Effective Support of DSP by Using MATLAB®
in Bachelor Type of Study

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Abstract: - in the article an original way of teaching DSP is introduced. MATLAB system is used for direct support of DSP. An original form of MATLAB applications is developed. Students use a graphical interface and they can also work with a source code which is available in one of application windows. The source code of all applications can be modified by student and the application is immediately changed including computation results. This way of teaching is very effective because the students need not write many rows of source code.

Key-Words: - MATLAB, effective teaching, DSP, original application, source code

1 Introduction

In our department DSP is taught by using a few forms. One of them is a direct support of DSP by using MATLAB. Many ways exist how to teach by using MATLAB system [1].

We formerly used a few forms of MATLAB applications. In our university most of students study as bachelors. That is why we had to find some effective way of teaching DSP in LAB.

2 Often used MATLAB application forms

A few basic ways exist how to use MATLAB. Selection of concrete form depends primarily on these conditions:

- ♣ year of study,
- ♣ previous knowledge of MATLAB and DSP,
- ♣ concrete training objective, etc.

2.1 MATLAB as simple interpreter

This utilization of MATLAB environment is acceptable in cases of simple solved problems or initial courses in lower years of study. A simple example is shown in Fig.1. There are also a few disadvantages. This way is unsuitable in case of more extensive LAB projects or reduced time. It is suitable also for the first introducing into MATLAB environment.

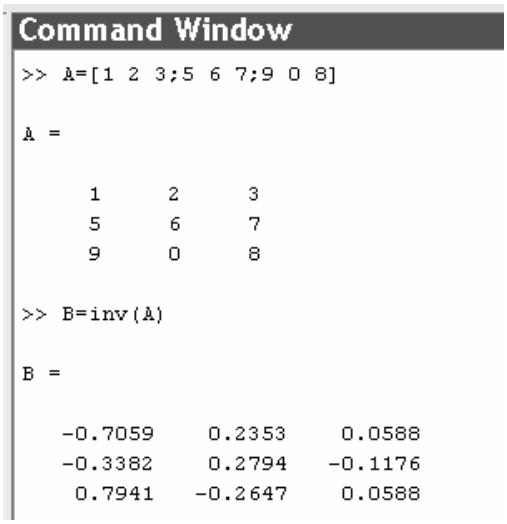

Fig.1. MATLAB as simple interpreter.

The user writes needed MATLAB commands and he can watch a response of the system immediately after confirmation by ENTER key. In this case no long preparation is needed. Such work witch MATLAB is quick and simple. The students must know a few usable commands before starting LAB.

2.2 Using MATLAB m-files

So-called m-files are text files with MATLAB source code which are often saved on a disk. Such m-files can be executed by starting them from MATLAB Command Window, see Fig.2 and Fig.3.

The m-file developed by student or prepared by teacher before the teaching is saved under any name, e.g. *Wseas*. After it the m-file is started from MATLAB Command Window by typing its name without extension *m*. MATLAB executes all commands written inside m-file. Such way of teaching can save time but there is more exacting preparation.

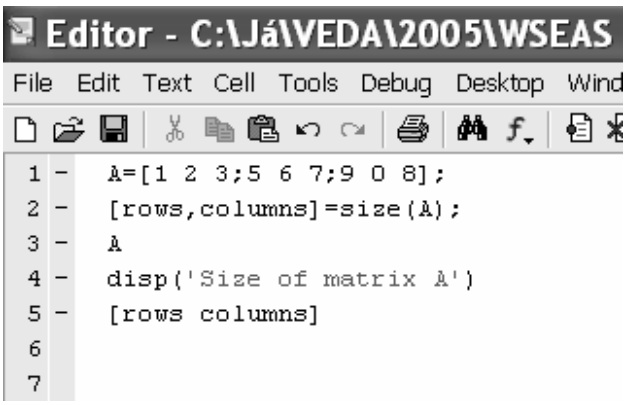

Fig.2. Simple m-file as MATLAB source code.

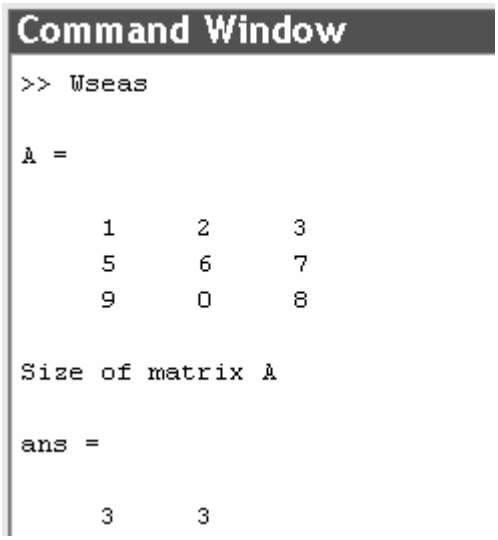

Fig.3. Starting the m-file with MATLAB response.

Students can change m-file if necessary. Relationship between m-file and MATLAB response is evident but it is not still sufficiently immediate.

2.3 Optimal way of using MATLAB

In case of a bachelor type of study a training time is relatively reduced. That is why it is necessary to develop LAB equipment and applications which are relatively optimal, simple and sufficiently illustrational. It is not simple task for teachers or instructors.

In our LAB a few MATLAB applications are used to support of DSP. The students had appropriate lectures and numerical exercises before. After it they are coming into our LAB and using the application described below.

The applications mentioned above consist of three logical parts. There is a place with a few buttons where a concrete LAB exercise can be chosen. The second part is reserved for main responses of the task. The third part contains a special window with a MATLAB source code. The students study important rows of the source code and also change them by using a keyboard and mouse. One of our applications is shown in Fig.4.

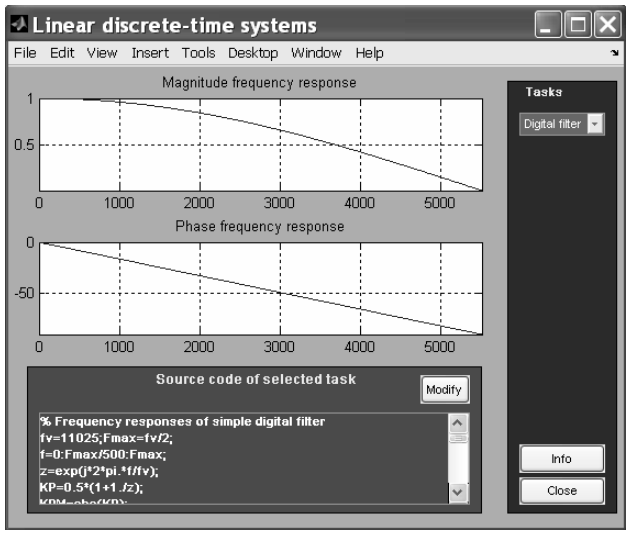

Fig.4. Application LDS.m with the source code.

The Fig.4 shows frequency responses of a simple digital FIR filter. These responses repeat with a sampling period. To prove it the students must modify the source code, e.g. according to Fig.5.

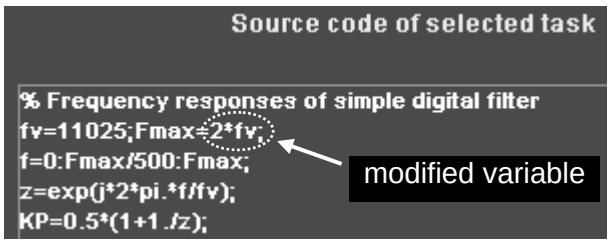

Fig.5. Change of maximum frequency F_{max} realized by students.

When the source code is changed it is necessary to click on the *Modify* button. Then the response of the application is modified according to Fig.6.

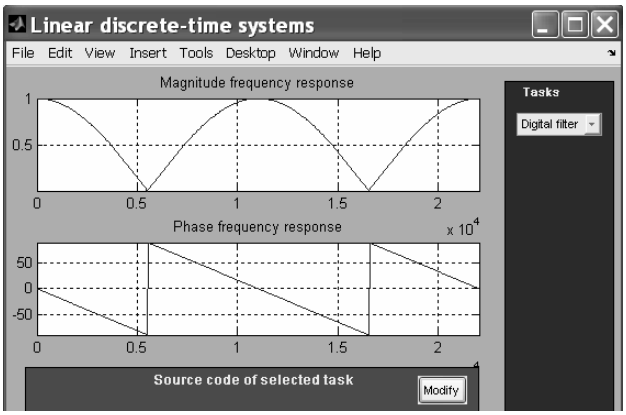

Fig.6. Modified response of the application.

The Fig.7 presents a selection of other offer from the task menu. The response is in Fig.8.

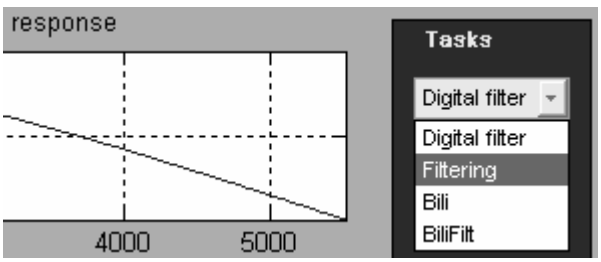

Fig.7. Selection of another task.

When all properties of the digital filter from Fig.4 are known then another task can be chosen from the task menu. Here is digital filtering of sound record loaded from the disk, see Fig.8 and [3].

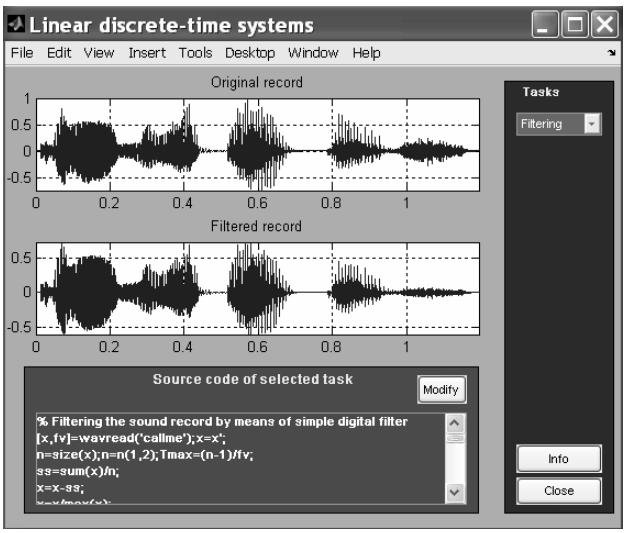

Fig.8. Digital filtering using the filter from Fig.4.

The students can study the source code and listen to the sound before and after filtering. Change of the source code is always possible.

3 Key part of original application

To see and change the source code in our effective application there are a few our original ideas. The key idea is to use the command ***str2mat*** as string, [1], [2]. An illustrational function is listed in Fig.9. Such code is written for each task and it is executed immediately after its selection.

function cmdStr=LDS_prumer;

```
cmdStr=str2mat( ...
'% Frequency responses of digital filter', ...
'fv=11025;Fmax=fv/2;', ...
'f=0:Fmax/500:Fmax;', ...
'z=exp(j*2*pi.*f/fv);', ...
'KP=0.5*(1+1./z);', ...
'KPM=abs(KP);', ...
'KPF=angle(KP)*180/pi;', ...
'assignin("base","fv",fv)');
```

Fig.9. Using the *cmdstr* command as key function.

4 Conclusion

A new form of the MATLAB applications is developed to teach DSP effectively and quickly in Bachelor type of study at the University of Defence in Brno, Czech Republic. A window with the source code is part of each application. The student can study the source code, change it and watch responses. Such way of teaching DSP is very effective, quick and perhaps interesting.

The presented form of MATLAB applications can be applied for many tasks and problems, e.g. digital filtering, signal processing, modulation etc.

References

[1] MATLAB® User's guide, the Mathworks, Inc., USA 2000.

[2] Hanselman, D., Littlefield, B., Mastering MATLAB 5, PrenticeHall, Inc. New Jersey, 1998.

[3] Oppenheim, A.V. et al., Discrete-Time Signal Processing, Prentice-Hall, Inc., New Jersey 1998.