Analysis and Synthesis of Electronic Circuits in Program Maple

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Abstract

This paper is a presentation of Maple packages for analysis and synthesis of electric and electronic circuits in Maple$^{\text{TM}}$ program. The packages have been developed on the authors' department for research and teaching support. Namely Syntfil package is intended for analog filter synthesis and PraSCAn package for numeric and symbolic analysis of linear circuits including both continuous time and switched circuits.

1   Introduction

Analysis and synthesis of electric circuits are often used operation in the process of electronic circuit design. Presently, several systems exist for this purpose. It is usually a case of single-purpose programs solving only one part of the design process or complete design. Most of them solve the task only numerically, hardly any program makes possible symbolic or semisymbolic computing. Their usage is not usually suitable for teaching purposes where it is necessary to follow results of separate design steps and mathematically treat them. From this point of view it is optimal to combine design system with suitable mathematical program and realize the design directly in this program – in our case Maple.

In the period of widespread global information technologies it is very advantageous to create also an interface for using this design system (packages) in the Internet environment. This allows us to use the system on computers with arbitrary operation systems, without any special software installation. The system can be used on every authorized computer with Internet connection. The application can be then easily administrated and actualized, because it runs in only one computer (server).

2   Syntfil Package

Syntfil is a package for analog filter design in Maple environment. The package was created at Czech Technical University in Prague, Faculty of Electrical Engineering. It contains all necessary procedures for complete design of analog electrical filters, which allows to user to calculate different filter approximations, and synthesize LC ladder filters or active RC (ARC) filters for all the basic filter types: lowpass, highpass, bandpass and band-rejection. New features have been added to Syntfil package. The extension consist of

functions for computation of the Bessel approximation, synthesis of filters with switched capacitors based on LTC 1060 chip, functions for Spice netlist creation of resulted filter structures, functions for creation of LATEX source file as a filter design documentation and Maplet™ interface for user friendly filter design. Syntfil package is sold through the Maplesoft Web site as part of the MapleConnect™ program.

3   PraSCAn Package

PraSCAn package is a library of functions for Maple which facilitates the symbolic analysis of electric circuits. PraSCAn is acronym for Prague Switched Circuits Analyzer. The input syntax for circuit description is near the same as in Spice programs. PraSCAn package can analyze continuous time linear circuits, idealized switched capacitor (SC) switched current (SI) and periodically switched linear (PSL) cirsuits. PSL circuits are either SC or SI circuits where nonideal effects such as e.g. switch r_{on} and r_{off} resistances are taken into account. The real course of signals are taken into account. In addition, time responses are calculated with respect to real input signal character, i.e. including so called leakage effect. By this way actual spectrum of the signals can be calculated including frequency response of circuits with undersampling.

4   WWW Interface

WWW interfaces for both packages is based on WWW (client-server conception). The computation and interface program runs on the server and a user uses an arbitrary graphic client ⇒ standard WWW browser (Internet Explorer, Mozilla, Opera etc.) for results displaying only. The server runs under operation system Linux. The design of filters is solved using the above mentioned Syntfil package in the mathematical program MAPLE. The interface between MAPLE and WWW is built up on scripts in PHP. According to client requests the results are presented by dynamically created WWW pages. These pages are provided to the client by means of HTTP server Apache.

5   Conclusion

Both packages represents original packages developed for using in Maple enviroment. The packages is drawn for using in engineering and also in teaching process at our university. Using the package in Maple enviroment, particular results can be mathematically treated and verified, directly in the worksheet. It is necessary for high-quality teaching software. Both packages are further being developed and extended about new facilities. Special functions are build for Syntfil package for digital IIR filter design and Maplet interface for user friendly filter design. The PraSCAn package is also being further developed to enable analysis of nonlinear circuits including electronic elements like diodes, transistors.

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