Tactile sensing for robots, wearable devices and human-computer interfaces

Proponents:

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The goal of this project is to design and develop novel soft 3D force/tactile sensors. The sensors will be based on soft materials (i.e. silicone elastomer) and magnetic sensing technologies (i.e. spin valves or MTJ). The design will be inspired by an existing 1D version of the sensor [Jamone et al. 2015 - http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=7070742&tag=1]. The development of such novel sensors would have a big impact both in robotics and digital interfaces, e.g. soft artificial skin that can improve the robot sensing capabilities (especially for grasping and manipulation), wearable glove that can measure the force interaction of a human with the environment, soft human-computer interface for enhanced virtual reality.

Several architectures will be explored for integrating the sensors in the fingers, and the detection principle will be evaluated targeting at the best performance and surface conformity. The overall system will be designed as a soft sensor that allows to measure the applied pressure/force.

The first part of the project will be to optimize the design of the sensor, starting from an existing design of a 1D version (i.e. a version that measures only normal forces), and redesign it to measure both normal and tangential forces. We will compare novel 3D hall-effect and magnetoresistive technology for field sensing, as well as the use of permanent magnets vs electrical coils as field generators. After a first working prototype is realized, it will need to be tested to further optimize the sensor structure (and possibly the components themselves) in order to achieve desired features of the sensor: high sensitivity, low hysteresis, mechanical robustness, intrinsic compliance (i.e. softness). The second testing phase is meant to reach a fully operational version of the sensor, and it will require the realization of the sensor readout circuit, and of a simple interface to visualize the sensor readings.

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