Priyanka Rao | PhD Student

Continuum Robotics Laboratory, University of Toronto

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Education

PhD Student, University of Toronto **CGPA: 3.94**
Mechanical and Industrial Engineering, Research on Continuum Robots *2023*

B.Tech + M.Tech, Indian Institute of Technology, Madras **CGPA: 9.26/10**
Mechanical Engineering, Dual Degree (M.Tech in Product Design) *2019*

Research Publications

Rao, P., Peyron, Q., Burgner-kahrs, J., Using Euler Curves to Model Continuum Robots, *International Conference on Robotics and Automation*, 2021

Rao, P., Peyron, Q., Lilge, S., and Burgner-Kahrs, J., "How to Model Tendon-Driven Continuum Robots and Benchmark Modelling Performance," *Frontiers in Robotics and AI*, vol. 7, p. 223, Feb. 2021

Grassmann, R., **Rao, P.**, Peyron, Q., Burgner-kahrs, J., FAS – A Fully Actuated Segment for Tendon-Driven Continuum Robots, *Accepted for publication in Frontiers in Robotics and AI*, 2022

Scholastic Achievements

2022: Awarded the **Barbara & Frank Milligan Graduate Fellowship** for biomedical research during PhD

2020: Awarded the **William Dunbar Memorial Scholarship** for graduate research in mechanical engineering

2019: PhD additionally funded by the **HeRo CREATE Student Fellowship** for research in medical robotics

2017: Recipient of the **DAAD-WISE** scholarship for a funded research internship in Germany

2014: Ranked **1520** in **IIT-JEE** (among 2 million+ students), for entrance into the IITs

Research Projects

Obstacle-Aided Motion Planning of continuum robots **July 2021 – Present**
Prof. Jessica Burgner-Kahrs, University of Toronto,

- Developed and implemented a model to predict the shape of a continuum robot interacting with its environment
- Currently working on developing a motion planning paradigm that leverages obstacle-aided navigation
- Future work will combine the above with shape-based control for industrial inspection

Using Euler curves to model tendon-driven continuum robots **May 2020 – Present**
Prof. Jessica Burgner-Kahrs, University of Toronto,

- Proposed a 3D **numerical static model** to model tendon-driven continuum robots experiencing external forces
- Proposed parameterization reduces the infinite parameters required to represent the continuous backbone to **six curvatures**
- Achieved an **average tip error of 3.07%** w.r.t the robot length, with an average computation time of **4 ms** in MATLAB
- Future work will apply the developed method for force control of the robot for minimally invasive procedures

Inspection of boiler drums using continuum robots (Masters thesis) **Jun 2018 – May 2019**
Prof. Krishnan Balasubramanian and Prof. Jessica Burgner-Kahrs, IIT Madras,

- Proposed methods for **computational design** and **motion planning** of a tendon-driven continuum robot that maximised the viewing capability of a camera placed at the robot tip
- Tested design methodology on cases of boiler drum inspection and gastroscopy with **over 90% coverage**
- Proposed algorithm avoids the computationally expensive calculation of inverse kinematics

Shape sensing of continuum tubular robots using stereo vision **May 2017 – Jul 2017**
Prof. Jessica Burgner-Kahrs, Leibniz University of Hannover,

- Responsible for the **parameter estimation** and **segment detection** of continuum robots
- Created a sub-module for robust estimation of the robot's location with **decrease** in processing time by a **factor of 100** by removing dependence on the accuracy of positioning
- Developed an algorithm for measurement of radius with a **maximum error of 6%**, allowing clear distinction between segments

Professional Experience

Machine Vision Intern **Nov 2016 – Dec 2016**
Zentron Labs Pvt. Ltd., Bangalore, India

- Programmed an inline **machine vision** system for non-contact measurement of machined workpieces
- Built modules for **geometric shape detection** and classification, minimizing user-inputs during gauging
- Formulated an algorithm for **decomposition of the contours** into different segments and their **classification** into various classes consisting of lines, arcs and circles with an **accuracy greater than 88%**

Computer Vision Intern **May 2016 – Nov 2016**
Detect Technologies Pvt. Ltd., Chennai, India *Prof. Krishnan Balasubramanian*

- Part of project **NOCTUA** providing automated and intelligent inspection systems for major process industries
- Ideated and implemented an algorithm to **detect punctures** and faults for given requirement
- Created modules for motion-blur correction, brightness correction, feature and template matching for strategic stitching of frames, estimation of intrinsic and extrinsic camera parameters, analysis of thermal infrared images
- Reduced the manual inspection time and enhanced the productivity by more than 80%

Computer Vision Intern **December 2015**
Icecream Labs, Bangalore, India

- Developed an algorithm for **shot boundary detection** and video segmentation using OpenCV and Python
- Optimized number of times facial recognition is run for developing user-video interface
- Used adaptive thresholding of distance between histograms to detect shot changes
- Achieved an **accuracy of over 92%** with zero false positives and increased robustness

Technical Skills

Programming : Python, Matlab, C, C++, OpenCV
Design : Autodesk Inventor, SolidWorks , LabVIEW, PTC Creo, AutoCAD
Multimedia : Adobe Photoshop, Adobe Illustrator, Inkscape

Interests and Extra-curricular Activities

Teaching & Volunteering

- **Teaching Assistant** for CSC376 : Fundamentals of Robotics, an undergraduate-level introduction to robotics (Fall, 2020)
  - Assisted the instructor with course planning and structuring for the online semester
  - Duties included conducting practicals and grading assignments on various concepts of robotics
- Outreach Manager for **LITAS for Girls**, an international non-profit that encourages women to pursue STEM fields
  - Lead the LITAS Certification program consisting of 8 clubs spread across 3 countries
  - Developed the Python and Artificial Intelligence curriculum for their e-learning platform
- **Volunteer** at **Teach For India** to teach students from low-income families with learning disabilities at a local government School
- Part of the **IITM Female Help Desk** to help girl students joining the IITs and equalize the skewed gender ratio in STEM

Design

- Freelance graphic designer and artist [*Instagram* (@how2drao)]
- **Illustrated** three book covers for Dushka Zapata (a popular life coach on Quora)
  - How to Build a Pillow Fort and Other Valuable life lessons
  - You Belong Everywhere: and Other Things You'll Have to See for Yourself
  - How to draw your boundaries and why no one else can save you
- **Creative branding and Design Strategist**, Shaastra 16-17, an annual technical fest
  - **Led** and **mentored** a team of 16 design co-ordinators for IIT Madras' annual technical festival
  - Designed their New Indian Express Newsletter, 2 million copies of which were circulated around Chennai