Yash Chitalia

Assistant Professor, University of Louisville
Shumaker Research Building, Room 246, Louisville, KY 40204

Email : yash.chitalia@louisville.edu
Phone : +1-734-757-0489
Website : yashchitalia.github.io
Google Scholar Profile

Education

Georgia Institute of Technology, Atlanta, GA 08/2021
Ph.D. in Robotics, Major: Mechanical Engineering
Thesis Title: Design, Modeling & Control of Micro-scale & Meso-scale Tendon-Driven Surgical Robots
Advisor: Jaydev P. Desai

University of Michigan, Ann Arbor, MI 05/2013
M.S. in Electrical Engineering, Major: Control Systems
Advisors: Anouck Girard & Ilya Kolmanovsky

University of Mumbai, Maharashtra, India 08/2011
B.E. in Electronics Engineering

Research Experience

Healthcare Robotics and Telesurgery (HeaRT) Laboratory 08/2022 - present
Principal Investigator and Assistant Professor, University of Louisville

- Investigating the design of robotic diagnostic tools for lung fibrosis, to replace current standard-of-care, which tends to marginalize underserved, Black and Hispanic populations in the United States.
- Developing a novel steerable needle catheter system for locally advanced cervical cancer.
- Designing a robotic probe for MR-compatible laser interstitial thermal therapy (LITT) for pediatric tumor treatment.

Pediatric Cardiac Bioengineering Lab 08/2021 - 08/2022
Research Fellow, Boston Children's Hospital, Harvard Medical School

- Design of a robotic minimally-invasive cardiovascular delivery system.
- A concentric-tube based bimanual robot for improved dexterity in neurosurgical procedures.

Medical Robotics and Automation (RoboMed) Laboratory 08/2016 - 07/2021
Graduate Research Assistant, Georgia Institute of Technology

- **Robotic Guidewires:** Developed two tendon-driven robotic guidewires to treat cardiovascular diseases, both guidewires, among the smallest continuum robots in the world. Designed a 0.78 mm outer diameter guidewire with two orthogonal degrees-of-freedom allowing 3D-motion capabilities. Miniaturized this design to a 0.4 mm outer diameter guidewire with follow-the-leader motion capabilities. Developed a handheld controller & motion stage for the guidewire, allowing it to be inserted, retracted and rolled, mimicking surgeon actions. Robot revisions were guided by collaborations with interventional radiologist from Emory University.
- **Robotic Neuroendoscope:** Developed a two degree-of-freedom robotic neuroendoscopy tool to treat pediatric hydrocephalus. Designed the tool by femtosecond laser micromachining a nitinol tube of 1.93 mm outer diameter, to form two tendon-driven joints. Designed a handheld controller, that allows manipulation of the distal tool tip with a joystick, along with insertion/retraction and rolling motion. Controller revisions were guided and tested by neurosurgeon collaborator from Children's Healthcare of Atlanta.
- **FBG Bending Sensor:** Developed a miniature large-deflection bending sensor based on fiber Bragg grating (FBG) for micro-scale guidewire and neuroendoscope joints. Novel sensor assembly uses FBG fiber bonded to nitinol micromachined tube, allowing measurement of curvatures of 145 m^{-1}, which is over 2x maximum reported curvatures in previous literature. Developed a Preisach hysteresis model and unscented Kalman filter based observer for accurate shape sensing.
- **Miniature Force Sensor:** Worked on the design of a dual-photointerrupter based low-cost, high-linearity, miniature tendon-force sensor for my tendon-driven robots. Incorporated the force sensor for the guidewire and neuroendoscope robot controllers for force-based control.

Healthcare Robotics Laboratory 08/2014 - 07/2016
Graduate Research Assistant, Georgia Institute of Technology

- **Autobed Robot:** Modified a standard hospital bed to be controllable via a web-interface, to be deployed in the home of Mr. Henry Evans, a quadriplegic person. Added encoders, pressure sensors to the bed for closed-loop control of the bed's degrees-of-freedom, and to sense the pressure distribution of the person sleeping on the bed. Conducted human subject trials to collect pressure distribution data. Wrote a controller for the bed in ROS to allow the bed to communicate and collaborate with a PR2 robot to help Mr. Evans perform tasks of daily living independently.

Vehicle Optimization, Dynamics, Control and Autonomy Lab 05/2012 - 05/2013

Graduate Student Member and Research Assistant, University of Michigan-Ann Arbor

- **Prioritized Reference Governors:** Designed two methods to prioritize constraints for reference and command governors, which are add-on schemes to ensure constraint enforcement for discrete-time closed-loop linear systems. Demonstrated the system's efficacy for a constrained spring-mass-damper problem and an F-16 aircraft with actuator constraints.
- **Classification Scheme for UAVs:** Developed a three-tiered classification scheme for UAVs inspecting objects of interest, especially when a single UAV operator is in charge of manning multiple UAVs in a hostile environment.

Publications

Journal Articles

10. K. Price, J. Peine, M. Mencattelli, **Y. Chitalia**, D. Pu, T. Looi, S. Stone, J. Drake, P. E. Dupont, "Using robotics to move a neurosurgeon's hands to the tip of their endoscope." *Science Robotics* 8, no. 82 (2023): eadg6042
9. **Y. Chitalia**, Y. Chitalia, A. Sarma, T. A. Brumfiel, N. J. Deaton, M. Sheft and J. P. Desai, "Model-Based Design of the COAST Guidewire Robot for Large Deflection," in *IEEE Robotics and Automation Letters*, vol. 8, no. 9, pp. 5345-5352, Sept. 2023, doi: 10.1109/LRA.2023.3286125. .
8. A. Sarma, T. A. Brumfiel (co-first-author), **Y. Chitalia (second author)** and J. P. Desai, "Kinematic Modeling and Jacobian-based Control of the COAST Guidewire Robot," in IEEE Transactions on Medical Robotics and Bionics, 2022, doi: 10.1109/TMRB.2022.3216026.
7. V. Del Bono, J. Peine, M. Finocchiaro, K. Price, M. Mencattelli, **Y. Chitalia**, V. Ko, L. Yu, J. Secor, A. Pan, Z. Machaidze, M. Puder, A. Artoni, P.E. Dupont, "Non-surgical Removal of Partially Absorbable Bionic Implants", *IEEE Transactions on Medical Robotics and Bionics*, 2022.
6. **Y. Chitalia**, S. Jeong (co-first author), K. K. Yamamoto, J. J. Chern, and J.P. Desai, "Modeling and Control of a Meso-scale Multi-Joint Continuum Robot for Pediatric Neurosurgery," in *IEEE Transactions on Robotics*, doi: 10.1109/TRO.2020.3031270 (Link).
5. S. Jeong, **Y. Chitalia (co-first author)**, and J.P. Desai, "Design, Modeling, and Control of a Coaxially Aligned Steerable (COAST) Guidewire Robot," in *IEEE Robotics and Automation Letters*. 10.1109/LRA.2020.3004782 (Link).
4. S. Jeong, **Y. Chitalia** and J. P. Desai, "Miniature Force Sensor based on Dual-photointerrupter with High Linearity and Disturbance Compensation," in *IEEE Sensors Journal* (Link).
3. **Y. Chitalia**, N. J. Deaton, S. Jeong, N. Rahman and J. P. Desai, "Towards FBG-Based Shape Sensing for Micro-Scale and Meso-Scale Continuum Robots With Large Deflection," in *IEEE Robotics and Automation Letters*, vol. 5, no. 2, pp. 1712-1719, April 2020 (Link).
2. **Y. C. Chitalia**, S. Jeong, N. Deaton, J. J. Chern and J. P. Desai, "Design and Kinematics Analysis of a Robotic Pediatric Neuroendoscope Tool Body," in *IEEE/ASME Transactions on Mechatronics*, vol. 25, no. 2, pp. 985-995, April 2020, doi: 10.1109/TMECH.2020.2967748 (Link).
1. A.S. Kapusta, P. M. Grice, H. M. Clever, **Y. Chitalia**, D. Park, C.C. Kemp, "A system for bedside assistance that integrates a robotic bed and a mobile manipulator," *PLoS One*, 2019;14(10):e0221854. Published 2019 Oct 16. doi:10.1371/journal.pone.0221854 (Link)

Conference Proceedings

11. **Y. Chitalia**, A. Donder and P. E. Dupont, "Modeling Tendon-actuated Concentric Tube Robots," *2023 International Symposium on Medical Robotics (ISMR)*, Atlanta, GA, USA, 2023, pp. 1-7, doi: 10.1109/ISMR57123.2023.10130176.
10. **Y. Chitalia**, A. Donder, and P. Dupont, "Modeling Telescoping Tendon-Actuated Continuum Robots," No. 8201. EasyChair, 2022.
9. N. Deaton, **Y. Chitalia**, and J. P. Desai, "Steerable Stylet for High Dose Rate Brachytherapy," in *International Symposium on Experimental Robotics*, Springer.
8. A. Sarma, G. C. Collins, N. Nayar, **Y. Chitalia**, S. Jeong, B. D.Lindsey, and J. P. Desai, "Towards the development of an ultrasound-guided robotically steerable guidewire," *2020 International Symposium on Medical Robotics (ISMR), IEEE.*
7. **Y. Chitalia**, S. Jeong, J. Bok, V. Nguyen, S. Melkote, J. J. Chern, J. P. Desai, "Towards the Design and Development of a Pediatric Neuroendoscope Tool," *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Macau, China, 2019, pp. 2998-3004 (Link).
6. **Y. Chitalia**, X. Wang, V. Nguyen, S. Melkote, J. J. Chern, and J. P. Desai, "Design and Analysis of a Bidirectional Notch Joint for a Robotic Pediatric Neuroendoscope," in *International Symposium on Experimental Robotics*, (pp. 24-33). Springer, Cham., November 2018 (Link)
5. H. M. Clever, A. Kapusta, D. Park, Z. Erickson, **Y. Chitalia** and C. C. Kemp, "3D Human Pose Estimation on a Configurable Bed from a Pressure Image," *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Madrid, 2018, pp. 54-61 (Link).
4. **Y. Chitalia**, X. Wang and J. P. Desai, "Design, Modeling and Control of a 2-DoF Robotic Guidewire," *2018 IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, QLD, 2018, pp. 32-37 (Link).

3. T. Bhattacharjee, J. Wade, **Y. Chitalia** and C. C. Kemp, "Data-driven thermal recognition of contact with people and objects," *2016 IEEE Haptics Symposium (HAPTICS)*, Philadelphia, PA, 2016, pp. 297-304 (Link).
2. **Y. Chitalia**, W. Zhang, B. Hyun and A. Girard, "A revisit-based mixed-initiative nested classification scheme for Unmanned Aerial Vehicles," *2014 American Control Conference*, Portland, OR, 2014, pp. 1793-1798 (Link).
1. U. Kalabić, **Y. Chitalia**, J. Buckland and I. Kolmanovsky, "Prioritization schemes for reference and command governors," *2013 European Control Conference (ECC)*, Zurich, 2013, pp. 2734-2739 (Link).

Patent Applications

- J. P. Desai, **Y. Chitalia**, S. Jeong, "System, Method, And Apparatus For The Control Of Multiple Degrees-Of-Freedom Bending And The Bending Length Of A Coaxially Aligned Robotically Steerable Guidewire," **Provisional patent, 63/013425** , 2020
- J. P. Desai, **Y. Chitalia**, S. Jeong, J. J. Chern, "Steerable and flexible robotic endoscopic tools for minimally invasive procedures," **PCT Patent, PCT/US20/20942, patent pending**, 2020
- J. P. Desai, **Y. Chitalia**, S. Jeong, J. J. Chern, "Multi-port, steerable, and flexible robotic endoscopic tools for minimally invasive procedures," **U.S. Patent Application No. 62/813,444, patent pending**, 2019
- J. P. Desai, **Y. Chitalia** "Systems and Methods for Steering Guidewires," **PCT Patent, PCT/US2018/021784, patent pending**, 2019
- J. P. Desai, **Y. Chitalia** "System, Method, and Apparatus for Active Control of Multiple Degrees-of-Freedom Micro-Scale Guidewires and Devices," **U.S. Patent Application No. 62/469,570, patent pending**, 2017

Teaching Experience

ME 575: Introduction to ME Robotics 01/2023 - Present

Professor

- Teaching a 500 level (mixed offering to undergraduate and graduate students) class in Robotics at the University of Louisville.

ME 2110: Creative Decisions and Design 07/2016 - 07/2018

Head Teaching Assistant, Instructor: Dr. Thomas Kurfess/ Dr. Christopher Saldana

- Led a team of approximately 15-20 Graduate and Undergraduate teaching assistants in successfully teaching a class of approximately 300 students (per semester). The class involved students building robots competing against each other in a final competition.
- Instructed students on mechanical design and failure mode identification, mechatronics design and machining practices and machine operation.

Petit Undergraduate Research Scholars Program 2015, 2018-19

Petit Scholar Mentor

- Awarded Petit Scholarship to mentor three undergraduate students in the field of Healthcare and Medical Robotics.
- For each undergraduate project, the students were required to visit collaborating surgeons, and completely understand the surgical procedure. Assisted the students in identifying a research topic, analyzing it thoroughly, designing phantom models and handheld controllers for a robotic surgical tool.
- Mentored students published their research in prestigious robotics publications like T-RO and IROS.
- Secured $7500 travel and research grants for mentorship.

Students Advised

- Doctoral Students
  - Kent Yamamoto (co-advised with Dr. Patrick Codd, Duke University) 05/2023-Present
  - Pejman Kheradmand 03/2023-Present
  - Florian Heemeyer (co-advised with Dr. Bradley Nelson, ETH Zurich) 01/2023-Present
  - Behnam Moradkhani 08/2022-Present
- Undergraduate Students
  - Harshith Jella 09/2022-Present
  - Kent Yamamoto 05/2018-06/2021
  - Ji Bok 01/2018-12/2018
  - Megan Rich 01/2015-12/2015

Industry Experience

Lutron Electronics 07/2013 - 06/2014

Senior Project Electrical Engineer

- Designed embedded software for the implementation of the Lutron proprietary wireless communication protocol in the mass market wireless home automation solutions.

Controls and Powertrain Research Group, Ford Motor Company 06/2012 - 08/2012

Summer Intern

- Implemented the 'Vector Reference Governor' predictive control scheme on the linearized models of the Ford Motor Company engines. Also implemented the non-linear version of the reference governor algorithm on the Ford vehicles.

Leadership Experience

- Editorial Board of the Robot Design track of the **Frontiers in Robotics and AI** journal.
- Organizing committee for the **2022 RSS Pioneers workshop**.
- **Co-organized two workshops** at the 2019-2021 IEEE International Symposium on Medical Robotics.
- Demonstrated robots and led lab tours for K-12 students and guests at Georgia Tech National Robotics Week (2017-19).
- 2015 - FIRST LEGO robotics league judge.
- **Peer Reviewer:** Serving as a reviewer for a number of conferences and journals, including: Science Robotics, IEEE Transactions on Robotics (T-RO), IEEE Transactions on Biomedical Engineering (TBME), IEEE/ASME Transactions on Mechatronics (T-MECH), IEEE Robotics and Automaton Letters (RA-L), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE International Conference on Robotics and Automation (ICRA), IEEE International Symposium on Medical Robotics (ISMR), American Control Conference (ACC).

Invited Talks

- **ICRA 2019** - Workshop on 'Open Challenges and State-of-the-Art in Control System Design and Technology Development for Surgical Robotic Systems'. 05/2019
- **Intuitive Surgical Research** - Seminar on "Design, Modeling and Control of Micro-scale Surgical Robotics". 06/2020
- **Siemens Healthineers** - "Design, Modeling and Control of Micro-scale and Meso-scale Continuum Robots". 06/2020
- **Cornell Robotics Seminar** - "Design, Modeling and Control of Micro-scale and Meso-scale Continuum Robots". 09/2021
- **University of Massachusetts, Dartmouth** - "Design and Modeling of Micro-scale Surgical Robots". 09/2022
- **University of Wisconsin - Madison** - "Tiny (and not so tiny) continuum robots". 04/2023
- **The Holistic Forum of Medical Robotics Junior Professors @ ISMR 2023** 04/2023
- **6th International Conference of Magnetic Surgery and Life Science(ICMS) - Plenary Talk** 05/2023
- **Duke Medical Robotics Symposium** 10/2023
- **University of Louisville Health - Neurosurgery Grand Rounds** 11/2023

Awards and Honors

- Ralph E. Powe Junior Faculty Enhancement Award 06/2023
- Gordon Research Seminar (GRS) 2022 on Robotics - Speaker 08/2022
- RSS Pioneer 06/2021