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Practical Teaching Method Based on MATLAB in AC Speed Regulating System Course

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Abstract—Because an AC speed regulating system is abstract and complex, the study on practical teaching method based on MATLAB software is quite necessary in the AC speed regulating system course at our university. The permanent magnet synchronous motor (PMSM) vector control system is taken as an example to explain in details the practical teaching method based on MATLAB. The course content is divided into several knowledge modules based on speed regulation methods. The concept of subsystem in Simulink is introduced. Each type of speed regulating systems can be divided into several subsystems according to its functions. The control principle, system constitution and design method of each AC speed regulation system is explained by different function subsystems. The instructor vividly demonstrates the control system simulation model of AC speed regulation systems in class, and the students establish and modify the existing simulation model by themselves on the computers under the guidance of the instructor. In this way, the students' practical ability and teaching quality of specialized courses can be improved greatly.

Keywords—AC speed regulation system; practical teaching method; subsystem; MATLAB/Simulink;

I. INTRODUCTION

The full name of MATLAB is Laboratory Matrix, developed by MathWorks. MATLAB is mainly used for scientific computing, data analysis and visualization and interactive programming. The MATLAB family has three members, namely, MATLAB, MATLAB Toolboxes and Simulink. Simulink, a visual simulation tool in MATLAB and a software package for dynamic system modeling, simulation and analysis, is widely used in modeling and simulation of linear systems, nonlinear systems, digital control and digital signal processing. The power system toolbox of Simulink is a module library dedicated to the RLC circuit, power electronic circuit, motor drive control and power system simulation. This module library contains a variety of AC / DC power supply, a large number of electrical components and electrical measuring instruments and analysis tools, etc. The operations and faults of the power system in various states can be simulated by using these modules^[1].

With the rapid development of microelectronics, power electronics, modern control theory and computer application technology, the study of AC speed regulation technology has

become a popular field. In particular, the advanced speed control methods, such as direct torque control, vector control and synchronous motor variable frequency speed regulation technology have been applied to AC speed regulation systems. Replacing DC speed regulation with AC speed regulation is an inevitable trend. With the advantages of fast response, high accuracy and energy saving, AC speed regulation systems are widely used in industrial production and high performance driving fields.

The AC speed regulating system course covers the subjects of electrical machinery, power electronics, modern control theory and computer science^[2]. Because the AC speed regulating system is abstract and complex, it is difficult for students to completely understand lectures. The challenges for the instructor lie in the following questions: How to help the students deeply understand the control principle, system structure and design method of an AC speed regulation system? How to motivate the class and enhance the students' practical ability? How to improve the teaching quality of the AC speed regulation system course?

II. TEACHING PURPOSES

AC Speed Regulation System is an important professional course in electrical engineering and automation major, and it is a basis for further learning motion control system and electrical energy saving technology. Taking into account the current teaching environment and the professional knowledge of the students in our university, the main goal of the teaching method reform is to motivate the class and improve the students' practical ability.

III. PRACTICAL TEACHING METHOD BASED ON MATLAB

The *AC Speed Regulation System* course needs to cover two major topics: asynchronous motor speed regulation technology and synchronous motor speed regulation technology. The teaching objectives are to make the students understand the basic principles of vector control, direct torque control and variable frequency speed regulation method and to design AC speed regulation systems for two types of motors with these control methods. The teaching content can be divided into several knowledge modules based on speed regulation methods. The important knowledge points should be

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