

# 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 - **Student Researcher**, *Stanford University, USA*  
Present Advisor: Prof. Somil Bansal  
○ Worked on developing Algorithms for Co-optimizing Safe and Optimal Control of Autonomous Systems.
- Dec'23 - **Student Researcher**, *Washington University, USA*  
Aug'24 Advisor: Prof. Andrew Clark  
○ Worked on synthesizing a formally verified Neural CBFs for safe control in Stochastic Systems.
- Aug'22 - **Research Intern**, *Strider Robotics, Bangalore, India*  
Dec'22 Advisor: Aditya Sagi  
○ Worked on development and control of custom bipedal robot.
- Apr'20 - **Research Intern**, *Siemens Technology and Services, Bangalore, India*  
May'20 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

- 2024 Finalist of **Qualcomm Innovation Fellowship (QIF)**, India.
- 2021-2025 Recipient of the prestigious **Prime Minister's Research Fellowship (PMRF)**.
- 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).
- [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* (Submitted).
- [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)* (Submitted).  
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,  
*IEEE Conference on Decision and Control (CDC)*.(Submitted)
- [11] CP-NCBF: Synthesizing Verified Neural CBFs using Conformal Prediction**, [\[Paper\]](#)  
**Manan Tayal\***, Aditya Singh\*, Pushpak Jagtap and Shishir Kolathaya,  
(Submitted).
- [10] Semi-Supervised Policy Synthesis using Barrier Certificates**, [\[Paper\]](#)  
**Manan Tayal\***, Aditya Singh\*, Pushpak Jagtap and Shishir Kolathaya,  
*IEEE Conference on Decision and Control (CDC)*.(Submitted)  
IROS Workshop on *Formal Methods & Techniques in Robotic Systems*, 2024.
- [9] GenOSIL: Generalized Optimal and Safe Robot Control using Parameter-Conditioned Imitation Learning**, [\[Paper\]](#)  
Mumuksh Tayal, **Manan Tayal**, and Ravi Prakash,  
*IEEE International Conference on Automation Science and Engineering (CASE)*.(Submitted)
- 2025 **[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)
- 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

- May'24 - **E1 316o Deep Learning for Robotics**, *IISc*, Bangalore  
July'24 Head Teaching Assistant with Prof. Shishir Kolathaya & Prof. Pushpak Jagtap
- Jan'24 - **CP315 Robot Learning and Control**, *IISc*, Bangalore  
Apr'24 Head Teaching Assistant with Prof. Shishir Kolathaya
- Mar'23 - **Robotics and Reinforcement Learning**, *Manipal Institute of Technology*, Manipal  
Oct'23 Took Lectures on Robotics and Reinforcement Learning
- Aug'22 - **MSDM 105 Robot Mechanics**, *NIT*, Srinagar  
Dec'22 Remote Tutor with Prof.
- Jan'22 - **Introduction to Computer Programming**, *Daksh ITI*, Mathura  
June'22 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, IROS, ACC, ECC, ICC