Computer-Aided Software Teaching Based on the Use of MATLAB

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ABSTRACT

This article highlights several of the problems in teaching and studying based on many years' experience of teaching and practice, with a focus on a software teaching course. MATLAB engineering software was introduced into the course, and it enabled the content of error theory and data processing to be strengthened while retaining the course's traditional contents. Four typical instruction examples are given and analyzed in this article. The analysis and results show that the examples are fit for class teaching and extracurricular practice study.

Keywords: *3Dsoftware, teaching reform, the space*

INTRODUCTION

Software teaching is one of the key specialized courses among the specialisations within the Art and design discipline, which include vehicle engineering, mechatronics engineering, and mechanical design, manufacture and automation. This course plays an important role in the formation of students' knowledge structure and the cultivation of their ability.

The architecture and knowledge content of the course are rather fixed in universities in many countries [1].and the overall composition of a test system is shown in Figure 1 .The test system includes several key components: transducers (always including a sensor and other circuits), signal conditioning, signal processing, and so on. The course mainly focuses on the key components and the test system itself.
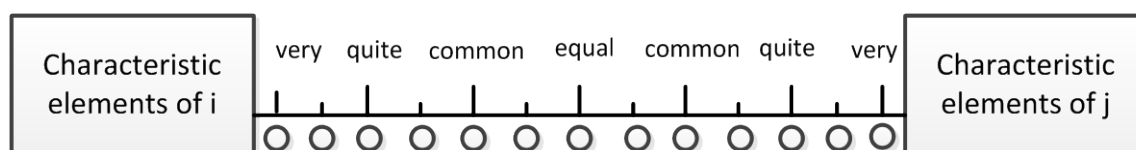
Overall, the course can be divided into three parts: fundamental theory and knowledge, typical applications and

modern test technology. The fundamental theory and knowledge part almost appears in every test technology textbook. The largest differences between textbooks concern the second and the third parts. Even so, the measurement of vibration and of stress, strain and torque are necessary content across all textbooks.

PROBLEMS IN TEACHING AND STUDYING

As teachers of the course, the authors regularly hear from students that the course is more tedious and difficult than interesting and easy, and from other teachers that there is overall dissatisfaction with the teaching. After years of teaching and practice, several problems have been identified, including:

1. There are too many complex and tedious formulas, such as response characteristics of second-order systems and transfer functions in the section on measurement system behavior.

2. The limited class time reduces the time available for practical classes. In many universities, only four or eight hours out of 32 or 40 hours for the overall course are devoted to experiments. Moreover, deficiencies in the equipment provided make teaching and studying more difficult for the teacher and students.

3. Even with multimedia teaching software, the amount of knowledge, complex graphs and curves make demonstration in classes difficult.

4. Students of some specialties in the art and design discipline would prefer more knowledge of basic measurement, such as error theory and data processing methods.

Given the problems outlined above, the content of error theory and data processing was introduced to the course, while retaining the traditional content and using MATLAB to the fullest extent possible.

The Fourier coefficients can be computed easily in MATLAB using symbolic functions, such as integration function *int* and symbolic substitution function *subs*. The MATLAB code for spectrum analysis of the periodic square pulse signal is as follows, and running results are shown in Figure 2
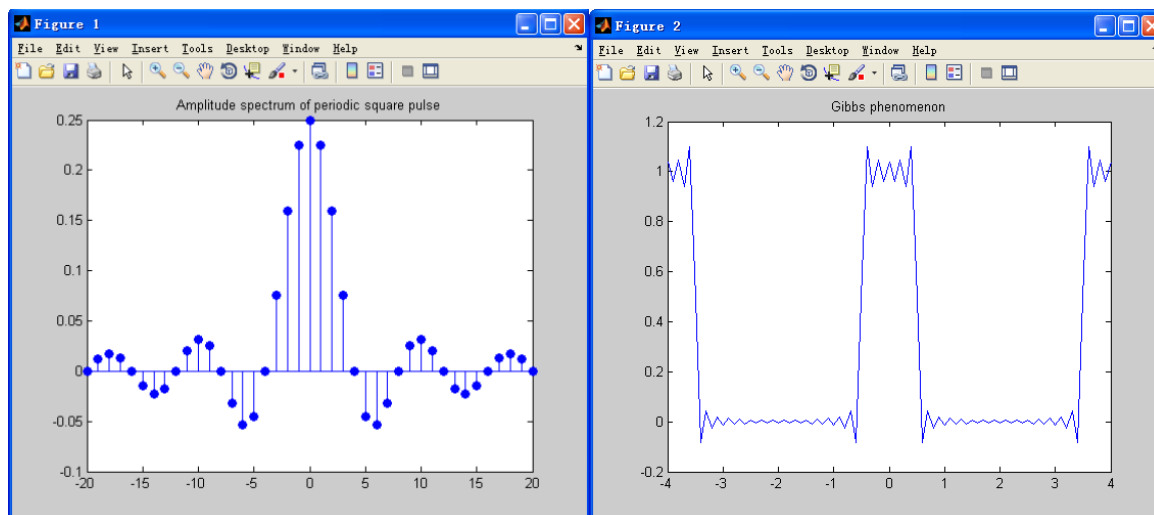
The simulation model was built in MATLAB/Simulink, as shown in Figure 3a. The Pulse Generator block was used to generate the periodic signal, so the block parameters are set as follows: Amplitude: 1, Period (seconds): 4, Pulse width (% of period): 25, and Phase delay (seconds): -0.5. The analog filter design block designs and implements a Butterworth, Chebyshev type I, Chebyshev type II, or elliptic filter in a highpass, lowpass, bandpass

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or bandstop configuration.

The simulation model uses 6 Butterworth filters. One is a low pass filter; the other five are bandpass filters. Filter order of all six filters has been set at 20. The pass edge frequency (rad/s) of the low pass filter is set as 2*pi*0.022; the lower and upper passband edges frequency (rad/s) of the bandpass filters responding to the fundamental, second, third, fifth, sixth harmonic are set as (2*pi*0.023, 2*pi*0.27), (2*pi*0.48, 2*pi*0.52), (2*pi*0.73, 2*pi*0.77), (2*pi*1.23,2*pi*1.27) and (2*pi*1.48, 2*pi*1.52).

A periodic function $x(t)$ with the angular frequency Kcan be represented by a trigonometric series, such that for any t:

$$X^{(1)}(k) = \sum_{i=1}^{k} X^{(0)}(i) = X^{(1)}(k-1) + X^{(0)}(k)$$

and also be represented as:

$$X^{(1)} = \left\{ X^{(1)}(k), k = 1,2,\ldots,n \right\}$$

The Fourier coefficients can be computed easily in MATLAB using symbolic functions, such as integration function *int* and symbolic substitution function *subs*. The MATLAB code for spectrum analysis of the periodic square pulse signal is as follows

$$Y_n = (X^{(0)}(2), X^{(0)}(3),\ldots X^{(0)}(n))^T$$

removed from the data, the detection procedure should be done again using the remaining data to find another outliers. So the MATLAB code is as follows.

```
x=[28.53, 28.52, 28.50, 29.52, 28.53, 28.53, 28.50, 28.49, 28.49, 28.51, 28.53, 28.52, 28.49, 28.40, 28.50];
disp('*********Computing results*************')
while(1)
    meanx=nanm
    ean(x);
    vx=x-meanx;
    stdx=nanstd(x
    );
    [maxvx,Index]=nanmax(abs(vx));
    if maxvx>3*stdx
        disp(['No.', num2str(Index), ' data ', num2str(x(Index)), ' is an outlier.'])
        x(Index)=NaN;
disp(['After the outliers are removed,'])
disp(['the mean value is ', num2str(meanx),','])
disp(['and the standard deviation',
num2str(stdx), '.'])
disp('******************************
****') The running results are as follows.
*********Computing
results************* No.4 data 29.52
is an outlier.
No.14 data 28.4 is an
outlier. After the
outliers are removed,
the mean value is
28.5108,
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and the standard deviation0.016564.

CONCLUSION

The problems and examples discussed here have several advantages. First, the teachers can prepare lessons, demonstrate course knowledge with great facility and make classroom activities more informative. Second, the students can make full use of teaching resources for extracurricular exercises in topics, such as programme code, simulation models and experimental systems. Third, the students are exposed to software applications, which cultivates students' consciousness and ability to solve practical problems using the computer. If some inventive and on-limits design projects or experiments are developed and introduced into teaching activities, the students' creativity can be enhanced. This will be examined in future work.

The software teaching course as many complex and tedious formulas, requires multidisciplinary knowledge, and there is limited class time. It would, therefore, appear that multimedia technology and engineering software could be used to improve the impact of teaching. In this article, five important problems were presented, based on years of teaching and practice. To solve these problems, MATLAB was fully introduced into the course, and the content of error theory and data processing were strengthened. Four typical instruction examples were given and analysed. These examples are appropriate for class teaching and extracurricular practice studying.

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