2018-00296 - [APICS] Tracking (un)stable poles during stability analysis of microwave circuits

Contract type: Internship agreement
Level of qualifications required: Graduate degree or equivalent
Function: Internship Research

About the research centre or Inria department

The Inria Sophia Antipolis - Méditerranée center counts 37 research teams and 9 support departments. The center's staff (about 600 people including 400 Inria employees) is composed of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrators. 1/3 of the staff are civil servants, the others are contractual. The majority of the research teams at the center are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Six teams are based in Montpellier and a team is hosted by the computer science department of the University of Bologna in Italy. The Center is a member of the University and Institution Community (ComUE) "Université Côte d'Azur (UCA)".

Context

A large part of the design of modern analog electronic circuits is performed using computer simulations due to the very high prototyping costs. The performance and robustness of a circuit are all verified on the computer first before an actual prototype of the circuit is constructed.

Stability is one of the most important circuit properties that has to be guaranteed in the circuit simulator. A solution of a circuit’s equations is stable when it can recover from a small perturbation. When an unstable solution is perturbed, the circuit will not return to the original solution, but will move to another, possibly unwanted, solution.

Take an amplifier as an example. When there is no signal applied to the input of the amplifier, there should be no output signal. When the equilibrium solution of the amplifier is unstable however, an amplifier without input signal will generate strong oscillations. This instability will reduce the amplifier’s performance and can cause the transistors to overheat. Instability in an amplifier needs to be avoided!

An oscillator, on the other hand, is designed to have an unstable equilibrium solution. This causes the oscillator to generate a signal of its own at a wanted frequency. For the design of both amplifiers and oscillators, designers need fast and reliable stability analysis tools.

To test the stability of a circuit solution in the simulator, the circuit is linearised around this solution and a frequency response function is obtained. When this function has poles in the complex right half-plane, the solution is unstable. Local stability analysis therefore boils down to determining whether a given complex function has poles in the right half-plane or not.

Assignment
At APICS, we have recently developed an analysis tool that can determine the stability of a given frequency response function. The goal of this internship is to help with the development of this stability analysis technique.

More specifically, you will use and modify our analysis tool to implement pole-tracking. Pole-tracking allows to study the movement of the poles of the linearised circuit when the circuit parameters vary. With access to this information, a circuit designer can speed up his or her design cycle and improve the robustness of the design.

**Main activities**

During the internship, you will invent a pole-tracking algorithm, implement your algorithm in Matlab and apply it to both synthetic and real examples to verify its performance.

**Skills**

You need a strong background in complex analysis and applied mathematics. Also, a good level of programming is required (Matlab). Some basic knowledge about electronic circuits or systems and control theory can help.

**Benefits package**

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities