

# Maithili Patel

PHD · ROBOTICS · GEORGIA INSTITUTE OF TECHNOLOGY

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## Research Interests

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My interest lies in Artificial Intelligence towards robot autonomy, specifically enabling robots to work alongside and assist humans in open environments. My research spans the fields of Human Robot Interaction and Deep Learning, and touches upon explainability, activity-recognition and smart home sensing.

## Education

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GEORGIA INSTITUTE OF TECHNOLOGY · *PhD, Robotics (Interactive Comp.)* · GPA 4/4 2021 - 2026

Advised by Dr. Sonia Chernova

UNIVERSITY OF MICHIGAN · *MSE, Mechanical Engineering (Robotics)* · GPA 3.98/4 2017 - 2019

Focus areas : Robot Navigation · Motion Planning · Kinematics and Dynamics · Automated Vehicles

INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY · *B.Tech, Mechanical Engineering* · GPA 8.99/10 2013 - 2017

Graduated with Honors, holding a Minor in Computer Science and Engineering

## Research Experience

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GRADUATE RESEARCH ASSISTANT · *Robot Autonomy and Interactive Learning Lab, Georgia Institute of Technology*

Advisor: Prof. Sonia Chernova

Proactive Robot Assistance via Spatio-Temporal Object Tracking Aug 2021 - Present

- Formulated the longitudinal proactive assistance problem as that of understanding user routines, anticipating user needs several minutes or hours into the future, and providing assistance by relocating objects where they would be needed by the user.
- Proposed a novel approach to understanding temporal patterns in user routines based on object movement observations to conserve user privacy and account for occlusions in observations of user actions.
- Created an object-interaction-level activity dataset representing daily routines of individuals for several weeks to enable training and evaluation of methods aimed at understanding human routines.
- Created a Generative Graph Neural Network based model to predict object movements resulting from user's routines. Benchmarked the method against common robotics baselines showing 42% improvement in F1 scores over the leading baseline on predicting object movements.

GRADUATE RESEARCHER · *The Laboratory for Progress, University of Michigan*

Advisor: Prof. Chad Jenkins

Planning over affordance wayfields Jan 2019 - Apr 2019

- Explored null-space subsumption architecture to create planners over potential-based affordance representations achieve constrained manipulation tasks. Demonstrated pick and place on a coffee mug without spilling its contents, using OpenRAVE to simulate and visualize.

Potential Field guided RRTs for motion planning Jan 2019 - Apr 2019

- Created a hybrid motion planner based on RRT and potential field based gradient descent and achieved greater obstacle-clearance and faster convergence compared to a vanilla RRT.

## Manipulation over Mobile Robot Platform

Jan 2018 - Apr 2018

- Implemented capability for a Fetch robot to open doors using MoveIt package on ROS platform, and integrated it into a mobile manipulation pipeline based on a behavior tree structure.

## Industry Experience

**TOYOTA RESEARCH INSTITUTE** · Software Engineer, Automated Mapping Platform

Jan 2021 - July 2021

*At TRI, the research arm of Toyota, I worked on a mapping project with the Autonomous Driving team.*

- Developed a validation toolkit for evaluating relative accuracy of feature-based maps against a given reference map.
- Made improvements to the algorithms used to probabilistically infer object changes in a SLAM-based map over time.
- Extended the validation toolkit to evaluate precision-recall over change detection, and evaluated and tuned the algorithm using simulated data.
- Helped the Women and Allies ERG host the Women's History Month to spread awareness and support women's progress.

**VEONEER** · Algorithm Engineer

June 2019 - Jan 2021

*Veoneer, formerly Zenuity, develops AD and ADAS software. I worked on Motion Planning and Localization teams based in US.*

- Contributed to improving the mapping and localization system by simulating worst-case sensor inputs, and introducing robust curvature calculation of lane-lines on the map.
- Implemented code for identifying roadside barriers in HD-maps and extracting a polygon representation of free space.
- Initiated and ran a Journal Club for team members to gain and share domain knowledge through literature discussions.

**ZENUITY** · Intern, Decision & Control

May 2018 - Aug 2018

- Improved path-tracking performance of the lateral dynamics controller in simulation and on vehicle.
- Identified challenges of autonomous parking in an indoor parking structure and created prototypes of decision trees for high-level behaviour planning and kinodynamic A\* based motion planning.

## Publications

### JOURNAL

- A Survey of Semantic Reasoning Frameworks for Robotic Systems ,  
W. Liu\*, A. Daruna\*, **M. Patel\*\***, K. Ramachandrani\*\*, S. Chernova  
Robotics and Autonomous Systems (RAS), 2022

### CONFERENCE

- Proactive Robot Assistance via Spatio Temporal Object Tracking,  
**M. Patel**, S. Chernova  
Conference on Robot Learning (CoRL), 2022

### WORKSHOP

- Understanding In-home Routines through Spatio-temporal Object Tracking for Proactive Assistance,  
**M. Patel**, S. Chernova  
ICRA, 2022 workshop - Prediction and Anticipation Reasoning in Human Robot Interaction

## Teaching And Mentorship

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**ROBOT AUTONOMY AND INTERACTIVE LEARNING (RAIL) LAB** · *Mentor*

*Fall 2022*

- Mentoring Amirtha Varshini (M.S. C.S.) and Aswin Prakash (M.S. C.S.) in the RAIL lab at Georgia Institute of Technology through research in semantic robotics towards in-home assistance

**HELEN SCHOLARS PROGRAM (NCWIT)** · *Mentor*

*Fall 2021-Present*

- Mentoring an undergraduate student towards professional and personal development as a part of a scholarship program by the National Center for Women & Information Technology (NCWIT)

**GRADUATE STUDENT INSTRUCTOR** · *University of Michigan, Ann Arbor*

*Recieved honorable mention for 2020 Richard and Eleanor Towner Prize for Outstanding GSIs*

- **Mobile Robotics** with Prof. Maani Jadidi *Winter 2019*  
Graduate-level course focusing on probabilistic methods in robotics like Bayesian methods and Graphical formulations, for perception and SLAM
- **Introduction to Autonomous Robotics** with Prof. Chad Jenkins *Fall 2018*  
Graduate-level introductory course on Autonomous Robotics focusing on planning, covering path planning, manipulation and controls

**INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY** · *Teaching Assistant*

- Biology : Qualitative and quantitative models in life systems and applications of engineering in biology *Fall 2014*

## Academic Activities

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- Selected for the **Google CS Research Mentorship Program** to receive mentorship from a Googler and network with other participants to further my career in computing *2022-2023*
- Selected for participation in **RPL Summer School, 2022, Stockholm, Sweden**, fully funded and organized by the Division of Robotics, Perception and Learning at KTH Royal University, Sweden *June 2022*

## Skills

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**Languages:** Python · C++ · LaTeX

**Platforms/Tools:** PyTorch · Tensorflow · ROS · Pytorch Lightning · Jupyter Notebook

## Interests

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- Dancing and teaching Brazilian Zouk
- Avid traveller; Spent a semester abroad in Denmark & traveled across 16 European countries
- Other hobbies: Rock climbing, Tennis, Reading