BIOGRAPHICAL SKETCH

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NAME: Prakash, Manu

eRA COMMONS USER NAME (credential, e.g., agency login): PRAKASH.MANU

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Indian Institute of Technology, Kanpur, UP, India	B.Tech	06/2002	Computer Science
Massachusetts Institute of Technology, MA, USA	Ph.D.	09/2008	Applied Physics
Harvard Society of Fellows, Boston, MA, USA	Junior Fellow	06/2011	Biophysics/Applied Physics

A. Personal Statement

The focus of my lab is two fold: to apply cellular and physical biology based approaches to problems in organismic biophysics and develop novel tools for measurements in biological systems. We also apply ideas from theoretical soft-condensed matter physics in order to understand material properties of active living systems. Future developments in microscopy and in particular SEM are a natural extension of my work actively seeking to improve accessibility of microscopy at all levels to scientists in a multitude of settings. One of the current themes in my lab is to develop new microscopy mechanisms involving novel approaches to how such devices are constructed.

B. Positions and Honors

Positions and Employment

2000-2002 Undergraduate Student Researcher at Center for Robotics
Indian Institute of Technology, Kanpur (India)
2002-2008 Graduate Student Researcher with Neil Gershenfeld
Massachusetts Institute of Technology
2008-2011 Junior Fellow, Harvard Society of Fellows
2011- Assistant Professor
Stanford University (Department of Bioengineering)
Senior Fellow, Center for Innovation in Global Health
Member, Woods Institute of the Environment
Member, Biophysics Program
Member, ChEM-H

Other Experience and Professional Memberships

2004- American Physical Society
2011- American Society of Cell Biology
2016- Co-founder, Foldscope Instruments

Honors

1998-1999 Director's Meritorious Student Award

2006	MIT 100K Development Prize Runners Up
2006	Boeing Sustainability Prize, MIT Ideas Award
2008	Lemelson-MIT Student Prize Finalist
2008-2011	Harvard University William F. Milton Fund Award
2011	TED Senior Fellow
2011	Terman Fellow, Stanford
2011	mHealth Alliance Innovation Award, United Nations Foundation
2011	APS DFD Gallery of Fluids Motion Award
2011	Vodafone Wireless Innovation Award
2011	Gates Foundation Explorations Award
2011-2012	Baxter Foundation Junior Faculty Award
2013-2016	Ellison Young Faculty Award (declined)
2013	APS DFD Gallery of Fluids Motion Award
2013-2017	Pew Scholar
2013	India Abroad Face of the Future Award
2014	Gates Foundation Explorations Award
2014	Invited Member, First White House Maker Faire
2014	Winner, Society for Science and the Public 21st Century Chemistry Set Competition
2014	Popular Science Brilliant Top 10 Award
2014	TR35 MIT Technology Review
2014	NSF Career Award
2015	NIH Directors New Innovator Award
2015	National Geographic Emerging Explorer
2016-2018	HHMI-Gates Fellow
2016	MacArthur Fellow

C. Contribution to Science

1. My publications in the area of physical biology bring tools from applied mathematics to novel questions in biology, at organismic and cellular scale. Physical mechanisms elucidated in these papers play a fundamental role in biological processes, including several active systems. This work takes a combined experimental and analytical approach to tackle each one of the problems.

a. *Krishnamurthy, D., Katsikis, G., Bhargava, A., and Prakash, M.* Schistosoma mansoni cercariae exploit an elastohydrodynamic coupling to swim efficiently arXiv:1605.04041 accepted in **Nature Physics.** Sep 2016
Mukundarjan H, Bardon T, Kim DH and Prakash M., Surface tension dominates insect flight on fluid interfaces, in press in ***Journal of Experimental Biology*****,** Dec 2015
b. Dumont S and Prakash M., Emergent Mechanics of Biological Structures ***Molecular Biology of the Cell*** Vol. 25 no. 22 3461-3465, 2014
c. Prakash M., Quere D., and Bush J., Surface tension transport of prey by feeding shorebirds: The capillary ratchet ***Science***, Vol. 320 (5878), 931-934 (2008)
d. Bush J., Hu D., Prakash M., The integument of water-walking arthropods: Form and function ***Advances in Insect Physiology****,* Vol. 34 117-192 (2007)
e. Prakash M. and Bush J., Interfacial propulsion by directional adhesion, **Int. J. of Nonlinear Mechanics**, Vol. 46, 607-615 (2011)

2. My publications in the field of frugal science

a. *Bhamla, M.S., Benson, B., Chai, C., Katsikis, G., Johri, A., and Prakash* M. Paperfuge: An ultra-low cost, hand-powered centrifuge inspired by the mechanics of a whirligig toy **BioRxiv** doi: http://dx.doi.org/10.1101/072207 Sep 2016
b. Cybulski, J., Clements, J. and Prakash, M., Foldscope: Origami based paper microscope ***PLoS ONE*** 9(6):e98781. doi:10.1371/journal.pone.0098781,June 2014
c. Korir, G. and Prakash, M. Punch Card Programmable Microfluidics ***PLoS ONE*** 10(3): e0115993. doi:10.1371/journal.pone.0115993

d. Ephraim, R.K.D., Duah ,E., Cybulski, J.S., Prakash, M., D'Ambrosio, M.V., Fletcher, D.A., Keiser, J., Andrews, J.R. and Bogoch, I.I., Diagnosis of Schistosoma haematobium Infection with a Mobile Phone-Mounted Foldscope and a Reversed-Lens CellScope in Ghana ***American Journal of Tropical Medicine and Hygiene***, Vol. 14-0741, 2015

3. My publications in physics of computation
   a. Katsikis, G., Cybulski, J.S. and Prakash, M., Sychronous Universal Droplet Logic and Control ***Nature Physics***, Vol. 11, 588-596, 2015
   b. Prakash, M., Gershenfeld, N., Microfluidic Bubble Logic ***Science*** Vol. 315, 832-835 2007

4. My publications in the field of active matter.
   a. Cira, N., Benusiglio, A. and Prakash, M., Vapor mediated sensing and motility in two-component droplets ***Nature*** Vol. 519, 446-450, 2015

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/myncbi/collections/bibliography/49563306/?reload=editSuccess

D. Research Support

Ongoing Research Support

HHMI-Gates Scholar Prakash (PI) 9/1/2016 – 8/30/2021
Organismic biophysics; biophysics of parasites; global health
Explore many different spectrums of the challenge of hands-on-scientific tools, ranging from *how to develop new technologies to truly scale deployment of scientific tools in global health and science education* and *how to directly measure biology at planetary scale* (imagine what happens to the world if every kid in the world had a microscope). Because we develop scalable tools/technologies with direct applications in global health and science education; direct deployment of products developed by my lab is conceivable. Furthermore, I am bringing precision measurement techniques in ecology, such as measuring disease state in vectors (example dengue positive mosquito) in field conditions that have direct implications in vector (mosquito) control globally. Our work on Schistosomiasis has the potential of discovering small molecules that could make humans invisible to swimming Cercariae. Passionate for the diversity of life forms on our planet, I bring soft-condense matter physics viewpoint in tackling problems in physical biology. My long term goal is to understand simple multi-cellular animals (basal metazoans) in complete detail. *This is motivated by a knowledge gap that currently exists between molecular cell biology and organismic function, physiology and behavior.* I believe my work will provide a unique integration, going from individual cells to live behaving organisms. Further more, scaling laws discovered in living “simple” metazoans may also provide unique insights into evolution of complexity in higher metazoans.

USAID Combating Zika and Future Threats Prakash (PI) 10/1/2016-8/30/2018
Shazam for mosquitoes - a citizen based approach for globally mapping disease carrying vectors in near-real time.
We propose a new solution for detecting infected and uninfected mosquito species using simple flipphones and/or smartphones - building an app equivalent to “Shazam for mosquitoes”. This global acoustic surveillance infrastructure - hardware for which is already deployed in pockets of billions of people around the world - provides a new way to engage and mobilize citizens around the world to join forces in almost real-time tracking of vectors, globally.

USAID Combating Zika and Future Threats Prakash (PI) 10/1/2016-8/30/2018
Vectorchip: Microfluidics based surveillance
Recent advances in microfluidic technology can drive a paradigm shift in disease surveillance. We propose to develop a novel microfluidic platform - VectorChip - that enables the large-scale autonomous collection of individual saliva droplets originating from single mosquito bites that can be used to identify the mosquito and pathogen species. This includes a broad range of human biting mosquitoes (Anopheles, Aedes, Culex) and numerous pathogens (including Zika, Dengue and Malaria). The low cost of sample collection and analyses

allows for high spatiotemporal resolution monitoring of pathogen occurrence in mosquitoes.

NIH Director's New Innovators Award Prakash (PI) 8/30/2015-6/30/2020
Mosquitoes meet Microfluidics: Novel tools for Ecological Surveillance of Insect borne Disease
Mosquitoes serve as vectors for a host of potent pathogens. Due to technological limitations, high-resolution spatiotemporal data on vector occurrence is lacking which limits our understanding of the ecology of mosquito-pathogen communities and hampers efforts of disease control. Using the pathogens mosquitoes expectorate when biting we utilize microfluidics to develop a field-deployable platform for the autonomous collection of many individual saliva droplets originating from single mosquito bites.
Role: PI

NSF Career Prakash (PI) 2/1/2015-1/31/2020
NSF CAREER: Print and Fold Optical Instruments
The primary goal of year one is to establish the class of optical components that can be "printed" by the creating techniques described in this proposal, to set the stage for origami based optical instruments. This will include mathematical modeling utilizing geometrical and wave optics without any thin-lens approximations.This work will be further validated with numerical ray-tracing based approaches (Zeemax based design modeling and optimization). The key aspect of concurrent analytical and numerical modeling is to build design curves for regimes in which proposed novel optical components can be utilized. This will allow us to ascertain performance metrics for key components including radial GRIN lenses, ball-lens beam splitters and positive and negative curvature multi-material lenses.
Role: PI

Army-MURI ONR-15-FOA-0011 Prakash (PI) 8/1/2015-1/7/2017
Evolutionary Mechanics of Impulsive Biological Systems: Guiding Scalable Synthetic Design
Mathematically define the "unit" toy models of impulsive propulsion, determine energy flow, efficiency and conversion by experimentally establishing Vorticella, nematocysts and ejectisomes as impulsive propulsion mechanism in the lab; map and define modular and system-level generation of asymmetric energy flow of these systems.
Role: PI of sub-award

Keck Foundation Research Grant Prakash (Co-PI) 7/1/2014-6/30/2017
Engineered Active Fluids: Bridging Scales from Nanomachines to Giant Cells
The goal of this award is to develop experimental and theoretical techniques to build artificial "active fluids" at cellular and molecular scales, homogenous systems that mimic aspects of elastic to plastic transitions and morphogenesis via in-vitro reconstitution.
Role: PI

Pew Scholars Program Prakash (PI) 8/1/2013-07/31/2018
High-throughput Tools to Uncover Multi-scale Insect-Parasite Ecology in the Field
The goal is to develop a method that could identify vector species and parasites they harbor in a scalable, efficient and cost-effective manner in field settings would be a major breakthrough for our ability to study spatial and temporal dynamics of insect-parasite interactions at ecological scale. The aims include developing high-throughput automated microfluidic tools for vector-parasite field ecology; a Cell-phone based citizen-science enabled spectrogram monitoring of insect vectors; and In-vivo imaging tools for live tracking of parasites in individual insects
Role: PI

Gordon & Betty Moore Foundation Prakash (PI) 11/15/2013-12/15/2016
Origami microscope to uncover wonders of microscopic cosmos for kids
The goal is to create a novel, general-purpose "print and fold" strategy for monolithic printing of functional microscopes of increasing complexity. The microscope employs embedded polymer optics, condenser lenses, apertures and an origami folding scheme with integrated optical, illumination and focusing stage, all in a single sheet of A4 size paper. The manufacturing process is inherently roll-to-roll and thus can be scaled-up. We utilize microfluidic synthesis to build complex polymer lenses and utilize directed assembly to "print" micro-scale optical components (from 100 micron to 1 mm) on two-dimensional sheets, including paper. A series of

folds converts this single sheet into a fully functional optical system with origami providing sub-10 micron optical alignment. The microscopes constructed with the above scheme only cost a dollar in parts. This has allowed us to conceptualize a new paradigm of “use-and-throw microscopy.” Empowered with Foldscope, we intend to scale-up and provide instruments, methods and techniques for microscopy made available to a large community (of kids and adults) to explore the microscopic cosmos.
Role: PI

Vodafone Foundation Prakash (PI) 9/1/2011-8/31/2024
Low-cost scanning of oral cavity for the detection of oral cancers in developing countries
Role: PI

Baxter Foundation Prakash (PI) 9/1/2011-12/31/2024
Novel, Low-cost tools for science, diagnostics and education
Role: PI

mHealth Alliance Award Prakash (PI) 8/1/2011 – 8/31/2024
mHealth Alliance Award from United Nations Foundation
Role: PI

Completed Research Support

C-IDEA Award (Stanford Internal) Prakash (PI) 1/1/2012-12/31/2014
Novel, Low-cost tools for science, diagnostics and education
Role: PI

Bill and Melinda Gates Foundation Prakash (PI) 11/1/2011-4/30/2015
Non-invasive detection of viable adult filarial infections
Role: PI

Woods Institute of the Environment Prakash (PI) 1/1/2013-12/31/2015
High Throughout Precision Measurement Tools for Insect-Parasite Ecology in Field Settings
Role: PI

Coulter Foundation (internal) Prakash (PI) 1/1/2012-12/31/2013
Novel, Low-cost tools for science, diagnostics and education
Role: PI

William F. Milton Fund, Harvard Univ Prakash (PI) 2007-2009
Role: PI