



Approaches to MATLAB Experimental Course

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Abstract

MATLAB programming is currently a widely established course for science and engineering specialty, different universities differ a lot in making the standard of this experimental course, however, the existing common problem is the weak disconnect between the contents and special training. To overcome the problem of disconnect between study and application of MATLAB, Schedule and contents of this course were discussed, and design experiment was enhanced. This revision takes not only into account for the connecting of contents but also fusion with corresponding frontier information field. Students enjoy the experiment, a preliminary understanding of the application situation of MATLAB programming language, and the educational quality can be improved.

Subject Areas

Education

Keywords

MATLAB Experiment Course, Design-Featured Experiment, Digital Image Processing, Gene Sequence Analysis

1. Background

In the middle of 1970s, the first version of MATLAB was demonstrated by Professor Cleve Moler in FORTRAN language. Cooperated by two other colleagues, they rewrite MATLAB Kernel in C programming language, established Mathworks Company and made the software a trademark. Now, 40 years later, the software has become the world-famous application software for mathematical computing, graph and image display, current simulation. It can be used for front-end idea verification toolbox for integrated development and circuit system design. As for digital image and speech signal processing area, MATLAB can be used for application software to implement real-time information processing. In China, many universities established MATA LB programming

course for training scientist and engineers, and in the course, some experiments were arranged for students practicing. As an average university, School of Physics and Electronic engineering Xinyang Normal University, also teach students MATLAB programming language for two majors, namely, electronic information engineering and electronic science & technology. The course has been carried out for seven years.

During recent years, major trans-conformation is rising to an unprecedented height. To improve the quality of our students, we carried out a series of actions. In 2009, our university cooperated with Xinyang city government built the service platform of common electromechanical technology, in 2010, our school cooperated with Shanghai Enlearn Electronic Company limited of Science and Technology built Enlearn innovative workroom, in 2011, our university cooperated by Shenzhen Jilan Company limited of Science and Technology built develop center and training base to join the research and development group, in 2012, based on electronic technology innovation group of our university and platform of common electromechanical technology, combined with the resources of teaching, electronic technology practical innovation base was built, and used for extracurricular practice base of two majors including electronic science & technology and electronic information engineering. About 350 K\$ was investment in the first period, and 340 K\$ was supported by central finance, 190 K\$ by our university, 15 K\$ by local enterprises. Up to now, the total value of equipments in our base is above 1 M\$. The main parts of our base includes electronic product design laboratory, electric and electronic training laboratory, PCB fabrication laboratory, digital control process laboratory, electronic product test center, student innovation management center, etc.

Based on the several platforms above, to improve the teaching quality and students abilities of software and hardware development, refer the literature about how to teach students to deeply understand the programming skills [1]-[7], the document provided by Mathworks Company titled “MATLAB getting started guide 2011B [8]” was selected as textbook, and contents from some other textbooks was fused [9]-[12].

2. Start Time

In many Chinese universities, MATLAB programming language starts up at the forth term or even later time. After a careful consideration and discussion, we decided to start up the course at the first semester. A different opinion occurred at the discussing meeting because our students haven't study linear algebra and MATLAB is based on matrix theory. According to the view, we should start up the course at fourth or even later semester due to linear algebra start up at third semester. For convenience, we call the former approach as first semester schedule, FirSS for abbreviation, and the latter one fourth semester schedule, FouSS for abbreviation. Now we list advantages and disadvantages for the two schemes.

2.1. Advantages for FirSS

If we start up MATLAB programming at first semester, the advantages include the fol-

lowing:

- 1) We can use MATLAB programming and Simulink in many courses such as circuit analysis, signals and systems, principles of communication, principles of automatic control theory, and other following courses. On the contrary, If we start up the MATLAB programming language at forth semester, we can't use MATLAB as a tool for many other courses such as signals and systems. It is well known that MATLAB is widely used in the first professional course named circuit analysis which is started up in the second semester or even in the first semester (according to our teaching schedule, circuit analysis is started up at second semester).
- 2) The basic techniques and knowledge of programming language can be extended to the next semester course called C programming language.
- 3) Students can study MATLAB programming and Simulink further step by step, and take part in some research group existing in our university, and some competes from all over the world including mathematical modeling.
- 4) According to our teaching schedule, another computer course named fundamentals of computer will be carried out in first semester, FirSS may help student understanding programming from different views.

2.2. Disadvantages for FirSS

If we start up MATLAB programming at first semester, the disadvantages include the following:

- 1) The absent matrix knowledge may cause hard degree of this course a little higher; hence the contents may puzzle a little more students.
- 2) The lack of basic skills and understanding at computer may prevent students from accepting some important concepts.

3. Experiment Contents

The existing textbooks always demonstrate how to finish some certain tasks with completed programs of reference. To avoid plagiarizes we designed a set of topics as the assignments of students. Each student has his or her unique assignment according to the student ID number and the picture of his or her own. Furthermore, we involved some interesting or frontier mattered contents. Every student can finish the assignments by himself or herself. To communicate with other MATLAB teachers, we list the contents in **Table 1**. We give an example for reference whose serial number is 0421035302 in Section 4.

4. Design Example

Demand: Cut your own image into 16 small pieces, and randomly put them together as shown in **Figure 1**. Here, we give a reference code as follows.

```
im = imread('barbara.png');
subplot (121); imshow (im,[]); imp = cell(4,4);
for m = 1:4
```

```

for n = 1:4
    imp{m, n} = im((m-1)*128 + 1:m*128,(n-1)*128 + 1:n*128);
end
end
k=rand(2,4); [C,ind] = sort(k,2); inr = zeros(size(im));
for m = 1:4
for n = 1:4 inr((m-1)*128 + 1:m*128,(n-1)*128 + 1:n*128) = imp{ind(1,m),ind(2,n)};
    end
end
end

```

Table 1. MATLAB experimental contents.

Serial Number	Experimental Name	Main content description	Class Time	Experimental Type	Default /Optional
0421035301	MATLAB Basic Operation	Generate a random matrix, implement conventional operation	3	Verification	Default
0421035302	Output Student image Number Circulation	Using loop to display your image by slices	3	Design	Default
0421035303	Image processing	Add 1000 salt and peppers noise to your own image and remove it using three kinds of mask method	3	Design	Default
0421035304	Plot	Plot 2D function curve and 3D surface	3	Design	Default
0421035305	Circuit analysis	For a given circuit, using KCL and KVL, establish circuit equation, design the code	3	Design	Default
0421035306	GUI	A GUI interface on one's own interesting	3	Design	Default
0421035307	Speech signal processing	Record one's own sound for about 10 seconds, analyze frequency characteristics	3	Design	Optional
0421035308	Gene sequence analysis	Generate a gene sequence by random function, simulate gene sequencing	3	Design	Optional

**Figure 1.** Personal assignment example.

5. Summary

In order to embody the application function of MATLAB, we established the course at first semester. To make the course interesting in study process, we emphasized the ratio of design experiment and made the assignments unique for each student. It should be pointed out that MATLAB is only one course in the whole training plan, it must be cooperated with other courses to make better effects. We arrange digital circuits at second semester and open Verilog HDL at the same time. Combining MATLAB and Verilog HDL can make good use of our several practical training platforms, and laying good fundamental for future courses.

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