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China's Capabilities in Disruptive Technologies and its Implications

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In the past few years, China has been making significant progress in modern technologies such as hypersonic weapons, targeted energy weapons, electromagnetic rail guns, counter-space weapons, quantum technology, block chain technology and unmanned and artificial intelligence equipped weapons. So much so that even advanced countries like the United States of America have started taking note of the advances that China is making in these technologies. These technologies which can bring about a drastic change in the world are termed as disruptive technologies. Moreover, China's technological advance has started a technological competition and a technology denial effort between the advanced countries and China. In this article, it is intended to look at some of the technological advances that China has achieved and their implications.

Background

China brought out a National Science and Technology Development Strategy in the year 2005 (Cao, 2006). It was a 15-year programme intended to develop China in science and technology. This strategy as an integrated programmme with funding to ensure its implementation. The main tenets of that strategy are:

A. Emphasis on indigenous innovation and the need to create an innovation oriented society. Towards achieving this, research will be conducted in 20 strategic areas. *Please refer Appendix A*

B. Broad areas of social needs cannot possibly be managed without increasingly sophisticated technology. For example, environmental degradation caused by economic development needs to be eradicated.

C. Develop indigenous capabilities for China's defence needs.

D. Improve the state of science and technology in China.

Key areas and topics for research under this strategy are given in Appendix B.

China seems to have followed this policy in right earnest. In order to understand where China stands today in the disruptive technologies, it is imperative to analyze as to where they stand in each of the technologies mentioned above.

> 'Made in China 2025' is aimed to boost China's manufacturing by pushing up levels of manufacturing to the 4th level

Artificial Intelligence:

Usage of artificial intelligence by China can be divided into two parts: (i) how China uses artificial intelligence for civil purposes and (ii) how does it use artificial intelligence for military purposes.

Civilian applications

China has adopted artificial intelligence in the civilian field in many ways. Three such applications are highlighted here. China implemented a social credit system (社会信用体系) (Kobie, 2019) to regulate corporate behaviour and incentivize good financial and civic behaviour among citizens. Points are allocated to each citizen based on his behavior. The behavior of a person can be assessed by looking at his adherence to the laws of the country and his political leanings that could be analyzed from his or her online behavior on the internet. Companies like Sense Time which specialises in facial and object recognition and iFlytek which specializes in voice recognition are working with the Chinese Government to empower the social credit system. Artificial intelligence is also used by the police in populating and analyzing the data from police cloud (Shih, 2019). The police cloud is a combination of artificial intelligence with cloud computing and big data analytics. The 3rd area in which China intends to use artificial intelligence is its 'Made in China 2025' Project (Sarah Dai, 2018). 'Made in China 2025' is aimed to boost China's manufacturing by pushing up the levels of manufacturing to the 4th level. This involves machine learning, robotics, automation and analysis of big data.

Artificial Intelligence in the military

China predicts that by 2025 use of lethal autonomous weapons in the battle fields will be a common phenomenon (Allen, 2019). Therefore, she has entered into carrying out research on a number of systems. A major area in which China has made considerable progress is in the autonomous armed vehicles by using unmanned aerial vehicles, unmanned underwater vessels and unmanned surface vessels. Though all these systems are in research stage, some trials have been carried out on all these systems. China is also employing artificial intelligence in command decision making (Allen, Understanding China's AI Strategy, 2019) and war gaming and simulation. She has also proved the concept of employing drones in swarms. On 7 December 2017, 1108 quad copters were flown simultaneously (Scott N. Romaniuk, 2018). On 31 May 2018, 56 unmanned boats were sailed to form the shape of China's first aircraft carrier Liaoning (Lung, 2018).

Image: A 56-boat drone swarm by Yunzhou-Tech makes the shape of China's aircraft carrier.

Source: The Defense Post

On 1 May 2019, during the Labour Day celebrations, China flew 1374 Ehang drones and created a world record. They are also trying out an armoured vehicle capable of launching 12 drones (Xuanzun, 2019).

Image: A multipurpose drone launching armored vehicle developed by Yanjing Auto is displayed at Beijing Civil-Military Integration Expo 2019

Source: Global Times

> As part of developing quantum communication, this satellite was used for an encrypted video call between Beijing and Vienna in September 2017

Quantum Technology

China took the world by surprise when she launched the world's first quantum satellite named Micius, named after an ancient Chinese philosopher and scientist, in August 2016 (Wall, 2016).

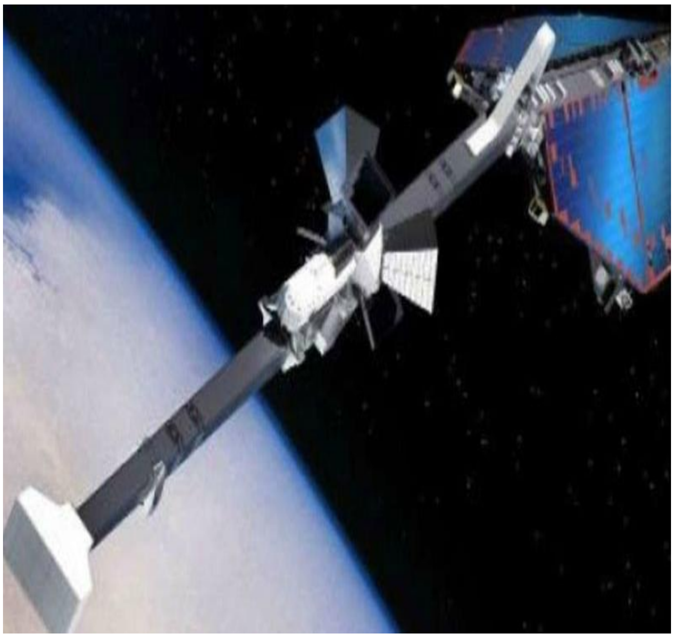


Image: Micius is the world's first quantum communication satellite

Source: Aerospace Technology

As part of developing quantum communication, this satellite was used for an encrypted video call between Beijing and Vienna in September 2017 (Johnston, 2017). China has also tried out quantum communication between Hefei and Wuhan (Zinan, 2018). She is carrying out research on the use of quantum technology for encryption. Under the domain of quantum computing, China is simultaneously working on quantum computers which are likely to come into use by 2030 (Valeri, 2019). There have been reports that China has been experimenting with quantum radar. If made operational, this radar will be capable of detecting stealth aircraft and missiles. It will also be capable of detecting and attracting satellites.

China is also using quantum technology in the fields of meteorology and simulation. Experimentation is also on in quantum resistance cryptography algorithm. There have been claims that China is trying out underwater communication, block chain protocol and associate quantum technology with machine learning.

Block Chain Technology

An alliance of Chinese government groups, banks, and technology companies will publicly launch the Blockchain-based Service Network (BSN) shortly. The BSN's proponents say it will reduce the costs of doing blockchain-based business by 80 percent. By the end of 2020, they hope to have nodes in 200 Chinese cities (Stockton, 2020). China has been quick to adopt block chain technology in both civilian and military fields. Block chain technology is being used in the civil sector primarily in financial, transportation and logistics fields.

It is also being used for generating subway electronic invoices and fight against fake invoices (Yakubowski, 2019). In March 2018, China carried out its first trade deal with Singapore using block chain technology (Zuckerman, 2018). In the military field, block chain technology is being used for secure communication, interpretation of data through various sensors and in the naval operations to enable decentralization of weapon systems on different platforms. Block chain, being a distributed ledger technology, is being tried out in military logistics in a big way.

Weather modification

China has attempted to modify the weather in Tibet. Under a project known as Tianhe, tens of thousands of fuel burning chambers are being placed in Tibet with a view to boost rainfall up to 10 bn cubic mtr annually (Dockrill, 2018).

Image: One of the fuel-burning chambers that have been deployed on the Tibetan plateau.

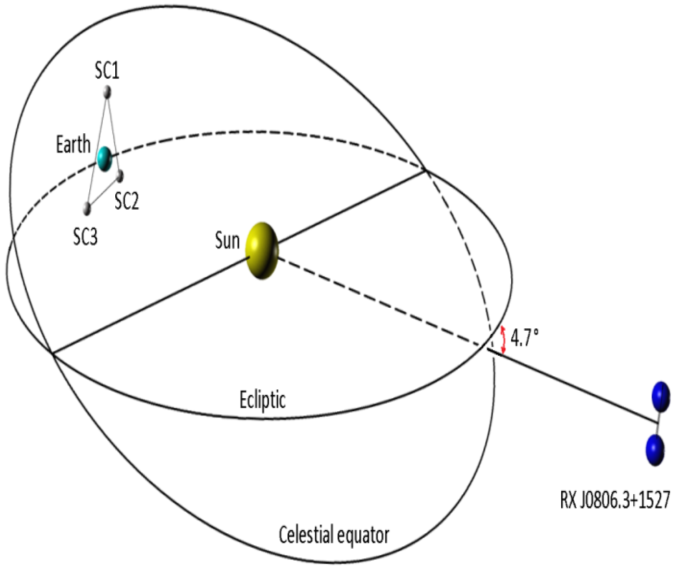
Source: South China Morning Post

This project covers an area of approximately 1.6 mn sq kms. The burning chambers will produce silver iodide particles. More than 500 burners have already been deployed in Tibet and Xinjiang. China and Russia have conducted a series of experiments to modify earth's atmosphere with high-frequency radio waves covering an area of 1,26,000 sq kms (Chen, 2018). This experiment was carried out on 7 June 2018 in the area of Vasilsursk, east of Moscow in Sura Ionospheric Heating Facility. During this experiment, scientists emitted high-frequency radio waves to manipulate the ionosphere. China's Seismo Electromagnetic Satellite (CSES) measured the effects on plasma disturbance from its orbit.

> China is planning space-based solar power station, a Mars exploration programme (2020) and a colony in moon for deep space exploration.

Space Technology

China is undertaking a project known as 'Tianqin'. This project is a space based gravitational wave detection system in the Milli Hertz Frequency Band. This project involves three satellites in equilateral triangles at 100,000 kms with a three-day orbital period.



Source: Wordpress.com

China launched a satellite named Taiji 1 for this purpose. This project is being undertaken by Zhuhai Campus of Sun Yatsen University at a cost of US $2.3 bn and this project is expected to be completed by 2035 (China National Space Administration, 2016). This project envisages sending a laser light into the instrument to measure changes in the length of the two arms between the satellites. A beam splitter splits the light and sends out two identical beams along the four km long arms. The light waves bounce and return. A gravitational wave affects the interferometer arms differently. When one extends, the other contracts as they are passed by the peaks and troughs of the gravitational base. Normally, the light returns unchanged to the beam splitter from both arms and the light waves cancel each other out. By studying the gravitational wave, study of the universe may be revolutionised.

China is also planning space-based solar power station, a Mars exploration programme (2020) and a colony in moon for deep space exploration. She is also showing a growing interest in nano satellites. China has tried out four Anti-satellite weapons starting from 2007. As a measure of her space capability, China carried out 38 launches in 2018 (China Power) and 34 launches in 2019. In one of the launches, she launched two satellites at an interval of six hours from the same satellite launch centre (Clark, 2019).

> The enhanced space-based capabilities will render the battlefield and vast areas of territory transparent in real time.

Implications

The long-term strategy of China to develop her science and technology capabilities seems to be paying off. More than the plan, the implementation seems to have been good. It is likely that China may get ahead of the advanced countries in some of the niche technologies that are being developed in the world.

Having seen all this, it will be useful to understand the implications of China's scientific advances in disruptive technologies. An increase in competition between developed countries and China is in the offing. It is also likely to create a technological divide between the countries that are aligned to the developed nations and the ones that are aligned towards China. This phenomenon is also likely to create a polarization of power in the world. As the competition takes place in space technology, the competition between countries is likely to extend beyond earth. The concept of using space for peaceful purposes only, is likely to undergo a change. The developments in artificial intelligence will enable increased intrusion into the privacy space. On the positive side, artificial intelligence may also facilitate the differently-abled persons and common good of the people.

In the military domain, early lead in the use of artificial intelligence will change the character of war. With advances in quantum technology, stealth and gaining intelligence will become more and more difficult. If the technology to modify weather matures, it will adversely affect the conduct of operations. The enhanced space-based capabilities will render the battlefield and vast areas of territory transparent in real time. If militarization of space is resorted to, that capability will augment kinetic war disproportionately.

Appendix A *(Refers to Para 2(a) of the paper)*

20 Strategic Areas

- Agricultural science and technology
- Basic science
- Conditions, platforms, and infrastructures for S&T development
- Culture for innovation and S&T popularization
- Ecology, environment protection, and recycled economy, S&T
- Energy, resources, and ocean S&T
- Human resources for S&T
- Input and management model S&T
- Law and policies for S&T development
- Modern manufacturing development S&T
- Modern services industry S&T
- National defense S&T
- Overall strategy for medium- to long-term S&T development
- Population and health S&T
- Public security S&T
- Regional innovation system
- S&T system reform and national innovation system
- Strategic high technology & industrialization of high and new technology
- Transportation S&T
- Urban development and urbanization S&T

Appendix B *(Refers to Para 3 of the Paper)*

Key Areas and Programmes

- Key areas
  – Agriculture
  – Energy
  – Environment
  – Information technology industry and modern services
  – Manufacturing
  – National defence
  – Population and health
  – Public securities

- Transportation
- Urbanization and urban development
- Water and mineral resources

• Frontier technology
- Advanced energy
- Advanced manufacturing
- Aerospace and aeronautics
- Biotechnology
- Information
- Laser
- New materials
- Ocean

• Engineering megaprojects
- Advanced numeric-controlled machinery and basic
- manufacturing technology
- Control and treatment of AIDS, hepatitis, and other
- major diseases
- Core electronic components, high-end generic chips,
- and basic software
- Drug innovation and development
- Extra-large scale integrated circuit manufacturing and
- technique
- Genetically modified new-organism variety breeding
- High-definition Earth observation systems
- Large advanced nuclear reactors
- Large aircraft
- Large-scale oil and gas exploration
- Manned aerospace and Moon exploration
- New-generation broadband wireless mobile
- telecommunications
- Water pollution control and treatment

• Science megaprojects

- Development and reproductive biology
- Nanotechnology
- Protein science
- Quantum research

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