Laboratoire d'enseignement assisté par ordinateur

Ecole polytechnique fédérale de Lausanne

PROCEEDINGS

INTERNATIONAL CONFERENCE ON COMPUTER AIDED LEARNING AND INSTRUCTION IN SCIENCE AND ENGINEERING

September 9-11, 1991
EPFL, LAUSANNE, SWITZERLAND.

PRESSES POLYTECHNIQUES ET UNIVERSITAIRES ROMANDES

HyperAutomatica: A Courseware in Control Teaching

J. Aranda, S. Dormido, J.L. Fdez-Marrón, F. Morilla, Mª.A. Canto
Dpto de Informática y Automática, UNED, Avda Senda del Rey s/n, 28040
Madrid, Spain

Summary

Hypertext techniques are becoming a popular method for the presentation of material for computer-aided learning. A courseware for teaching a first course in automatic control is been developed, using MATLAB and HyperCard. The course is organized in the same way as an ordinary one. It begins with the study of a linear continuous system, after which a second part with the same structure presents the study of linear discrete systems. Both parts contain eight lessons. Also a number of development tools have been implemented to ease the distance learning of this course.

1 INTRODUCTION

The object of this work is the development of courseware for a first course in automatic control to be used by the students of U.N.E.D. (UNED is the Spanish Open University).

Hypertex techniques are becoming a popular method for the presentation of material for computer-aided learning. However in order to teach automatic control nowadays, it is necessary to use programs with mathematical abilities to manipulate the control systems in order to perform designs and other practical tasks. For this work MATLAB (Moler 1978,1989) one of the most popular and powerful tool has been used. MATLAB is an interactive command language, that in fact has turned out to be standard in the computer aided design of control systems. For all these reasons HyperCard and MATLAB have been put together to develop the course, combining the best characteristics of both programs.This paper is organized as follow. First a brief discussion of HyperAutomatica is shown in section 2. Following this, in section 3 there is a description of the development tools used for making this course.

2 HYPERAUTOMATICA

HyperAutomatica is a courseware made by five interconnected HyperCard stacks: Presentation Stack, Help Stacks, Teaching Help Stack, Lessons Stacks, Problems Stacks

The purpose of the Presentation Stack is to present the course and communicate with other Stacks. It has only two Cards

There are two Help Stacks, the first is the proper Help Stack, it gives information about HyperAutomatica, HyperCard, MATLAB and the use of buttons for navigation. The other is the Teaching Help Stack, which gives information about the objectives and methodology of the course (figure 1), and shows the recommended bibliography and other auxiliary material for studying. It also displays information about the practical studies which are needed to pass the exam.

The Problems Stacks contain problems to be solved by the student. Every lesson in the course has its own problems that are set to the student. These problems are resolved with MATLAB, and the student also has the opportunity to practice with MATLAB and

compare his solution with the solution proposed in the lesson. He can also use the interface HyperLab (Dormido, 1990) to develop the solution and simulate it.

The lessons Stacks are the main part of the course. It is organized in the same way as an ordinary one, begins with the study of the linear continuous systems lessons, and after that presents the study of the linear discrete system. Every lesson of the program has its own Stack, which can be connected to others items (cards, buttons, stacks, etc) in order to explain concepts that are used in previous lessons. The program consists of sixteen lessons, eight in the first part (linear continuous systems) and eight in the second (linear discrete systems) (figure 2)

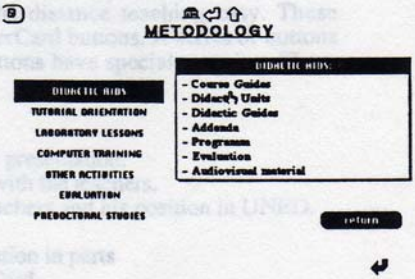

Figure 1

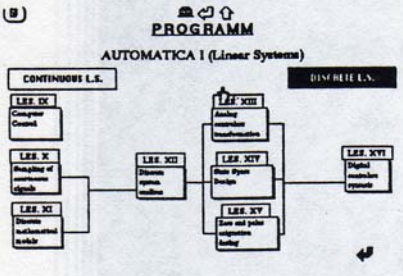

Figure 2

The lessons in the first part are: 1.-Introduction to control systems, 2.-Mathematical foundations, 3.-Representation of physical systems, 4.-Temporal response, 5.-Root locus, 6.-Frequency response, 7.-Analysis in the state space, 8.-Design in the state space

The lessons in the second part are: 9.-Computer Control, 10.-Sampling of continuous signals, 11.-Discrete mathematical models, 12.-Analysis of discrete systems, 13.-Transformation of analog controllers, 14.-Design in the state space, 15.-Pole and zero placement, 16.-Synthesis of digital controllers.

The student acts in front of the computer as he would with a book, turning over cards as if they were pages of a book. Every concept that appears in the text has an associated button that links it to the card where this concept was explained. HyperAutomatica also offers oral explanation. It also links with the Problems Stacks that contain the exercises related to the part of the lessons that it is being studied at this moment.

The lessons begin with a recall of any previous concept that is going to be used in them. In certain points of the lessons there are exercises to show how the theoretical concepts explained are applied to typical problems. These exercises are resolved using MATLAB (figure 3). When MATLAB ends its work control is returned to the point of the stack where it was before.

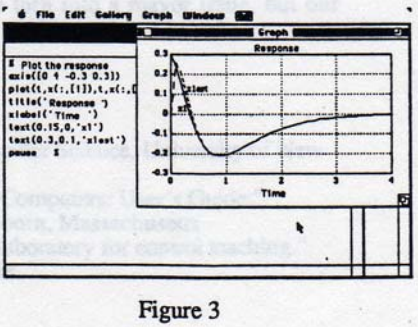

Figure 3

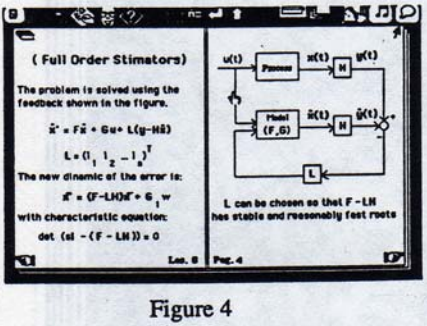

Figure 4

In order to explain the structure of the lessons,we show some cards from the lesson eight (Design in the State Space) The cards have many features on them, such as graphs, figures, text, etc (figure 4). The first card is a closed book with the title of the lesson on a label attached to it. Similarly the last card is the back cover of a book.

3 DEVELOPMENT TOOLS

The design of tools to ease the development of courses in HyperCard is an important task to make computer teaching effective. A number of development tools have been implemented. These tools are focused on making the distance teaching easy. These development tools are implemented by means of HyperCard buttons. A series of buttons are located in the upper part of the cards.All these buttons have special meaning. There follow a brief explanation of them:

Help: Links to the help Card.
Print: Prints the current card in the printer.
Music: Introduces music in certain moments of the presentation.
Telephone: Establishes telephone communication with the teachers.
Information related to the teachers: Presents the teachers and his position in UNED.
Notebook: Opens a notebook to make annotations
Gradual display of knowledge: Exhibit the information in parts
Oral explanation: Gives an oral illustration of the Card.

In the future there are going to be more buttons for other uses, buttons are planed for the use of multimedia elements (f.e. videodisc, videotape,..), in connection with the HyperCard stacks.This structure of information transmission is going to be tried out with students, in order to improve it. In the future we plan to apply this structure to the computer-aided teaching of others Department matters.

4 CONCLUSIONS

Our point of view is that Hypertext techniques allows user's interfaces to be constructed in an optimal way having the characteristic that are considered as "friendly". This was the principal reason for putting together HyperCard and MATLAB to develop HyperAutomatica to verify the advantages of this kind of solution.

HyperAutomatica is a Hypertext courseware to be used like a normal "text" to study Automatic Control in UNED. It is not in its definitive form, it still must be tried with students in order to improve the proficiency of this kind of teaching.

An other important contribution to this work is the design of development tools to facilitate the development of courses and to have a common display aids for other disciplines of the Department.

There are many problems to be solved in particular when the system has a large amount of data. In this case browsing and navigation turn into a mayor issue, but our impression with HyperAutomatica is very promising.

5 REFERENCES

Moler, C.(1978). "MATLAB". Dept of Computer Science, University of New Mexico, Albuquerque,NM.

Moler,C., et al (1989) "MATLAB for Macintosh Computers: User´s Guide." The MathWorks, Inc. Sherborn, Massachusetts

Dormido, S et al (1990) " HyperLab: A simulation laboratory for control teaching." CATS´90. Barcelona. Spain.