

Deepak Krishnamurthy

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Research Interests

Biophysics; Ocean Biophysics; Fluid mechanics; Microscopy

Education

Stanford University

SEP 2014-JAN 2021

Doctor of Philosophy (Mechanical Engineering), CGPA: 3.92/4.0

Bio-X Bowes Fellow, Advisor: Prof. Manu Prakash

Jawaharlal Nehru Centre for Advanced Scientific Research

AUG 2011-AUG 2014

Master of Science (Engineering Mechanics) (Advisor: Prof. Ganesh Subramanian)

CGPA: 7.5/8.0 (*1st in graduating class*)

Thesis title: *Heat Transfer from Drops in Shearing Flows*

& Collective Motion in Micro-scale Swimmer Suspensions.

Roddam Family Best MS thesis award for 2014.

Birla Institute of Technology and Science (BITS)-Pilani

AUG 2007-MAY 2011

Bachelor of Engineering (Honours) (Mechanical Engineering)

CGPA: 9.15/10.00 (*Distinction*), Undergraduate thesis grade: *Excellent*

Research Experience

Schmidt Science Fellow, Fletcher Lab, U C Berkeley

08/30/2021-Present

Biophysics of adhesion and mechano-transduction in the Ocean

and Emergent Mechanosensing in Immune Cell Behavior

Postdoctoral Scholar, Prakash Lab, Stanford University

02/18/2021 – 08/29/2021

Emergent behavior and Chaos in Dynamically Driven Active Filaments

PhD research, Prakash Lab, Stanford University

09/2014 - 12/2020

Scale-free Vertical Tracking Microscopy

- Invented “Scale-free Vertical Tracking Microscopy” using a “Hydrodynamic treadmill” for single cells.
- Leading an interdisciplinary team in microscope design, development and scale-up.
- Novel multi-scale measurements, relevant to ocean biophysics, cell biology and beyond, of microscale cell behavior over ecological scales.

Biophysics of Swimming and Host-seeking in Schistosoma mansoni cercariae:

- Experimental measurements, theoretical and robotics-based models to understand motility of a human parasite affecting 200 Million people worldwide.

How cells jump? Energetics of microscale impulsive cell motility in Halteria grandinella:

- Understanding limits of single-cell motility by exploring cellular metabolic processes and ciliary mechanics.

Physiology course research, Marine Biological Laboratory, Woods Hole and HHMI, Janelia Farm:

JUN 2017–DEC 2017

- *Characterization of Protein Mobility in the Endoplasmic Reticulum (ER) using Single Molecule Tracking.* Used super-resolution microscopy techniques along with image analysis to track ER luminal proteins.

M S Thesis, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)

AUG 2011–JUN 2014

- *Thesis part I: Heat Transfer from Drops in Shearing Flows:* Novel theory based on non-orthogonal transformations for heat transfer from drops at small but non-zero Reynolds number.
- *Thesis part II: Collective Motion in Micro-scale Swimmer Suspensions:* Simulation of suspension of microswimmers including hydrodynamics and orientation decorrelation mechanisms.

Summer Internship & Undergraduate thesis, Simon Fraser University, Vancouver, BC, Canada

JUNE – DEC 2010

- *Computational modelling of a microfluidic fuel cell with flow-through porous electrodes.*

Publications (applicant's name underlined)

- **Deepak Krishnamurthy**, & Prakash, M. (2023). Emergent programmable behavior and chaos in dynamically driven active filaments. *Proceedings of the National Academy of Sciences (PNAS)*, 120(28) (2023). [[bioRxiv](#)] [[weblink](#)] [[Cover image](#)]
- **Deepak Krishnamurthy**, Rachel Pepper, and Manu Prakash. "Active sinking particles: sessile suspension feeders significantly alter the flow and transport to sinking aggregates." *Journal of the Royal Society Interface* 20, no. 199 (2023) [[weblink](#)] [[bioRxiv](#)]
- **Deepak Krishnamurthy**, Hongquan Li, François Benoit du Rey, Pierre Cambournac, Adam Larson, Ethan Li and Manu Prakash. "Scale-free Vertical Tracking Microscopy", *Nature Methods* (Aug, 2020) [[weblink](#)] [[bioRxiv](#)]
[Project website](#) | [Nature Methods News and Views](#) | [Stanford News](#) | [TechCrunch](#) | [EurekAlert](#)
- Scott M Coyle, Ellie Flaum, Hongquan Li, **Deepak Krishnamurthy**, Manu Prakash, "Coupled active systems encode emergent behavioral dynamics of the unicellular predator *Lacrymaria olor*", *Current Biology*, (2019) [[biorxiv](#)] [[weblink](#)]
- **Deepak Krishnamurthy**, Ganesh Subramanian, "Heat or mass transport from drops in shearing flows. Part 1. The open streamline regime", *Journal of Fluid Mechanics*, (July 2018). [[weblink](#)]
- **Deepak Krishnamurthy**, Ganesh Subramanian, "Heat or mass transport from drops in shearing flows. Part 2. Inertial effects on transport", *Journal of Fluid Mechanics*, (July 2018). [[weblink](#)]
- Ilton, M. , Bhamla, M. S., [et al, including **Deepak Krishnamurthy**] The principles of cascading power limits in small, fast biological and engineered systems, *Science*, (April 2018) [[weblink](#)]
[Wired Magazine](#) | [Quanta Magazine](#) | [IEEE Spectrum](#) | [Scientific American](#) | [EurekAlert](#) | [Discover Magazine](#) |
- **Deepak Krishnamurthy**, Georgios Katsikis, Arjun Bhargava, Manu Prakash, "Schistosoma mansoni cercariae exploit an elastohydrodynamic coupling to swim efficiently", *Nature Physics*, (Oct 2016). [[weblink](#)]
[Stanford News](#) [[youtube link](#)] | [Physics World](#) | [Science Daily](#)
- **Deepak Krishnamurthy**, and Ganesh Subramanian. "Collective motion in a suspension of micro-swimmers that run-and-tumble and rotary diffuse.", *Journal of Fluid Mechanics*, (Sep 2015). [[weblink](#)]

Preprints

- Li, H., **Krishnamurthy, D.**, Li, E., Vyas, P., Akireddy, N., Chai, C., & Prakash, M. (2020). Squid: Simplifying Quantitative Imaging Platform Development and Deployment. [[bioRxiv](#)].

Covid-19 response

- Li, Hongquan, Ethan Li, **Deepak Krishnamurthy**, Patrick Kolbay, Beca Chacin, Soeren Hoehne, Jim Cybulski et al. "Utah-Stanford Ventilator (Vent4US): Developing a rapidly scalable ventilator for COVID-19 patients with ARDS." [[medRxiv](#)] (2020).

Undergraduate Research

- **Deepak Krishnamurthy**, Erik O. Johansson, Jin Wook Lee, Erik Kjeang, "Computational modeling of microfluidic fuel cells with flow-through porous electrodes", *Journal of Power Sources*, December 2011. [[weblink](#)]
- **Deepak Krishnamurthy**, J. S. Rathore, and N. N. Sharma, "Nanorobot Propulsion Using Helical Elastic Filaments at Low Reynolds Numbers", *ASME Journal of Nanotechnology in Engineering and Medicine*, February 2011. [[weblink](#)]

Patents

- [US PATENT GRANTED] **Deepak Krishnamurthy** & Prakash, Manu. "Hydrodynamic treadmill: a tracking device to study biotic/abiotic systems in gravitational and hydrodynamic fields." U.S. Patent 11,033,006, issued June 15, 2021. [[weblink](#)]

Fellowships and Grants

- [Burrighs Wellcome Fund, Career Awards at the Scientific Interface \(CASI\) awardee, 2024](#)
- **Catalyst Seed Grant Award**, Won an independent seed grant competition open to Schmidt Science Fellows globally. Awarded for the project "Emergent Mechanosensation in Immune Cell Behavior"
- **Schmidt Science Fellowship 2020**, One of 22 students selected globally for interdisciplinary postdoctoral work and world-class professional development training.
- **Bio-X Bowes family fellowship**. Awarded to 20 Stanford Students each year.

- **Stanford Graduate Fellowship** (declined). Awarded for standing first in the department qualifying examinations.
- **Pfizer Inc. Endowed Scholarship, Marine Biological Laboratory- Physiology Course Funding**: Full tuition fee support for attending the Marine Biological Laboratory's Physiology Course.
- **HHMI Visiting Scientist grant**: Partial financial support for carrying out post-course research or 3 weeks at the HHMI, Janelia Farm, research campus
- **JNCASR Senior Research Fellowship, Government of India**: Awarded full-tuition fee support and stipend for my Master's degree at JNCASR.
- **DST Travel fellowship, Government of India**: Competitive travel award to attend international conferences
- **CSIR Travel fellowship, Government of India**: Competitive travel award to attend international conferences

Honors and Awards

- **Best Lightning Talk**, Microscale Ocean Biophysics meeting, Whistler, BC, Canada 2018
- **Rowland Junior Fellowship Finalist, Harvard University** 2018
- **Best Poster Award across categories** (among ~100 contestants), at the Mechanical Engineering Conference, Stanford University, 2016.
- **Roddam family award for Best Masters thesis** at JNCASR in December 2014.
- **All India Rank – 4** in the **Graduate Aptitude Test in Engineering (GATE)** 2012 in Engineering Sciences category.
- **Ranjit Singh Chauhan Award for Excellence in undergraduate research** by BITS-Pilani in 2011.
- **Research Productivity Award** for research contributions at *Simon Fraser University*, Canada.
- **MITACS Globalink Scholar 2010** - awarded a scholarship to carry out 3 months of research in Canada.
- **Best Student Project**, APOGEE Annual Technical Festival, BITS-Pilani
- **BITS-Pilani Merit scholarship**

Invited Talks and Seminars

- “*Active sinking particles: Sessile filter-feeders fundamentally alter flow and transport to sinking aggregates*”, ASLO workshop (June 2023)
- “*Active sinking particles: Sessile filter-feeders fundamentally alter flow and transport to sinking aggregates*”, University of Puget Sound, Physics seminar (2022)
- “*Active sinking particles: Sessile filter-feeders can fundamentally alter the fate of sinking aggregates*”, Technical University of Denmark – DTU (Feb 2021)
- “*Novel Multi-scale tools for ocean biophysics*”, Rowland Institute, Harvard University (October 2018)
- “*Life under gravity: bridging scales in the ocean*”, MCB, University of California, Berkeley (October 2018)
- “*Biophysics of Swimming and Host-seeking in Schistosoma mansoni cercariae*” Presented at Carbon Inc. Redwood City, California, USA on 27th January, 2016.
- “*Biophysics of Swimming and Host-seeking in Schistosoma mansoni cercariae*” Presented at the Applied Mechanics Seminar, IIT-Madras, India, 30th November, 2016.
- “*Investigation of the swimming mechanics of Schistosoma mansoni cercariae and its role in disease transmission*” Presented at the Molecular, Cell and Developmental Biology Department of University of California, Santa Cruz, 9th February, 2016

Field Research

- **(Dec 2019): Scale-free Tracking Microscopy of plankton sampled during the HOT-317 cruise: On-board R/V Kilo Moana**
 - First ever measurements of single plankton behavior on-board a research vessel.
 - Assembled plankton behaviors consisting of >30 species, adding to a first-of-its-kind database.
- **(Nov 2018) Single-cell measurements of planktonic diatoms using vertical tracking microscopy: Isla Maguëyes Marine Station, Puerto Rico**
 - Discovered novel dynamic sinking behaviors in marine diatoms, and new methods for drag control.

- **(Jan-July 2018)** *Behavioral Quantification of Planktonic Microorganisms using a novel Vertical Tracking Microscope: Hopkins Marine Station, Monterey California*
 - Novel behavior measurements using a vertical tracking microscope of marine planktonic larvae of species indigenous to Monterey Bay
- **(October 2016)** *Field Study of Schistosomiasis: Connecting microscale behavior of parasite to macroscale ecology: Ranomafana National Park, Madagascar.*
 - Snail sampling to locate hotspots of Schistosomiasis, a disease affecting 250 million people across the world

Teaching Experience

Undergraduate

- Lab assistant for the course Prime movers and Fluid machines. Assisted with setting up and conducting experiments on water turbines, pumps and IC engines. Redesigned the laboratory manual and prepared lecture notes.

Graduate

- Teaching assistant for the course *Introductory Fluid Mechanics* (Jan–April 2013). Responsible alongside the course instructor for preparing lecture notes, homework assignments and solutions and conducting tutorial sessions.
- Teaching assistant for the course *Physical biology of macromolecules* (Jan-Mar 2015) at Stanford University. Involved in conducting weekly tutorial sections, design of problem sets and designing experimental demos.

Teaching-Assistant for the *Physiology course* at the *Marine Biological Laboratory (MBL), Woods Hole* (July 2023).

- Responsible for design, planning and mentoring of advanced graduate students and postdocs during an intensive 2-week research rotation.

Research Mentorship

Directly mentored the following Undergraduate, Masters and PhD students for their summer research and research rotations at the Prakash Lab, Stanford University and Fletcher Lab, U C Berkeley:

- Arjun Bhargava, MS Student, Applied Physics (now at Otherlab) DEC 2014-DEC 2015
Project: Design and construction of a scaled-up robot to study swimming of *Schistosoma cercariae*
- Fabien Cockenpot, Graduate student, Ecole Polytechnique (now a graduate from ISAE-SUPAERO) APR-JULY 2016
Project: Biophysics of ultrafast cell motility in *Halteria grandinella*
- Pierre Cambournac, Graduate student, Ecole Polytechnique APR-JULY 2017
Project: Hydrodynamic Treadmill as basis for a novel tracking microscope
- Elgin Korkmazhan, PhD Student, Bioengineering, Stanford University AUG-DEC 2017
Project: Controlling transient flows in a hydrodynamic treadmill with applications to tracking microscopy.
- Francois Benoit Du Rey, Graduate student (Mechanics), Ecole Polytechnique APR - JULY 2018
Project: Hydrodynamic Treadmill as basis for a novel tracking microscope
- Delphine Mion, Graduate student (Mechanics), Ecole Polytechnique APR – JUN 2019
Project: Rapid modulation of single-cell density in planktonic diatoms.
- Matteo Massey, Undergraduate Student (Engineering Physics) Stanford University MAR 2019-AUG 2019
Project: Virtual-Reality paradigm for single-cells to mimic the oceanic environment in the lab.
- Ethan Li, 1st year PhD Student (Bioengineering) Stanford University JUN 2019 – AUG 2019
Project: Design and fabrication of a novel mechanical stage for vertical tracking microscopy.
- Jared Huzar, 1st year PhD student, Bioengineering, U C Berkeley
Project: Design and fabrications of DNA-based receptors to study the mechanics of cell interfaces

Professional courses completed

- Marine Biological Laboratories' (MBL) Cell **Physiology** course 2017 (Woods Hole, Massachusetts)
- CISM Summer School on “Interaction Of Microscopic Structures And Organisms With Fluid Flows”, Udine, Italy

- COMPFLU Winter School on Complex Fluids, IIT-Guwahati 2015
- Certified in the Stanford Varian Physics Machine shop.

Outreach & Professional Service

- *March 2020 – Present*: Volunteer Engineer for the international academic, industry partnership [Pez-globo](#), working on the *PufferFish* Open-source, rapidly scalable ventilator for covid-19 patients. Contributions to Pneumatics and Power subsystems.
- Journal Referee for: *Advanced Science*, *The Journal of Chemical Physics*, *Journal of Experimental Biology (JEB)*.
- Machine shop director for Shriram center basement lab cluster.
- Volunteer, Bio-X Science Day **2015** and **2016, 2019**: Set up stalls and scientific demos to communicate scientific concepts to the public.
- Volunteer, APS-DFD Annual Meeting, San Francisco, 2014
- Foldscope (frugal microscope) workshops in several locations in Bay area, Stanford, and also conducted at two schools in San Juan, and one school in Magueyes, Puerto Rico

References

Prof. Daniel Fletcher (Postdoc mentor)

Professor,
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Prof. Ganesh Subramanian (Masters thesis advisor)

Associate Professor,
Engineering Mechanics Unit
Jawaharlal Nehru Centre for Advanced Scientific Research
Bengaluru, India
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Prof. Manu Prakash (PhD advisor)

Associate Professor,
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Stanford University
California, USA
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Prof. Rob Phillips

Fred and Nancy Morris Professor of Biophysics, Biology, and Physics
California Institute of Technology (Caltech)
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Prof. Sanjiva Lele (PhD thesis committee member)

Professor
Department of Mechanical Engineering and Department of Aeronautics and Astronautics
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Prof. Erik Kjeang (Undegraduate thesis advisor)

Associate Professor,
School of Mechatronic Systems Engineering
Simon Fraser University
Vancouver, BC, Canada
[ekjeang\[at\]sfu.ca](mailto:ekjeang[at]sfu.ca)

Prof. Jennifer Lippincott-Schwartz

Senior Group Leader
Howard Hughes Medical Institute
Janelia Research Campus

Non-Academic Activities

- President, **Stanford Society for the Promotion of Indian Classical Music And Culture Amongst Youth** 2016-2017
- Elected Student Representative, **JNCASR, Bangalore** 2012-13
- Coordinator, **Ragamalika (Classical music and dance club), BITS-Pilani** 2009-10