulsion Laboratory	Allowed "full functional control" over JPL networks
	2014	Computer network attack against NOAA	
	2017	Computer network attack against Indian satellite communications	
	2018	Computer network attack against satellite operators, defense contractors, and telecommunication companies	
Directed energy			
	2006	Lased US remote sensing satellite	Intent unknown

Sources: Brian Weeden and Victoria Sampson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, April 2019 and Todd Harrison, Kaitlyn Johnson, and Thomas G. Roberts, *Space Threat Assessment 2019*, April 2019.

Kinetic tests

According to the Director of National Intelligence, "the PLA has an operational ground-based antisatellite (ASAT) missile intended to target low-Earth-orbit satellites, and China probably intends to pursue additional ASAT weapons capable of destroying satellites up to geosynchronous Earth orbit."[21] In 2010 and 2013, China conducted mid-course tests of a missile defense system that has been widely regarded as having counterspace implications.[22] In July 2014, China again conducted what it called a missile defense test. The Department of Defense, however, characterized the event as a non-debris producing ASAT test[23] and assesses that development of this system continues.[24] In November 2015, China conducted an unacknowledged missile intercept test of an unknown type.[25]

In 2013, China conducted what it called a "high altitude science mission" with a sounding rocket that released a barium cloud at an altitude of more than 10,000 kilometers to study the Earth's magnetosphere.[26] The Department of Defense, however, concluded that the launch was a test of direct ascent counterspace technologies and stated that the rocket "appeared to be on a ballistic trajectory nearly to GEO" and "was not consistent with traditional space-launch vehicles, ballistic missiles or sounding rocket launches used for scientific research."[27] This test demonstrated an expansion of China's counterspace capabilities to GEO, which would allow China to threaten GPS and communication satellites with a direct ascent kinetic kill vehicle.

[21] Dan R. Coats, "2019 Worldwide Threat Assessment of the U.S. Intelligence Community," January 29, 2019, 17.

[22] Brian Weeden and Victoria Sampson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, April 2019, 1-9.

[23] Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2015*, 14.

[24] Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2016*, 37.

[25] Bill Gertz, 'China Tests Anti-satellite Missile,' *Washington Free Beacon*, 9 November 2015, http://freebeacon.com/national-security/china-tests-anti-satellite-missile/.

[26] "China Again Conducts a High Altitude Science Mission: Higher Altitude and More Data," (中国在高空科学探测实验：高度更高数据更多), China News (中国新闻网), May 14, 2013, http://www.chinanews.com/gn/2013/05-14/4817925.shtml.

[27] *Military and Security Developments Involving the People's Republic of China 2015*, 14.

Co-orbital operations

China has also conducted a number of close-proximity operations between spacecraft.[28] In 2008 as part of the Shenzhou-7 human spaceflight mission, the Banxing-1 satellite (BX-1/Companion Satellite) flew around the Shenzhou-7 space capsule taking images of the spacecraft.[29] In August 2010, in what may have been a test of docking procedures for the future Tiangong space station, a Shijian-12 satellite likely bumped into the Shijian 6F satellite.[30] In an apparent test of robotic arm technologies for a future space station, in August 2013, China tested a satellite equipped with a robotic arm to grapple a target satellite.[31]

Directed energy

According to acting Secretary of Defense Patrick Shanahan, the PLA will "field a ground-based laser system aimed at low-earth orbit space sensors by [2020]."[32] In 2006, China lased a US military reconnaissance satellite. The action temporarily blinded the satellite but caused no permanent damage, leading to speculation that China may not have been intentionally trying to interfere with the satellite.[33]

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[28] Office of the US Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2012*, 9.

[29] "Small Companion Satellite Will Chase After the Shenzhou 7 Orbital Capsule After Separation," (伴飞小卫星将"追赶"分离后的神七轨道舱), Xinhua, September 24, 2008, http://news.xinhuanet.com/newscenter/2008-09/24/content_10104787.htm; 'Shenzhou-7 Launches Small Monitoring Satellite,' *Xinhua*, September 27, 2008, http://news.xinhuanet.com/english/ 2008-09/27/content_10123015.htm; "Small Companion Satellite Will Take Photographs of Shenzhou 7," (伴飞小卫星将给神七"照相"), Xinhua, September 24, 2008, http://news.xinhuanet.com/newscenter/2008-09/24/content_10104656.htm.

[30] Brian Weeden and Victoria Sampson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, April 2019, 1-2.

[31] Kevin Pollpeter, "China's Space Robotic Arm Programs," SITC News Analysis, October 2013, http://igcc.ucsd.edu/assets/001/505021.pdf.

[32] Patrick M. Shanahan, "Remarks by Acting Secretary Shanahan at the 35th Space Symposium, Colorado Springs, Colorado," April 9, 2019, https://dod.defense.gov/News/Transcripts/Transcript-View/Article/1809882/remarks-by-acting-secretary-shanahan-at-the-35th-space-symposium-colorado-sprin/

[33] Elaine M. Grossman, 'Top Commander: Chinese Interference with U.S. Satellites Uncertain,' *World Politics Review*, 18 October 2006, http://www.worldpoliticsreview.com/articles/267/top-commanderchinese-interference-with-u-s-satellites-uncertain

Computer network operations

China has also conducted computer network operations against US computer systems involved in space operations. According to NASA, in 2012 hackers traced to Chinese IP addresses gained "full access to key Jet Propulsion Laboratory [computer] systems and sensitive user accounts" and "full functional control over… networks," [34] although it is unclear whether the compromised networks were involved in the control of spacecraft. In November 2014, the National Oceanic and Atmospheric Administration (NOAA) reported that its agency's networks had also been compromised. Although NOAA did not identify the perpetrator of the attack, Congressman Frank Wolf stated that NOAA had told him that China was behind the hack.[35] If accurate, the attack suggests preparation by the Chinese military to deny important meteorological forecasting data not only to the US military, but also to civil weather forecasting agencies. More recently, cyber security company Symantec in 2018 revealed that attacks coming from Chinese IP addresses had targeted a satellite communications operator and a geospatial imaging and mapping organization.[36]

Jamming

China also has the ability to jam satellite communications and GPS receivers. The GPS signal, in particular, can be easily jammed [37] and even low-power jammers can be effective over distances of hundreds of kilometers.[38] According to DIA, "The PLA routinely incorporates jamming and anti-jamming techniques against multiple communication, radar systems, and GPS satellite systems in exercises. China continues to develop jammers dedicated to targeting SAR aboard military reconnaissance platforms, including low Earth orbit satellites.

[34] Statement of Paul K. Martin, Inspector General, National Aeronautics and Space Administration, "NASA Cybersecurity: An Examination of the Agency's Information Security," February 29, 2012, 5.

[35] Mary Pat Flaherty, Jason Samenow, and Lisa Rein, "Chinese Hack U.S. Weather Systems, Satellite Network," *Washington Post*, November 12, 2014, http://www.washingtonpost.com/local/chinese-hackus-weather-systems-satellite-network/2014/11/12/bef1206a-68e9-11e4-b053-65cea7903f2e_story.html.

[36] "Thrip: Espionage Group Hits Satellite, Telecoms, and Defense Companies," Symnatec, June 19, 2018, https://www.symantec.com/blogs/threat-intelligence/thrip-hits-satellite-telecoms-defense-targets.

[37] Congressional Budget Office, "The Global Positioning System for Military Users: Current Modernization Plans and Alternatives," October 2011, 4.

[38] Defense Science Board, "Report of the Defense Science Board Task Force on Tactical Air Warfare," November 1993, 12.

Additionally, China is developing jammers to target SATCOM over a range of frequency bands, including military protected extremely high frequency communications."[39]

Strategic Support Force

The PLA Strategic Support Force (SSF) is a functional command that unifies strategic-level space, cyber, and electronic warfare operations.[40] China's leader, Xi Jinping, has described the SSF as "a new type operational force to maintain national security" and "an important growth point" for the PLA's "new quality operational capability."[41]

The SSF has two subordinate operational departments: a Network Systems Department responsible for conducting strategic cyber and EW operations and a Space Systems Department responsible for space operations.[42] A major goal of the SSF appears to be to improve the PLA's joint operational capability by integrating strategic-level C4ISR and counter-C4ISR capabilities with service and theater command capabilities.[43]

More than three years after its founding, we still know relatively little about the SSF. The SSF does command China's space launch centers and satellite control centers. However, its role in coordinating or commanding the operations of civilian satellites and counterspace operations is unknown.

[39] Defense Intelligence Agency, "Challenges to Security in Space," 2019, 20.

[40] Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2017*, 1.

[41] Wang Shibin and An Puzhong, "Xi Jinping Confers Military Flags to Chinese People's Liberation Army Ground Force, Rocket Force, and Strategic Rocket Force,"习近平向中国人民解放军陆军火箭军战略支援部队授予军旗并致训词), *China Military Online*, (中国军网), January. 1, 2016, http://www.81.cn/sydbt/2016-01/01/content_6839896.htm.

[42]"Class-A Qualification List for Integrated Information System," (涉密信息系统集成甲级资质单位名录), National Secrecy Science and Technology Evaluation Center, (国家保密科技测评中心), http://www.isstec.org.cn/zzpg/zwsx/jgzz/zzml/352934.shtml.

[43] Defense Intelligence Agency, "Challenges to Security in Space," 2019, 14.

Implications for Coercion

China's increasingly capable space program raises questions about how China may use space as a part of a coercive campaign and whether the US can deter China from taking counterspace actions. According to acting Secretary of Defense Patrick Shanahan speaking at the 35th Space Symposium on April 9, 2019, "We are not going to sit back and watch. We are going to act. We are going to deter conflict from extending into space, and ensure we can respond decisively if deterrence fails."[44]

Any discussion of Chinese views on deterrence must first start with definitions. One source defines the Chinese term *weishe* (威慑), commonly translated as deterrence, as "the use of momentum or force to create submission."[45] Another source states that it is the use of "military strength and will to create pressure on the enemy's psychology in order to reach the goal of delaying or preventing combat."[46] According to the 2013 edition of the *Science of Military Strategy*, a book published by the Chinese military's top think tank, the Academy of Military Sciences, *weishe* is a "strategic activity of a country or political group for the purpose of achieving certain political goals to influence an opponent's strategic judgement in order to make them believe that goals will be difficult to achieve or that the cost of achieving them will be too high."[47]

Regardless of the specific definition, *weishe* is described as an "important means" to contain war, prevent escalation, and maintain peace.[48] It has two basic uses: to prevent the enemy from taking an action and to force an enemy to take an action.[49] Based on these discussions, the

[44] Patrick M. Shanahan, "Remarks by Acting Secretary Shanahan at the 35th Space Symposium, Colorado Springs, Colorado," April 9, 2019, https://dod.defense.gov/News/Transcripts/Transcript-View/Article/1809882/remarks-by-acting-secretary-shanahan-at-the-35th-space-symposium-colorado-sprin/

[45] Chen Jie. "Discussions of the Use of Deterrence in Preparation for Military Struggle." *University of Electronic Science and Technology of China (Social Science Edition)* 2006 04, 75.

[46] Jiang Yibin. "The Use of Information Deterrence and Joint Operations in Battle." *Journal of Xi'an Politics Institute*, 2011, 24(5), 32.

[47] *Science of Military Strategy*, 2013, 134.

[48] China Academy of Military Science Military Strategy Studies Department, *Science of Military Strategy* (战略学), Beijing: Military Science Press December 2013), 92 and Peng Guangqian and Yao Youzhi, *The Science of Military Strategy*, (Beijing: Military Science Publishing House, 2005), 215.

[49] Liu Huijun, "The China- India Border Dispute: A Study from the Deterrence Perspective," *South Asia Studies,* 2011 (3), 4.

concept of *weishe* takes on a broader set of measures than the Western concept of deterrence by including both deterrence and compellence measures. In Western literature, deterrence is defined as "prevention or discouragement, by fear or doubt, from acting."[50] Forcing a side to take an action, on the other hand, is referred to as compellence.[51] In short, deterrence is to prevent an action while compellence is intended to force an action. Taken together, deterrence and compellence are more broadly defined as elements of coercion.[52] However, whether the term is translated as coercion, deterrence, or compellence can depend on context.

According to Chinese sources, coercion is conducted to achieve a political goal by raising the threshold of war so that the costs of entering into armed action against China will exceed the benefits.[53] Coercion, therefore, involves controlling the other side's strategic evaluation, most importantly its assessment of risks and rewards. Chinese writers also describe coercion as conforming to Chinese strategic thinking and the Sun Zi concept of subduing the enemy without fighting.[54]

Role of space in coercion

Recently, Chinese writers have paid increasing attention to the role of space coercion. The 2013 *Science of Military Strategy* notes that modern society and military activities are increasingly dependent upon space systems, which increases the coercive value of the means to disrupt them.[55] It also advocates "constantly strengthening space deterrence capabilities, grasping different deterrence mechanisms, innovating deterrence methods" and upholding various principles to restrict adversaries' space interests, to counter activities that threaten China's own space security, and to form a strategic deterrent.[56]

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[50] Gary F. Wheatley and Richard E. Hayes, *Information Warfare and Deterrence*, (Washington DC: NDU Press, December 1996), iv.

[51] Thomas C. Schelling, *Arms and Influence* (New Haven and London: Yale University Press, 1966), 70-72.

[52] Ibid., 71.

[53] *Science of Military Strategy* (2013), 133 and 135 and Wang Huan, Guo Yanying. "Conditions Strategic Selections for Our Country's Path of Peaceful Development," *International Forum*, March 12, 2010, 4.

[54] Gao Baoxi,. "The Value Selection of Military Deterrence," *Journal of Xi'an Politics Institute,* October, 2001, 88 and Liu Huijun, "The China- India Border Dispute: A Study from the Deterrence Perspective," *South Asia Studies,* 2011 (3). 3.

[55] *Science of Military Strategy* (2013), 181.

[56] Ibid., 85-187.

Coercion methods

Chinese writers discuss coercive activities and methods for use during times of peace and conflict. *Study of Space Operations* lists four types of coercive activities based on the intensity of the conflict, from peace to outright conflict.[57]

Revealing space forces[58]

During peacetime and the initial stages of a crisis, China may demonstrate opposition to an adversary's actions by revealing its own space forces and capabilities. This low intensity coercive activity can include counterspace tests.

Space military exercise[59]

If revealing space forces is not enough to deter an adversary or prevent a crisis from escalating, it may be necessary to conduct space military exercises. Exercises may demonstrate offensive, defensive, and supportive capabilities; current state of readiness; and operational resolve in order to demonstrate to an adversary the ability and resolve to win. These include ballistic missile defense exercises, counterspace exercises, and space war games.

Space force deployment[60]

As a crisis worsens, it may be necessary to deploy space capabilities. This includes deploying additional space assets or repositioning existing space assets.

Space shock and awe attack[61]

If the previous three non-violent coercive methods are insufficient to achieve China's goals, it could demonstrate its resolve by conducting a punitive strike that may be either kinetic or non-kinetic. The Chinese literature describes kinetic strikes as having more shock and awe value that can create psychological effects that can weaken an adversary's resolve. The 2013 *Science of Military Strategy* notes that China should cautiously consider the use of kinetic methods to warn an adversary to "prevent losing control of the situation and conflict escalation."[62]

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[57] *Study of Space Operations*, 127-129.

[58] Ibid., 27

[59] Ibid., 127

[60] Ibid.

[61] Ibid.

[62] *Science of Military Strategy* (2013), 186.

Can China be deterred from attacking US space assets?

Whether China can be deterred from attacking US space assets is unknown. My own personal opinion is that a number of factors suggest that the ability of the United States to deter Chinese action against US space assets is limited.

The Chinese Communist Party's stake in successfully defending core interests

Although China is not a democracy, the Chinese Communist Party is aware that its continued rule requires maintaining its legitimacy with the Chinese people. This is most apparent in its commitment to maintaining economic growth and improving the economic situation of its citizens. Another component of this is defending China's perceived interests, including through the threat of or use of force. It is likely that the Chinese Communist Party leadership views success in an armed conflict as critical to maintaining its legitimacy with the Chinese people. This may result in the Chinese Communist Party being more forceful and less limited in the types of actions it is willing to take against the United States.

Importance of achieving information superiority and the view of space as the US military's Achilles' heel

A second factor that may limit the ability of the United States to deter Chinese attacks against space assets is the PLA's characterization of modern war. The PLA plans to fight what it calls "informatized local wars"[63] wherein information superiority—the ability to use information and deny its use to an adversary—is the key determiner of battlefield success.[64] In this respect, a central component of China's strategy is to conduct asymmetric strikes against an opponent by targeting critical C4ISR nodes, the debilitation or destruction of which would have decisive effects.[65]

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[63] State Council of the People's Republic of China, *The Diversified Employment of China's Armed Forces,* April 2013, http://english.gov.cn/archive/white_paper/2014/08/23/content_281474982986506.htm

[64] Wu Changde, "Actively Adapt to the New System and Effectively Perform New Duties," (积极适应新体制 有效属性新职能), *China Military Science* (中国军事科学), no. 1 (2016). 37.

[65] *Science of Military Strategy* (2013), 127–29.

Chinese analysts conclude that space is a primary component of informatized local wars. Indeed, China's 2015 defense white paper states that space is a "commanding height in international strategic competition" and designates space as one of four critical warfighting domains, in addition to the maritime, cyber, and nuclear domains. Chinese analysts assess that the US military relies upon space for 70–90 percent of its intelligence[66] and 80 percent of its communications.[67] The reliance of the US military on space leads Chinese analysts to conclude that the loss of these capabilities could so debilitate the US military that it would be unable to achieve victory.[68] As a result, achieving space supremacy, including the use of counterspace capabilities against the US military, may play a central role in Chinese warfighting. The 2013 *Science of Military Strategy* for example, concludes that "achieving space superiority and cyber superiority are critical for achieving overall superiority and being victorious over an enemy."[69]

Emphasis on striking first

A third factor limiting the effects of US deterrence actions is China's strategy of active defense. Despite its name, active defense is strongly weighted towards offensive action. Within the context of the active defense strategy, Chinese policy states that military action is limited to the defense of China's core interests. But Chinese military analysts also write that offensive military actions, including preemptive strikes, are permissible when defending these core interests.[70]

The focus on seizing the initiative at the beginning of a conflict has led to an emphasis in Chinese writings on the concept of "gaining mastery by striking first" that takes into account preemption and surprise attack.[71] Indeed, numerous Chinese strategists emphasize achieving victory through surprise by striking at an unexpected time and place[72] and conducting the

[66] *Textbook for the Study of Space Operations* (空间作战学教程), 50.

[67] Chang Xianqi, *Military Astronautics* (军事航天学), (Beijing: National Defense Industry Press, 2002), 257–58.

[68] See, for example, Wang Liping and Zhang Ya, "Development of Space War Based on Space Operation Exercises," (从太空作战演习天战的最新发展), *Aerospace Electronic Warfare* (航天电子对抗), 27/3 (2011), 4–6, 13.

[69] *Science of Military Strategy* (2013), 96.

[70] See, for example, *The Science of Campaigns*, (战役学), Zhang Yuliang, ed., (Beijing: Military Science Press, 2006), 82.

[71] Peng Guangqian and Yao Youzhi, eds., *The Science of Strategy*, (Beijing: Military Science Press, 2001), 108-110.

[72] Ibid.

strongest first strikes possible.[73] These first strikes focus on an adversary's center of gravity[74] and are intended to have "a direct impact on the overall situation of the campaign or to produce an overall effect."[75]

The concept of "gaining mastery by striking first" is also apparent in Chinese military writings on space. The authors of the *Study of Space Operations* conclude that China will "do all it can at the strategic level to avoid firing the first shot,"[76] but recommend that China should "strive to attack first at the campaign and tactical levels in order to maintain the space battlefield initiative" and that the PLA should "conceal the concentration of its forces and make a decisive large-scale first strike."[77] Indeed, seizing the initiative in space is so important that the 2013 *Science of Military Strategy* states that wars may begin in space and cyberspace.[78]

Misguided assumptions

China's political and military leadership may also approve strikes against US space assets due to misguided assumptions or lack of deep analysis by their advisors.

- Chinese analysts do not discuss how space warfare can differ from other types of warfare. Although space debris is an acknowledged problem, the generation of space debris by kinetic attacks is infrequently acknowledged.
- Chinese analysts do not discuss China's own vulnerabilities that may lead it take actions without full knowledge of the consequences. For example, Chinese analysts do not discuss the PLA's growing vulnerabilities as it invests more in space.
- Chinese analysts do not discuss how tactical actions against individual satellites may trigger a broader space war.
- Chinese writings do not discuss the possible escalatory ramifications of attacking certain satellites, such as early warning satellites that the United States uses for nuclear warning.

[73] Dai Qingmin, *Integrated Network Electronic Warfare*, (网点一体战), (Beijing: Liberation Army Press, 2002), 57.

[74] He Dingqing, *A Course on the Science of Campaigns*, (Beijing: Military Science Press, 2001), 244.

[75] Wang Houqing and Zhang Xingye, eds., *The Science of Campaigns*, (Beijing: National Defense University Press, 2000), 90, 96.

[76] *Study of Space Operations*, 42.

[77] Ibid., 52.

[78] *Science of Military Strategy* (2016), 96.

- In the broader Chinese literature on coercion (as well as in discussions of space warfare), there appears to be an assumption that an adversary will back down after China escalates. There is no consideration that an adversary may become more invested in winning a conflict after China takes escalatory actions.

China views its use of force as more principled than the Western approach

A fifth factor influencing whether China can be deterred is China's view of itself as a more principled country than the United States and as a peaceful country that only fights wars of defense.[79] Although the case can be made that nations normally believe that they only fight just wars, the strong tendency of Chinese to believe that their country is more peace loving than other countries has led to a widespread belief in China in what Andrew Scobell calls the "Cult of the Defense."[80] This belief, coupled with a victimization narrative instilled in the Chinese psyche over foreign aggression and efforts by the Chinese Communist Party to convince the people that only it can return China to its rightful place in the global order may make it difficult for the Party to be able to ratchet down public demand to not back down from foreign conflicts.

[79] See, for example, State Council of the People's Republic of China, "China's Military Strategy," May 2015, http://english.gov.cn/archive/white_paper/2015/05/27/content_281475115610833.htm and State Council of the People's Republic of China, "China's Peaceful Development," September 2011, http://www.china.org.cn/government/whitepaper/node_7126562.htm

[80] Andrew Scobell, *China's Use of Military Force: Beyond the Great Wall and the Long March*, (New York: Cambridge University Press, 2003), 27.

Implications

Space plays a prominent role in China's efforts to establish a military capable of winning informatized wars through an asymmetric strategy directed at critical US military platforms. China's use of space-based C4ISR to enable long-range strikes, offensive space control measures to deny the acquisition of space-based C4ISR capabilities by an adversary, and cyber and kinetic attacks against other C4ISR nodes could delay the flow of US military forces to the region and hinder the ability of US military forces already in the region to conduct operations effectively. This strategy could be even more effective when coupled with the PLA's predisposition to gaining the initiative at the beginning of a conflict. These capabilities, when directed at less capable militaries, would have an even more salient effect on overall military operations.

China's space program leverages a dual-use strategy to meet national security objectives while fulfilling economic goals. As a result, even nominally civilian or commercial space activities can have military applications. This is due in part to the dual-use nature of most space technologies, but it is also due to an explicit strategy of civil-military integration. This approach is evident in solid-fueled rockets marketed for commercial space launch that can also generate operationally responsive space capabilities. Civilian remote sensing capabilities that can gather intelligence. Satellite navigation services offered to countries participating in the Belt and Road Initiative also serve PLA needs. The development of communication satellite constellations to deliver global communications and internet could also support the PLA presence globally. China's space program is thus one indicator of its growing economic influence and power projection capabilities.

While China's use of space to coerce other countries is growing, the ability of the United States to deter Chinese counterspace operations is less certain. This analysis has some important caveats, however, that should make us cautious about reaching definitive conclusions. PLA thinking on coercion and escalation may still be evolving, especially when applied to space warfare. Moreover, the attitudes of China's top political and military leaders towards risk are not well understood. Despite decades of study, the China-watching community still has an inadequate grasp of how China's political and military leaders make decisions.

Finally, space warfare can occur across a spectrum of capabilities, not all of which result in the destruction of US space assets. China could conduct localized jamming of satellite communications and the GPS signal or temporarily blind reconnaissance satellites as they orbit over Chinese territory. In short, China's counterspace actions could occur along an escalatory ladder that could require a range of responses from the US military.

Unfortunately, the lack of understanding of how China's political and military leadership reach decisions (and their level of risk tolerance) suggests that the United States should have a low level of certainty in its ability to deter China from attacking US space assets. This conclusion suggests that the United States needs to take steps to make its space-based C4ISR infrastructure less vulnerable. These steps include increasing redundancy by creating a more distributed satellite network, increasing resiliency by hardening satellites to attack, developing defensive and offensive space control capabilities, and lessening the US military's dependence on space-based systems.

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