Review of PhD Thesis

Author:  Ing. Nabhan Khatib
Title:  Circuits for Analog Signal Processing Employing Unconventional Active Elements
Reviewer:  Prof. Ing. Jaromir Brzobohaty, CSc.

The thesis deals with new or improved electronic circuit blocks for the modern low-voltage low-power integrated circuits in CMOS technology. The thesis is focused to the circuits in the bulk-driven quasi-floating-gate technology.

The object of the thesis well corresponds to the field of the thesis and belongs among the up-to-date research interests of the world scientific community in the field of circuit theory and integrated circuit design. It is orientated to the so called new circuit principles which try to improve the parameters of circuits by introducing new circuit structures mostly in the current standard technology of the manufacturer. Such a solution is usually much cheaper than the change in standard technology.

The main objectives of the thesis are defined as the implementation and improvement of various types of the of active circuit blocks by using new concepts and techniques, e.g. many low-voltage low-power techniques, current-mode circuits etc.

The core of the thesis consists in the design, improvement, use and simulation of the following novel circuit blocks (according to the author’s denotation):

1. LV LP BD CCII based on the folded cascode OTA
2. Ultra LP FG CCII+ based on the folded cascode OTA in the class AB
3. LV ultra LP QFG CCII based on the folded cascode OTA in the class AB
4. LV ultra LP FG DVCC based on the folded cascode OTA in the class AB
5. LV LP high precision BD DBeTA
6. Ultra LV BD QFG transconductor
7. High precision GD CCCDBA
8. High precision GD VDBA
The other part of the thesis core presents some new filter and oscillator applications of the above mentioned circuit blocks:

1. Current mode multifunction filter based on the BD CCII
2. Current mode quadrature oscillator based on the FG CCII+
3. Current mode quadrature oscillator based on the QFG CCII
4. Voltage mode multifunction filter based on the FG DVCC
5. Voltage mode oscillator based on the BD DBe TA
6. Voltage mode multifunction filter Gm-C based on the BD QFG transconductor
7. Electronically tunable voltage mode quadrature oscillator based on the GD CCCDBA
8. Voltage mode multifunction filter based on the GD VDBA

The positive results of the thesis can be summarized as follows:

- Definition and description of the new circuit block -DBeTA- is the main contribution of the thesis to circuit theory.
- Improvements of many above named circuit blocks by using LV LP techniques and universal conveyors.
- Novel application of the designed circuit blocks in filter and oscillator circuits.

Regarding the negatives, in the thesis I did not find any serious drawbacks but there are some negatives e.g. the experimental verification of the design on a chip is missing and all the experiments are only software ones. The function of the oscillators is verified only by a simulation of the steady state without any circuits for stabilizing the amplitude. It means that the amplitude is stabilized only by the nonlinearities of the feedback loop which is not a good solution. For the filters the simulation is done only for low quality factors, which hides some real effects.

The structure of the thesis corresponds to the required standard form. The English technical terminology is correct but some current sentences are grammatically incorrect.
Some of the results have been published in reviewed journals. The author declares about 12 reviewed publications in the list of his publications.

I ask the following questions:

1. The experiment in the thesis is reduced to a simulation only. To what extend can we rely upon your PSPICE results?
2. How can you provide the oscillation condition in the designed oscillators automatically?
3. How can you verify that the designed applications, e.g. filters, are stable?

As a conclusion I can declare that Ing. Nabham Khatib meets the requirements given by the rules in force for awarding the title PhD and for this I give my full recommendation.

In Brno, November 18, 2013

Prof. Ing. Jaromir Brzobohaty, CSc