Design Projects

Some sample design projects used in previous terms are described briefly below, and are representative of the types of projects we will use. Descriptions, specifications and design goals for this term's projects will be provided later in the term. The scope of each project will include a microfabricated device, the drive/detection electronics, and a packaging concept. Each project will have a team of four or five students. Depending on enrollment, there may be more than one team on a given topic.

1. A fast dielectrophoretic cell sorter

Cell sorting is a commonly used biological technique that can isolate target cells from a bulk population based on differences in size, shape, or molecular specificity. In this project you will explore the fundamental limits for micro-flow sorters by designing a truly fast (>1,000 cells/sec) micro-cell sorter. The sorter will be created out of PDMS on glass and will use dielectrophoresis to push incoming cells into one of two outlet microchannels. In the process you will couple it to an optically based detection system, actuation electronics, and identify the fundamental limits on sorting.

2. A piezoresistive sensor for biomolecular recognition

The goal of this project is to create cantilever-based device that detects stress induced by molecular binding. Two cantilevers (operated differentially) will be created out of SU-8 with integrated poly-Si piezoresistors. The packaged device will be used in a hand-held point-of-care diagnostic monitor and so must be robust, small, and connected to a circuit that gives an output proportional to the logarithm of the concentration ratio.

3. RF-IF filter

The superheterodyne radio receiver, one of the truly brilliant inventions of the 20th century, uses a nonlinear frequency converter in combination with a tunable local oscillator to convert the incoming radio signal to a lower fixed frequency (the so-called “intermediate frequency” or “if”). The goal of this project is to design a surface-micromachined silicon resonator or combination of resonators that are used to create an if filter for incorporation into a one-chip radio.

4. A micro flex-tester for measuring the compliance of microstructures

The goal of this project is to build a microfabricated force-displacement sensor device to characterize the compliance of microstructures. The micro-flextester is a metrology tool used to measure the actual force-displacement characteristic of microfabricated compliant structures. You will select a sensing scheme (i.e., piezoresistive strain gauges or capacitive displacement sensors) and use it in a device that must be small, have tunable force resolution, and integrated displacement and force sensing.