Application of DSP Technology in Radar Signal Processing

Authors name: Zhu Aichun¹, Sun Wenhui², Wang Kejin³
Author unit: QingDao Institute Of Technology¹,²,³
postal code: 266300¹,²,³

Abstract: Aiming at the problems existing in applying DSP technology to radar signal processing, the article analyzes the current use of DSP technology from a practical view, and proposes methods and strategies for optimal control of future technologies. The results show that only under the premise of the operational control requirements of the radar signal processing system can the application advantages and reliable effects be brought into full play, thereby promoting the healthy and stable development of the industries involved.

1. Introduction:
The DSP technology in radar signal processing has been used more and more in the field of development and construction. It can achieve a series of processing in signal acquisition, conversion, budget, and filtering to improve signal transmission and reception reliability. The reason is that the technology can use special computers to prevent accuracy from being affected by unstable factors. However, the relevant builders did not fully realize the value of the DSP technology application control system. To this end, researchers should analyze the actual application of DSP technology in radar signal processing systems to find the focus and direction of optimal control. In this way, the operation control of the radar signal processing system can meet the needs of the modernization and development of the communication field in which it is located, thereby enabling the radar signal to achieve the goal of upgrading to software programming. Therefore, the people in the industry should analyze the importance of DSP signal processing to radar signal. On the basis of this, the difficulties and key points of technology application can be found out to provide strong support for parameterization and function module design of the hardware platform.

2. The practical significance of research on DSP technology in radar signal processing
At the current stage, the radar signal processing system mainly implements real-time detection targets in complex noise environments through analog-to-digital conversion and filtering of clutter in processing the radar echo signal obtained by the radar receiver. The system can use the extraction method to obtain the target information in the data, which refers to azimuth, distance, etc. When it is displayed on the device, the radar information processing is completed⁴. As shown in figure 1, it is a schematic flowchart of a radar signal processing system.
However, with the diversified development of the market, the workload of radar signal processing has increased with difficulties. The signal processing cannot meet the high real-time and strong stability. To this end, relevant builders should use DSP technology to provide conditions for the processing of large amounts of data in radar systems. Specifically, it is to improve the radar signal processing capability, reduce the volume and energy consumption, and strengthen the stability to make the radar signal processing work develop towards software, thereby achieving the goal of upgrading. As far as the current is concerned, the application of DSP technology in radar signal processing is not effective without meeting the expectations of operation. Therefore, researchers should analyze it by DSP to grasp the direction and focus [2].

3. Application status of DSP technology in radar signal processing

After analyzing the DSP technology of radar signal processing, it is found that the use of DSP has the advantages of small size, high accuracy, and fast operation. Its full name is digital signal processing technology. The application requires the use of special computers to make the signals in digital form complete the acquisition, conversion, budgeting, filtering. A large amount of data calculation is required for digital signal processing. There are two calculation methods available in the current market, namely the FFT and the FIR filter. The data processing requires multiple operations. As a digital signal microprocessor, the DSP technology should be used by a general-purpose processor to achieve the expectations of signal processing related algorithm[3].

However, the speed of radar signal processing systems is constantly accelerating, and the demand for data information processing is showing a diversified trend. The application effect of the DSP technology is achieved, and the following needs goals should be achieved through necessary adjustments. For the main signal, to improve the flexibility of data signal processing, the radar system should be associated with statistics, reflection and physical related in the identifying and imaging the target as well as detecting. DSP technology should optimize various functional software and technologies of the radar system to increase the data storage capacity, calculation and data transmission speed.

For the signal pre-processing, the data signal should be filtered, pre-processed, compensated, and pre-distorted based on the large amount of data, high speed, and real-time characteristics of the current. In this way, the radar signal processing system can take into account each function to achieve the independence of each function. The trend of modern radar system operation and use is low energy consumption, miniaturization and distribution in the physical environment. DSP technology operators need to focus on more complex environments[4].

4. Application control strategy of DSP technology in radar signal processing

4.1. Hardware platform construction method

Before constructing a radar signal processing system, a DSP technician should master the operation and analyze the signal processing to determine the specifications and attention issues to be followed. At present, ASIC (FPGA) + DSP + large-capacity RAM is usually used as a high-speed signal processing method. The flexibility of FPGA is higher than that of ASICDSP technology. The digital signal processing capability is very high as the device has large capacity RAM and supports external expansion.
RAM. Therefore, while storing a large amount of data information, it can also provide conditions for target acquisition and detection[5].

When designing a radar signal processing hardware platform by DSP programming, the signal should be converted and processed after the system receives the radar echo. The specific process is to use FPGA to collect radar signals and control timing, and extract information and target detection according to DSP, and then display the target information on the display device. In this way, compared with the radar signal processing system, the radar signal processing system programmed by DSP is more flexible. The reason is that the system effectively combines the hardware platform and software algorithms, so that the system can adjust the parameters according to requirements, and successfully improve the flexibility of signal processing.

It is worth noting that extracting information and target detection as the control algorithm structure is more complex. A DSP chip with addressing mode flexibility and high operation speed needs to be used to start the construction of the entire hardware platform[6].

4.2. Parameterized design control
After the radar signal processing system removes the interference radar signal echo signal, it can perform target detection to obtain useful signals, such as system operating parameters. In the parametric design of the radar signal processing system, it is necessary to use DSP technology to start with the construction of the hardware platform. According to the function characteristics of the system’s radar signal processing, the parameterized design effect of the system is improved. The design effect here refers to improving the design efficiency of radar signal pulse and re-frequency parameters by simplifying the function[7]. Attention should be paid to the problem of signal waveform in parametric design. The signal waveform is the change of the physical quantity x with the change of t, and the specific change is shown in formula (1):

\[ x(t) = \text{rect}(t)A \cos(2\pi f_0 t + \phi) \]

During the parametric design control, attention must be paid to the parameter of each. Only in this way can the rationality of the final parametric design be ensured.

4.3. Design of radar system function module
Because the object of DSP technology is digital signals, the quality effect control of analog-to-digital conversion should be performed during the processing of radar signals. The specific process is to use DSP technology to design the functional modules of the radar system to optimize the signal processing method of DSP programming. For the advantages of high accuracy and fast calculation of DSP technology, the FFT is used to design the data processing module so that the algorithm details can be reconstructed, and the processing program is controlled to occupy the memory of the radar system[8]. For example, the system module is used to perform the skew removal processing, and the specific flow is shown in figure 2.

4.4. Application of DSP technology in functional module design
The most commonly used high-speed signal processing method of the platform is ASIC (FPGA) + DSP + large-capacity RAM, of which the logic function of the FPGA is more suitable for configuration conditions. For the application of the DSP processor, its peripheral interfaces are rich and highly programmable, which enables to store a large amount of radar data information, and provides a reliable technical environment for the subsequent radar signal processing. After using the DSP technology, it
mainly uses DSP programming to achieve the desired system control effect. After analyzing the actual application system situation, the use of the characteristics of previous target detection and signal extraction can only guarantee the collection of a small amount of data information. Only the use of DSP chips can use arithmetic control requirements such as complex structural algorithms and flexible addressing methods[9].

From the above, it can be seen that when the hardware structure of the radar signal processing system is flexible. It can provide conditions for achieving modular control and improving algorithm efficiency. However, it is necessary to rely on DSP software programming to facilitate the rapid reconstruction of the system. It is worth noting that the radar signal processing system built under DSP technology will not be affected by system differences and different standard radar signal processing tasks. It can be programmed by DSP software to meet the processing requirements of radar corresponding signals[10].

5.Conclusion:

In summary, the limitations of using DSP technology in radar signal processing systems focus on more complex environmental conditions, differences in systems and standards, and tasks. The application of DSP technology requires software programming and chip methods to continuously reconstruct the radar signal processing system to provide a high-speed and high-accuracy signal processing technology platform for a large number of tasks. Facts have proved that only in this way can the DSP technology application fully affect the control of the radar signal processing system, and then promote the modernization. Researchers should apply the above analysis and scientific research results to radar signal processing of different constitutions and mission standards to improve the accuracy and reliability of information data transmission. In this way, China is involved in radar signal processing systems, and it will not be affected by the complex factors of the market. It will serve the sustainable development of modern economic construction with high stability.

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