Electronic interfaces to thin-film silicon MEMS

Proposers

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Microelectromechanical resonators (MEMS resonators) show resonance frequencies that can vary from kHz to GHz and quality factors up to 10^7. MEMS resonators are fabricated using clean room micro and nanofabrication techniques and a variety of structures and resonant modes are available (flexural, torsional, bulk resonators, for example). MEMS resonators are promising devices for multiple high-performance sensing applications.

The Thin-Film MEMS and BioMEMS group at INESC MN has developed a low-temperature, large-area process for the fabrication of MEMS resonators that allows these resonators to be implemented on glass and flexible polymeric substrates, as well as integrated with CMOS in a backend process. There is a variety of actuation and transduction mechanisms that can be used with the MEMS resonators, but the most widespread and more amenable to integration is the electrostatic actuation and the electronic detection of the motion of the resonator.

Central to the applications of MEMS resonators is the integration of the resonator with its addressing electronics and, in particular, the integration of the MEMS resonator as the resonant component of an oscillator. This objective requires an in-depth understanding of the electromechanical properties of the MEMS resonators and how these properties couple to the design and micro and nanofabrication of the MEMS devices, and also an in-depth understanding of the field of oscillator electronics. This project integrates these two capabilities with the aim of developing thin-film silicon MEMS oscillators which integrate the MEMS resonator with different types of addressing electronics, from individual components in a PCB to monolithic CMOS to thin-film electronics, and the concurrent aim of using these oscillators both for mass sensing applications and to achieve an in-depth understanding of the frequency stability characteristics of thin-film silicon MEMS resonators.

Profile sought: preference, but not limited, to students with a background in Physics with an interest in Electronics or Electrical Engineers with an interest in Physics, Devices, and Micro and Nanofabrication.