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Single Cell Response to Time-dependent Stimuli using a Microfluidic Bioreactor[1] ERIC M. JOHNSON-CHAVARRIA, Center for Biophysics and Computational Biology, University of Illinois at Urbana-Champaign, UTSAV AGRAWAL, MELIKHAN TANYERI, Department of Chemical and Biomolecular Engineering, University of Illinois at Urbana-Champaign, THOMAS E. KUHLMAN, Department of Physics, University of Illinois at Urbana-Champaign, CHARLES M. SCHROEDER, Department of Chemical and Biomolecular Engineering, University of Illinois at Urbana-Champaign — Cellular adaptation is critical for survival under uncertain or dynamic environmental conditions. Recent studies have reported the ability of biological systems to implement low-pass filters to distinguish high frequency noise in environmental stimuli from lower frequency input signals, yet we still lack a complete understanding of this phenomenon. In this work, we report a microfluidic-based platform for single cell analysis that provides dynamic control over periodic, time-dependent culture media. Single cells are confined in free solution by the sole action of gentle fluid flow, thereby enabling non-perturbative trapping of cells for long time scales. In this way, our microfluidic-based technique provides the ability to control external stimuli with precise methods while observing non-adherent cells over long timescales. Using this approach, we observed intranucleoid diffusion of genetic repressor proteins released from a chromosomal binding array. Overall, this microfluidic approach provides a direct method for sustaining periodic environmental conditions, measuring growth rates, and detecting gene expression of single cells in free solution.

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