

Electronic Platforms and Signal Processing for Magnetic Biochips

Proponents: Gonalo Tavares (INESC-ID), Susana Freitas (INESC-MN)

Introduction:

Point-of-care (POC) devices are a promising technology for pathogen detection enabling an increased response speed, sensitivity and portability. Magnetoresistive (MR) sensors have promising characteristics as sensing devices, as they are highly sensitive and allow a discrete quantification of magnetic entities, therefore being an interesting tool for biomolecule quantification, assuming magnetic labelling can address the specificity and identity. In these devices, biochips are combined to electronic and microfluidic platforms enabling a multiplex detection signal acquisition and processing. Although impressive advances have been done in the past years towards a portable, autonomous platform, several challenges are still to be solved.

Aims:

This project aims at developing a fully integrated Point-of-Care POC device comprising a sample preparation module, a multiplexed magnetoresistive chip and data acquisition interface so that biological samples can be directly loaded and analysed. The existing multichannel PCB developed for the simultaneous detection of 15 magnetic sensors of the cytometer will be used with advantage, while improving the data acquisition and analysis methods. In particular, filtering and amplification studies are required to optimize the signal-to-noise ratio and signal peak shape detection, so the interpretation of the bipolar pulse shape can be accurately and unequivocally linked to biomolecular events. The platform needs to include an autocalibration mode for the parallel readout from the 15 MR sensors. Together with a magnetic detection of labelled biomolecules, the POC will incorporate an integrated optical system, enabling the simultaneous identification of particles motion inside the microfluidics, when large nanoparticles are used, allowing a cross-calibration of the magnetic results obtained with the MR sensors. Power consumption, portability and appealing design will also be considered while assembling the electronic and mechanical components of the POC platform.