

Spacety's 20th Space Mission: Parameters and Functions of the Six Satellites by One Rocket

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Abstract: On May 17, 2025, there were 6 commercial satellites developed by Spacety Co., Ltd successfully launched aboard the Zhuque-2-Y2 improved rocket. They are “Shenqi-02” satellite, “Dizhi-1” satellite, “NCHU-1” satellite, “SUSTech-1”, “BUPT-2” and “BUPT-3” satellites. The “Shenqi-02” satellite is a lightweight, low-cost, high-performance C-band SAR satellite with operational InSAR capabilities. It can achieve millimeter-level precision in surface deformation monitoring and provide commercial SAR imagery data services across multiple fields. The “Dizhi-1” satellite is a hyperspectral remote sensing mini-satellite, mainly applied for geological and environmental exploration; the “NCHU-1” satellite is a multispectral remote sensing microsatellite, mainly applied for monitoring of water bodies and terrestrial ecological environment; the “SUSTech-1” satellite carries multiple payloads for space science research, while the “BUPT-2” and “BUPT-3” satellites are equipped with laser communication payloads and other instruments, and are planned to carry out a series of verifications of cutting-edge achievements in aerospace information technology in orbit. The success of the “six satellites by one rocket” has set a new record for Spacety Co., Ltd, and also marks the completion of the 20th space mission. With the cumulative number of on-orbit satellites deployed reaching 37, Spacety Co., Ltd has established a complete satellite full-industry ecosystem, promoting the development of commercial aerospace. This milestone marks that Spacety Co., Ltd's small satellite technology has entered a new stage, laying an important foundation for subsequent industrialized applications.

Keywords: Spacety; six satellites by one rocket; commercial aerospace; SAR remote sensing satellite; optical remote sensing satellite; scientific research satellite; satellite parameters

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1 Introduction

The Spacety Co., Ltd (located in Changsha City) (hereinafter referred to as “Spacety”) was founded in 2015. As a China’s high-tech enterprise and a national-level “Little Giant”^[1] being specialized, refined, unique and innovative, Spacety focuses on the entire commercial satellite industry chain. Its business encompasses commercial satellite development, constellation operations, and data services. The Spacety puts commercial SAR (Synthetic Aperture Radar) remote sensing satellites^[2] as its priority business, and is committed to establishing a cost-effective SAR constellation and imagery data service system. It provides end-to-end solutions covering satellite design, system integration, launch coordination, in-orbit testing and operation control, and data services. After a decade of development, Spacety has become a frontrunner in China’s commercial satellite sector and one of the pioneers globally in lightweight, small commercial SAR remote sensing satellites^[1].

To date, the company has successfully completed 20 space missions^[3], and launched a cumulative total of 37 satellites (Table 1), including China’s first commercial networked SAR satellites—“Hisea-1”^[4], “Chaohu-1”^[5], “Fucheng-1”^[6] and “Shenqi-01” and “Shenqi-02”^[7], filling multiple gaps in China’s commercial SAR satellite domain. Moreover, “Fucheng-1” and “Shenqi-01” achieved China’s first commercial repeat-pass InSAR service capability in the space sector, enabling millimeter-level precision in surface deformation monitoring, which have been demonstrated and applied across different industries including construction, transportation, power, water resources, and geology^[1,8].

Table 1 Main parameters of Spacety’s 20 satellite launch missions

Launch sequence	Launch date/site	Rocket	Satellite	Developer	Main performance	Note
1st	November 10, 2016/Jiuquan Satellite Launch Center	Long March 11	Xiaoxiang-1	Spacety	6U CubeSat, 10 kg class, designed service lifetime of 1 year	Commercialized experimental satellite
2nd	February 15, 2017/Satish Dhawan Space Centre	PSLV-C37	Chen Jiayong-1	Spacety and others, together with SpacePharma, Israel	3U CubeSat, carrying a microgravity experiment payload, designed service lifetime of 1 year	Microgravity chemical experiment satellite
3rd	January 19, 2018/Jiuquan Satellite Launch Center	Long March 11	Xiangjiang New Area	Spacety	6U CubeSat, 10 kg class, carrying optical fiber sensing payload, etc., designed service lifetime of 3 years	Commercialized experimental satellite
			Yizhuang-Qu antutong-1	Spacety	6U CubeSat, 10 kg class, carrying integrated navigation and communication payload, etc., designed service lifetime of 3 years	Commercialized experimental satellite
4th	October 29, 2018/Jiuquan Satellite Launch Center	Long March 2B	Xiaoxiang-1-02	Spacety, Shenzhen LaseFleet Space Technology Co., Ltd.	6U CubeSat, 10 kg class, carrying laser communication payload, designed service lifetime of 3 years	Commercialized experimental satellite
			Tongchuan-1	Spacety, Tsinghua University, Tongchuan, Shaanxi Province	6U CubeSat, 10 kg class, carrying X-ray detector payload, designed service lifetime of 3 years	Commercialized experimental satellite
			Tianfu Guoxing-1	Spacety, Chengdu Adaspace Co., Ltd.	6U CubeSat, 10 kg class, carrying 5 m remote sensing camera payload, designed service lifetime of 3 years	Medium-resolution remote sensing satellite
			Changsha Hi-Tech	Spacety	6U CubeSat, 10 kg class, carrying 5 m amateur radio payload, designed service lifetime of 3 years	Commercialized experimental satellite

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Launch sequence	Launch date/site	Rocket	Satellite	Developer	Main performance	Note
5th	December 7, 2018/Jiuquan Satellite Launch Center	Long March 2D	Tianfu Xinhe	Spacety	6U CubeSat, 10 kg class, carrying 5 m remote sensing camera payload, designed service lifetime of 3 years	Medium-resolution remote sensing satellite
			TY/DF-1	Spacety	6U CubeSat, 10 kg class, carrying 5 m remote sensing camera payload, etc., designed service lifetime of 3 years	Medium-resolution remote sensing satellite
			Tianfu Guoxing-2	Spacety	6U CubeSat, 10 kg class, carrying 5 m remote sensing camera payload, designed service lifetime of 3 years	Medium-resolution remote sensing satellite
6th	January 21, 2019/Jiuquan Satellite Launch Center	Long March 11	Qingteng	Spacety	6U CubeSat, 10 kg class, carrying panchromatic micro remote sensing camera payload, etc., designed service lifetime of 3 years	Commercialized experimental satellite
7th	June 5, 2019/Sea Launch	Long March 11	Louxing	Spacety	6U CubeSat, 10 kg class, carrying 7.2-m resolution RGB remote sensing camera payload, etc., designed service lifetime of 3 years	Medium-resolution remote sensing satellite
8th	August 31, 2019/Jiuquan Satellite Launch Center	Kuaizhou 1A	Xiaoxiang-1-07	Spacety	6U CubeSat, 10 kg class, for the verification of new satellite platforms, designed service lifetime of 3 years	Commercialized experimental satellite
9th	November 3, 2019/Taiyuan Satellite Launch Center	Long March 4B	Dianfeng	Spacety	6U CubeSat, 10 kg class, carrying multispectrometer, etc., designed service lifetime of 3 years	Medium-resolution remote sensing satellite
10th	December 7, 2019/Taiyuan Satellite Launch Center	Kuaizhou 1A	Xiaoxiang-1-06	Spacety	6U CubeSat, 10 kg class, designed service lifetime of 3 years	Medium-resolution remote sensing satellite
			Xiaoxiang-1-23	Spacety	6U CubeSat, 10 kg class, designed service lifetime of 3 years	Medium-resolution remote sensing satellite
			Tianqi-4B	Spacety	6U CubeSat, 10 kg class, designed service lifetime of 3 years	IoT satellite
11th	November 6, 2020/Taiyuan Satellite Launch Center	Long March 6	BUAA Aviation-1	Spacety, Beihang University	12U CubeSat, 20 kg class, carrying space-based ADS-B payloads, etc., designed service lifetime of 3 years	Commercialized experimental satellite
12th	December 22, 2020/Wenchang Satellite Launch Center	Long March 8	Yuanguang	Spacety, Hebei Technology	12UCubeSat, 20 kg class, carries space tribology experiment payloads, etc., designed service lifetime of 3 years	Commercialized experimental satellite
			Hisea-1	Spacety	C-band commercial SAR remote sensing satellite, 185 kg, designed service lifetime of 3 years	Commercial SAR remote sensing satellite

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Launch sequence	Launch date/site	Rocket	Satellite	Developer	Main performance	Note
13th	December 7, 2021/Jiuquan Satellite Launch Center	CERES-1 -Y2	Lize-1	Spacety, Zhongguancun Ruichen Satellite Innovation Application Research Institute, etc.	12U CubeSat, 20 kg class, carrying space tribology experiment payloads, etc., designed service lifetime of 3 years	Commercialized experimental satellite
			Baoyun	Spacety	12U CubeSat, 20 kg class, carrying satellite intelligent service and computing platform payloads, etc., designed service lifetime of 3 years	Commercialized experimental satellite
14th	February 27, 2022/China Wenchang Space Launching Site	Long March 8	Chuangxing Leishen	Spacety	12U CubeSat, 20 kg class, carrying Aurora-2 detector, etc., designed service lifetime of 3 years	Commercialized experimental satellite
			Chaohu-1	Spacety, The 38th Research Institute of China Electronics Technology Group Corporation	C-band commercial SAR remote sensing satellite, 285 kg, highest resolution 1 m, designed service lifetime of 5 years	Commercial SAR remote sensing satellite
15th	December 14, 2022/Jiuquan Satellite Launch Center	ZQ-2-Y1	Wangqizhou	Spacety	12U CubeSat, 20 kg class, designed service lifetime of 3 years	Commercialized experimental satellite
16th	January 15, 2023/Taiyuan Satellite Launch Center	Long March 2D	BUPT-1	Spacety, Beijing University of Posts and Telecommunications	12U CubeSat, 20 kg class, carrying distributed intelligent computer platform, etc., designed service lifetime of 3–5 years	Commercialized experimental satellite
17th	June 7, 2023/Jiuquan Satellite Launch Center	PR-1	Xi'an Hangtuo-8	Spacety	50 kg class scientific research satellite structure, equipped with a panchromatic camera and a laser communication system, designed service lifetime of 5 years	Commercialized experimental satellite
			Fucheng-1	Spacety	C-band SAR satellite, 285 kg, designed lifetime of 5 years, achieves a highest resolution of 1 m, capable of operational InSAR imaging capability	Commercial SAR remote sensing satellite
18th	December 9, 2023/Jiuquan Satellite Launch Center	ZQ-2-Y3	Honghu	Spacety	A 50 kg class scientific satellite, featuring a xenon/krypton Hall-effect propulsion payload, with a designed lifetime of 3 to 5 years	Commercialized experimental satellite
			TY33	Spacety, Hunan University of Science and Technology	50 kg class scientific research satellite, carrying remote sensing camera module payloads, etc., designed service lifetime of 3–5 years	Commercialized experimental satellite
19th	September 24, 2024/Seas near Haiyang, Shandong	SD-3-Y4	Shenqi-01	Spacety, Zhangye Constellation Space Technology Co., Ltd.	C-band SAR satellite, 285 kg, designed service lifetime of 5 years, highest resolution of 1 m, capable of operational InSAR imaging	Commercial SAR remote sensing satellite

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Launch sequence	Launch date/site	Rocket	Satellite	Developer	Main performance	Note
20th	May 17, 2025/Dongfeng Commercial Aerospace Innovation Pilot Zone	ZQ-2E	Shenqi-02	Spacety, Zhangye Constellation Space Technology Co., Ltd.	C-band SAR satellite, 297.5 kg, designed service lifetime of 5 years, highest resolution of 1 m, capable of operational InSAR imaging	Commercial SAR remote sensing satellite
			Dizhi-1	Spacety, China University of Geosciences	89 kg, carrying hyperspectral camera payload, designed service lifetime of 5 years	Hyperspectral geological remote sensing intelligent satellite
			NCHU-1	Spacety, Nanchang Hangkong University	43.4 kg, carrying multispectral camera payload, designed service lifetime of 5 years	Multispectral ecological environment monitoring intelligent remote sensing satellite
			SUSTech-1	Spacety, Southern University of Science and Technology	22.4 kg, carrying space electric field measurement payloads, etc., designed service lifetime of 5 years	Micro satellite for space science research
			BUPT-2, BUPT-3	Spacety, Beijing University of Posts and Telecommunications	73.6 kg/69.8 kg, carrying laser communication payloads, etc., designed service lifetime of 5 years	Tiansuan Constellation second batch of satellites

Spacety is a full member of the International Astronautical Federation^[9] and has been recognized as a “National Sci-Tech Small and Medium Enterprise”. It undertakes major projects under China’s National Mass Entrepreneurship and Innovation Demonstration Base, and is designated as a Hunan Provincial New R&D Institution. The company operates multiple innovation platforms, including the “Joint Laboratory for Advanced Micro-Nano Satellite Development” and the “Hunan Engineering Research Center for Microsatellites”. Additionally, leveraging its efficient operational capabilities in SAR satellite remote sensing, Spacety established the Commercial (Spacety Satellite) Data Resource Subcenter under the National Earth Observation Data Center^[10]. Having captured over 100,000 SAR remote sensing images, the company consistently provides high-quality, time-sensitive data services to users across multiple fields and industries.

2 Metadata of the Dataset

The metadata of Parameter dataset of six satellites of the Spacety’s 20th space mission by a single rocket^[11] is summarized in Table 2. It includes the dataset full name, short name, authors, year of the dataset, data format, data size, data files, etc.

3 Main Parameters and Functions of Six Satellites Launched by One Rocket

3.1 Satellite Orbits and Main Parameters

At 12:12 UTC+8 on May 17, 2025, six commercial satellites developed by Spacety were successfully launched aboard the Zhuque-2-Y2 improved rocket^[13] from the Dongfeng Commercial Aerospace Innovation Test Zone (Figure 1).

The satellites launched this time include 1 commercial SAR remote sensing satellite—“TY42” (“Shenqi-02”), 2 optical remote sensing satellites—“TY29” (“Dizhi-1”) and

Table 2 Metadata summary of the Parameter dataset of six satellites of the Spacety’s 20th space mission by a single rocket

Items	Description
Dataset full name	Parameter dataset of six satellites of the Spacety’s 20th space mission by a single rocket
Dataset short name	SpacetyTwentiethSpaceMission
Authors	Zuo, Q. Y., Spacety Co., Ltd (Changsha), zuoqiya@spacety.cn Wen, Y., Spacety Co., Ltd (Changsha), wenyi@spacety.cn Li, Y., Spacety Co., Ltd (Changsha), liying@spacety.cn Du, J., Zhangye Constellation Space Technology Co., Ltd., dujian@kuafusar.com Wang, L. Z., China University of Geosciences, lizhe.wang@gmail.com Tu, X. M., Nanchang Hangkong University, tuxinman@126.com Wang, S. G., Beijing University of Posts and Telecommunications, sgwang@bupt.edu.cn Liu, K. J., Southern University of Science and Technology, liukj@sustech.edu.cn Ren, W. J., Spacety Co., Ltd (Changsha), renweijia@spacety.cn Yang, F., Spacety Co., Ltd (Changsha), yangfeng@spacety.cn Xiong, S. J., Spacety Co., Ltd (Changsha), xiongshujie@spacety.cn He, Y. X., Spacety Co., Ltd (Changsha), heyixiong@spacety.cn Zheng, W. P., Spacety Co., Ltd (Changsha), zhengwanping@spacety.cn Liu, W. F., Spacety Co., Ltd (Changsha), liuweifang@spacety.cn Li, G. S., Spacety Co., Ltd (Changsha), liguanshan@spacety.cn
Year	2025
Data format	.jpg, .xlsx
Data size	210 MB
Data files	(1) launch site images of the 6 satellites; (2) the first batch of images from “Shenqi-02”, “Dizhi-1”, and “NCHU-1”; (3) SAR constellation simulation images from Spacety; (4) the main parameters of 6 satellites
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	(1) <i>Data</i> are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use <i>Data</i> subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute <i>Data</i> subject to written permission from the GCdataPR Editorial Office and the issuance of a <i>Data</i> redistribution license; and (4) If <i>Data</i> are used to compile new datasets, the “ten percent principal” should be followed such that <i>Data</i> records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset ^[12]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC

“TY35” (“NCHU-1”), as well as 3 space science experiment satellites—“TY34” (“SUSTech-1”), “TY45” (“BUPT-2”), and “TY46” (“BUPT-3”). The orbital parameters and key specifications of the satellite launched in this mission are presented in Table 3.

After the 6 satellites accurately entered their orbits, telemetry parameters were normal, and the satellite solar panels and antennas were successfully deployed. The launch mission achieved complete success. As of May 29, 2025, the 6 satellites were confirmed to be in normal in-orbit status, and their payloads successively commenced testing as planned. Among them, the SAR payload and 2 sets of optical camera payloads have completed preliminary imaging tests and obtained the first batch of images.

3.2 The Shenqi-02 Satellite

As the focal point of this launch mission, the “Shenqi-02” Satellite is a miniaturized, low-cost, high-performance C-band SAR satellite^[14], and the second commercial SAR satellite jointly developed by Spacety and Zhangye Constellation Space Technology Co., Ltd^[15]. Equipped with a new-generation synthetic aperture radar payload, its key parameters are comparable to international advanced levels. The satellite supports all-weather Earth observation, capable of providing high-resolution remote sensing data support in fields such as land

Table 3 Satellite orbits and main parameters

Parameters	Dizhi-1	SUSTech-1	NCHU-1	Shenqi-02	BUPT-2	BUPT-3
Orbit type	Sun-synchronous orbit					
Orbit altitude	525 km					
Local time of descending node	10:30 AM					
Main payload	Hyperspectral camera	Space electric field Measurement payload, aurora camera, GRID payload, CXPD payload	Multispectral camera	SAR payload	Laser communication payload, space server, satellite computing computer, Kaufman Electric Propulsion	Laser communication payload, space server, satellite computing computer
Attitude control accuracy	Pointing accuracy: 0.5°(3σ); Stability: 0.05°/s(3σ)	Pointing accuracy: 0.1°(3σ); Stability: 0.01°/s(3σ)	Pointing accuracy: 0.05°(3σ); Stability: 0.005°/s(3σ)	Pointing accuracy: 0.01°(3σ); Stability: 0.001°/s(3σ)	Pointing accuracy: 0.1°(3σ); Stability: 0.01°/s(3σ)	Pointing accuracy: 0.1°(3σ); Stability: 0.01°/s(3σ)
Data transmission rate	600 Mbps	100 Mbps	600 Mbps	600 Mbps	100 Mbps	100 Mbps
Mass	89 kg	22.4 kg	43.4 kg	297.5 kg	73.6 kg	69.8 kg
Designed lifetime	5 Years	5 Years	5 Years	5 Years	5 Years	5 Years

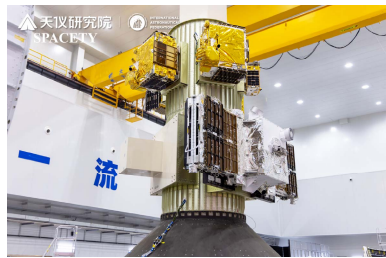


Figure 1 Photo of 6 satellites launched deployed on 1 rocket integration

such as safety monitoring of water conservancy, electricity, and transportation infrastructure, building safety monitoring, and geological disaster emergency management^[16–20]. the “Shenqi-02” Satellite will provide global users with normalized, high-quality, and self-controllable commercial InSAR image data services.

The “Shenqi-02” Satellite inherits the mature technology of Spacety’s in-orbit SAR satellites. Through continuous optimization and iteration of the satellite platform and payload, the overall performance and reliability of the satellite have been continuously improved. The satellite platform of the “Shenqi-02” Satellite incorporates 3 optimized designs: First, a new generation of electronics architecture from Spacety was introduced for the first time, effectively enhancing the reliability of the satellite service system and energy system, and significantly improving the business support capability of the satellite platform to support longer payload operation; Second, the precision orbit determination system was upgraded, doubling the satellite’s orbit determination accuracy and thus significantly improving the positioning accuracy of InSAR imagery; Third, the data transmission system and attitude/orbit control system were upgraded, significantly enhancing the satellite’s data downlink capability and attitude maneuverability. In addition, the SAR payload was also optimized in design to improve component phase stability and signal-to-noise ratio, further enhancing the satellite’s imaging quality.

The main specifications of the “Shenqi-02” Satellite are shown in Table 4. Meanwhile, the table also shows that “Shenqi-02” is technically advanced and competitive: its key parameters are not inferior to those of mainstream foreign commercial satellites, and some parameters are even better.

resource monitoring, disaster emergency response, urban infrastructure management, agricultural and forestry assessment, marine environment observation, and geoscience research.

Additionally, the “Shenqi-02” Satellite is the third satellite developed by Spacety with operational InSAR imaging capability, supporting millimeter-level deformation monitoring of the earth’s surface, possessing extremely wide application values in key livelihood-related fields

Table 4 Key parameters comparison between the “Shenqi-02” Satellite and other commercial satellites

Indicators	Shenqi-02	ICEYE/Finland ^[21,22]	Capella/the United States ^[23]
Frequency band	C-Band	X-Band	X-Band
Antenna type	Phase Array	Phase Array	Parabolic
Antenna size	4.56 m×0.8 m	3.25 m×0.4 m	Φ3.5 m
Maximum bandwidth (MHz)	300	300/600	700
Polarization	VV	VV	VV or HH
Incidence angle	15°–40°	15°–35°	15°–50°
Imaging mode	Spot/Sliding spot, Strip, Scan	Spot/Sliding spot, Strip, Scan	Spot/Sliding spot, Strip
Resolution Spot and swath width	Spot	1 m×1 m @ 5 km×5 km	(0.4 m–1.3 m)×0.5 m @ 5 km×5 km
	Strip	3 m @ 30 km	(0.7 m–2.3 m)×1 m @ 5 km×10 km
	Scan	20 m @ 170 km	(1.1 m–3.3 m) ×1.2 m @ 5 km×20 km
Equivalent noise figure/dB	Strip mode: better than –22 dB	Strip mode: better than –21.5 dB	Strip mode: better than –22 dB
Orbit control	≤150 m	≤300 m	/
Post-processing precise orbit determination accuracy	5 cm	/	/
Interferometry capability	Provides operational services	Be in the experimental phase	No reports available
Target rapid switching capability	Rapid electro-scan switching	Rapid electro-scan switching	Attitude adjustment switching
Data transmission rate	900 Mbps	500 Mbps	1.2 Gbps

After the launch of the “Shenqi-02” Satellite, all statuses were normal during its pass monitoring. The next day, it executed the first imaging command and successfully acquired the first batch of images, creating the fastest imaging record for Spacety’s SAR satellites after orbit insertion (Figure 2).

After the “Shenqi-02” Satellite entered orbit, it will first carry out orbit adjustment to enter the same repeat-pass interferometry pipeline as “Shenqi-01” and “Fucheng-1” (Figure 3). Thereafter, “Shenqi-02” will collaborate with “Shenqi-01” and “Fucheng-1” to carry out operational repeat-pass InSAR services, and its interferometric measurement cycle will be shortened to 1 day.



Figure 2 The first batch of images by Shenqi-02 (18-5-2025)

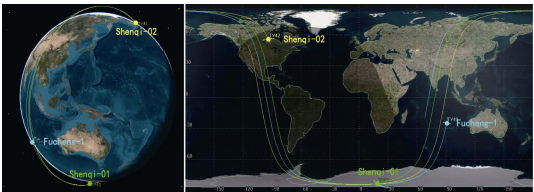


Figure 3 Satellite orbit and subsatellite point simulation diagram of Shenqi-02, Shenqi-01 and Fucheng-1

3.3 The Dizhi-1 Satellite

The “Dizhi-1” Satellite is a hyperspectral geological remote sensing microsatellite^[24] led by China University of Geosciences, mainly used for geological environment monitoring. The main parameters of “Dizhi-1” camera are shown in Table 5. The “Dizhi-1” Satellite has undergone concentrated and refined design of geological exploration spectral bands, covering 410 nm to 2,480 nm, including 16 visible light spectral bands and 10 short-wave infrared spectral bands, forming characteristic spectral bands for geological industry applications. The resolution and swath width of the visible spectrum of the “Dizhi-1” Satellite are 14 m @ 43 km, and the resolution and swath width of the short-wave infrared spectrum are 30 m @ 30 km.

In addition, the “Dizhi-1” Satellite has overcome several key technologies, including the design of a highly reliable integrated opto-mechanical system, highly reliable infrared focal plane filter spectroscopy technology, and camera TDI multi-spectral visible light detection technology. These technological breakthroughs have provided a solid foundation for the efficient application of satellite data in the field of geological environment remote sensing. The “Dizhi-1” Satellite is capable of providing high-precision remote sensing data and professional analysis services for the detection, monitoring, identification, interpretation, and analysis of geological and environmental features. Its application scope covers multiple fields, including mineral composition detection, rock type identification, alteration information extraction, soil quality assessment, and water pollution monitoring. Through these high-quality data and services, the “Dizhi-1” Satellite has the capability to provide high-precision remote sensing data and professional analysis services for the geological and environmental fields, and is applied to tasks such as detection, monitoring, identification, interpretation, and analysis, its application scope covers multiple fields such as mineral composition detection, rock type identification, alteration information extraction, soil quality assessment, and water pollution monitoring. Through these high-quality data and services, the “Dizhi-1” Satellite will assist scientists in more accurately interpreting the geological structure of the Earth, providing strong scientific basis and technical support for resource development, environmental protection, and disaster prevention.

After the first week of testing, the “Dizhi-1” Satellite has preliminary achieved imaging capability and obtained the first batch of images (Figure 4).

Table 5 Main parameters of the Dizhi-1’s camera

Satellite	Dizhi-1
Imaging mode	Push-broom
Spectral range	410 nm–2,480 nm
Quantity of spectral bands	Visible light band: 16 Short-wave infrared band: 10
Resolution	Visible light band: 14 m Short-wave infrared band: 30 m
Swath width	Visible light band: 43 km Short-wave infrared band: 30 km
Side swing angle	±20°
supporting imaging	

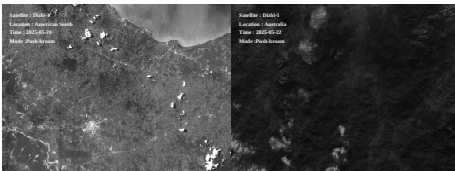


Figure 4 First batch of images by Dizhi-1 (20/22-5-2025)

3.4 The NCHU-1 Satellite

The “NCHU-1” Satellite is a multispectral intelligent remote sensing satellite for ecological environment monitoring, led by Nanchang Hangkong University in its development. The satellite platform has significant advantages in intelligence and autonomy. The carried multispectral camera adopts an advanced off-axis three-mirror optical system, which comprehensively improves imaging performance and quality through fine optimization of optical parameters such as focal length, field of view, F-number, clear aperture, spectral range, and band selection. The main parameters of the “NCHU-1” Satellite multispectral camera are shown in Table 6. The camera supports 1 panchromatic band (5 m resolution) and 8 multispectral bands (20 m resolution), with an imaging swath width of 100 km.

Additionally, the camera carries CMOS (Complementary Metal-Oxide-Semiconductor) detector features high quantum efficiency, low

Table 6 Main parameters of the NCHU-1’s camera

Satellite	NCHU-1
Imaging mode	Push-broom
Spectral range	Panchromatic band: 450–850 nm Multispectral band: 430–860 nm
Quantity of spectral bands	Panchromatic band: 1 Multispectral band: 8
Resolution	Panchromatic band: 5 m Multispectral band: 20 m
Swath width	100 km
Side swing angle	±20°
supporting imaging	

noise performance, and high-speed imaging capabilities, strongly supporting real-time monitoring and rapid response applications. The “NCHU-1” Satellite excels in the field of water environment remote sensing, capable of accurately detecting and analyzing water pollution, water quality, and algae information. Meanwhile, it is also suitable for terrestrial environment monitoring (such as soil and vegetation), providing comprehensive data support for achieving regional sustainable development goals.

Through the initial week of testing, the “NCHU-1” Satellite has preliminarily achieved imaging capability and obtained the first batch of images (Figure 5).

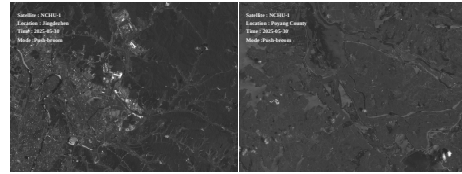


Figure 5 First batch of images of the “NCHU-1” Satellite (30-5-2025)

3.5 The BUPT-2 and BUPT-3 Satellites

The “BUPT-2” and “BUPT-3” satellites (the second batch of the TianSuan Constellation) were developed by Beijing University of Posts and Telecommunications, with the core mission of verifying cutting-edge achievements in aerospace information technology. Both satellites are equipped with laser communication payloads supporting a communication rate of 200 Gbps and a communication distance of 2,000 km, and respectively carry space servers, satellite-borne computers, and Kaufman electric propulsion systems. The important in-orbit verification projects of the 2 satellites include 6G intelligent semantic communication transmission, 6G satellite-borne core network architecture testing, satellite-borne container operation reliability and performance testing, satellite-ground high-speed data transmission link protocol performance testing, satellite-ground IP network real-time audio-video calling quality of service testing, on-board IoT time-series database management system testing, and power consumption and heat dissipation-aware satellite image inference. The collaborative application of these advanced technologies will promote the gradual realization of the vision of “both space-side and ground-side data calculated in space”, contributing innovative momentum and intelligent solutions for the country to explore the construction of aerospace information infrastructure.

3.6 The SUSTech-1 Satellite

The “SUSTech-1” Satellite was the Southern University of Science and Technology’s first space science micro-satellite, carrying the space electric field measurement payload and aurora camera payload independently developed by the university. The satellite also carries the GRID payload (Gamma Ray Integrated Detection payload), the CXPD payload (Cosmic X-ray Polarization Detection payload) from Guangxi University, as well as the satellite-ground IP link terminal and thermoelectric conversion verification unit^[25] independently developed by Spacety. Among them, the space electric field measurement payload, utilizing antenna booms, detects dynamic electric fields in space plasmas, establishing itself as a critical technique for monitoring Earth’s magnetosphere and ionosphere. This payload deployment marks the first global instance of deploying an electric field antenna exceeding 10 m (up to 12 m) on a micro-satellite platform, breaking the record for micro-satellite electric field antenna length. This breakthrough enables micro-satellites to perform high-precision electric field measurements, offering new solutions for the development of China’s deep space exploration technology.

The auroral camera payload enables real-time monitoring of large-scale auroral phenomena, with a focus on dynamically capturing auroral activities in high-latitude regions. As China’s first micro-satellite-based auroral optical observation mission, the “SUSTech-1” Satellite leverages precision orbit design to provide a 9-minute continuous observation window during each pass through the auroral zone. Its high-sensitivity aurora imager meticulously documents morphological evolution features of auroras, delivering critical

observational data for decoding solar wind-magnetosphere coupling mechanisms.

4 Special Features of Spacety’s 20th Space Mission

This launch marks Spacety’s first dedicated six-satellite mission and its 20th space expedition to date. With 37 satellites successfully deployed cumulatively, the achievement not only signifies Spacety’s transformational shift from “single-satellite technology demonstration” to “volume satellite production”, but also establishes the world’s first end-to-end C-band commercial SAR satellite ecosystem—spanning satellite design, constellation operations, and data services.

The successful completion of this space mission demonstrates the following 2 characteristics.

(1) Practice of Spacety’s full-range satellite products: It covers full-range satellite products, including optical remote sensing satellites, SAR remote sensing satellites, and scientific research satellites; it also covers full-range satellite platforms, with applications of 20 kg to 300 kg-class satellite platforms.

(2) In-orbit verification of multiple new technologies by Spacety: “Shenqi-02” will carry out key technology verification of in-orbit optical-SAR collaboration with “Dizhi-1” and “NCHU-1”, achieving efficient fusion processing and precise utilization of the 2 types of remote sensing data, improving the integrity, accuracy, and timeliness of earth observation data in complex environments, and providing more reliable space-air-ground information support for disaster emergency monitoring, environmental monitoring, resource dynamic assessment and other fields. At the same time, relying on “BUPT-2”, “BUPT-3”, and “SUSTech-1”, Spacety will focus on independently developing and validating key technologies such as real-time data interaction via IP links between satellites and ground stations, thermoelectric conversion, and attitude control for laser inter-satellite communication. This move will comprehensively enhance the technical capabilities of Spacety’s satellite platform in the fields of intelligent measurement and control, efficient energy utilization, and high-speed inter-satellite data transmission, laying a solid technical foundation for the networking and operation of the next-generation high-performance SAR satellites in the future.

5 Spacety’s SAR Constellation and Satellite Technology Road Map

Spacety aims to “provide full-link technical support for the large-scale networking and operation of commercial SAR remote sensing satellites, and build a highly reliable and high-performance SAR constellation service system”, comprehensively empowering space technology innovation and industrial application ecosystem construction. Spacety’s SAR constellation plans to have 120 satellites, adopting a multi-inclination hybrid constellation scheme (Table 7). After the constellation is completed, the timeliness of earth observation will be significantly improved: the maximum revisit period for global targets is better than 30 minutes, the average revisit period for targets between 60° north and south latitudes is better than 11 minutes, and the InSAR imaging coverage period of the whole China does not exceed 2 days.

Table 7 Main parameters of Spacety’s SAR constellation

No.	Inclination	Satellite quantity	Orbital planes quantity	Quantity of satellites per orbital plane	Orbit altitude
1	97.4°	48	6	8	500 km
2	55°	48	6	8	500 km
3	35°	24	6	4	500 km

Facing the future development trend of instant remote sensing SAR satellite constellations, Spacety has bench-marked international cutting-edge technologies, established a technical road map for lightweight small SAR satellites with high spatial-temporal resolution, and launched the development of low-cost, mass-produced, and high-performance SAR satellites

for constellation deployment (Figure 6). Focusing on technical directions such as commercial device-based, miniaturized, lightweight, and standardized satellite technologies, Spacety will prioritize breaking through more than 10 key technologies, including satellite reliability design based on industrial-grade components, miniaturized antenna array design, distributed energy system design, integrated platform-payload structural design, and high-precision lightweight antenna deployment mechanism design. It is committed to the research and development of core components such as integrated modular integrated electronic systems and lightweight modular digital phased array antennas. The technical level of Spacety’s next-generation SAR satellites will be significantly improved with a substantial cost reduction, making them suitable for mass and rapid constellation deployment to support the upgrading of China’s commercial space industry chain.

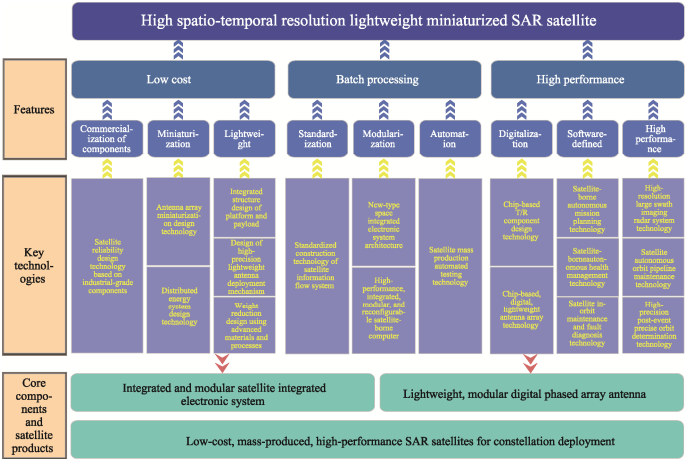


Figure 6 Technical roadmap for lightweight small SAR satellites with high spatiotemporal resolution

6 Conclusion

The successful 20th space mission of Spacety, launching six satellites by one rocket, is not only a milestone in its commercial space endeavor but also marks the leapfrog upgrade of China’s small satellite technology system from “single-mission execution” to “systematic capability building”. The differentiated payload configurations of the 6 satellites demonstrate Spacety’s parallel breakthrough capabilities in multiple technical paths such as SAR remote sensing, hyperspectral detection, and space environment monitoring—from operational InSAR deformation monitoring by C-band SAR satellites, to precise inversion of mineral compositions by hyperspectral satellites, and to in-orbit verification of space electric field measurement and laser communication technologies. This R&D model of “platform-based universal design + payload modular integration” provides a replicable engineering paradigm for low-cost and high-efficiency technological iteration in commercial space.

This successful launch mission of Spacety is of milestone significance for industrial development: it has achieved the first development upgrade from “single-satellite verification” to “mass production”, and established a C-band commercial SAR satellite industrial ecosystem covering the whole process of “satellite design-constellation operation and maintenance-data service”. The 20-kg to 300-kg full-spectrum satellite platform products launched this time not only demonstrate Spacety’s comprehensive R&D strength and product matrix layout in the field of small satellite technology, but also lay a solid foundation for the subsequent industrial application of satellites.

Author Contributions

Zuo, Q. Y., Wen, Y. and Li, Y. wrote the original draft; Du, J., Wang, L. Z., Tu, X. M.,

Wang, S. G., Liu, K. J., Ren, W. J., Yang, F., Xiong, S. J., He, Y. X., Zheng, W. P., Liu, W. F. and Li, G. S. reviewed and edited the paper.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Department of Industry and Information Technology of Hunan Province. Spacety: the satellite “made in Changsha” soars in space [EB/OL]. (2024-10-21) [2025-5-17]. https://gxt.hunan.gov.cn/gxt/ztzl/zzgdzt/zzgdkqy/202410/t20241021_33481125.html.
- [2] Baidu Baike. Radar satellite [OL]. <https://baike.baidu.com/item/雷达卫星/2273221?fromModule=search-result lemma#4-7>.
- [3] China News Service. Spacety completed its 20th space mission, having sent 37 satellites into space [EB/OL]. [2025-5-17]. <https://www.chinanews.com.cn/sh/2025/05-17/10417172.shtml>.
- [4] Baidu Baike. Hisea-1 [OL]. <https://baike.baidu.com/item/海丝一号?fromModule=lemma search-box>.
- [5] Baidu Baike. Chaohu-1 [OL]. <https://baike.baidu.com/item/巢湖一号卫星/60179999?fromModule=search-result lemma>.
- [6] Baidu Baike. Fucheng-1 [OL]. <https://baike.baidu.com/item/涪城一号?fromModule=lemma search-box>.
- [7] Baidu Baike. SAR Satellite Shenqi [OL]. <https://baike.baidu.com/item/“神启号”SAR卫星/65144824?fromModule=search-result lemma>.
- [8] China Remote Sensing Application Association. Commercial aerospace enterprises in China have achieved dual-satellite repeat-pass interferometric imaging [EB/OL]. [2025-5-17]. <http://www.carsa.org.cn/site/content/1187.html>.
- [9] Baidu Baike. International Astronautical Federation [OL]. <https://baike.baidu.com/item/国际宇航联合会?fromModule=lemma search-box>.
- [10] Baidu Baike. National Earth Observation Science Data Center [OL]. <https://baike.baidu.com/item/国家地球观测科学数据中心?fromModule=lemma search-box>.
- [11] Zuo, Q. Y., Wen, Y., Li, Y., et al. Parameter dataset of six satellites of the Spacety's 20th space mission by a single rocket [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2025. <https://doi.org/10.3974/geodb.2025.05.05.V1>.
- [12] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. <https://doi.org/10.3974/dp.policy.2014.05> (Updated 2017).
- [13] Baidu Baike. Zhuque-2 Improved version Y2 launch vehicle [OL]. <https://baike.baidu.com/item/朱雀二号改进型遥二运载火箭?fromModule=lemma search-box>.
- [14] Baidu Baike. Satellite Shenqi-02 [OL]. <https://baike.baidu.com/item/神启号02星?fromModule=lemma search-box>.
- [15] Baidu Baike. Zhangye Constellation Space Technology Co., Ltd. [OL]. <https://baike.baidu.com/item/张掖星座空间科技有限公司?fromModule=lemma search-box>.
- [16] Wang, M. M., Wang, L. Y., Cai, J., et al. Research progress of the application of InSAR technology in the deformation monitoring of water conservancy project [J]. *Jiangsu Water Resources*, 2021(z2): 66–71.
- [17] Zhang, Y. S. Research on key technologies of time-series InSAR and its application in deformation monitoring of power infrastructure [D]. Shaanxi: Xidian University, 2021.
- [18] Wang, X., Zheng, W. Q., Miao, X. L. Monitoring the subsidence of traffic infrastructure in Xi'an City using InSAR technology [C]. Proceedings of the 2020 Annual Conference of the Underground Pipeline Professional Committee of China City Planning Association, 2020: 134–138.
- [19] Zhu, M., Guo, T., Building safety risk monitoring method based on InSAR [J]. *Construction Science and Technology*, 2024(9): 76–79. DOI: 10.16116/j.cnki.jskj.2024.09.017.
- [20] Tao, C. X., Zhang, Y. S., Ren, S. S. Research progress of InSAR technology application on landslide identification and monitoring [J]. *Geology in China*, 2025, 52(2): 513–526. DOI: 10.1029/gc20240515001.
- [21] Iceye. ICEYE Product Documentation [OL]. <https://sar.iceye.com/latest/productspecification/imagingmodes/>.
- [22] 360doc Personal Library. Analysis of low-Earth orbit satellite TT&C technology (12): orbit control of ICEYE SAR satellite [OL]. http://www.360doc.com/content/22/1217/18/65679503_1060613488.shtml.
- [23] Capellaspace. What SAR imagery products are available with Capella? [OL]. <https://support.capellaspace.com/what-sar-imagery-products-are-available-with-capella>.
- [24] An, Z. H., Wang, L. Z. China's first hyperspectral remote sensing small satellite for the geological industry, “Dizhi-1”, was successfully launched [EB/OL]. [2025-05-22]. <https://www.iziran.net/news.html?aid=5394710>.
- [25] Baidu Baike. Thermoelectric conversion [OL]. <https://baike.baidu.com/item/热电转换?fromModule=lemma search-box>.