Mechanobiology of Cell Protrusions

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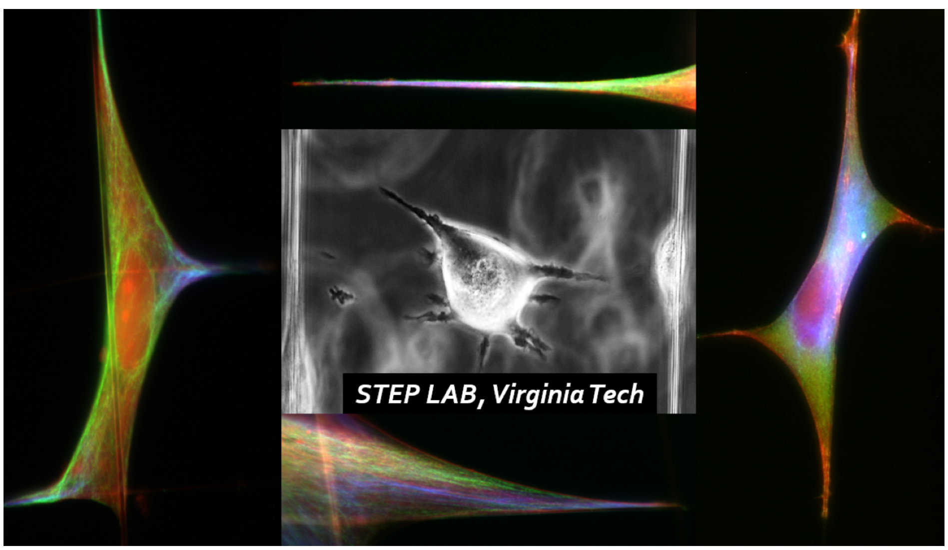
Native fibrous proteins of small to large diameters (tens of nm to microns) distributed in various configurations (sparse/dense or random/aligned) form the complex and heterogeneous fibrous extracellular microenvironment (ECM). Cells probe and navigate the ECM through the formation of force exerting 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 independent of cell-body migration direction. First, using aligned parallel fiber networks coupled with Nanonet Force Microscopy (NFM) to measure forces, I will discuss our findings in (i) spatiotemporal distribution of focal adhesions and arrangement of cytoskeleton components during anisotropic cell stretching, and (ii) the role of twine-bridges formed lateral to cell polarized direction 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 mechanobiology of cell protrusions in a controlled and repeatable manner.



Brief bio:

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). 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).