Research on a New Type of Electronic Audio Communication System

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Abstract. Bluetooth technology realizes the wireless data transmission between modern communication equipment and the Internet, which greatly improves the efficiency of office and communication. This research is based on matlab/simulink as the development platform to realize the simulation of Bluetooth voice transmission system. The system is composed of master transmitter, slave receiver and transmission, interference, signal source, error table and signal display unit. Through simulation, the frequency spectrum of frequency hopping signal, Bluetooth signal, 802.11 and slotting signal time domain diagram are obtained. The system improves students' understanding and design ability of data wireless transmission technology.

Keywords: Bluetooth; frequency hopping signal; Simulink.

1. Introduction

Bluetooth technology is a short-distance wireless communication technology that supports point-to-point or point-to-multipoint voice and data services. Bluetooth technology products use low energy consumption radio communication technology to achieve voice, data and video transmission, its transmission rate is up to 1Mb/s, full-duplex communication is carried out in time division mode, the communication distance is about 10m, frequency hopping technology is adopted, it can resist signal fading, and forward error correction coding technology is adopted to reduce the interference of random noise. The ISM band of 2.4Ghz is used to save the trouble of applying for a special license, and the Gaussian frequency shift keying (Gauss Frequency Shift Keying, GFSK) modulation mode is adopted to make the equipment more simple and reliable.

2. Introduction to Matlab/Simulink

Matlab is a computing environment released by mathworks Company in the United States, which is mainly faced with scientific computing, visualization and interactive programming. It integrates many functions, such as numerical analysis, matrix calculation, scientific data visualization and nonlinear dynamic system modeling and simulation, into an easy-to-use window environment. It provides a comprehensive solution for scientific research, engineering design and many scientific fields in which effective numerical calculation must be carried out, and to a large extent gets rid of the editing mode.
of traditional non-interactive programming language. Simulink is a visual simulation tool in Matlab, a block diagram design environment based on Matlab, and a software package that can realize dynamic system modeling, simulation and analysis. it is widely used in the modeling and simulation of linear system, nonlinear system, digital control and digital signal processing. It provides a faster, more straightforward way, and users can immediately see the simulation results of the system [1].

3. Simulation system of Bluetooth Voice Transmission

The system is taken from the communication module of matlab toolbox (toolbox\ commblocks). It is a simulation system composed of main transmitting (Main Transmitter), slave receiving (Slave Receiver) and transmission (AGWN, BT PathLoss), 802.11bInterferer), signal source, error table and signal display unit. The composition of the system is shown in figure 1. The signal flow of the system is as follows: the signal sent by the main transmitter first passes through two modules: the additive white noise transmission environment which can be controlled by the switch and the free space propagation loss module whose attenuation is set to 40dB. It is then added to an interference signal designed for 802.11b mode (also through the free space propagation loss of 40dB). The final feed is sent to the slave receiving module [2].

3.1. Main transmitting part

Click on the main transmitter (Master Transmitter) shown in figure 1 and pop up the emulation block diagram of the transmitter shown in figure 2.

![Figure 1 Simulation system of Bluetooth Voice Transmission](image-url)
Figure 2 Simulation block diagram of transmitter of Bluetooth voice transmission simulation system

The signal source uses the (Signal FromWorkspace), sampling time of the signal from the workspace is 8000s, and the number of samples per frame is 1 (voice signal sampling). Increase the sampling rate to 64kb/s to achieve continuous variable slope delta modulation (get 64kb/s binary digital speech signal) to form a payload.

The frequency hopping sequence generator (Hop Sequence Generator) generates (±39MHz 79 frequencies, frequency interval 1MHz) frequency hopping signals. Random integer generator is used for error test (Optional Random Bit Data for BER tests).

Click the coded modulation (Encode and Modulate shown in figure 2) and pop up the schematic block diagram shown in figure 3.

Figure 3 Coding and Modulation Unit of Bluetooth Voice Transmission Simulation system

After the payload is coded by forward error correction (Payload FEC Encode), the header information CRC check and the access code are combined in the coded modulation (Encode and Modulate)[3], and the GFSK modulation frequency hopping module (GFSK Modulate and Frequencyhop) is fed. After continuous phase modulation, the signal [4] is multiplied with the 79-FSK signal to complete the frequency hopping operation [5].

3.2. Transmission part

The conflict information specified in 02.11b is woven into a slot adjacent to the transmitted time and added to the signal output by the main transmitter. Plus additive white Gaussian noise interference (Es/No is 15dB) and free space transmission loss 40dB.
3.3. Receiving part
The receiving unit receives the signal from the transmission part and goes through the opposite process of transmission: de-hopping and unpacking under the action of 79-FSK frequency hopping signal source. The binary signal is restored to speech signal by continuous variable slope increment demodulation (Continuous Variable Slope Delta Modulation).

4. Result analysis
Click to turn on or off the matrix display of the time domain diagram (Scopes), error table (Error Rate Display) and transmit power spectrum (Spectrogram) of the signal in figure 1.

Figure 4 is the frequency spectrum of Bluetooth voice a. Frequency hopping signal B. time domain diagram of Bluetooth signal, 802.11b and slotted signal Fig. 4 part of the graphics displayed by the Bluetooth voice transmission system is the frequency spectrum of the frequency hopping signal, respectively. Time domain diagrams of Bluetooth signal, 802.11b and slotted signal. Through the graphic analysis, it can be seen that the Bluetooth voice transmission system realizes the transmission of frequency hopping and the modulation and demodulation of data, which is restored to the voice signal.

Figure 4 Graphics displayed by Bluetooth voice transmission system

5. Concluding remarks
Using the powerful functions of Matlab software in numerical calculation, symbol operation, graphic processing and graphical user interface, the realization of simulink simulation of Bluetooth voice transmission system will be of great significance in shortening the development cycle, reducing cost, improving reliability and so on. At the same time, the simulation software is introduced into the teaching to let the students design or develop the practical circuit model themselves, and simulate the running effect of the system, which greatly improves the students' thinking ability and practical ability.
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