Chapter 16

A User-Friendly Application-Based Design Aid Tool for Power Electronics Converters

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EXECUTIVE SUMMARY

Power electronics and its related subjects are well-known difficult to understand especially for students taking them for first time. This is due to nature of the subjects which involve many areas and disciplines. The introduction of general-purpose simulation package has helped the student a step further in understanding this subject. However, because of the generality of these tools and their drag-and-drop and ad-hoc features, the students still face problems in designing a converter circuit. In this section, the problem above is addressed by introducing a design aid tool that guides the student over prescribed steps to design a power electronics circuit. The tool is interfaced with Pspice and its knowledge base encompasses two types of knowledge; topologies' knowledge and switching devices' knowledge. The first step in the design procedure is the selection of an application of the desired circuit. Then few steps are to be followed to come out with the appropriate topology with the optimum switching devices and parameters. System structure, its different modules and the detailed design procedure are explained in the following paragraphs. At the end a design example is demonstrated and its results are displayed and discussed. It is aimed that this tool will enhance the understanding of the subject by introducing an interactive user friendly graphical interface that guides the user to the right topology. The complex design steps are hidden for the sake of saving the design time. However, an explanation module is included for the users who want to know how the results are drawn.

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INTRODUCTION

Different simulation software are being widely used to design and simulate electrical and electronic circuits. These software require the user to be proficient in designing the circuits and need deep training to be familiar with. Moreover, the design is based on trial and error, till the user reaches the required outputs. Indeed, these packages have facilitated the task of the design engineer by providing a virtual way to check the reliability of the circuit without the need of its hardware realization. However, an approach to overcome the drawbacks of these packages and augment their functionality is to introduce the expert system techniques along with these packages. In this sense, in literature only few considerable researches could be found. An earlier work (Cumbi et al., 1996) was the development of PECT tool. This tool is a knowledge-based system developed using object-oriented technique. The drawback of this tool is the need of many packages to develop and to operate such as HUMBLES expert system shell, HSPICE, semiconductor library and the Smalltalk-80TM system. In (Fezzani et al., 1997) an automatic design process for UPS was presented as an attempt to develop an expert system tool for computer-aided design of static converters. It was interfaced with SUCCESS simulation software and was developed using SMECI expert system shell. (Wang and Lee, 1996) proposed an expert system for designing, analyzing and optimizing power converters. Fuzzy logic was introduced to select the optimum topology; Pspice was used as a simulator and the MATSPICE tool as an optimizer. A computer algorithm (Amaya, 1998) was introduced for synthesis of switching power converters (dc choppers for instance). Although, this algorithm was not based on artificial intelligence techniques, it can be considered as an advanced stage in automating the design process. Other works in this area can be found as in (Masatoshi, 1997), (Debebe and Rajagopalan, 1995), (Fezzani, 1998) and (Bouketir et al., 2002 and 2003),

In the present tool; power electronic design aid system (PEDAS) (omrane et al., 2005) a different approach is introduced to overcome the difficulties faced in the literature in order to come out with a fully-automated tool specifically for designing power electronics converters. The tool is interfaced with *Pspice* simulator and establishes an interaction with the user starting from the selection of a specific application until arriving to the optimum topology with all parameter values and switches suggested. The topologies are stored in the knowledge base as schematic files, allowing the *Pspice Schematic* to be able to display the resulted circuit. Here, PEDAS general outlook and its graphical user interface (GUI) are illustrated. Then, the various and attractive controls and tools used to build a smooth and flexible interaction medium with the user are stated in details. The topologies knowledge base representation and implementation methods are described. This includes both types of this knowledge; type-based topologies and application-based topologies. The access paths to this knowledge and its manipulation procedures are explained when the inference engine module is elucidated. Instances of the explanation and help module are given. Lastly, the devices library module, its significance and its considerable features and functions are thoroughly explained and demonstrated.

PEDAS LAYOUT (GUI)

The general layout or the system outlook or the graphical user interface (GUI) is of great importance. It gives the user the first impression about the tool. Hence, this outlook must be designed carefully and cautiously. Fortunately, the programming tool selected for the system development makes this task easy to accomplish. *Visual Basic* programming language, one of its famous features is the ability to provide pre-designed graphical controls (e.g. text boxes, command buttons, and list boxes), dialog boxes and flexible

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