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Proposal for modeling and conformation of a virtual library with Matlab® for practical disciplines in higher education

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ABSTRACT

The text highlights the growing importance of technology, especially Matlab®/Simulink®, in optimizing industrial, economic and health processes through mathematical calculations, modeling and simulation. The focus of the work presented is the proposal for a virtual library for practical subjects in higher education, using these tools to help students model and simulate real systems. The study is justified by the need to support the development of practical activities in courses such as engineering and medicine, exploiting the capabilities of Matlab®/Simulink® to create and implement simulations of various systems.

Keywords: Virtual library, Higher education, Modeling and simulation.

INTRODUCTION

In an increasingly industrialized and technological world, there is a need for progress and expansion of computational resources in various areas of education, since the study of different processes and areas has become fundamental to mitigate energy and input costs. Currently these processes, which can be industrial, economic and even the study of human health, can be facially optimized by such tools, it is not new that technology has made life easier for human beings, both in the professional and personal fields. Therefore, these systems are fundamental in the process of developing research and modernization in various scientific and technological sectors. Aiming at the great growth in the technological field in recent years, during the need to develop more sophisticated systems for the creation, analysis and simulation of mathematical models applied to the most diverse areas, Matlab® (CHAPMAN, 2003) emerges, which came as a mathematical tool for calculation and simulation to help professionals from the most diverse areas. In this way, this system can help with: mathematical calculations or modeling, as well as simulation and visualization of dynamic system behaviors.

From this context, the work presented here by the authors focuses on showing how to make the proposal of modeling and conformation of a virtual library for practical disciplines in higher education, with the help of Matlab®/Simulink® (MATHWORKS, 2024). This aims to help students who have a certain difficulty in modeling real systems and designing simulations by implementing the use of

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Simulink®, (GUZMAN et al, 2021; PET, 2009), a tool that is also a component of Matlab®, which adds value and will make it possible to design and simulate any system of interest to the user. The general objective is to know how to model and conform a virtual library with Matlab®/Simulink® for practical disciplines in higher education courses, such as engineering and medicine courses.

MATERIALS AND METHODS

The development of the research is justified by the need to support the development of practical activities that exist today in higher education courses. This is how the use of virtual techniques is proposed to help the development of these activities, starting a bibliographic research in the areas of interest of implementation and development, such as systems, virtual libraries, modeling and simulation. The development of the research allows the selection and description of the main parameters or utility equipment in the area of the discipline object of the analysis of the specific higher education course where it is intended to be implemented, for example it can be for the discipline of Control, in the course of Electrical Engineering; then it is possible to carry out a study that allows to justify the selection of the program to be used, in this case, Matlab®/Simulink®, to show its characteristics, programming, editing and graphic tools available, in order to establish, develop or select from the variables or parameters of interest in the disciplines, the models of practical activities that allow their implementation in the virtual environment of the program, even developing the conformation of the virtual library to meet the demands of the students of the discipline.

EXAMPLE OF HOW IT CAN BE APPLIED IN A HIGHER EDUCATION DISCIPLINE

When developing this work, the Control disciplines in the Electrical Engineering course were taken as an example base. The methodological procedure for its realization is divided into stages.

In the first step, the bibliography research necessary for the understanding and realization of the work in the areas of mathematical modeling of dynamic systems, processes, control, components and simulation is presented, as well as the description of the main characteristics of parameters to be researched. Next, a study of the tools of the program to be used, in this case Matlab®/Simulink®, is carried out to know everything related to its programming, editing and graphics utilities available, which justifies the need for its use, thus showing the advantages of the development and subsequent implementation of the research, such as its use to carry out virtual laboratories. This is how the modeling and simulation methods to be applied for the conformation of virtual blocks in the form of a library are determined, making a choice of the most used system models in the large area of the specific course, for example in electrical engineering, which can be those related to energy efficiency, components of industrial and control systems (DORF and BISHOP, 2013), everything can be done from the previous

works developed or from the bibliographic review, thus establishing the theoretical basis that supports the research.

In a second stage, the choice of the model or system typology is made, forming the blocks in Matlab®/Simulink®. It should be noted that this choice for the conformation of models or systems is based on those areas of greater academic interest (based on the content of the discipline where it will be used). Finally, the design and conformation of the blocks is carried out in Matlab®/Simulink®, allowing facilities for the insertion of parameters with their magnitudes, which allows the choice and use in the simulation of virtual practices. Finally, the virtual tool now created is available in the form of a virtual platform for its use in the practical classes of the selected discipline. This procedure can be used by any other discipline of a higher education course as one has in economics or medicine.

FINDINGS

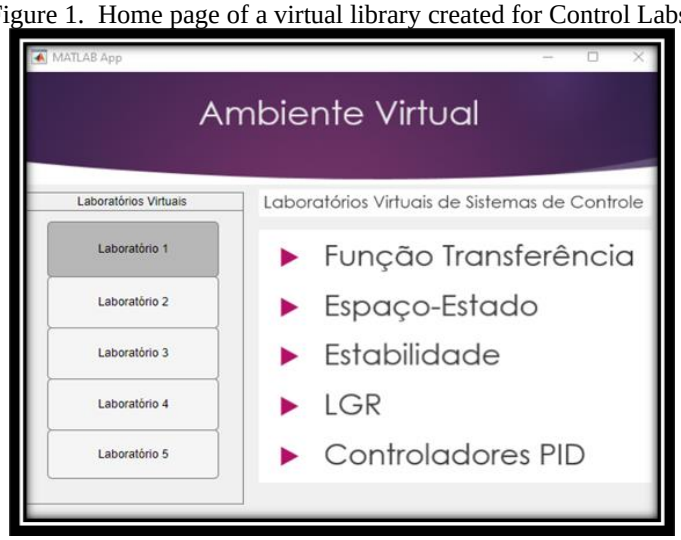
One of the fundamental reasons for choosing Matlab®/Simulink® is its wide acceptance in both the academic and scientific community and industry. The popularity and widespread adoption of this tool provides students with familiarity with a virtual development environment that is widely used in both spheres, preparing them for their life as a professional.

RESULT OF APPLICATION IN THE DISCIPLINES OF HIGHER EDUCATION, CONTROL AND ELECTRICAL CIRCUITS

The choice of the Matlab®/Simulink® program stands out for the complete integration of its system modeling and simulation tools. This characteristic allows students to understand and apply in a practical way the theoretical concepts received in the classroom, for example in the discipline of Control of the electrical engineering course, in its content different dynamic systems used in the engineering course are presented (OGATA, 2010,) because systems can be modeled and simulated or projects can be carried out on a single unified platform.

The virtual library, (NIASAR, 2021) designed based on the advantages and benefits of this program, proves to be a highly effective tool in the teaching and learning process. The continuation in Figure 1 shows an example of a virtual library created for carrying out practical activities in the discipline of Control, (JUNIOR, 2023) where the main components used were then the image and button components, and for the image components it is enough to select an image stored on the computer and for the buttons to program its function (MATLAB® *App Building*, 2024).

Figure 1. Home page of a virtual library created for Control Labs.

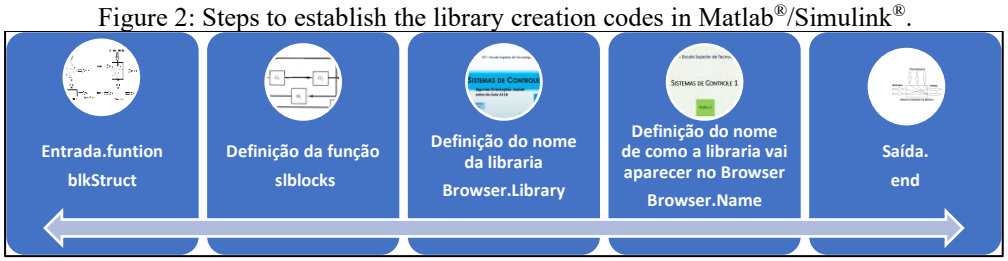


Source: Authorship.

In the library window, buttons were programmed for the different laboratories to be carried out and a button called "Help" was also programmed which, when clicked, opens a file where the application's instruction manual was placed for the user to read and familiarize themselves with the application and a general guide with instructions for running the laboratory. Figure 2 shows the steps to follow to establish the codes for creating other components, blocks, of the library in Matlab®/Simulink®.

The following Figures 3, 4 and 5 present visual evidence of the interactive resources employed, simulations and examples of system models created to enrich the students' experience in the practices. These concrete results reflect the practical application of the theoretical principles of the discipline shown here as an example, Control Systems (OGATA, 2010), allowing students to understand, experiment and improve their skills in the discipline.

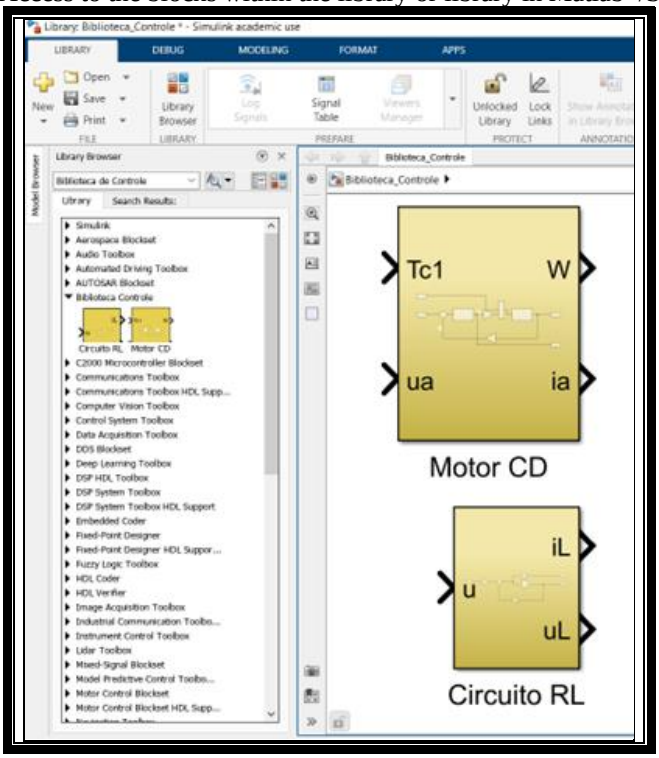
Figure 2: Steps to establish the library creation codes in Matlab®/Simulink®.



Source: Authorship.

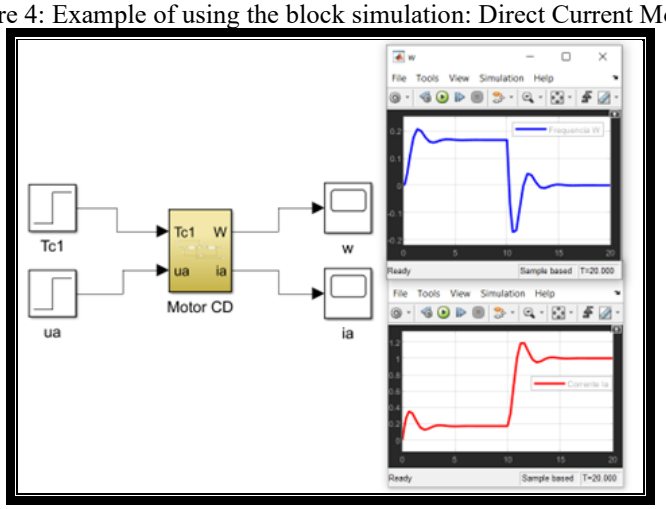
In the conformation of the virtual library blocks, a strategy is adopted that involves the creation of independent and reusable subsystem blocks, where the parameters of the variables can be inserted. These subsystems are designed with the purpose of offering students specific and ready-to-use virtual resources in various disciplines, with wide iterativeness, which undoubtedly improves the acquisition of knowledge about dynamic and control systems (SILVA et al, 2024).

Figure 3: Access to the blocks within the library or library in Matlab®/Simulink®.



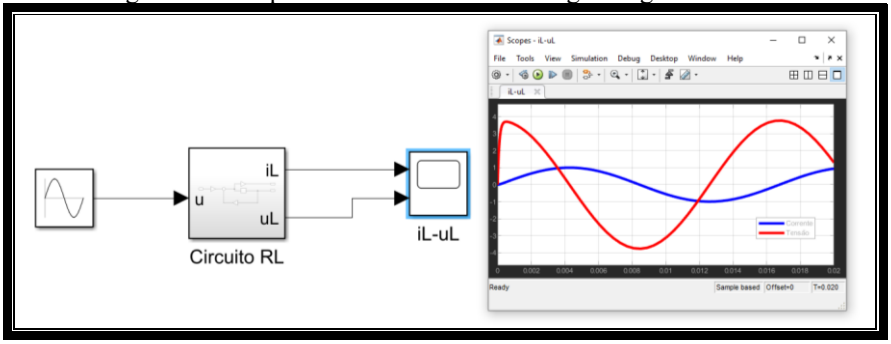
Source: Authorship.

Figure 4: Example of using the block simulation: Direct Current Motor.



Source: Authorship.

Figure 5: Example of block use : Alternating voltage RL circuit.



Source: Authorship.

FINAL CONSIDERATIONS

By implementing examples of how to create a virtual library with Matlab®/Simulink® to be used in higher education courses, it is demonstrated how computer technologies used for educational purposes can significantly improve the learning experience in the courses. The availability of interactive resources, practical simulations and system models, helps students in understanding and understanding the concepts and dynamic phenomena or behavior of a given system, which prepares them for challenges in the real and technological world.

In addition, the modular organization of the library, with the creation of specific subsystems in blocks, allows for a personalized approach that is adaptable to the individual knowledge needs of students. This approach not only strengthens the teaching of the discipline now researched, as for example it was in the Control System laboratories, but also promotes a solid basis for the study and use in other disciplines of higher education courses, where the use of modeling and simulation of systems and components is widely recognized and valued

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