

Exploration and Practice of Visual Teaching of Communication Principle

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Abstract: Combined with the characteristics of communication principle, explore the establishment of a comprehensive visual teaching system. In terms of classroom teaching, develop corresponding visual teaching courseware and teaching demonstration system. In practice after class, establish a visual interactive experiment and practice platform. In this paper, the application of visual teaching in communication principle course is illustrated in detail by taking the low-pass sampling theorem as an example. Practice shows that visual teaching can not only enhance the vividness and imagery of the teaching content, but also enhance the interaction in the teaching process, thus improving the quality and efficiency of teaching.

1. Introduction

Communication principle is a compulsory basic course for electronic and information majors, and also a compulsory subject for the entrance examination of communication and information graduate students in many schools. The characteristics of this course are: strong theory, mathematical formula derivation and abstract concept, thus increasing the learning difficulty of students. In order to improve the teaching quality and improve the teaching effect, how to visualize the abstract concepts, principles and analysis methods in the course to promote teachers' analysis of teaching and students' understanding of learning has become an important subject worth discussing in the teaching of communication principle.^[1-3]

2. The main Problems in Communication Principle Teaching

At present, the main problems in communication principle teaching are as follows:

(a) In traditional teaching, teachers can only derive formulas on the blackboard and draw some simple and inaccurate waveforms or spectrum for analysis and interpretation. It is difficult to describe dynamic signal waveforms or complex system response waveforms.

(b) Most of the multimedia courseware is a copy of the textbook. It is difficult for students to accept the large section of text description listed on the courseware.

(c) The main content of the experiment box is verification. Students are in the passive learning state with low enthusiasm, and the effect is not very ideal.^[4-5]

(d) Matlab software is used to simulate the important content of the course, which has a certain effect. However, M file programming and Simulink modeling, which are widely used at present, have the disadvantages of poor readability, reusability and expansibility, and unfriendly man-machine interface.^[6-7]

(e) The demo animation making by Flash software can make difficult content visualization. However, it can not adapt to the situation of parameter change, and can not see the effect of waveform and spectrum change with parameter change, and the interaction is poor.

In view of the above problems, combined with the characteristics of communication principle, the establishment of a comprehensive visual teaching system from two aspects of classroom teaching and after-class practice is explored.

3. Visual Teaching System of Communication Principle

The visual teaching system of communication principle established from classroom, experiment and application practice by using modern education technology and combining images, video information, visual programming software and online resources.

In terms of classroom teaching, closed to the textbook content, the corresponding visual teaching courseware and teaching demonstration system are developed. On visual teaching courseware, communication principle course has its own high-quality resource sharing course website. PPT courseware and Flash animation on the website are constantly improved and updated according to the teaching requirements. On teaching demonstration system, interactive real-time dynamic demonstration system is designed by Matlab GUI to complete the analog signal digitalization, digital baseband transmission, digital frequency band transmission, analog signal modulation and channel coding. In the after-class practice, the visual interactive experiment and practice platform are established. The experiment and practice platform is established by Matlab GUI including basic experiment and practice as well as comprehensive experiment and application, so as to enhance students' practical ability, consolidate the knowledge learned in class, and use the knowledge learned to solve practical communication problems.^[8-9] These two aspects complement each other after class, students' understanding of principles and algorithms is deepened and students' interest in learning is stimulated.

4. Application Case of Visual Teaching

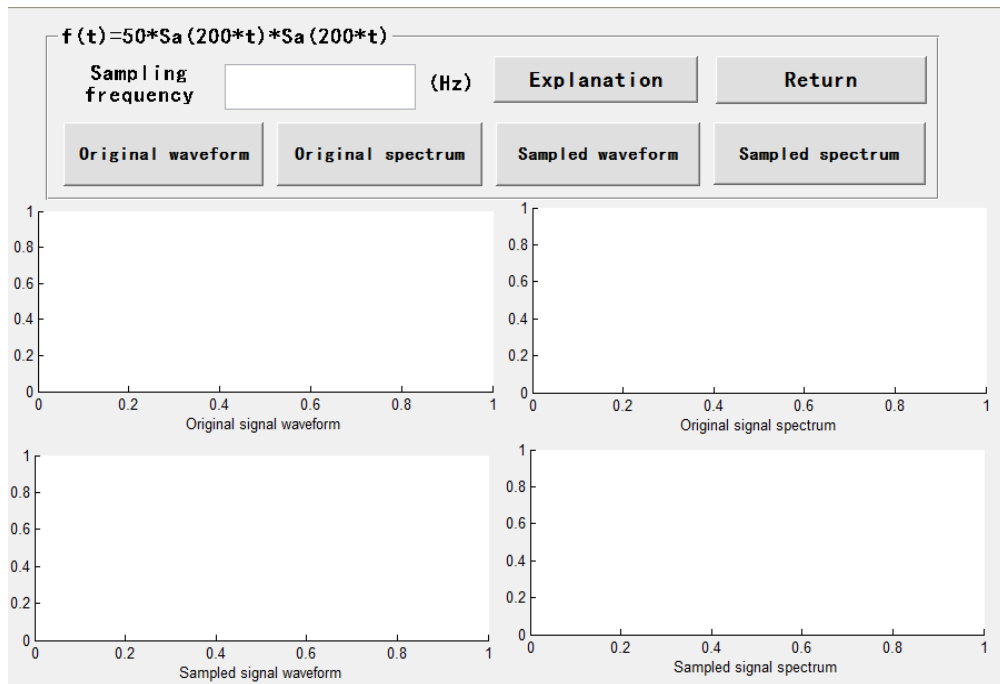
The following will take the low-pass sampling theorem as an example to illustrate the application of visual teaching in the classroom teaching of communication principle. Sampling is the first step of digitalization of analog signals. Low-pass sampling theorem must be followed during sampling to reconstruction of the original signal at the receiving end. For the description of this knowledge point, we will be divided into the following steps.

(a) Multimedia courseware is used to show the proposal of sampling theorem and the content of low-pass sampling theorem.

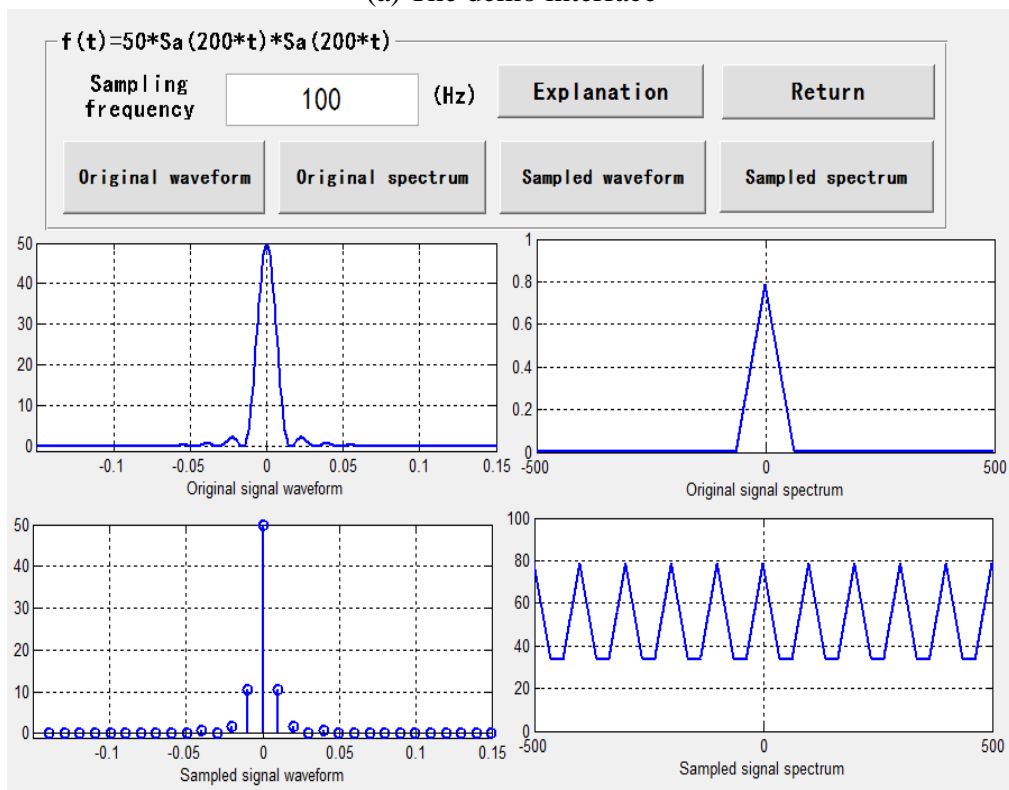
(b) The low pass sampling theorem is proved by theoretical analysis and graphic analysis. Firstly, the time-frequency domain expressions of original signal, sampled signal and sampled signal are written in detail on the blackboard. Then, the simple animation in the multimedia courseware is used to gradually display the time-domain waveform and spectrum of various signals, and indicate the spectrum of sampled signals under different sampling frequency conditions. Finally, a low pass filter is added to verify the conclusion that the original signal can be recovered only when the sampling frequency is greater than or equal to twice the maximum frequency of the signal.

(c) Flash animation visually shows the dynamic change process of the sampled signal spectrum when the sampling frequency changes, deepening the understanding of the principle.

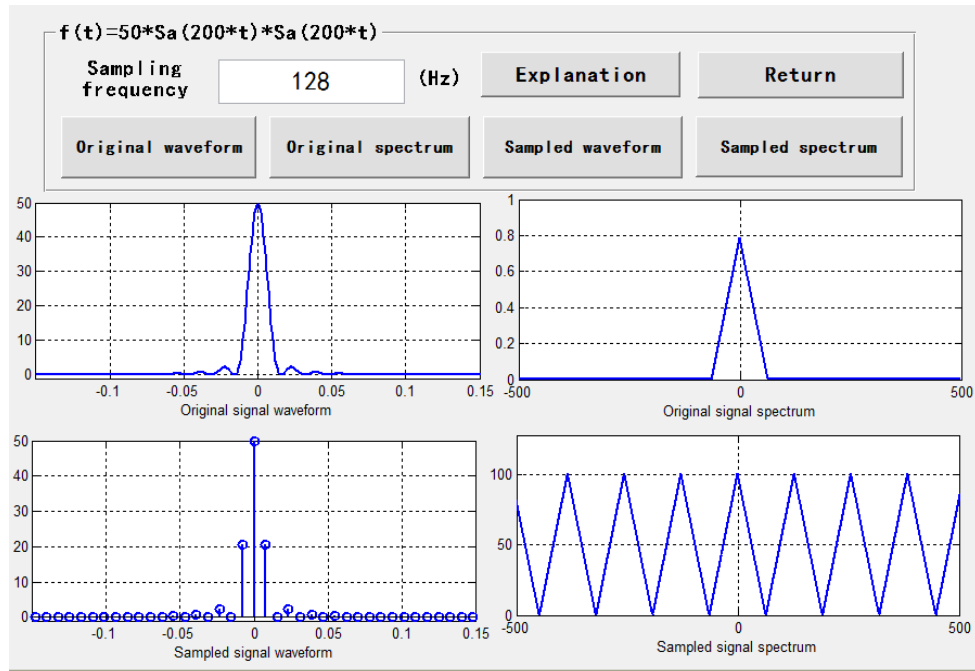
(d) The sampling demonstration system designed by Matlab GUI is used to further explain the connotation of the sampling theorem. The interface and running results of the demonstration system are shown in Fig.1. It can be seen from Fig.1 that the original signal is $f(t)=50Sa(200t)^2$ in the demonstration system, and the highest frequency of original signals is about 64Hz. The sampling frequency is input by the user. The corresponding button is clicked to draw the waveform and spectrum of the original signal and the sampled signal. The input sampling frequency of Fig.1(b) is 100Hz. As the sampling frequency is less than 128Hz, the spectrum of sampled signals is aliased, which is called "undersampling". The input sampling frequency of Fig.1(c) is 128Hz. As the sampling frequency is exactly equal to 128Hz, neither aliasing nor over sampling has occurred in the spectrum of sampled signals. The input sampling frequency of Fig.1(d) is 200Hz. As the sampling frequency is greater than 128Hz, the spectrum of sampled signals does not have aliasing and the frequency interval is large, which is called "over-sampling". Here, the sampling frequency can be arbitrarily input to observe the changes of waveform and spectrum, and the operation results are consistent with the theory.



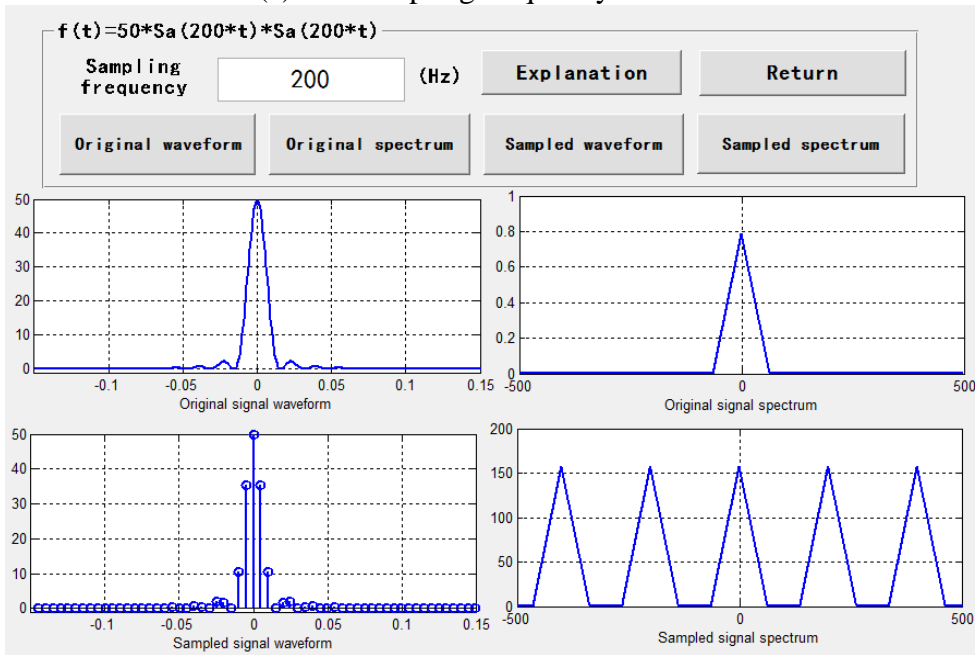
(a) The demo interface



(b) The sampling frequency is 100Hz



(c) The sampling frequency is 128Hz



(d) The sampling frequency is 200Hz

Figure 1 Sampling demonstration interface and running results.

The teaching demonstration system based on Matlab GUI has the characteristics of good interaction, simple operation, strong intuitionistic, correct results and so on. It overcomes the limitations of traditional teaching methods. It can not only enrich the teachers' teaching methods, but also deepen the students' understanding of the course content and stimulate their interest in learning. [10-11]

(e) After class, students can log on to the high-quality resource sharing course website of Communication Principle to complete the rearrangement, practice and experiment of the class content. If they encounter problems, they can also communicate with the teacher through the course website.

5. Conclusion

According to the existing problems in the teaching of communication principle, this paper

explores the establishment of a comprehensive visual teaching system, and takes the low-pass sampling theorem as an example to detail the application of visual teaching in the course of communication principle. Visual teaching makes the abstract, theoretical, difficult to understand and master in communication principle course easy to understand, intuitive, visual, which can not only simplify the complexity of the teachers' teaching, but also stimulate the students' interest in learning, convenient for students to learn, so as to effectively improve the quality and effect of teaching. In the future, the teaching methods of communication principle course will be continuously explored to meet the requirements of modern science and technology development.

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References

- [1] Tan Jiajie, "Research on Visual Aided Teaching of Communication Principle ", China Modern Educational Equipment. 2013: 50-52.
- [2] Yang Limin. "Features of Wisdom Education in Information Era". China Educational Technology. 2014: 29-32.
- [3] Fan Xingjuan, LI hui, Huang Hongyan, Yang Fei. "On-line and Off-line Hybrid Teaching Design and Practice of 'One-line-through, Two-side-introduction and Three-dimensional Education'-Taking the Course of Communication Principle as an Example". Computers Telecommunication. 2021: 75-78.
- [4] Li Guangqiu. "Exploration and practice of cultivating students' ability to solve complex engineering problems in the teaching of Communication Principle". Journal of Higher Education. 2017:62-63.
- [5] Xu Donghui, Liu Guodong, Wei Suyuan, Yang Wenke. "Research and practice on teaching mode of Communication Principle based on CDIO engineering concept". Electronic Component and Information Technology. 2020:147-148.
- [6] Zhang Ming. "Reform of Teaching Method based on Wisdom Education in Communication Theory Curriculum Matlab". The 3rd International Conference on Intelligent Transportation, Big Data&Smart City. 2018: 187-190.
- [7] Zhang Fuding, GUO Yunjun, AI Xiaoqian. "Research on practical application of Matlab simulation in communication principle teaching" [J]. Science Tribune. 2018: 20-21.
- [8] Xiong Hongqi. "Promotion of reform and innovation on integration of theory teaching and experimental teaching by virtual simulation experiment teaching". Experimental Technology and Management. 2020: 1-4.
- [9] Guo Changying, XU Chunyu, XU Guoqing. "The Design and Application of Auxiliary Teaching System for Communication Principle". Education Modernization. 2019. 146-150.
- [10] Yuan Min "Simulation experiment research of communication principle based on Matlab". Computer Engineering and Applications. 2021:238-239.
- [11] Zhang Ming. "Design of the Demonstration System in Communication Principle Based on MATLAB GUI", Experimental Technology and Management. 2013: 111-113.