Nonlinear Circuit Analysis Using PSPICE in Electrical Engineering Education

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Abstract

Computer simulation is a common technique in analysis and synthesis of electrical circuits in electrical and electronics engineering education. The models for components and devices together with operational blocks aid in the design and analysis of various circuits by allowing for detailed simulation of the circuit being tested. This paper describes application of Orcad PSpice on the analysis of nonlinear circuits over selected simple examples together with theoretical background. In this study, the educational role of the powerful simulation software Orcad PSpice in Electrical Engineering is investigated over three example circuits, each having at least one nonlinear circuit component, which effectively utilize the potential of the simulator. The examples are selected considering their educational value. Simulation results have shown that Orcad Pspice is highly visual and effective for understanding the theory underlying the circuits.

Keywords: Orcad PSpice, simulation, nonlinear circuit analysis.

INTRODUCTION

Computer simulation is a common technique for predicting the real world behaviour of a circuit. Although simulation software only reflect the capability of the model used in the back-plane and they cannot substitute the real-time experimentation, they have proven educationally useful due to their easy to construct and visual properties. Orcad PSpice is a general purpose circuit simulator and one of the various versions of SPICE capable of handling analog logical and mixed-signal parts, circuits and systems [1,2,3,4,5]. It has been extensively used by Universities and semiconductor manufacturers as an CAD [6,7,8,9,10] tool because of its simplicity and effectiveness. Evaluation versions suited for educational purposes are available and can be found at the URL : http://www.pspice.com/. Many parameters of circuits and devices can be profitably simulated using these free educational versions of PSpice.
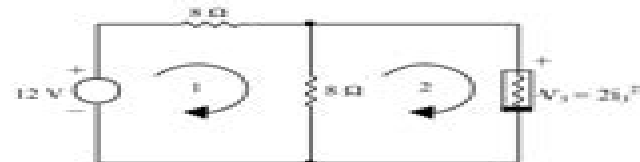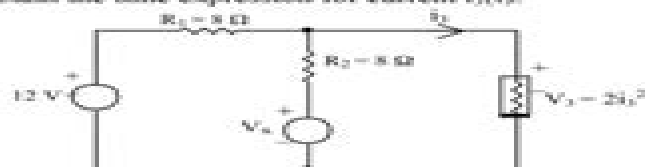
In the simulation procedure different approaches may be followed, namely, electrical component level, subsystem functional block level and higher system level comprising both of the previous ones[11].

On the other hand, many electrical devices are built from nonlinear components. In order to understand the design of these devices, a fundamental understanding of nonlinear circuits is necessary. Moreover there are no hard and fast rules to analyze most nonlinear circuits.

This paper treats three worked examples each including at least one nonlinear component with an educational view. Somewhat detailed theoretical background is presented followed by an Orcad Pspice construction and analysis completed with output graphics. Inside looks of any hierarchical blocks of models are also provided.

WORKED EXAMPLES

Example I : The circuit in Fig. 1a has a nonlinear component. $V_s(t)$ is given as $E.Sin(t)$, so that $E<<12$ V. Obtain the time expression for current $i_3(t)$.

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methods algorithms and software applied to scien tific computing symbolic numeric analysis and solving differential equations efficient computations with polynomials groups matrices and other related objects special purpose programming environments application to physics mechanics optics and to other areas In particular a significant group of papers deals with applications of com puter algebra methods for the solution of current problems in group theory which mostly arise in mathematical physics   Adaptive Systems in Control and Signal Processing 1995 Cs. Banyasz,2014-05-23 Leading academic and industrial researchers working with adaptive systems and signal processing have been given the opportunity to exchange ideas concepts and solutions at the IFAC Symposia on Adaptive Systems in Control and Signal Processing This postprint volume contains all those papers which were presented at the 5th IFAC Symposium in Budapest in 1995 The technical program was composed of a number of invited and contributed sessions and a special case study session providing a good balance between applications and theory oriented papers   **Transactions** American Society of Mechanical Engineers,1958   **Proceedings** ,1961   Frequency-response Methods in Control Systems Alistair George James MacFarlane,1979 A book of selected reprints Includes a chapter on the development of frequency response methods in automatic control   Engineering Journal ,1961 Vol 7 no 7 July 1924 contains papers prepared by Canadian engineers for the first World power conference July 1924

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