Thesis proposal: Design and implementation of circuit blocks for the synthesis of parameter-varying filters

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I. JUSTIFICATION OF THE THESIS PROPOSAL

Parameter-varying filters are a new class of continuous-time filters whose transient response has been improved by means of the variation of one or more of its describing parameters. Although the theory behind the operation of these filters has been mainly formulated for the continuous-time case [1]–[3] and some applications for these filters have been found in the field of instrumentation systems [1], [4], [5], there are few analogue implementations of these systems [6], [7].

II. AIM OF THIS PROJECT

In the frame of this thesis proposal, analogue CMOS electronic circuits will be designed to implement a second-order parameter-varying filter. The circuits to be designed comprise:

- A second-order lowpass filter whose transfer function can be modified by the variation of one or more bias currents.
- An automatic tuning loop to compensate for process and aging variations of the components of the filter to ensure that the desired transfer function will be attained.
- Circuits for the generation of the functions required to vary the filter parameters.
- Circuits for the control loop required for the adjustment of the transient behaviour of the filter.

It is expected that the prototype to be designed in this project will operate at frequencies up to 1 MHz.

III. EXPECTED PRODUCT

The following products are expected from this project:

- A MSc degree thesis reporting the results of the research work carried out during the project. The thesis will be defended in front of a thesis committee not later than August 2012.
- A conference article which will be submitted to a high-ranking international conference in 2012. It is expected that the student (or students) involved in this work present themselves the results of their findings.
- A complete layout of the designed filter for its fabrication in a standard CMOS process - to be defined in the course of the project.

IV. PROJECT VARIATIONS

The project supports two variations to welcome the participation of at most two students. This means that two different thesis proposals are available.

It should be noted, however, that the maximum number of students allowed in this project will depend on the amount of students registered in the proposal entitled “Simulation of electronic circuits using RPCs.”

Each of the students will develop a complete parameter-varying lowpass filter comprising the circuit blocks mentioned in Section II of this document. Each filter will be based on a different dynamical model formulated with the so-called time-varying eigenvalues [8], [9]. The models for these filters are already available.

V. ADDITIONAL INFORMATION

The interested students should contact Dr. M.Á. Gutiérrez de Anda (office 1422). The project is funded by CONACyT and there are resources available for IC fabrication, participation in conferences as well as extraordinary financial support for students.

REFERENCES