

Forces, flows, and fractures: Leveraging physics for fundamental discoveries in organismal biology

Vivek N. Prakash, Ph.D.
Department of Bioengineering
Stanford University

Abstract

Organismal behavior results from emergent properties of a large number of physical and biological processes occurring across multiple scales. My focus is on understanding how physics shapes biology. My overarching research goal is to reveal how biomechanical phenomena at small-scales determine emergent behavior at large-scales in different animal systems. In the first part of my talk, I will show examples of how tissues exhibit liquid-like ‘cellular flows’ while maintaining their integrity, during morphogenesis and development. I will present our surprising discovery of physiological tissue fractures and healing in a simple, early divergent animal - the *Trichoplax adhaerens*, and demonstrate how fracture mechanics govern extreme plastic shape changes. Next, I will show fascinating bilateral cellular flows during early chick embryo development, and reveal their key role in establishing the embryonic symmetry axis. In the last part of my talk, I will focus on the role of fluid mechanics in marine invertebrates. I will elucidate how a beautiful array of vortex structures around starfish larvae creates a physical tradeoff between feeding and swimming. My research exemplifies the promise of leveraging physics to unearth the general organizing principles underlying fundamental form-function relationships in organismal biology.

Biography

Vivek Prakash is a postdoctoral researcher working with Prof. Manu Prakash at Stanford University, California. His research in organismal biomechanics at the interface of Physics, Engineering and Biology is driven by a sense of curiosity, fascination and discovery. He is the recipient of several awards including the APS-DFD Milton van Dyke award, NSF Vizzies challenge award, Nikon Small World in Motion competition prize, and the New Journal of Physics video abstract prize. His graduate research training is in experimental fluid dynamics. He received his Ph.D. in Applied Physics working with Prof. Detlef Lohse and Prof. Chao Sun at the University of Twente, The Netherlands. He obtained his master’s and undergraduate degrees in Engineering Mechanics and Mechanical Engineering in India. For more information, please visit his website: <http://www.vprakash.com>