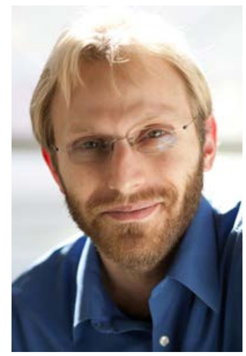
UCSD Jacobs School of Engineering | NANOENGINEERING

UCSD NANOENGINEERING SEMINAR

Thursday, July 21
Seminar Presentation: 11:00am – Noon
Fung Auditorium



Nano-magnetic Manipulation of Cells

Dino Di Carlo
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Abstract:

Developing the next generation of tools to automate cell biology research and quantitatively separate the most active cells for cell therapies requires new approaches to interfacing at the cellular and sub-cellular scale. My lab is developing a set of tools to de-amplify macroscale motions and forces to nanoscale perturbations to separate and locally stimulate cells. I will discuss the core of this platform - a micromagnetic substrate composed of: i) electroplated soft magnetic (NixFey) elements, ii) a biocompatible, planarized resin layer, and iii) lithographically patterned micro-magnet arrays. Magnetizing the micro-magnetic elements with a permanent magnet generates large magnetic potential minima that rapidly and precisely apply magnetic forces on nanoparticles attached to the surface of or inside of cells. We have used this platform to perform quantitative equilibrium separations of cells based on surface expression by labeling with superparamagnetic nanoparticles as well as select mutant magnetotactic bacteria that produce increased numbers of magnetic nanoparticles. By applying forces on nanoparticles bound to the surface of cortical neurons we were able to control calcium signaling locally within neural networks and bias the direction of neural network growth. By applying forces approaching the yield tension of single cells, we were also able to generate coordinated responses in cellular behavior, including the PAK-dependent generation of active, leading-edge type filopodia, and significant (45 to 90 degree) biasing of the metaphase plate during cell mitosis. The technique shows promise as a tool for cell purification, analysis and engineered control.

Biosketch:

Dino Di Carlo received his B.S. in Bioengineering from UC Berkeley and a Ph.D. in Bioengineering from UC Berkeley and San Francisco. From 2006-2008 he conducted postdoctoral studies in the Center for Engineering in Medicine at Harvard Medical School. He joined the UCLA Bioengineering faculty 2008 where he pioneered using inertial fluid dynamic effects for the control, separation, and analysis of cells in microfluidic devices. His work now extends into numerous fields of biomedicine and biotechnology including directed evolution, nano-magnetic cell analysis and control, new amplified molecular assays, next generation biomaterials, and phenotypic drug screening. He co-founded and currently advises four companies that are commercializing UCLA intellectual property developed in his lab. Honors he received include the Presidential Early Career Award for Scientists and Engineers (PECASE), Fellow the American Institute for Medical and Biological Engineering (AIMBE) and of the Royal Society of Chemistry (FRSC). He also has been honored by academic societies with the Pioneers of Miniaturization Prize, the Materials Research Society (MRS) Outstanding Young Investigator Award and the Analytical Chemistry Young Innovator Award. He was awarded the National Science Foundation (NSF) Faculty Early Career Development award, the U.S. Office of Naval Research (ONR) Young Investigator Award, and the Packard Fellowship. His translational research was also supported by the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award, the National Institutes of Health (NIH) Director's New Innovator Award and Coulter Translational Research Award.