Manan Tayal

Curriculum Vitae

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Evolution is a Tinkerer, So am I

Research Summary

I work on problems at the intersection of **Control, Optimization, and Machine Learning**, with a focus on **safety-enforced decision-making in dynamical systems**. Developing methods that integrate learning with **formal guarantees** to ensure constraint satisfaction and robust performance in uncertain, data-driven environments.
Keywords: Control Barrier Functions (CBF), Hamilton-Jacobi (HJ) Reachability, safe Reinforcement Learning (RL), Autonomous Robots.

Education

2021-Present **Ph.D. Candidate**, *Indian Institute of Science (IISc)*, Bangalore
Advisor: Prof. Shishir N.Y. Kolathaya & Pushpak Jagtap,
Safe and Performant Control of Autonomous Systems

2021-2023 **M.Tech. (Res.)**, *Indian Institute of Science (IISc)*, Bangalore
Advisor: Prof. Shishir N.Y. Kolathaya,
Learning based Control of Bipedal robots, CGPA: 9.30/10

2017-2021 **B.Tech.**, *Indian Institute of Technology (IIT)* , Bombay
CGPA: 9.13/10

Research Experience

Nov'24 - Present **Student Researcher**, *Stanford University, USA*
Advisor: Prof. Somil Bansal
- Worked on developing Algorithms for Co-optimizing Safe and Optimal Control of Autonomous Systems.

Dec'23 - Aug'24 **Student Researcher**, *Washington University*, USA
Advisor: Prof. Andrew Clark
- Worked on synthesizing a formally verified Neural CBFs for safe control in Stochastic Systems.

Apr'20 - May'20 **Research Intern**, *Siemens Technology and Services*, Bangalore, India
Advisor: Sagar Pathrudkar
- Worked on adaptively controlling a self balancing bot on various terrains using various classical and learning based control methods.

Awards and Recognition

2021-2026 Recipient of the prestigious **Prime Minister's Research Fellowship (PMRF)**.
2024 Finalist of **Qualcomm Innovation Fellowship (QIF)**, India.
2018-2019 Awarded **AP grades** in two courses at IIT Bombay for exceptional performance.
2017 Secured **All India Rank 626** in JEE Advanced out of 1,59,540 candidates.
2017 Secured **All India Rank 289** in JEE Mains out of 10.2 lakh candidates.
2017 Recipient of **Kishore Vaigyanik Protsahan Yojana (KVPY) Scholarship.**
2016-17 Among National Top 1% in **National Standard Examination in Physics(NSEP)**.
2015 Recipient of the prestigious **National Talent Search (NTSE) Scholarship**.

Research Publications & Pre-Prints

(* - indicates Equal Contribution)

Journal Publications

Under Review **[3] Stochastic Neural Control Barrier Functions**
Hongchao Zhang, **Manan Tayal**, Jackson Cox, Pushpak Jagtap, Shishir Kolathaya, Andrew Clark
Transactions on Automatic Control (TAC) (Submitted).

2025 **[2] A Collision Cone Approach for Control Barrier Functions**, *[Paper]*
Manan Tayal, Bhavya Giri Goswami, Karthik Rajgopal, Rajpal Singh, Tejas Rao, Jishnu Keshavan, Pushpak Jagtap and Shishir Kolathaya
Transactions on Control System Technologies.

[1] A Theoretical and Empirical Study on the Convergence of Adam with an Exact Constant Step Size in Non-Convex Settings, *[Paper]*
Alokendu Mazumder, **Manan Tayal**, R. Sabharwal, Bhartendu Kumar and Punit Rathore
Transactions on Artificial Intelligence (TAI).
Cyber Physical System Symposium (CyPhySS), 2024

Conference Publications

Under Review **[12] Neural Control Barrier Functions from Physics Informed Neural Networks**, *[Paper]*
Shreenabh Agrawal, **Manan Tayal**, Aditya Singh, Pushpak Jagtap and Shishir Kolathaya,
American Control Conference (ACC).(Submitted)

[11] CP-NCBF: Synthesizing Verified Neural CBFs using Conformal Prediction, *[Paper]*
Manan Tayal*, Aditya Singh*, Pushpak Jagtap and Shishir Kolathaya,
(Submitted).

[10] GenOSIL: Generalized Optimal and Safe Robot Control using Parameter-Conditioned Imitation Learning, *[Paper]*
Mumuksh Tayal, **Manan Tayal**, and Ravi Prakash,
IEEE International Conference on Robotics and Automation (ICRA).(Submitted)

2025 **[9] Semi-Supervised Policy Synthesis using Barrier Certificates**, *[Paper]*
Manan Tayal*, Aditya Singh*, Pushpak Jagtap and Shishir Kolathaya,
IEEE Conference on Decision and Control (CDC), Rio, Brazil, 2025.
IROS Workshop on *Formal Methods & Techniques in Robotic Systems*, 2024.

[8] A Physics-Informed Machine Learning Framework for Safe and Optimal Control of Autonomous Systems, *[Paper]*
Manan Tayal*, Aditya Singh*, Shishir Kolathaya and Somil Bansal.
International Conference on Machine Learning (ICML), Vancouver, Canada, 2025.

2024 **[7] BiRoDiff: Diffusion policies for bipedal robot locomotion on unseen terrains**, *[Paper]*
GVS Mothish, **Manan Tayal** and Shishir Kolathaya,
Indian Control Conference (ICC), Bhopal, India, 2024.

[6] Learning a Formally Verified Control Barrier Function in Stochastic Environment, *[Paper]*
Manan Tayal, Hongchao Zhang, Pushpak Jagtap, Andrew Clark and Shishir Kolathaya.
IEEE Conference on Decision and Control (CDC), Milan, Italy, 2024.

[5] Control Barrier Functions in Dynamic UAVs for Kinematic Obstacle Avoidance: A Collision Cone Approach, *[Paper]*
Manan Tayal, Rajpal Singh, Jishnu Keshavan and Shishir Kolathaya.
American Control Conference (ACC), Toronto, Canada, 2024.

[4] Collision Cone Control Barrier Functions: Experimental Validation on UGVs for Kinematic Obstacle Avoidance, *[Paper]*
B.G. Goswami*, **Manan Tayal***, Karthik Rajgopal, Pushpak Jagtap and Shishir Kolathaya.
American Control Conference (ACC), Toronto, Canada, 2024.

[3] Polygonal Cone Control Barrier Functions for safe navigation in cluttered envs., *[Paper]*
Manan Tayal and Shishir Kolathaya.
European Control Conference (ECC),Stockholm, Sweden, 2024.

[2] Stoch BiRo: Design and Control of a low cost bipedal robot, *[Paper]*
GVS Mothish*, Karthik Rajgopal*, Ravi Kola*, **Manan Tayal** and Shishir Kolathaya
IEEE International Conference on Control, Automation and Robotics (ICCAR), Singapore, 2024

2023 **[1] Collision Cone Control Barrier Functions for Kinematic Obstacle Avoidance in UGVs**, *[Paper]*
Phani Thontepu*, Bhavya Giri Goswami*, **Manan Tayal**, Neelaksh Singh, Shyam Sundar PI, Shyam Sundar MG, Suresh Sundaram, Vaibhav Katewa and Shishir Kolathaya
Indian Control Conference (ICC), Vizag, India, 2023

Pre-Prints/Workshops/Short Papers

2024 **[4] Real Time Safety of Fixed-wing UAVs using Collision Cone CBFs**, *[Paper]*
Aryan Agarwal*, **Manan Tayal***, Ravi Agrawal, Pushpak Jagtap and Shishir Kolathaya.
Cyber Physical Systems Symposium (CyPhySS), 2024.

2023 **[3] Safe Legged Locomotion using Collision Cone Control Barrier Functions**, *[Paper]*
Manan Tayal and Shishir Kolathaya

2022 **[2] Realising the role of arms in improving the stability of bipedal robots**, *[Paper]*
Manan Tayal and Shishir Kolathaya
Cyber Physical Systems Symposium (CyPhySS) 2022, IISc Bangalore

2021 **[1] Travelling Salesman Problem: Parallel Implementations & Analysis**, *[Paper]*
Amey Gohil*, **Manan Tayal***, Tezan Sahu*, Venkatesh Sawalpurkar*
HPSC workshop 2021, IIT Bombay

Teaching Experience

Mar'24 - Present **Deep Learning for Robotics**, *Gujarat Technical University (GTU)*, Ahmedabad
Took Lectures on Deep learning techniques required for Robotics

May'24 - July'24 **E1 316o Deep Learning for Robotics**, *IISc*, Bangalore
Head Teaching Assistant with Prof. Shishir Kolathaya & Prof. Pushpak Jagtap

Jan'24 - Apr'24 **CP315 Robot Learning and Control**, *IISc*, Bangalore
Head Teaching Assistant with Prof. Shishir Kolathaya

Mar'23 - Oct'23 **Robotics and Reinforcement Learning**, *Manipal Institute of Technology*, Manipal
Took Lectures on Robotics and Reinforcement Learning

Aug'22 - Dec'22 **MSDM 105 Robot Mechanics**, *NIT*, Srinagar
Remote Tutor with Prof.

Jan'22 - June'22 **Introduction to Computer Programming**, *Daksh ITI*, Mathura
Main instructor of the course to teach computer programming in C/C++.

Invited Talks

2025 *"A Physics Informed Machine Learning approach for Safe and Optimal Control of Autonomous Systems"*, Safe and Intelligent Autonomy Lab, Stanford University.

2024 *"Learning Formally Verified Neural Control Barrier Functions in Stochastic Environments"*, Cyber Physical Systems Symposium, Bangalore.

2023 *"A Collision Cone Approach for Control Barrier Functions"*, Systems and Controls Workshop, IIT Bombay.

Research Mentoring

I have had the fortune of working with and mentoring some fantastic student collaborators.

Bachelors and Masters Students

2022-2024 GVS Mothish (M.Tech. @ IISc) → (Ph.D. @ CDS IISc)

2022-2024 Karthik Rajgopal (B.Tech. @ BITS Pilani) → (MEngg. @ UC Berkeley)

2023-2024 Ravi Kola (B.Tech. @ GTU) → (MS @ RWTH Aachen University)

2024-Present Aditya Singh (B.Tech. @ IIT Patna)

Research Services

Peer-reviewing

Conferences ICRA, CDC, CoRL, IROS, ACC, ECC, ICC