

# Davidson School of Chemical Engineering welcomes 2017-2018 **New Faculty**



## **Dr. Vivek Narsimhan**

### *Assistant Professor*

Dr. Vivek Narsimhan earned his M.S. and PhD from Stanford University in Chemical Engineering, his M.A.st. in Mathematics from University of Cambridge, and his B.S. from Caltech in Chemical Engineering. He also was a Postdoctoral Associate at Massachusetts Institute of Technology (MIT).

Dr. Narsimhan's research uses a mixture of theory, simulations, and experiments to examine problems in the areas of suspensions, complex interfaces, fluid mechanics, and polymers. He has developed mathematical models, performed simulations, and conducted experiments to describe the mechanics of droplets, red blood cells, and vesicles under various flow types and microfluidic geometries. These investigations provide insight into how complex membranes alter the mechanical stability and motion of fluid-filled particles, both individually and as a suspension. Dr. Narsimhan has also simulated the jamming and translocation dynamics of knotted polymers. He has modeled the relaxation of knotted DNA that has been validated by single-molecule experiments. These studies have possible applications in next-generation DNA mapping/sequencing as well as providing insight into the dynamics of entanglements in polymer systems.

Dr. Narsimhan has mentored several students throughout his academic career and has won a Chemical Engineering Outstanding TA award at Stanford. He has also worked closely with other graduate students and postdocs in organizing departmental workshops, colloquiums, and symposiums.

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## Dr. Narsimhan's Complex Fluids and Rheology Laboratory

Soft matter such as biological membranes, cells, tissues, body fluids, colloidal dispersions, and gels have properties that fall between those of liquids and solids. They are composed of polymers and/or particulates (liquid or solid) dispersed in a continuous phase. Biological processes and technological applications often use flow and external forces to alter the organization of soft matter at the microscale, which can manifest as significant changes in the material's mechanical behavior. Our laboratory is interested in developing theory and simulations to describe the micro to macroscale behavior of soft matter systems such as polymeric and biological fluids. We will complement these studies with experiments.

Our research program can be broken into three categories: (1) interfacial rheology, (2) multiphase flows, and (3) polymer dynamics. A few questions we address are:

- Can we develop theoretical and large scale computational tools to describe the dynamics and rheology of multicomponent, viscoelastic interfaces? Can we develop different analysis/measurement techniques for probing viscoelastic interfaces? These tools will enable the design of dispersions for consumer products, oil recovery, and nanotechnology, as well as providing insights into biofilms and biological membranes.
- Can we describe the physics of particulate transport in complex fluids and concentrated suspensions, particularly when the geometry of either the flow channel or the particle is complex and transient effects are important? This information would be valuable in developing separation methods based on particle shape and size, as well describing the motion of blood, cells, and platelets in the micro-circulation.
- How do entanglements give rise to stress in semi-dilute solutions of polymers, where mean-field theories of reptation often fail in describing the dynamics? This information would be important in developing simpler theories to predict the rheology of polymer solutions.

Students in the lab will be exposed to a mixture of theory, simulations (boundary integral and Brownian dynamics), and experiments (microfluidics, rheology).

Learn more about the Davidson School of Chemical Engineering at Purdue University at <https://engineering.purdue.edu/ChE>

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