

Research on Application of Digital Signal Processing Technology in Communication

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Abstract. With the continuous development of modern information technology and the continuous improvement of people's living standards, electronic information technology has been widely used in people's lives. People's lives are inseparable from it. With its continuous development, its application range is getting wider and wider. This article first gives a brief overview of digital signal processing technology, analyzes the advantages and disadvantages of digital signal processing technology in the communication field, and the specific applications of speech compression coding and software radio in communication are analyzed in order to better promote the application of digital signal processing technology in the communication field.

1 Introduction

Digital signal processing technology, as an important product of the information age, exists in all aspects of the communication field and is an indispensable technology in the communication field. In recent years, China has increased its support for chips. Therefore, it has promoted the development and promotion of DSP chips, making it a control chip for many mainstream software communication products. In the field of communications, the equipment that applies digital signal processing mainly includes systems such as telephone communications, video voice, and voice signals, which effectively promote information exchange and information sharing. In the field of communication, digital signal processing technology is mainly applied to speech compression coding and software radio. Of course, there are still problems such as signal quality and signal transmission speed that need to be resolved. Therefore, in order to solve these problems, it is necessary to continue in-depth research on digital signal technology based on the current research results and promote the healthy

development of the communication industry.

2 Digital signal processing technology

2.1 Digital Signal Processing Basic Theory

The core and symbol of digital signal processing technology is digital signal processor. Digital signal processing is a subject that uses computers or special digital processing equipment to process signals using numerical methods. It includes data acquisition, signal transformation, analysis, synthesis, filtering, evaluation and identification, etc., in order to extract information. Compared with the traditional analog processing method, digital processing has incomparable advantages. Digital signal processing systems can process digital signals as well as analog signals. Of course, the analog signal must be converted into a digital signal before it can be processed by a digital signal processing system. A typical digital signal processing flow is shown in Figure 1.

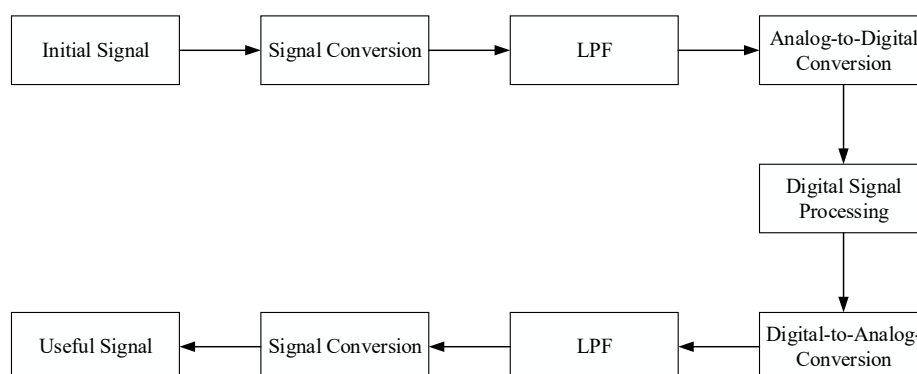


Figure 1. Digital Signal Processing Flow

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The basic theory of digital signal processing includes the following:

- Pre-processing of analog signals: filtering unwanted frequency components and noise in the input analog signals to avoid spectral aliasing distortion after sampling;
- Time domain sampling and recovery of analog signals: analog-to-digital conversion technology, sampling theorem, quantization error analysis;
- Analysis of time-domain discrete signals and systems: representation and operation of signals, various transformations, description and analysis of time-domain and frequency domains of time-domain discrete signals and systems;
- Fast algorithms in digital signal processing: fast Fourier transform, fast convolution, etc.;
- Design and implementation of analog filters and digital filters;
- Multi-sampling-rate signal processing technology: The basic principle of the sampling rate conversion system and its efficient implementation method.

The quasi-signal processing system can only perform some conventional simple processing on signals, while digital signal processing uses numerical operations to implement signal processing, and many complex processing can be performed using computers. Therefore, digital signal processing applications will be more extensive.

2.2 Advantages of digital signal processing technology

Compared to analog signal processing, digital signal processing has many advantages, which are summarized as follows:

- Good flexibility. Digital signals are suitable for computer processing, and can also be realized by programmable devices. It is easy to change the parameters of digital signal processing systems through programming, so that the system can realize various processing functions.
- Stable and reliable, there is no impedance matching problem. As long as the design is correct, you can ensure the stable operation of the digital system, and the characteristics of the digital system are not easy to change with the changes in the use conditions. And because the digital systems at all levels are coupled through data, there is no impedance matching problem in analog circuits.
- High processing accuracy. The internal noise of the analog circuit and the external environment will affect the processing accuracy, while the digital system works in a binary state, so it is basically not affected by internal noise.
- Easy to encrypt and decrypt. With the increasing requirements of information security, encryption and decryption algorithms are becoming more and more complex, and only digital processing can solve this problem.

- Facilitate large-scale integration and miniaturization. Because digital circuits have low requirements for the consistency of circuit parameters, the basic units and basic modules that make up a digital system have a high degree of consistency, so it is convenient for large-scale integration and large-scale production.

- Easy to automate and multifunctional. Digital systems can easily perform corresponding operations based on various states, and a system can implement multiple functions.

2.3 Lack of digital signal processing technology

Although digital signal processing technology is more and more applied in reality, the problems still need to be further improved.

- Deal with speed. The speed of digital signal processing is a relatively common problem. It has been around since the birth of digital signal processing technology. However, due to factors such as equipment, environment, and technology, this problem is gradually being solved to facilitate communication.

- Quality problem. Information quality problems such as bad signal and unclear picture transmission also exist all the time. Digital signal processing technology needs to be better improved, and solutions such as multi-core processing are used to solve it.

- Anti-interference problem. Although the anti-interference ability has been significantly improved in digital signal processing technology, the anti-interference problem of the analog signal from the RF antenna needs to be improved. Improve all aspects of information transmission, ensure signal quality and effects, and provide more convenient services for communication.

3 Application research in communication

3.1 Speech compression coding

The main purpose of speech compression coding is to obtain clear and high-quality speech through corresponding equipment to convert information. Therefore, its transmission signal must have strong anti-interference ability and be able to transmit information in a narrow bandwidth spectrum in order to achieve reception. And fully restore the transmitted voice information to facilitate information communication. At the beginning of the speech coding system, the coding method mainly adopted large waveform coding, fully following the sampling guidelines of discrete Fourier transform, focusing on the use with the external environment, and ensuring the high-quality state of the speech signal. It is relatively fast, and it is easy to appear a series of problems in use, which affects the final voice signal quality. Another common form of speech coding is parameter coding. The difference is that the key parameters of the speech signal are used as the coding,

but the coding rate is relatively low, which affects the speech effect.

A typical compression-sensing-based speech compression coding and reconstruction framework is shown in Figures 2 and 3.

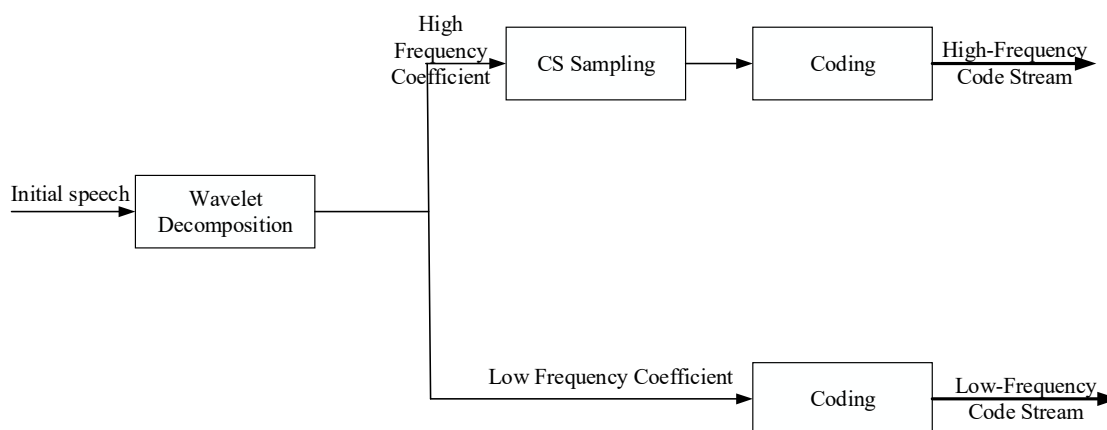


Figure 2. Sending voice compression and encoding

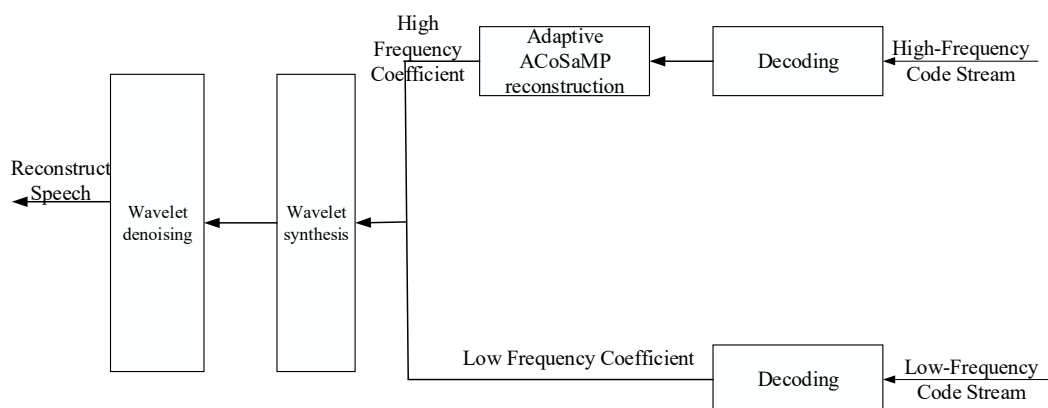


Figure 3. Decoding and reconstruction of speech at the receiving end and de-noising

In a speech compression system, it is mainly composed of a speech encoder, a digital storage medium, and a decoder. The speech input is dominated by the speech encoder, and the speech output is led by the speech decoder. The information transmission process is mainly the speech input of the speech encoder → the digital storage medium → the speech output of the speech decoder, which is the simplified speech compression coding. With the development of the times, the voice compression system mainly consists of a voice input module, a DSP module, an A / D conversion module, a D / A conversion module, and a voice output module. The key technology is the DSP module, which is the voice. Compression and decompression need to be implemented with the help of special algorithms and techniques to ensure that the voice signal is not damaged. The DSP chip has simple data processing characteristics and can implement multiplication and addition operations in a single instruction cycle. It is more suitable for voice compression systems. In addition, various hybrid encodings have also gradually emerged. For example, linear predictive encoding, as a new type of speech encoding technology, has a processing speed of 4 to 16 kilobytes per second, but it needs to match higher algorithms and digital signal processors. The digital signal processor can solve these problems, effectively

improve the problem of voice transmission, and improve the stability and reliability of the voice compression system.

3.2 Software radio

Software-defined radio is a solution to the coexistence of multiple systems in the field of radio communications and the inability to formulate a unified standard between different systems. Because software radio implements various functions based on software programming, its main characteristics are manifested in flexibility and openness. Software-defined radio is mainly a communication software to rely on. This software can complete functions such as wireless calls and video surveillance with software programming. It has features such as functionalization and modularity. As long as the signal frequency band that its hardware system can process, the communication function in the corresponding frequency band can be increased by software. Digital signal processing technology has the characteristics of stable signal, fast transmission and strong anti-interference. It can be seamlessly connected with software radio and promote the application and development of software radio.

Software radio is a multi-band radio. It has a wideband antenna, a radio frequency front end, and an analog-to-digital / digital-to-analog conversion. It can support multiple air interfaces and protocols. In an ideal state, all aspects (including the physical air interface) can pass Software to define. The ideal software radio uses wideband analog-to-digital converters and digital-to-analog converters to perform A / D, D / A conversion at the antenna port, and digital signal processing at the back

end is implemented by software of programmable devices. The structure of the radio is shown in Figure 4.

It is a characteristic of software-defined radio architecture to place the analog-to-digital converter and digital-to-analog converter as close to the RF front-end as possible. The status of the analog-to-digital converter and digital-to-analog converter in software-defined radio systems is also critical, which will directly affect the performance indicators of the entire system are excellent.

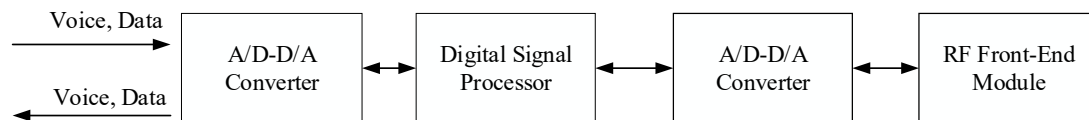


Figure 4. Ideal Software Radio Architecture

At present, the hardware implementation of digital processing mainly depends on two types of high-speed DSP chips and FPGAs. The respective characteristics of DSP and FPGA are relatively obvious, which are suitable for different occasions. At present, a development direction that is relatively well-recognized by everyone is the structure of DSP and FPGA. The purpose is to make the most of the advantages of these two processors and complement each other to achieve the parallel processing of signals in the entire system. When the clock is limited, the processing power of the system is improved as much as possible.

4 Conclusion

In the field of communication, the application of digital signal processing technology is mainly manifested in speech compression coding and software radio. Although its advantages are relatively obvious and it is a development trend in the future, there are still certain shortcomings, such as signal quality and signal transmission rate. Therefore, it is necessary to continue the research on digital signal processing technology in communication in the future to ensure more convenient and reliable communication. For example, high-speed digital processing technology and multi-core digital processing technology are under research.

References

1. Vinay K. Ingle, "Digital Signal Processing and Its Implementation of MATLAB", Xi'an Jiaotong University Press, 1998.
2. Meng Wenhan. Research on the application of digital signal processing technology in the communication field[J]. Electronic World, 2018, 552 (18): 124-127.
3. Zhang Ze. Application analysis of modern digital signal processing technology in optical access network [J]. Electronic Test, 2015 (09): 102-104 + 107.
4. Sun Bing. Research on the application and development of digital signal processing technology[J]. Information and Communication, 2015 (7): 177-177.

5. Song Yuanqing. Development of Digital Signal Processing Technology [J]. Shandong Industrial Technology, 2016 (24): 130-130.
6. Zhou Hongou. Design of Audio Signal Acquisition and Processing System Based on DSP [J]. Journal of Southwest University for Nationalities (Natural Science Edition), 2011,37 (S1): 100-103.
7. Wang Zibo, Huang Shilong. Signal and Information Processing Technology Analysis of Emergency Communication System [J]. Electronic Test, 2018 (09): 123 + 119.
8. Deng Caibao. Analysis of the Application of Intelligent Information Processing Technology [J]. Information System Engineering, 2018 (11): 42-43.