



# ME Seminar



## 3D Printing Cellular Communities: Mammalian Cells, Bacteria, And Beyond

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### ABSTRACT

While the motion and collective behavior of cells are well-studied on flat surfaces or in unconfined liquid media, in most natural settings, cells thrive in complex 3D environments. Conventional bioprinting approaches address this challenge by embedding cells in bio-degradable polymer networks. However, heterogeneity in network structure and biodegradation often preclude quantitative studies of cell behavior in specified 3D architectures. Here, I will present a new approach to 3D bioprinting of cellular communities that utilizes jammed, granular polyelectrolyte microgels as a support medium. The self-healing nature of this medium allows the creation of highly precise cellular communities and tissue-like structures by direct injection of cells inside the 3D medium. Further, the transparent nature of this medium enables precise characterization of cellular behavior. I will describe two examples of my work using this platform to study the behavior of two different classes of cells in 3D. First, I will describe how we interrogate the growth, viability, and migration of mammalian cells—ranging from epithelial cells, cancer cells, and T cells—in the 3D pore space. Second, I will describe how we interrogate the migration of *E. coli* bacteria through the 3D pore space. Direct visualization enables us to reveal a new mode of motility exhibited by individual cells, in stark contrast to the paradigm of run-and-tumble motility, in which cells are intermittently and transiently trapped as they navigate the pore space; further, analysis of these dynamics enables prediction of single-cell transport over large length and time scales. Moreover, we show that concentrated populations of *E. coli* can collectively migrate through a porous medium—despite being strongly confined—by chemotactically “surfing” a self-generated nutrient gradient. Together, these studies highlight how the jammed microgel medium provides a powerful platform to design and interrogate complex cellular communities in 3D—with implications for tissue engineering, microtissue mechanics, studies of cellular interactions, and biophysical studies of active matter.

### ABOUT THE SPEAKER

Tapomoy Bhattacharjee is Distinguished Postdoctoral Fellow at the Andlinger Center for Energy and the Environment at Princeton University, working with Prof. Sujit Datta in Chemical and Biological Engineering. He did his undergraduate work in Chemical Engineering at Jadavpur University and graduate work in Mechanical Engineering at the University of Florida with Prof. Tommy Angelini. Tapomoy received the Award for Outstanding Doctoral Thesis Research in Biological Physics by the American Physical Society. His professional involvements include chairing sessions at APS March meetings, reviewing for leading journals including *Soft Matter* and *Biofabrication*, and serving as a member of the DSOF Student Affairs committee of the American Physical Society. His research focuses on understanding and controlling the behavior of complex cellular communities in 3D media.



**May 22, 2020, 3:00 pm, Microsoft Teams**