



Multimedia based teaching aids for basic electric circuit theory

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Abstract

This paper describes multimedia software developed to increase understanding of basic electric circuit theory concepts. The package is designed to be used by first year students exposed by the first time to this material. Two packages are described here. The first one is called WinCIR! and the second one is called Circuits Tutorial. Both packages require Windows to work and are written in Visual Basic and Hypertext, respectively. Animations, audio, and video are included to better appreciate some of the concepts taught in the course.

Introduction

The first course on circuit theory[1] is the foundation for the study of electrical engineering. Thus, it is important for instructors to make sure that every student has a good mastering of each of the techniques taught in such a course, for example, to analyze circuits and in some topics, early concepts about design. Usually, this first course on circuit theory places heavy demand on student's time because the solution to many circuit problems requires calculation extensive exercises such as finding the solution for differential equations, calculating Bode plots, inverting matrices to solve mesh or node equations, and so on. To be able to successfully accomplish the proposed goal of teaching basic electric circuit theory, instructors have at their disposal a great deal of tools[1-3], one of the most important being the personal computer. Thus, we took advantage of this tool to design two packages that are very helpful to students in the circuit theory learning process. They are windows oriented and require WindowsTM to run. The first one is called WinCIR![4] and is written in VisualBasic. The second one is written in hypertext and includes animations and audio/video portions to show more detailed results in the theory. These two packages show how multimedia tools can be used to improve the circuit theory learning process. Finally, both packages are available in English and Spanish.



Description of WinCIR!

WinCIR! began as a collection of summaries on circuit theory to be distributed to students. However, at the time we saw the possibility to make it friendly to students by giving to it an attractive look and to provide an access to Pspice without having to teach a bore set of Pspice instructions. In addition, users can have a glimpse about founders of circuit theory. WinCIR! is formed of five parts. The first part is an administrator, the second one is the tutorial on circuit theory, the third part is the one which allows the simulations on Pspice, the fourth part is a set of examples of circuit simulations, and the last part is a set of biographical data on circuit theory founders. In addition, WinCIR! has a help option to obtain information on any of the tasks WinCIR! performs. WinCIR! is written in VisualBasic and requires, therefore, Windows to run.

Description of Circuits Tutorial

This is a full multimedia tool to be used as a teaching aid in circuit theory[5]. It is similar to WinCIR! but it has been enhanced to include animations of circuits showing changes to facilitate analysis of them. For example, there is a circuit having current and voltage sources. An animation shows how this circuit can be changed to one having only one type of source, either voltage source or current source. Also, video/audio presentations are available showing how the theory, simulation, and the actual lab experiment agree, as expected.

This Circuits Tutorial is written in hypertext in such a way that users can access additional options for each underlined topic. This is very useful to students because they can go as deep as they need according to their knowledge. Finally, they have access to oral presentations by an instructor explaining some of the topics appearing in the Circuits Tutorial.

Examples

As an example of what a student can do with WinCIR! we show how a description of the technique to obtain matrix node equations is given showing a network and its equation. This is shown in Fig. 1

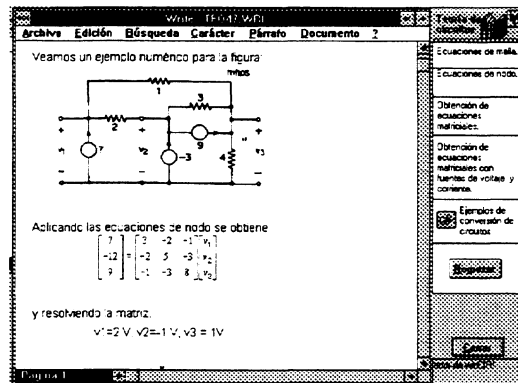
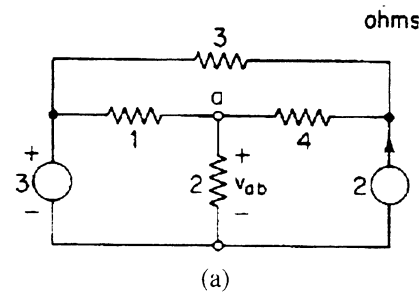


Fig.1 WinCIR! example showing how to obtain matrix node equations

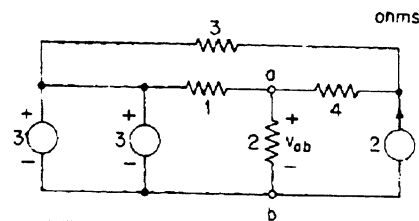


Fig. 2 shows three circuits showing how to change a circuit containing voltage and current sources to a circuit only with current sources. The animation shows how this actually is done in the network. By use of video several topics can be accessed showing results of many laboratory experiments such as Thevenin and Norton equivalents, mesh and node analysis, transient response, steady-state response, etc.

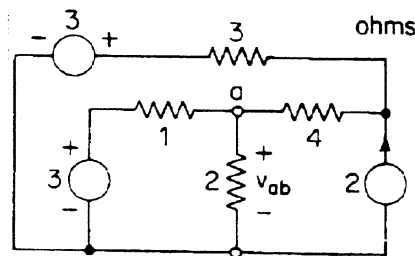
Fig. 3 shows another option available. This option allows students to analyze any given network for a dc or steady-state response. In this last one analysis, users can specify the frequency where evaluation is to be done. Arbitrary networks are allowed in this analyzer, too.



(a)



(b)



(c)

Fig.2 Step is the animation. a)Network with voltage and current sources. b)Duplication of the voltage source. c)Slitting the node to have each voltage sources in series with a resistance and ready to change them to current sources to perform node analysis

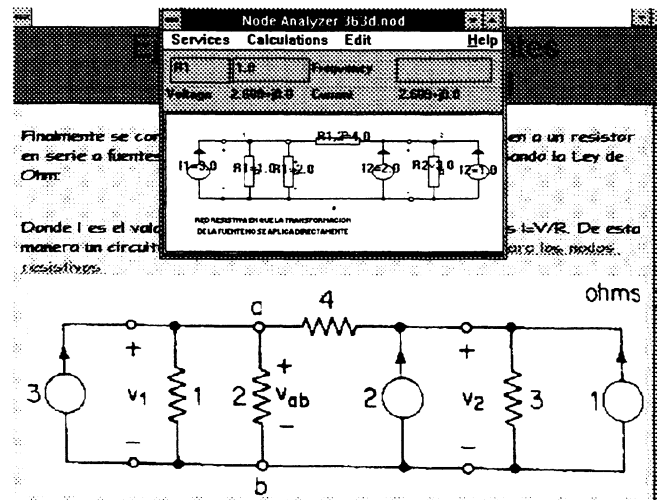


Fig.3 Circuit solver. Users can modify any circuit to obtain results.

Conclusions

We have presented two packages to assist students in basic circuit theory courses. One package is fully multimedia showing animations, audio, and video of some experimental results. It has been found that these packages can aid students to improve their problem solving capability and better understanding of circuit theory concepts.

References

- [1] L.P. Huelsman, Basic Circuit Theory, Prentice-Hall Inc, Englewood-Cliffs, N.J., 1992.
- [2] J.L. Ballesteros and D. Báez-López, RECIA: Software for the use of Simulators in Engineering Education, Vol. 2, No. 1, Jan. 1994.
- [3] See for example, IEEE Transactions on Education, Special Issue on Education Circuits and Systems, Aug. 1989.
- [4] G. Velasco, WinCIR!, B.S. Thesis (in Spanish), Universidad de las Américas-Puebla, 1996.
- [5] R. Jaroszyński, Multimedia Based Circuit Teaching, M.S. Thesis (in Spanish), Universidad de las Américas-Puebla, 1996.