Department of
Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

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Fiber Curvature Drives Cell Protrusive Behavior

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Native fibrous proteins of small to large diameters (tens of nm to microns) distributed in various configurations (sparse/dense or random/aligned) form the complex and heterogeneous fibrous extracellular microenvironment (ECM). Cells probe and navigate the ECM through the formation of force exerting protrusions of varying morphologies. Despite decades of in vitro studies, our knowledge of fiber curvature driven cell protrusive behavior remains in infancy. In this talk, I will discuss our approach of using suspended fibers of controlled diameters (large: 2000 nm to small: 100 nm) mimicking the native ECM dimensions for studying single protrusions in-line with and lateral to cell-body migration direction. First, using aligned parallel fiber networks that also act as force sensors, I will discuss our findings in force driven (i) spatiotemporal distribution of focal adhesions and cytoskeleton-nucleus caging during anisotropic cell stretching, and (ii) utility of lateral and suspended twine-bridges in cell spreading. Second, using a network of orthogonal fibers, I will discuss our method of isolating protrusions independent of cell-body migration direction. This approach enables us to develop morphodynamic metrics that quantitatively describe cell-specific protrusive behavior (protrutyping), and we show a diminished role of intermediate filament vimentin in the formation of protrusions of long lengths. Altogether, using ECM-mimicking fiber networks in various configurations, we demonstrate the ability to isolate and interrogate cell protrusive behavior in a controlled and repeatable manner.

ABOUT the SPEAKER

Amrinder Nain is an Associate Professor in the Department of Mechanical Engineering, Virginia Tech where he directs the Spinneret based Tunable Engineered (STEP) laboratory. STEP lab focusses on mechanobiology and biophysics of cell-fiber interactions. He is the inventor of non-electrospinning STEP fiber manufacturing platform and Nanonet Force Microscopy (NFM) for measuring single and multi-cell forces. Amrinder obtained his Ph.D. from Carnegie Mellon University and prior to graduate school worked in the semi-conductor industry (precision engineering, finite element modeling and robotics).

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12 PM in Tong Auditorium (1003 Engineering Centers)