

# Power Thought in Microwave Antenna

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**Abstract:** This paper discusses the theoretical and practical significance of introducing the idea of a strong nation into microwave antenna technology. The introduction of the idea of a strong country into microwave antenna technology aims to enhance the innovation capability and competitiveness of Chinese microwave antenna technology from the political, economic, scientific and technological, military and other levels, in order to achieve the strategic goals of national security and development. This paper discusses the following aspects: firstly, it elaborates the history of wireless communication development and explains the necessity of wireless microwave development; secondly, it elaborates the arduous history of Chinese microwave antenna technology development; thirdly, it puts forward the development trend of microwave antenna technology and the challenges and opportunities it faces.

**Keywords:** microwave antenna, wireless communication, educational trend, patriotism

## 1. Introduction

Communication is the foundation of a nation. As we all know, the level of development of communication equipment and technology is an important symbol of a country's level of scientific and technological innovation. The United States has always been a strong country in science and technology innovation, and its "free and open" way of thinking and the spirit of continuous pursuit of innovation are worth learning and learning from us. On the contrary, China is lagging behind in the international development of science and technology, and the reason is related to our lack of understanding of technological development. Technological innovation requires continuous learning from advanced countries after they have made outstanding achievements in a certain field, summarize their experiences, combine them with China's national conditions, and get back on the same starting line for a new round of innovation. This paper intends to further stimulate students' patriotic feelings by introducing the idea of a strong country.

## 2. History of Wireless Communication Development

In the 1950s, people first tried radiation on a metal plate and successfully achieved electromagnetic radiation, which laid the foundation for the development of antennas; in the 1960s, people increased the gain of the antenna by increasing the excitation current to achieve a certain broadband microwave transmission; in the 1970s, people used waveguides as a feed source for the design of radiation sources and transmission lines, and formed a microwave In the early 1980s, people developed a variety of low-loss, broadband and wideband radiation sources and conducted system experiments to achieve broadband microwave transmission; in the early 1990s, people developed high-gain, high-efficiency, multi-polarization and multi-functional microwave radiation sources; after the mid-1990s, people proposed the space wave front control theory (SCS) to achieve Space wavefront control technology and microwave radiation source technology combined; late 1990s to the early 21st century, people developed a variety of high-performance antennas and experimental research.[1]

With the rapid development of wireless communication technology, wireless communication system is also developing towards miniaturization and multi-band direction, high gain, high efficiency, multi-polarization and multi-functional antennas have become the trend of today's wireless communication system development. Since the 1980s, the development of microwave antenna has a certain history, microwave antenna occupies a very important position in the modern wireless communication system.

Microwave antenna technology was developed in the early 20th century, the development of radar, microwave relay communications, radio and television services, the rise of satellite communications so that microwave technology has been rapidly developed and continuously improved. Microwave

antenna is one of the most important components of microwave system, which is responsible for converting microwave energy from transmission line or waveguide into electromagnetic wave radiation to space, or receiving electromagnetic wave from space and converting it into microwave energy to send into transmission line or waveguide. Therefore, the level of microwave antenna technology directly affects the performance and efficiency of the entire microwave system. Compared with the traditional antenna, microwave antenna has many advantages, such as small size, light weight, low cost, etc.. Especially in modern wireless communication system, it can make full use of RF resources and achieve high spectral efficiency and high speed data transmission. Therefore, microwave antennas play an irreplaceable role in modern wireless communication systems.[2]

In order to meet the demand of modern wireless communication system, microwave antenna development shows the following trends.

### **2.1. Widebanding**

As the application of broadband antenna is increasingly widespread, therefore, the bandwidth of the antenna puts forward higher requirements to meet the needs of various applications.[3] The bandwidth of the antenna refers to the effective frequency range of the antenna, which depends on the spectrum width of the antenna radiation field distribution. Because the antenna radiation field amplitude and phase change with frequency, thus the antenna design into broadband form, it can reduce the standing wave, reduce reflection and in-band resonance.

### **2.2. Miniaturization**

Antenna miniaturization is an important development direction of the current antenna research. The size of the traditional antenna is very big, and the radome accounts for more than 80% of the whole antenna volume. Because the traditional antenna uses metal as the radiating body, need to use low loss feed network, so the size and weight of the antenna is larger, in addition, because the feed network and transmission line is propagated in the medium, it is easy to be affected by the external environment, so with the application of microwave energy to expand the scope, the transmission distance continues to extend, its size and weight will further increase. Some research shows that the flexible radiation body represented by microstrip antenna can greatly improve the power transmission efficiency without changing the size and weight of the original antenna.

### **2.3. Multi-frequency/multi-functional**

In the wireless communication system, the transmission of broadband signals and multi-frequency signal processing has become an urgent problem, high gain, miniaturization, simple structure, low cost broadband antenna will be the future direction of antenna development. There are two main applications of microwave frequency band, one is to transmit digital signal; the other is to transmit analog signal. In the future mobile communication system, will be mainly digital communication technology, supplemented by digital-analog hybrid system.

### **2.4. Lightweight**

Because microwave antenna has the characteristics of small size and light weight, so it is widely used in the communication system. But with the development of wireless communication technology, transmission capacity and bandwidth demand is increasing, which puts forward higher requirements for microwave antennas. In order to achieve high gain and multi-frequency signal processing, it is necessary to design miniaturized and lightweight antennas.

### **2.5. Multi-band antennas**

Now it has entered the 4G mobile communication era, 5G mobile communication system has also started research and development, but because the 5G wireless communication system is in a higher frequency band, the antenna system has put forward higher requirements. So the future wireless communication system antenna will develop in the direction of multi-band, in order to realize the millimeter wave band, microwave band and terahertz band multi-frequency signal processing and transmission.

## **2.6. Frequency diversity antenna**

Frequency diversity antenna is a multi-band microwave signal receiving and transmitting circuit, which is used in the receiving and transmitting end of the switch devices such as phase shifter to achieve frequency division multiplexing function; at the same time its transmitting end can also use filters, isolators, etc. to achieve frequency diversity. This technology is mainly used in satellite communication, which can greatly improve the transmission rate of satellite communication.

## **3. History of Antenna Development and the Old Generation of Experts Struggle**

At the beginning of the 20th century, it was discovered that electromagnetic waves could also generate electromagnetic beams or electric or magnetic fields in space, and in 1903, Einstein published his paper "The Frequency of Light" and proposed the "principle of invariance of the speed of light", which laid the foundation for the establishment of "quantum theory". This principle laid the foundation for the establishment of "quantum theory". After the emergence of quantum mechanics, people began to apply quantum mechanics to the study of electromagnetic waves. By the middle of the 20th century, due to the application of quantum mechanics, antenna systems in the high-frequency band have been rapidly developed and widely used. These include radar antenna systems, satellite antennas, naval antennas and airborne radars. In the field of communication, there is also such a group of people, they have contributed their precious youth for China's communication career, and some even gave their precious lives. They are the famous space information technology experts and educators in China - Ye Shuhua and He Zhaohao, academicians of Chinese Academy of Sciences. As the first generation of space information technology experts and one of the leaders of the second generation of space information technology disciplines in China, Academician Ye Shuhua has always been mindful of the motherland and national defense in her 70 years of scientific research career, and has made outstanding contributions to national modernization and national defense construction with her solid scientific background.

During her 70 years of scientific research career, she has always been at the forefront of wireless communication research and has completed many major national science and technology projects, making outstanding contributions to the field of wireless communication in China. Under her leadership, China completed the development of the first generation of digital cellular mobile communication system (802.11b for short) and extended it to the whole country. She also completed a number of major national scientific research projects, such as 863 program and 973 program, and developed a number of major scientific research achievements with independent intellectual property rights on this basis.

As a leading figure in the field of wireless communication in China, Shuhua Ye has made great contributions to the development of wireless communication technology in China. In Shuhua Ye's view, a country must master the core technology if it wants to be invincible in the fierce international competition. Because of this, she is full of confidence in the research she is engaged in. In Shuhua Ye's view, the idea of a strong country in science and technology must be reflected in the areas where the country needs its own research the most. For this reason, Ye Shuhua is actively involved in scientific research: on the one hand, she actively studies and draws on advanced foreign theories and technologies; on the other hand, she constantly innovates and develops new theories and technologies in practice. Shuhua Ye has brought this thinking to the field of research she is engaged in, and has achieved remarkable results.

Nowadays, wireless communication has entered the digital stage, which realizes many functions that cannot be achieved by traditional wired communication methods with the advantages of higher efficiency, lower cost and more intelligence.

## **4. Future Development of Microwave Antenna Technology**

In recent years, microwave antenna technology has been developed rapidly, but this also brings some new challenges for the future development of microwave antenna technology in China. Because microwave antenna technology is an emerging discipline in the development process, so we still have many problems. For example, when designing microwave antennas for some applications in satellite communication, radar, wireless communication, mobile communication and other fields, we have not found a very good way to realize these applications. In addition, with the development of new materials

and new processes, the microwave antenna design has also put forward higher requirements.

In the new era, we are faced with the historical mission of building a modern socialist power and promoting the great rejuvenation of the Chinese nation in a comprehensive manner. Integrating development and security is a major strategic thought proposed by General Secretary based on the new international and domestic situation and new situation in the new development stage, which has great practical significance and far-reaching historical significance. Under the guidance of this strategic thought, how should we grasp and promote the innovation and development of microwave antenna technology? We should adhere to the following aspects.

First, adhere to the people as the center, to meet the people's growing needs of a better life. As a means of information transmission and processing, microwave antenna technology should serve the various needs of the people, such as communication, navigation, remote sensing, control, etc. We should continuously improve the coverage, reliability, security and intelligence of microwave antenna technology in these areas, so that people can enjoy more convenient and efficient information services.

Second, adhere to the innovation as the leader, to enhance the independent innovation capacity and core competitiveness. As a basic and cutting-edge science and technology, microwave antenna technology needs to constantly break through theoretical and practical problems and challenges. We should strengthen the combination of basic and applied research, train high-level innovative talents, build national key laboratories and engineering centers and other innovation platforms, promote the construction of collaborative innovation mechanism between industry, academia, research and application, and achieve original results in key core areas.

Third, adhere to the openness as the driving force to strengthen international exchanges and cooperation. As a science and technology with broad market prospect and social influence, microwave antenna technology needs to learn from and absorb international advanced experience and ideas, and actively participate in the development of international rules and standards. We should expand the channels and ways of foreign exchange, and carry out multi-level, multi-forms and multi-disciplinary cooperation projects under the premise of respecting intellectual property rights and protecting our own interests.

Finally, we hope that the majority of scientific researchers can keep in mind the idea of a strong country put forward by Academician Ye Shuhua. Only by continuously improving the innovation ability and scientific research level in our work can we make greater contribution to the development of our national defense.

## 5. Conclusion

Today, China has become a world power in communications and occupies a place in the international communications field. In stark contrast, the blockade and suppression of our technology by western countries has never stopped. May the future research workers will not forget their original hearts and minds for the motherland, and always insist on using their knowledge and wisdom in their research career to provide more high-quality products and technical support for the country.

## Acknowledgment

Graduate Education and Teaching Reform Research Project of Xidian University, No.: JGYB2206.

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