NEEL DOSHI

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SUMMARY

Extensive experience with developing algorithms and mechanisms for autonomous robotic manipulation and locomotion. Proven track record of using control, optimization, mechanical design, and machine learning to enhance the capabilities of a wide range of robots, from centimeter-scale legged robots to large industrial robotic arms. Strong ability to collaborate and work in a team environment on multi-disciplinary projects as well as to conceptualize and execute in-depth independent research. U.S. citizen.

EDUCATION

Harvard University — Cambridge, MA
Doctor of Philoshophy, Engineering Sciences — *May 2019*
Thesis: *Model-based design, control, and planning for legged microrobots*
Advisors: Professors Robert J. Wood and Scott Kuindersma

Harvard University — Cambridge, MA
Master of Science, Engineering Sciences (GPA: 4.0/4.0) — *Nov 2015*

University of Pennsylvania — Philadelphia, PA
Master of Science, Robotics (GPA: 3.9/4.0) — *May 2013*

University of Pennsylvania — Philadelphia, PA
Bachelor of Science, *summa cum laude*, Mechanical Engineering (GPA: 3.83/4.0) — *May 2012*
Minors: Electrical Engineering, Mathematics

SKILLS

- **Analytical:** Nonlinear, quadratic, and linear programming; trajectory optimization; optimal control and estimation; mechanics and dynamics; linear algebra; machine learning for perception.
- **Software:** Python; MATLAB and Simulink; C++; Linux/Unix; Robot Operating System (ROS).
- **Fabrication**: SolidWorks; OnShape; DraftSight; 3D printing; laser cutting; laminate manufacturing.
- **Languages:** English (native); Gujrati (fluent); Hindi (basic).

RESEARCH EXPERIENCE

Massachusetts Institute of Technology — Cambridge, MA
Postdoctoral Researcher, The MCube Lab — *Apr 2019-Present*

- Developing a framework that leverages mechanics, trajectory optimization, and machine learning for contact-rich robotic manipulation of real-world objects (partially in collaboration with Amazon Robotics & AI).
- Formulated an approach to manipulation of unknown polygonal objects through regulation of their *contact-configuration*: the location, geometry, and mode of all contacts between the object, robot, and environment.
- Collaborated with a team to design and fabricate robotic fingers that simplify dexterous manipulation.

Harvard University — Cambridge, MA
Doctoral Student, Harvard Microrobotics Laboratory — *Sep 2013-Mar 2019*

- Developed a trajectory optimization based framework to automate the generation of closed-loop locomotion trajectories for computationally limited centimeter-scale (cm-scale) legged robots.
- Applied this framework to control the Harvard Ambulatory MicroRobot (HAMR), improving its locomotion speed, stability and efficiency, as well as enabling dynamic behaviors, such as jumping.
- Modeled and fabricated cm-scale mechanisms, including electro-adhesive feet that enabled vertical/inverted climbing (collaboration with Rolls Royce), and a robot capable of hybrid terrestrial and aquatic locomotion.

University of Pennsylvania — Philadelphia, PA
Research Assistant, ModLab — *Mar 2012-July 2013*

- Collaborated with a doctoral student to devise an analytic simulator that resolved the hydrodynamics of large elastically linked modular sea-bases for Defense Advanced Research Projects Agency (DARPA) research.

NASA Goddard Space Flight Center — Greenbelt, MD
Robotics Intern, NASA-GSFC — *Summer 2011*

- Member of a team of five engineers who designed and fabricated a weatherproof thermal enclosure for the electronics of Grover 2 an autonomous rover deployed to explore Greenland's ice sheets.

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LEADERSHIP AND MANAGEMENT EXPERIENCE

Massachusetts Institute of Technology Cambridge, MA
Postdoctoral Researcher, The MCube Lab *Apr 2019-Present*

- Mentored two doctoral students, one master's student, one research assistant, and one high-school student in the conceptualization and execution of their research. Co-authored publications with all five researchers.
- Established and maintained several cross-disciplinary collaborations that resulted in two publications.

Harvard University Cambridge, MA
Doctoral Student, Harvard Microrobotics Laboratory *Sep 2013-Mar 2019*

- Co-led a team of five to seven researchers working on HAMR from 2017-2019. Identified research directions.
- Advised or co-advised five masters' students, one research assistant, and four undergraduate students. Co-authored seven publications, including a best paper nominee and two manuscripts in *Science Robotics*.
- Oversaw two undergraduate capstone projects, one of which was awarded the Dean's Design Award.

SELECTED PUBLICATIONS

Planning and control through contact

11. **N. Doshi***, O.T. Taylor* et al., *Manipulation of unknown objects via contact configuration regulation.* In press, the International Conference on Robotics and Automation (ICRA) 2022.
10. J. Gruenstein, et al., including **N. Doshi**, *Residual Model Learning for Microrobot Control.* ICRA 2021.
9. **N. Doshi**, et al, *Hybrid differential dynamic programming for planar manipulation primitives.* ICRA 2020.
8. **N. Doshi** *, K. Jayaram*, et al., *Effective locomotion atmultiple stride frequencies using proprioceptive feedback on a legged microrobot.* Bioinspiration & Biomimetics, 2019.
7. Z. Manchester, **N. Doshi**, R. J. Wood, and S. Kuindersma, *Contact-Implicit trajectory optimization using variational integrators.* The International Journal of Robotics Research (IJRR) 2019.
6. **N. Doshi**, et al., *Contact-implicit optimization of locomotion trajectories for a quadrupedal microrobot.* Robotics: Science and Systems (RSS) 2018.

Design for manipulation and locomotion

5. I. H. Taylor et al. including **N. Doshi**, *PnuGrip: An active two-phase gripper for dexterous manipulation.* International Conference on Intelligent Robots and Systems (IROS) 2020.
4. Y. Chen, **N. Doshi**, et al., *Inverted and inclined climbing through capillary adhesion in a quadrupedal insect-scale robot.* IEEE Robotics and Automation Letters, 2020.
3. S. D. Rivaz et al. including **N. Doshi**, *Inverted and vertical climbing of a quadrupedal microrobot using electroadhesion.* Science Robotics 2018.
2. Y. Chen, **N. Doshi**, et al. *Controllable water surface to underwater transition through electrowetting in a hybrid terrestrial-aquatic microrobot.* Nature Communications 2018.
1. **N. Doshi** et al., *Model driven design for flexure-based microrobots.* IROS 2015.

AWARDS AND RECOGNITION

Fellowships: Intelligence Community Postdoctoral Research Fellowship from *2019-2021*†; National Defense Science and Engineering Graduate (NDSEG) Fellowship from *2014-2017*†; Honorable Mention, National Science Foundation (NSF) Graduate Fellowship (*2014*).

Best Paper/Project Awards: RA-L Best Paper Award for *2020*; Finalist, Best Conference Paper Award at *ICRA 2018*; Finalist, Best Conference Paper Award at *IROS 2017*; Winner, Best Automation Paper at *ICRA 2014*; William K. Gemmill Memorial Award for Senior Design Project (*2012*).

Popular Press: Publication **#3** covered in Wired, TechTimes, Tech Xplore, +15 more (*2018*); Publication **#2** covered in Popular Mechanics, Science Daily, My Science +75 more (*2018*).

INTELLECTUAL PROPERTY

N.C. Dafle, A. Rodriguez, **N. Doshi**, and I. Taylor, *PnuGrip: an active two-phase gripper for dexterous manipulations.* Provisional Application, 2020.

For a full academic CV, see https://nddoshi.github.io/assets/pdfs/FullCV.pdf.

*contributed equally
†full funding