China's Space Capabilities:

CAST Institute of Remote Sensing Satellites

Summary

The Institute of Remote Sensing Satellites (IRSS) was formally established under the China Academy of Space Technology (CAST) in August 2020. It had previously been an office within the CAST General Design Department, but it is now a separate institute. Statements by CAST claim that IRSS and its predecessor had "launched more than 30 large- and medium-scale remote sensing satellites." CAST also identified some of the satellite systems produced by IRSS: the Ziyuan series earth-resources satellites, the Haiyang oceanographic satellite series, and the Gaofen high-resolution earth-observation satellites.

Probable Institute of Remote Sensing Satellites building north of Beijing

Source: Google Earth

IRSS is located on the CAST Headquarters compound north of Beijing (see image above). Open sources identify the current IRSS Director as Chen Hu (陈虎), the Deputy Director as Liu Jie (刘杰), and the Chief Designer as Fan Lijia (范立佳).

Recruiting data and research reporting indicate that IRSS is likely involved in end-to-end satellite development, from initial design through on-orbit system testing after launch. Analysis of IRSS research reporting over the past few years confirmed IRSS design and development of additional specific systems: the GFDM-1 and Gaofen-7 high-resolution earth-observation satellites and the Ziyuan-1 02 D earth-resources satellite.

IRSS research under way for future systems seems focused on increasing imaging resolution, in part through control of satellite micro-vibration that degraded image collection. Research also investigated improving data rates to deal with increasing resolution. Work on synthetic-aperture radar (SAR) imaging included new image-processing techniques that they claim could lead to super-high-resolution SAR systems.

China has deployed a Yaogan satellite series ("Yaogan weixing," meaning "remote sensing satellite") used for military reconnaissance missions since 2006. Despite the Institute's name, no evidence was found to indicate that IRSS was involved in the development of Yaogan systems.

Background: China Academy of Space Technology

China has an immense state-owned spacecraft (manned and satellite) research and production infrastructure consisting of scores of companies and factories distributed under the supervision of corporations and "academies." Many of these have evolved over time from government ministries into state-owned enterprises. Space production is dominated by two such giant enterprises: China Aerospace Science and Industry Corporation (CASIC) and China Aerospace Science and Technology Corporation (CASC). Responsibilities for space research, development, manufacturing, and launching are distributed across numerous academies under each of these entities.

CASC is mainly engaged in the research, design, manufacture, test, and launch of space products such as launch vehicles, satellites, manned spaceships, cargo spaceships, deep-space exploration craft, and a space station, as well as strategic and tactical missile systems. For the most part, CASC's spacecraft and satellite manufacturing entities are found in the CASC Fifth Academy, also known as the China Academy of Space Technology (中国空间技术研究院), or CAST.

China Keyhole has recently focused open-source research on identifying the current status and missions of CAST and some of its components. Previous reporting[1] identified 30 CAST organizations that appear to be involved in satellite development and manufacturing. Of these, 11 appeared to perform ancillary functions such as space component quality assurance, facilities management, or non-space commercial production. The other 19 appear to have missions in satellite or manned spacecraft research, design, development, or manufacturing.

This report is intended to identify the role of one of these entities, the CAST Institute of Remote Sensing Satellites (IRSS), in space systems development. This report is based on open-source materials available through search of the Chinese-language portion of the Internet. It uses general descriptions found in public Chinese media and taken from CAST itself. Perhaps the most valuable data source used to characterize the IRSS role is research reporting by IRSS itself, available in Chinese archives for academic journal articles.

CAST Identity

One basic description of IRSS found online was provided for a September 2021 job fair in Xi'an. This was written by IRSS itself, as indicated by the IRSS Human Resources Department email address and phone number that accompanied the description. A translation of this statement reads as follows:

[1] See China Keyhole - The CAST Catalog: China's State Organization for Satellite Manufacturing, October 26, 2021.

> "The CAST Institute of Remote Sensing Satellites was formally established in August 2020, and its previous identity was as the First Office of the CAST General Design Department. It is CAST's supervisory unit for development of remote sensing satellites and their systems. It is responsible for remote sensing satellite business development, market development, and customer maintenance. Its responsibilities include spacecraft development, overall design, systems integration, on-orbit technical support, and after-sales services. It has successfully launched more than 30 of CAST's large- and medium-scale remote sensing satellites, including the first transmitting remote sensing satellite (Ziyuan-1), the first ocean dynamics satellite (Haiyang-2), the first civilian stereo mapping satellite (Ziyuan-3), the first sub-meter [resolution] earth observation satellite (Gaofen-2), the first high-resolution, full-polarization radar imaging satellite (Gaofen-3), and the first high-orbit, high-resolution optical remote sensing satellite (Gaofen-4)."

As mentioned in the above text, IRSS was recently taken out of the CAST General Design Department and stood up as a separate institute. (Some job listings have said that, "to the outside" [the public], this General Design Department was also called the "Beijing Spacecraft General Design Department" (北京空间飞行器总体设计部)). One source claimed that IRSS, stood up to "make progress in optimizing space mission systems and strengthen the improvement in overall capabilities," was formed through the reorganization of CAST's General Design Department, Qian Xuesen Space Technology Lab, and Communications and Navigation Satellite Institute. One other reference also said that IRSS was formerly known as the "501 Institute." This was an earlier name for the CAST General Design Department itself, and it is unclear if this name is actually now applied to IRSS instead.

The full name for IRSS (遥感卫星总体部) could be translated as "Remote Sensing Satellite General Department." However, this entity's Human Resource Department has posted its email address as "irss_hr@163.com." The use of the "irss" abbreviation here indicates that "Institute of Remote Sensing Satellites" is their English translation for the name.

Organization

Few direct references were found to the IRSS leadership cadre or its internal organization. The fact that this entity has only existed independently for just over a year has probably limited its exposure in online media. The following details taken from fragmentary online information appear to be current:

IRSS leadership

Director	Chen Hu	(陈虎)
Deputy Director	Liu Jie	(刘杰)
Chief Designer	Fan Lijia	(范立佳)
Senior Engineer	Cao Haiyi	(曹海翊)
Senior Engineer	Wang Shitao	(王世涛)
Senior Engineer	Liu Xigang	(刘希刚)

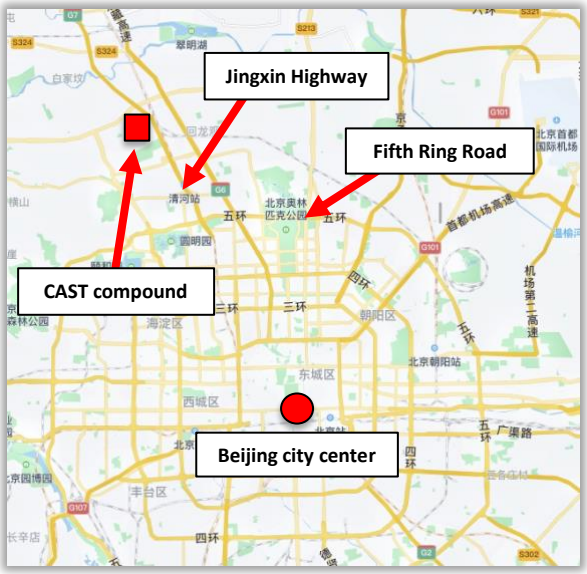
IRSS offices identified

Administrative Office
Human Resources Office
R&D Marketing Office
Electrical Engineering Research Office
Mechanical Engineering Office
Quantitative Remote Sensing General Research Office
Microwave Remote Sensing R&D Offic

IRSS Location

CAST and several of its components (including IRSS) use the street address "No. 104 Youyi Road, Haidian District, Beijing, postal code 100094." This address equates to a large compound on the north side of Beijing and on the west side of the Jingxin Highway (see map, right, and image, below). This compound appears to encompass CAST headquarters and many of its component organizations.

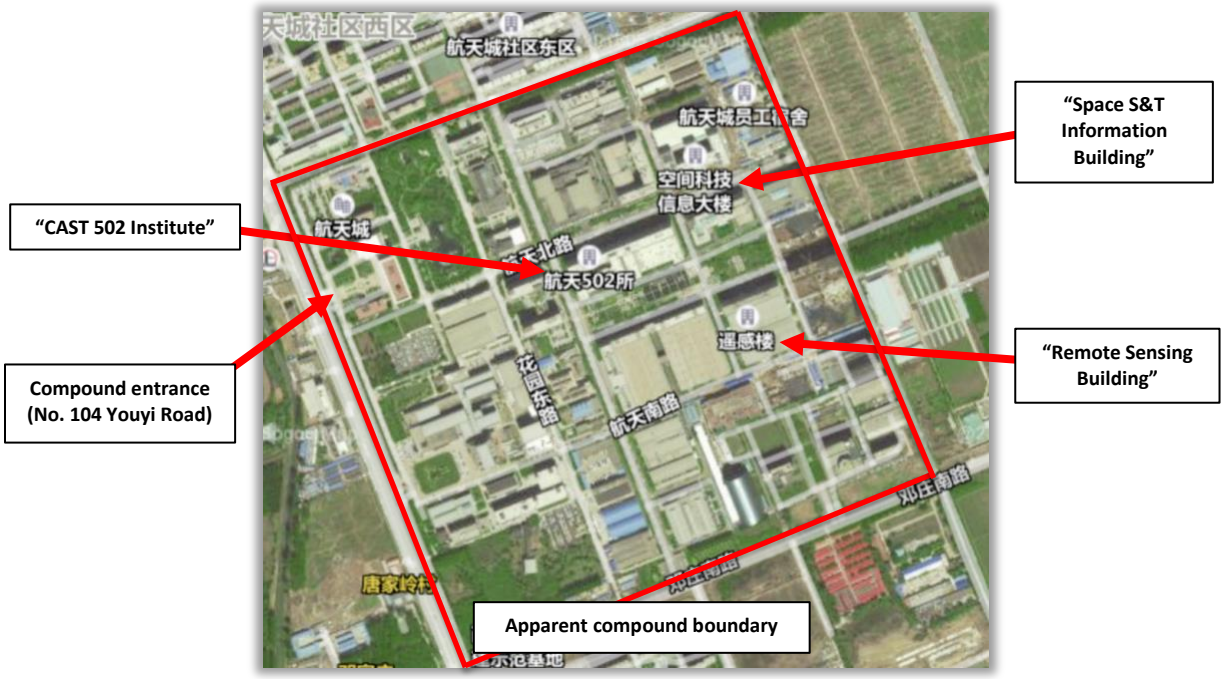
CAST location in Beijing



Source: qq.com

Only limited information was found about specific locations of CAST entities in this compound since they all seem to share the same street address. Chinese online map systems did name certain buildings, however. The image below is one example, in which some CAST element names appeared in the map. While not authoritative, such labels indicate what was public knowledge in China about the locations of these elements.

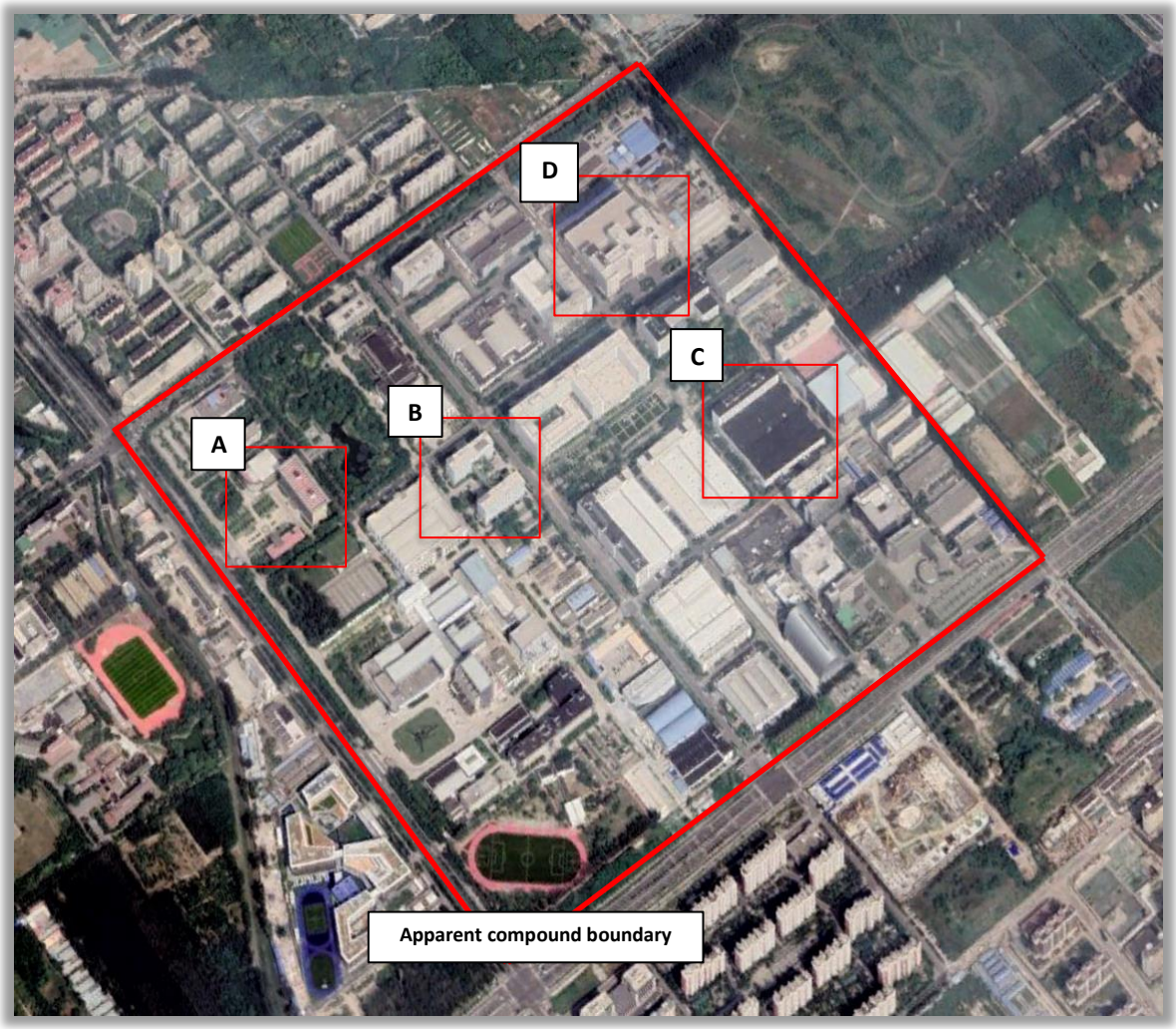
CAST elements identified in Chinese online maps



Source: map.sogou.com

Based on such data from several Chinese map systems, the Google Earth image below is annotated with the location of four CAST buildings, labeled "A" through "D," that may be related to IRSS. Descriptions and enlargements of each structure follow.

Location of some structures in the CAST compound



Source: Google Earth

Building A: One map system labeled this simply as "China Academy of Space Technology." Another called this the "Beijing Institute of Spacecraft Systems Engineering," reportedly the entity from which IRSS was derived. However, rather than housing this component, this building's appearance matches that of the probable CAST Headquarters building posted on the CAST website, shown below on the right. This is probably an administrative headquarters for CAST or for ceremonial events, or both. One map system identified the "Space City Auditorium" as being in this building.

Building A: CAST Headquarters

Source: Google Earth

Headquarters image on CAST website

Source: cast.cn

Building B: Chinese maps label this as "Space Fifth Academy [CAST] General Department" (see image on right). This entity is sometimes also called the "CAST General Design Department," another name for the element from which IRSS was created. The building has an administrative look to it, and no associations were found between IRSS and the Buildings No. 21, 22, or 23, as they are annotated in the Chinese map image at right.

Building B: CAST General Department

Source: Google Earth

Annotation in Chinese map image

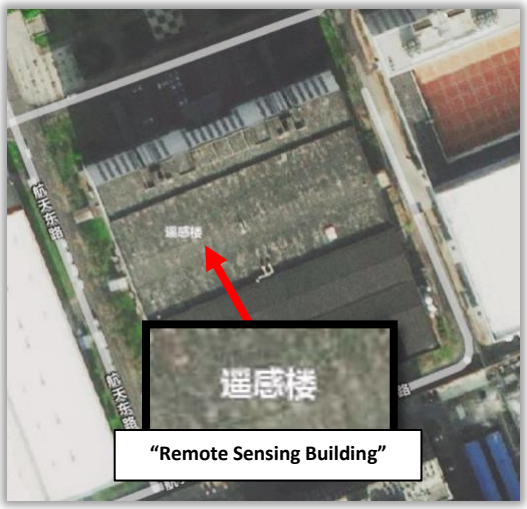
Source: map.sojourn.com

Building C: One structure, which appears to be primarily factory space, was noted in Chinese online maps as the "Remote Sensing Building." This is not a conclusive identification for IRSS, however, because other references were found online to the "Beijing Institute of Space Mechanics (508 Institute) China Space Remote Sensing Building." Therefore, this structure could be part of the 508 Institute rather than the IRSS base, although it theoretically could be involved in production of some IRSS systems.

Building C: Remote Sensing Building

Source: Google Earth

Annotation in Chinese map image



Source: map.qq.com

Building D: This facility was called the "Space S&T Information Building" in one Chinese map notation. However, this may be an old association. Its configuration closely matches that of an illustration that was included in a September 2020 job solicitation for positions in IRSS. Other than the CAST Headquarters building, it was the only building image included in the IRSS solicitation, suggesting that **this is the location for IRSS**. The approximate geographic coordinates for this structure are 400435N 1161625E. A review of commercial satellite imagery showed that groundbreaking began at this location in late 2013 and the building was at least externally complete by late 2016. The structure appears to be a combination of high-rise administrative office space and a lower building in the back, possibly for construction or testing of Institute products.

Building D: Probable IRSS building

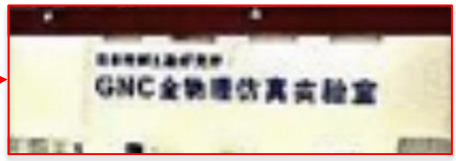
Source: Google Earth

Illustration in IRSS job advertisement

Source: sohu.com

The 2020 IRSS job solicitation included inside images that may be from inside the section at the back of this building. The equipment present was not identified in the posting. A sign on the wall at the back of this hall is too indistinct to translate. However, the "GNC" in Latin letters appears in some of the IRSS research and stands for "Guidance, Navigation, and Control." The last three Chinese characters in this sign appear to say "Laboratory."

Interior images of IRSS factory floor space



Source: sohu.com

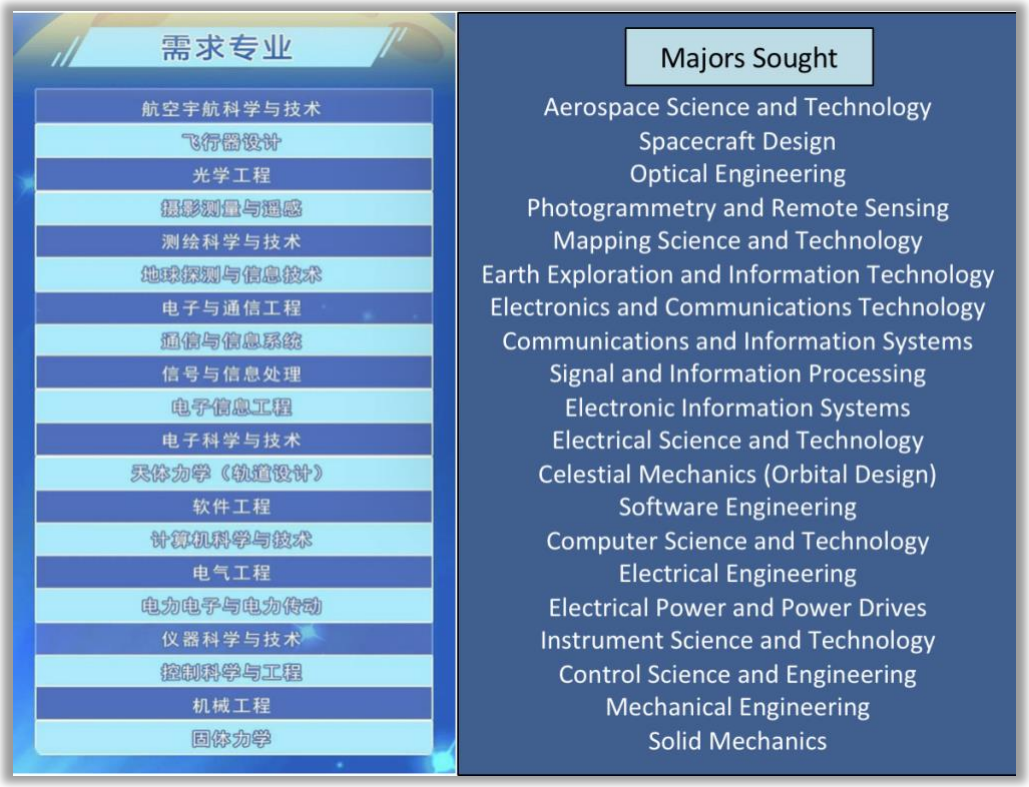
Identifying IRSS Work: Recruiting Data

Like many Chinese scientific research or academic enterprises, IRSS reveals something of the nature of its work when it seeks new personnel with specific skills. The building illustration shown in the section above is from an extensive IRSS job recruiting announcement posted online in September 2020, targeting university students who will be graduating in 2021. The advertisement outlined, in general terms, the accomplishments of the Institute, essentially a repeat of the description above in the CASDT Identity section. The advertisement highlighted the wages, work environment, accommodations, and paths for advancement available at this facility. It also detailed the academic backgrounds needed at IRSS. The image below from the advertisement named IRSS and announced the recruiting drive. The following image shows the academic majors they were looking for.

Image announcing IRSS recruiting drive, with translation

Source: sohu.com

Academic majors sought by IRSS in recruiting drive, with translation



Source: sohu.com

Identifying IRSS Work: Research Reporting

IRSS has not publicly reported on its satellite and spacecraft production in detail, but extensive reporting on its research work does appear in Chinese academic journals. A total of 63 articles published in 2020 and 2021 were found that were attributed to researchers working at IRSS and co-authors from other entities. From this body of work, there were 66 researchers identified as working at IRSS during this period. (The list of researcher names appears in the Appendix to this report.)

Chinese sources indicate that IRSS was formed in August 2020 as an separate institute, and that it had previously been the First Office of CAST General Department, also known as Beijing Institute of Spacecraft Systems Engineering (北京空间飞行器总体设计部). Chinese journal articles do not identify any works specifically by this First Office. In order to identify work by this research cadre for an earlier period, a series of articles was identified for 2015-2020 from the Beijing Institute of Spacecraft Systems Engineering as a whole that were written by researchers in the set of 66 authors later identified at being in IRSS. This series of reports was examined on the assumption that researchers

later identified with IRSS had all or mostly all been in the First Office from which IRSS was created.

This earlier series of 67 articles showed two things. First, there was a continuity of major themes from the 2015-2020 series into the 2020-2021 set of IRSS articles. The most prevalent topics included specific satellite systems, such as Gaofen-7 high-resolution satellites and Ziyuan-1 earth resources satellites, as well as broader reporting on LEO remote sensing satellites, synthetic aperture radar satellites, and remote sensing satellite and satellite imaging technologies in general. In these cases, the same topics were covered in research publications before and after the formation of IRSS as a separate entity.

Second, there was continuity of topic: the same researchers were often writing on their topic areas both before and after establishment of IRSS. This continuity between the two sets of articles suggests that the researchers identified before the separation of IRSS were in fact in the First Office. Therefore, the articles from both sets were considered for identification of what is IRSS work. The sections that follow identify the primary themes of this body of work, covering 2015-2021.

GFDM-1 Earth Observation Satellite

As described in IRSS reporting, GFDM-1 (for "high-resolution multi-mode" in Chinese) is China's first civilian optical remote sensing satellite with multiple agile imaging modes and sub-meter resolution. One IRSS description called it "the highest-resolution earth observation system of the national civil space infrastructure." GFDM-1 was launched in July 2020. It is mounted on the ZY2000 remote sensing satellite platform and is classified as a "medium agile remote sensing satellite."

There were 19 research reports found by IRSS authors about the GFDM-1 satellite, all published in 2020 and 2021. The IRSS research cadre working on GFDM-1 includes Fan Lijia, Jiang Yang, Wang Jinghua, Wang Yue, Yang Wentao, Yu Longjiang, and Zhang Guobin (see the Appendix for their Chinese-character names). All reporting found on GFDM-1 came after the founding of IRSS in 2020. These research reports were highly technical in the main and covered specific satellite subsystems or technologies associated with this satellite.

One IRSS article describing the system focused on the implementation of agile maneuver technology with construction for low rotating inertia, a highly agile control system, and experiments for key products such as high-rigidity solar wings and its large momentum control motion gyroscope. Another paper put forward the design architecture for the GFDM-1 satellite's autonomous health management system that included ideas for the control interface and event reporting. This design was apparently adopted; the report stated that "on-orbit operation results" showed that health status

could be monitored in real time, and fault diagnosis, isolation, and recovery strategies could be triggered by abnormal indicators.

One report described a system of integrated space-ground image positioning accuracy indicators that included "orbit determination, attitude measurement, time synchronization, structural stability, camera intrinsic parameters stability, and ground calibration." One report described the factors influencing image quality estimation as carried out for the agile imaging modes of GFDM-1 satellite. These were addressed in the design by the use of a synchronization monitoring atmosphere corrector, improved resolution of the sub-satellite points, the real-time setting of integral time, and setting integral time separately on different CCD chips. The research report claimed that, as tested and verified on orbit, the image quality in agile imaging mode met the expected requirements. Other papers gave the overall GFDM-1 design scheme and described a measurement and control sub-system, micro-vibration suppression, and autonomous task management.

Ziyuan-1 02 D Earth Resources Satellite

IRSS reporting on earth resources satellites focused almost exclusively on one satellite: the Ziyuan ("Resources") ZY-1 02 D, which was launched in September 2019. This satellite is the first Chinese civilian hyper-spectral earth resources satellite. Its assessed mission is to acquire high-resolution panchromatic and multispectral imagery for land resource surveys, disaster monitoring, forestry, and environmental monitoring. IRSS researchers published 16 reports on the ZY-1 02 D, again all in 2020 and 2021, subsequent to the launch of this satellite. The core set of authors for these reports included Han Bo, Lei Yong, Li Yifan, Liang Deyin, Wang Xiaohu, Zhang Hongyu, and Zhang Minglei.

Much of this reporting was simply descriptive, recapitulating satellite characteristics. These included details of the software system for the satellite, its technical scheme, power supply system, reliability design, and independent management systems. One report covered the geo-location requirements for the visual, near-infrared, and hyper-spectral cameras. Another report claimed that this satellite could simultaneously acquire hyper-spectral and multispectral images at 30-meter and 10-meter spatial resolution, respectively. It further described a spatial-spectral features separated network (SSFSN) method based on deep learning to achieve hyper-spectral and multispectral image fusion.

Gaofen-7 Mapping Satellite

Gaofen-7 ("gaofen" meaning "hi-res") is China's first civil-use, transmitting optical three-dimensional surveying and mapping satellite. It uses two line-scan cameras to create three-dimensional images of Earth. It was launched in November 2019 and was declared operational in August 2020. Cao Haiyi was named in Chinese media as the Chief

Designer for this project. Cao Haiyi appears as author of several articles on Gaofen-7 and on stereo mapping technologies. There were a total of 11 IRSS reports found on Gaofen-7. In addition of Cao Haiyi, the team of IRSS researchers writing most of the reports on Gaofen-7 included Dai Jun, Liu Fuqiang, Mo Fan, Zhang Xinwei, and Zhao Chenguang.

One report from 2020 proposed an autonomous orbit control method without the support of ground stations to counter problems with orbit control that included operation complexity, low efficiency, and task execution issues. Another described the use of a GPS receiver on the satellite for the on-board high-precision timing system, high-precision pointing of the high-speed data transmission antenna, and precise orbit determination, all to accomplish high-precision stereo mapping.

A 2020 report on the Gaofen-7's laser altimeter described ground and on-orbit tests that confirmed the laser altimeter's ranging accuracy was finer than 0.3m (1 foot), which was "consistent with pre-launch design and analysis." Other aspects of the Gaofen-7 project discussed included dimensional stability of the satellite structure in relation to temperature measurement data in orbit, task management, risk management, and product assurance.

Remote Sensing Technologies

As might be expected at the Institute of Remote Sensing Satellites, a focus on remote sensing technologies was evident in 17 reports found in this category, including 10 published before the formation of IRSS. These reports covered a spectrum of technical issues, including lunar calibration for optical payloads, the failure factors of lithium-ion batteries, and control moment gyroscopes for attitude control in maneuverable satellites.

Two technical issues were covered in several articles over this period. First, remote sensing satellites with higher resolutions had created a demand for large volumes of high-rate data transmission to ground. Solutions discussed in the research reporting included:

- Redesigned image collection systems to ease the burden of reception and processing of image data and auxiliary data,
- Ka-band dual circular-polarization frequency multiplexing,
- Variable coding modulation (VCM) to make full use of the system link margin, and
- Adaptive coding and modulation (ACM) to overcome issues derived from the time-varying characteristics of the atmosphere.

Second, as one 2016 report mentioned, control of the micro-vibration environment on optical remote sensing satellites had become a "hot topic" because of its influence on image quality. Two early reports analyzed the need for on-orbit micro-vibration isolation

and suppression. One additional report from 2021 discussed the use of a control moment gyroscope vibration isolation device to reduce the vibration transmitted to the gyroscope during launch and also decrease the influence of vibration generated by the gyroscope on orbit.

Synthetic Aperture Radar Technologies

During this period from 2015 to 2021, 11 IRSS reports addressed technologies associated with synthetic aperture radar (SAR) satellites. The authors who appeared most often in this reporting included Liu Jie, Zhang Qingjun, and Zhang Running.

This research showed that SAR was being applied in a number of different ways. One research report from 2016 focused on space-borne dual-antenna InSAR (Interferometric Synthetic Aperture Radar, which measures changes in land surface altitude), analyzing how the payload operation mechanism and the height of orbit affect altitude mapping precision. Two reports from 2019 addressed issues for Geosynchronous Orbit Synthetic Aperture Radar (GEOSAR), including the design of a GEOSAR quick-look imaging system, while another discussed a system for satellite pitch-roll attitude guidance that was suitable for GEOSAR satellites with large antennas and large moment of inertia. A 2021 paper proposed image processing using sub-band imaging and multi-sub-band splicing to achieve “ultra-high resolution” for space-borne SAR. Other technologies that appeared in IRSS research documentation included image formation for space-borne video SAR, high-resolution SAR echo simulation, and multi-satellite SAR single-pass 3D imaging,

Conclusions

The information outlined above gives, at best, a fragmentary portrait of IRSS missions. Still, there is enough available to provide some answers to a couple of key questions.

First, what does this data say about the IRSS role in satellite development? The recruiting data show the technical skills that are employed at this facility, including spacecraft design. This suggests that IRSS starts at the beginning with designing the satellites and their subsystems. The interior images found online seem to show direct engagement with the hardware rather than just theoretical design. The facility looks like it is set up for satellite construction and perhaps ground testing of some systems. The data also confirm some specific satellites that IRSS has had a hand in developing in the last few years: GFDM-1, Gaofen-7, and Ziyuan-1 02 D.

Research reporting for GFDM-1 described design and experiments for key products, as well as “on-orbit operation results” that validated or updated predicted performance. The research stated that design features to suppress vibration for image quality were also “tested and verified on orbit.” For Gaofen-7, Cao Haiyi was named as chief designer, confirming that IRSS involvement starts with systems design. Likewise, reporting on

Gaofen-7 described "ground and on-orbit tests" on its laser altimeter's accuracy, indicating a research and testing role after satellite launch. There were no specific references to manufacturing of satellites, but the interior images of the factory space suggests that IRSS is engaged end-to-end: in remote sensing satellite design, ground testing of systems, probably satellite assembly, and on-orbit testing of their products.

What does recent research say about the technologies that IRSS is exploring for future remote sensing systems? The remote sensing characteristics that appeared in their work were tied to increasing resolution in the future. They focused on the problem of onboard micro-vibration, how it affected image resolution, and what vibration suppression techniques could be used to attack this problem. They discussed how better resolution would drive higher data rates and how to accommodate those needs. In addition, most of the research reporting on SAR satellites was forward-looking rather than describing systems they have already built. These future technologies included Interferometer SAR for terrain definition, how to maneuver geostationary SAR platforms, and image-processing techniques that would lead to super-high-resolution SAR imaging.

The final question: what was missing from IRSS open-source information and research reporting? Many details are, of course, still absent, but the one glaring omission was any mention of Yaogan satellites: "Yaogan weixing" (遥感卫星). This is the Chinese term for "remote sensing satellites," including in the name of this institute. IRSS researchers sometimes use the term in their research and in reference to some of their systems, but nothing found from IRSS referred to the Yaogan satellite series per se. Chinese open media call these earth-observation satellites for land survey, disaster forecasting, crop evaluation, and urban planning. Western analysts identify them as operated by the People's Liberation Army for military intelligence collection since 2006. Even some Chinese online sources Indicate the Yaogan satellite series from Yaogan-27 to Yaogan 35, which were launched during this same period, 2015-2021, conducted missions including optical imaging, SAR imaging, and signals intelligence collection. Strangely, there was no information found to connect Yaogan remote sensing satellites to the Institute of Remote Sensing Satellites.

Is this significant? One explanation is that Yaogan satellites are designed and made at IRSS but are highly classified and so not mentioned in open sources. Alternatively, Yaogan satellites may in fact be produced elsewhere, and the coincidence in nomenclature is just that: coincidental. Experience with open-source research in China suggests that masking large production programs, even classified ones, is hard to do, and so the second alternative may be more likely. More research may confirm (or refute) the notion that Yaogan satellites are indeed made elsewhere.

Appendix: IRSS research authors identified in 2020-2021 reporting

(Number of articles by each author during this period in parentheses)

1. Yu Longjiang	于龙江	(8)
2. Yang Wentao	杨文涛	(7)
3. Fan Lijia	范立佳	(6)
4. Wang Yue	王跃	(5)
5. Zhang Guobin	张国斌	(5)
6. Zhang Hongyu	张宏宇	(5)
7. Jiang Yang	姜洋	(4)
8. Lei Yong	雷勇	(3)
9. Wang Jinghua	汪精华	(3)
10. Cao Haiyi	曹海翊	(2)
11. Chen Hu	陈虎	(2)
12. Dai Jun	戴君	(2)
13. Fan Daliang	范大亮	(2)
14. Gao Yang	高阳	(2)
15. Li Yifan	李一凡	(2)
16. Liang Deyin	梁德印	(2)
17. Liu Jie	刘杰	(2)
18. Wang Jian	王建	(2)
19. Yu Jing	余婧	(2)
20. Zhang Minglei	张明磊	(2)
21. Zhao Chenguang	赵晨光	(2)
22. Cai Yawen	蔡娅雯	(1 each for the remainder)
23. Feng Shuo	封硕	
24. Gao He	高何	
25. Gao Heli	高贺利	
26. Gao Xingsu	高行素	
27. Han Bo	韩波	
28. Hao Xiulai	郝修来	
29. Hao Zhihua	郝志华	
30. He Zhengwen	何正文	
31. Huang Yufei	黄宇飞	
32. Jiao Hongchen	焦洪臣	
33. Kuang Hui	匡辉	
34. Li Xiaofei	李小飞	
35. Li Yong	李勇	
36. Li Yuting	李雨廷	
37. Ling Qiong	凌琼	

38. Liu Fuqiang	刘付强
39. Liu Jiuli	刘久利
40. Liu Lei	刘磊
41. Lu Xiang	陆翔
42. Luo Rongzheng	罗荣蒸
43. Mo Fan	莫凡
44. Qiao Ming	乔明
45. Qin Suran	秦素然
46. Wang Teng	王腾
47. Wang Wenping	王文平
48. Wang Xiaohu	王啸虎
49. Wang Yaodong	王耀东
50. Wang Zhongguo	王中果
51. Wu Beibei	吴蓓蓓
52. Xiao Menghan	肖梦菡
53. Xu Chi	徐驰
54. Yang Guowei	杨国巍
55. Yang Li	杨黎
56. You Jia	尤佳
57. Yu Haifeng	于海锋
58. Zhao Pengfei	赵鹏飞
59. Zhang Running	张润宁
60. Zhang Qingjun	张庆君
61. Zhang Yue	张玥
61. Zhang Shasha	张莎莎
63. Zhang Tianqing	张田青
64. Zhang Xinwei	张新伟
65. Zhong Weikun	仲维昆
66. Zhu Huabin	朱华斌