

System Control of Cellular Systems

Micro-Electro-Mechanical-Systems (MEMS) technology enables us to design and fabricate transducers matching the length scale of a biological cell. With this unprecedented capability, we can interrogate and manipulate cells for diagnostic or therapeutic purposes.

Micro implantable systems or drug screening systems need to interface with live cells which make the task become extremely challenging. Cell consists of a large number of macro functional molecules. Cellular activities are manifestations of intra- and inter-molecular transports, motions of cellular molecules, and signaling pathway regulation. Design an engineering system to interact with a biological complex system to achieve a well defined goal leads toward an extremely rich research field.

In this presentation, we will present a unique approach which employs an engineering system control scheme to direct a cellular system toward a desired phenotype through combinatorial drug stimulations [1]. With the system control, we can rapidly search the optimal drug combination from a large number, say 1,000,000, potential trials. In addition, much lower drug doses than would be necessary if the drugs were used alone; in fact, the concentrations of the drugs were only about 10 percent of that required when used individually.

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