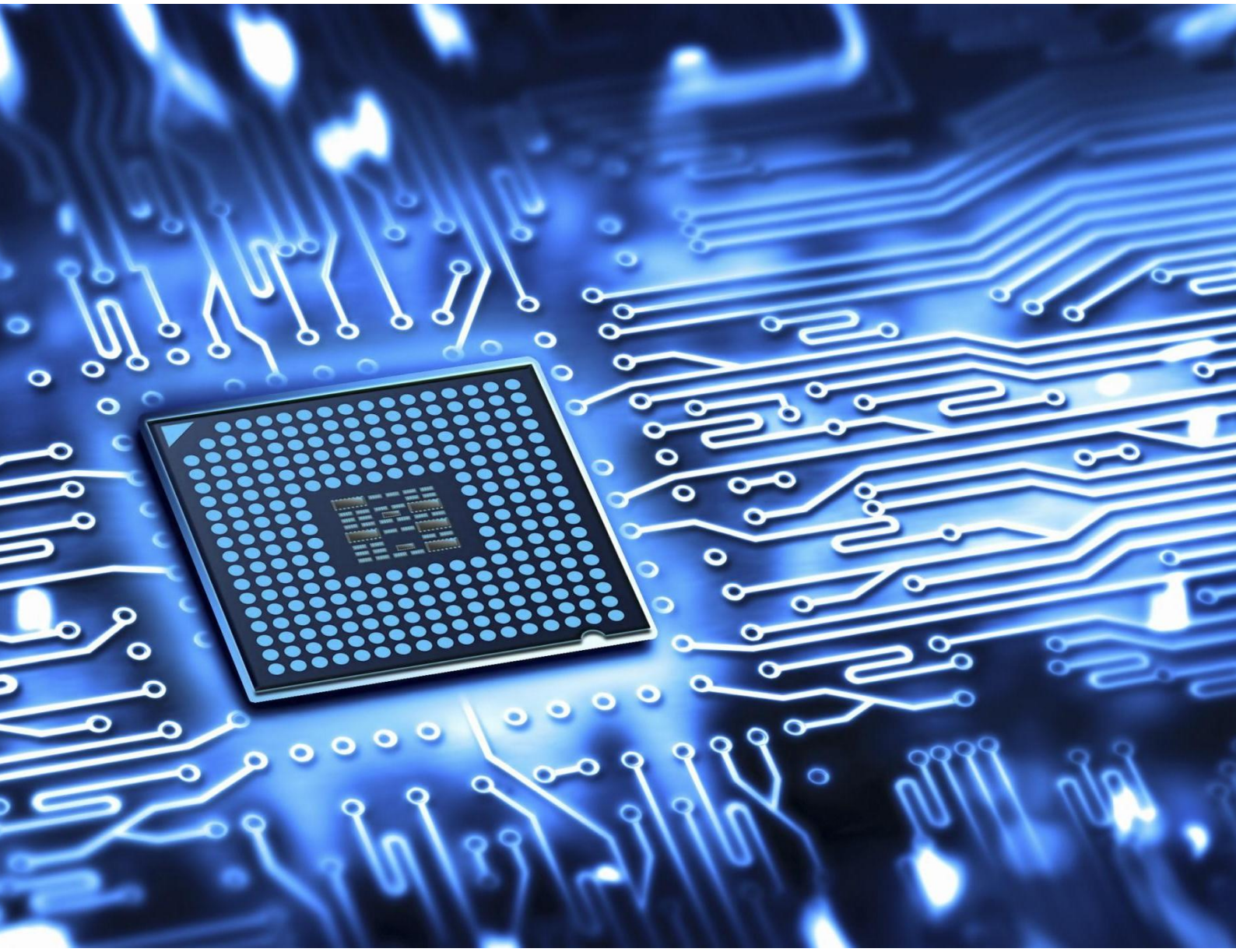
Integrated & Embedded Systems Laboratory



Automation of Analog Integrated Circuits Design

Poznan 2016

SI-Studio, a layout generator

Abstract

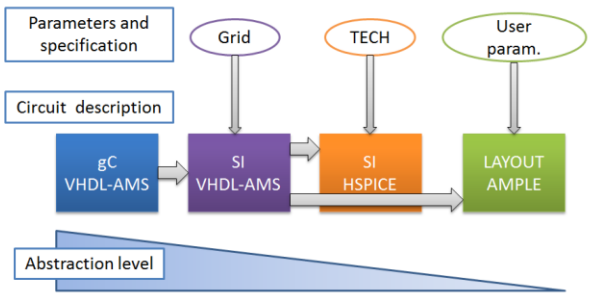
SI-Studio is an environment which is an answer to the problem of the SI analogue circuit layout generation. Difficult design steps, which have already taken a lot of time and caused a lot of mistakes, have been automated to the level of executing suitable programs and algorithms which realise those complex tasks.

Highlights / Key features

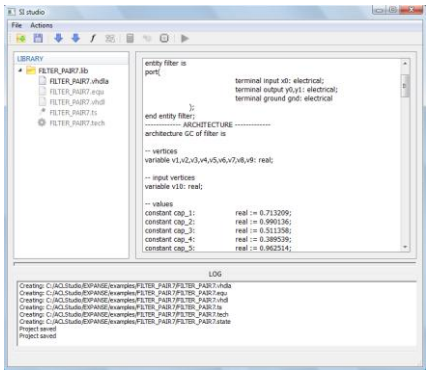
full design automation of SI circuits; technological independence; control of power, work speed and layout area parameters; assigning features of synthesizability to the VHDL-AMS language; compatibility with commercial solutions; using digital techniques for designing analogue circuits;

CAD Tool

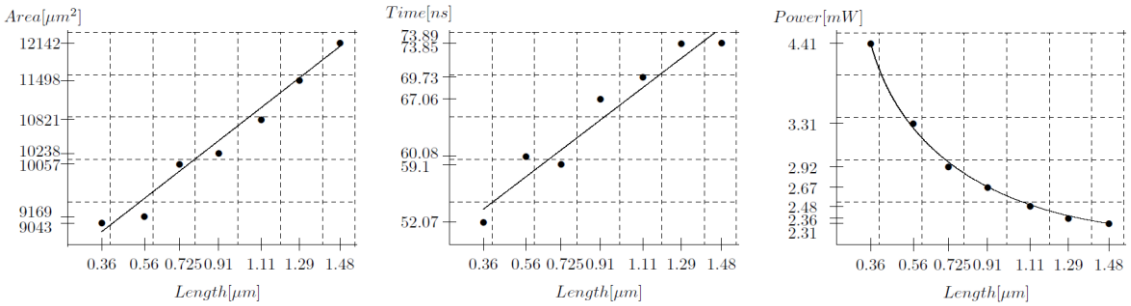
This work is the answer to the so far unsolved problem of generation of integrated circuits topography for current mode circuits. Synthesis methods corresponding to already existing digital methods are proposed. Among others – the following has been shown: a digital adaptation of the row strategy for analog cell design, as well as performance control of the circuits with respect to chip area, power consumption and speed operation. Technology independence is obtained thanks to including the technological specification in the process of generating scripts.



Concept of design automation system

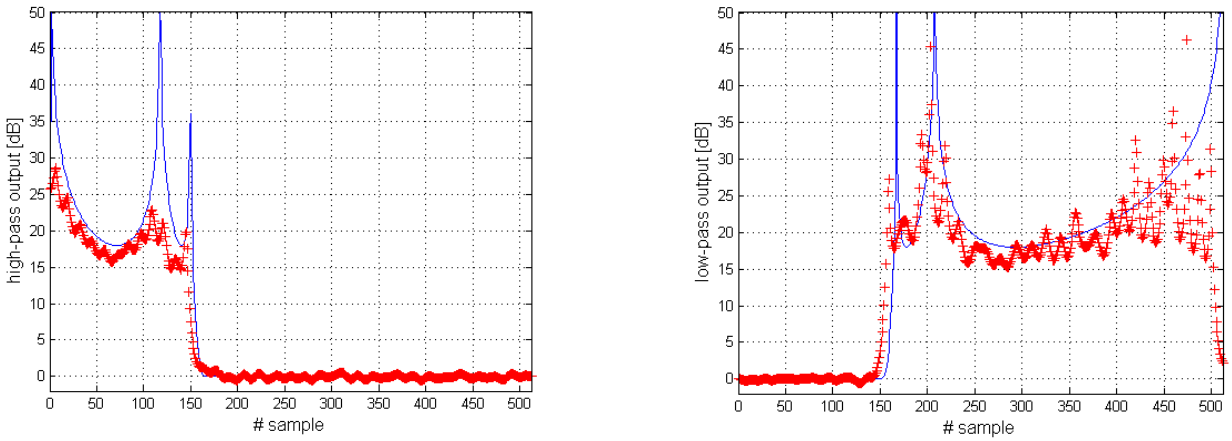


Main window of the SI-Studio

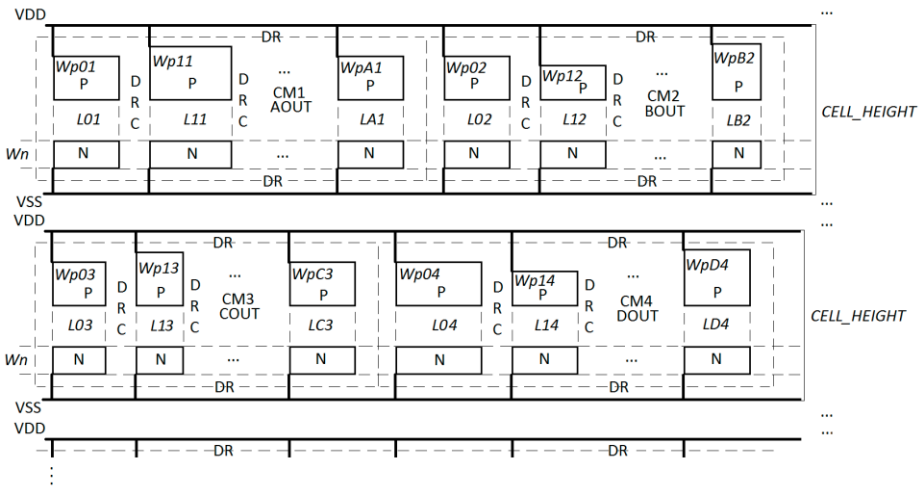


Performance control – design focus

The proposed algorithms are integrated with the already-existing tools for automatic layout generation of analog circuits with behavioral description at the beginning. At each stage of the synthesis process – an architecture description in the VHDL-AMS language was used, which so far has been not useful to synthesize.



Filter pair frequency characteristics for low-pass and high-pass outputs calculated from chip measurements environment



Analog devices floorplan generator

SI-Studio which allows automatic layout generation of analog current mode circuits with controlled chip area, power consumption and speed operation is a research contribution of the project. The practical advantage is an experimental chip fabrication in CMOS technology and testing in the environment based on FPGA.

Main Contributions

A. Handkiewicz, S. Szczęsny, M. Naumowicz, P. Katarzyński, M. Melosik, P. Śniatała, M. Kropidłowski, SI-Studio, a layout generator of current mode circuits, Expert Systems with Applications, vol. 42, Issue 6, pp. 3205-3218, 2015, IF = 2.24

Szczęsny Sz.; Naumowicz M.; Handkiewicz A., SI-Studio – environment for SI circuits design automation, Bulletin of the Polish Academy of Sciences, Technical Sciences, vol. 60, Issue 4, p. 757-762, 2012, IF = 0.914

Handkiewicz A.,Szczesny S., Melosik M., Naumowicz M., Katarzynski P., Generation of SI filters layout using the row strategy, Przegląd Elektrotechniczny, vol. 87, Issue 10, pp. 80-83, 2011

gC-Studio - the environment for automated filter design

Abstract

gC-Studio is an environment that allows to automatic design of different, elaborated analog filters, by provide basic parameters of the filter. The parameters are provided with VHDL-AMS syntax, that allows to work with commercial tools.

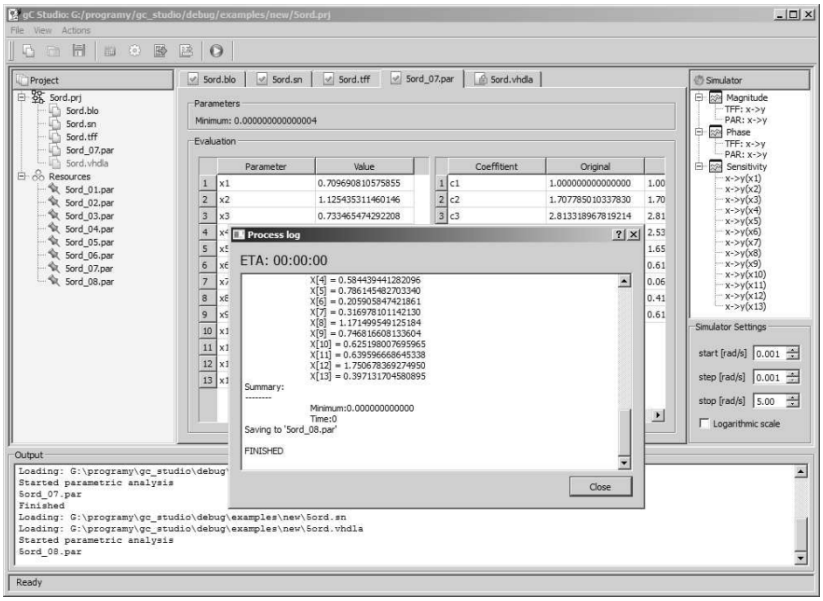
Highlights / Key features

simulates the frequency responses; producing the transfer functions; constructs the symbolic matrices; finds the values of the components in the circuit;

CAD Tool

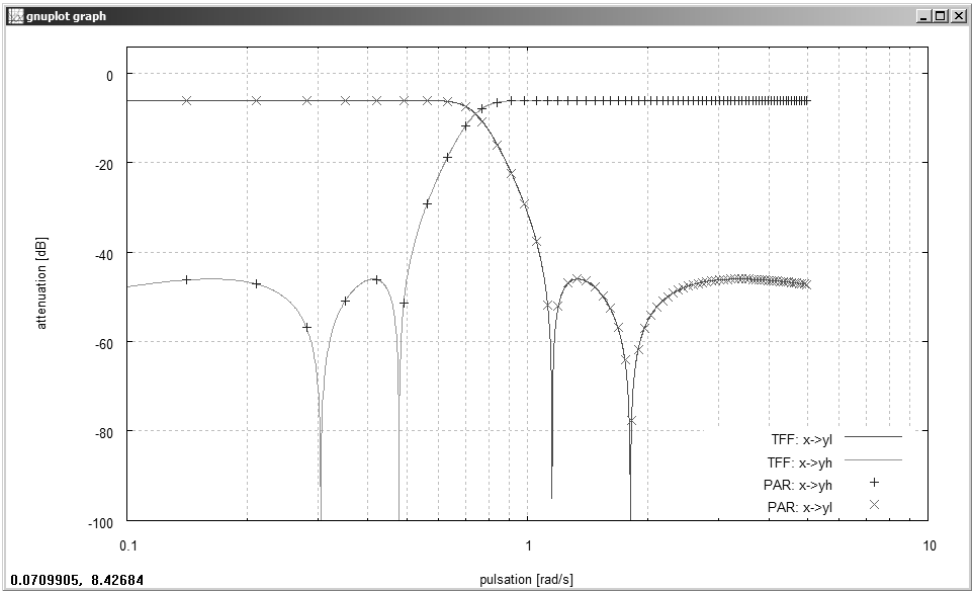
The gC-Studio software suite integrated several applications:

- gc analyser, that creates the netlist of elements basing onto the model provided with VHDL-AMS syntax. It constructs the symbolic matrices for the nodal potential method and calculates their determinants in order to provide the symbolic transfer function. It may also export the data at any stage of the analysis to the third party software such like Matlab;
- filter, that finds the mathematical approximations of the transfer functions for filters of given properties for their frequency responses. Currently the Butterworth, Chebyshev and Cauer approximations are supported. Both low-pas and high-pass versions are obtainable. Moreover, the software is capable of producing the transfer functions for filter pairs;
- param calc, that implements the Hooke-Jeeves direct search algorithm in order to find the values of the components in the circuit;
- gc sim, simulates the frequency responses for both symbolic and approximated transfer functions. It is also possible to realize the sensitivity analysis with respect to values of parameters.



Main window of the gC-Studio

The obtained software suite supports the behavioral synthesis of filtering structures that in general may be multiport circuits. According to filter pairs the mathematical approximation for the transfer functions have been implemented basing onto the elliptic low-pass filter. Figure present the frequency responses of filter pairs obtained with gc sim.



Frequency responses for filter pair obtained with gC-Studio

Main Contributions

Piotr Katarzynski, Michał Melosik, Andrzej Handkiewicz, gC-Studio - the environment for automated filter design, Bulletin of the Polish Academy of Sciences Technical Sciences, vol. 61, Issue 2, pp. 541-544, IF=0.914

Andrzej Handkiewicz, Piotr Katarzyński, Szymon Szczęsny, Jarosław Wencel, Paweł Śniatała, Analog filter pair design on the basis of a gyrator–capacitor prototype circuit, International Journal of Circuit Theory and Applications, vol. 40, Issue 6, pp. 539-550, 2012, IF = 1.179

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A. Hankiewicz, P. Katarzyński, S. Szczęsny, M. Naumowicz, M. Melosik, P. Śniatała, M. Kropidłowski, Design automation of a lossless multiport network and its application to image filtering, Expert Systems with Applications, vol. 41, Issue 5, pp. 2211-2221, 2014, IF=2.24