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Title: Phenotyping *C.elegans* and Neuronal Cells in Microengineered Devices

Abstract:

Phenotype denotes the observable traits or behaviors of any living subject such as cells, animals, and humans. In the post-genomics era, the next major challenge in the biological community is establishing the link between genotype and observed phenotype. Even though phenotypic characterization of higher mammals is complicated, it is possible to quantify the phenotype of live cells and model organisms with relative accuracy. In this respect, engineering platforms are being created with controlled microenvironments and ease of manipulation to quantify visible behavioral differences. Such platforms are especially developed to enable increased experimental throughput, data reproducibility, device robustness, and system versatility. With these broad goals, this thesis focuses on two technology platforms families that we built in our research group. The first platform family is microfluidic systems with real-time imaging to characterize the behavior of *Caenorhabditis elegans* microorganisms under chemical, electrical or mechanical stimulation. The second platform family is microelectronic/microfluidic assays to quantify the degree of cell migration among different cell populations. For each of the two platforms families, the process of device development, system assembly, software interface, and experimental results are presented. The results demonstrate the advantage of using microscale technologies, particularly high spatial and temporal resolution, for studying phenotype and lead our discussion to future technological considerations for successful adoption in biological laboratories. Lastly, this thesis also emphasizes the need for sustained collaborations between engineers and biologists for proper problem identification and proposed solutions.