Aman Tiwary

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EDUCATION

Aug 2024	**MS** in Mechanical Engineering UNIVERSITY OF WASHINGTON

MS in Mechanical Engineering   UNIVERSITY OF WASHINGTON
Advised by Prof. Behçet Açıkmeşe, Aeronautics & Astronautics
<u>Relevant Courses</u>: Convex Optimization, Intelligent Controls, Multivariable Controls, Probabilistic Robotics, Computer Vision
GPA: 3.80/4.0

May 2017

BE in Mechanical Engineering   BIRLA INSTITUTE OF TECHNOLOGY, MESRA
Advised by Prof. Sudip Das, Space Engineering and Rocketry
<u>Relevant Courses</u>: Data Structures & Algorithms, Finite Element Method, Design of Machine Element
GPA: 7.91/10.0

RESEARCH INTERESTS

I am deeply intrigued by leveraging active vision to enhance robust autonomous robot navigation. My research explores the synthesis of active vision techniques and the guarantees of convex optimization-based guidance methods to generate safe and efficient trajectories in real-time for robots navigating uncertain environments while achieving a specified goal (e.g., search and rescue operations, environmental monitoring, object reconstruction, scene exploration, and inspection). I am interested in exploring:

- **Non-Model-based navigation (Active Vision):** Autonomously navigating through an unknown environment by formulating information gain through visual sensors and rewarding uncovering new information

- **Localization and Mapping:** Identifying a sequence of sensor pose and associated controllable parameters for building a complete high-quality map of an unknown environment

- **Real-time Trajectory Optimization with perception in loop**

PUBLICATIONS

JOURNALS

[J1] Skye Mceowen, Daniel Calderone, **Aman Tiwary**, Jason Zhou, Taewan Kim, Purnanand Elango, Behcet Acikmese *"Auto-Tuned Primal-Dual Successive Convexification for Hypersonic Reentry Guidance,"* Under review for the AIAA Journal of Guidance, Control and Dynamics ↗

[J2] Skye Mceowen, Daniel Calderone, **Aman Tiwary**, Avi Mittal, Sho Kiami, Purnanand Elango, Behcet Acikmese, *"Hypersonic Reentry Guidance with Continuous Time Constraint Satisfaction,"* In preparation for the AIAA Journal of Guidance, Control and Dynamics

CONFERENCES

[C1] Skye Mceowen, Daniel Calderone, **Aman Tiwary**, Jason Zhou, Taewan Kim, Purnanand Elango, Behcet Acikmese *"Auto-Tuned Primal-Dual Successive Convexification for Hypersonic Reentry Guidance,"* AIAA SciTech 2025 (Accepted, finalist for the 2025 AIAA SciTech GNC Graduate Student Paper Competition)

RESEARCH EXPERIENCE

Mar. 2022 - Current   **UW Autonomous Controls Laboratory (ACL)**   WA, USA

Trajectory Optimization for 3D scene reconstruction: (Master's Thesis)
Advised by: Dr. Behçet Açikmeşe

Developed **6DOF quad-rotor trajectory planning** package (`C++, Python`), integrating active vision techniques with convex optimization-based guidance methods (**Successive Convexification** with **state-triggered line of sight constraints**)

Built a guidance framework to generate feasible trajectories for continuous acquisition of high-resolution images of the target object in complex environments resulting in high-quality **point cloud reconstruction**

Active View Planning with Guaranteed Keypoint Coverage :

Developed and implemented a novel framework for **view plan optimization** by formulating the problem in the sensor frame and imposing hard constraints on the sensor's field of view. This transformed the problem into a **convex optimization** problem and provided mathematical guarantees for keypoint coverage.

Research Assistant:

Maintaining **Trajectory Optimization** software library for live flight demonstrations with quad-rotor (`C++`) that directly contributed to successful execution of **20+** live flight demonstrations involving complex aerial maneuvers with quad-rotors

Developing next generation of drone hardware to support perception and onboard trajectory computing tasks

Sep. 2022 - Dec. 2022	**Reinforcement Learning for Flying Insect Robots** (CSE571)

Low-power Reinforcement learning on Visual Confined-Space Navigation for Insect-scale Robots : Implemented the Proximal Policy optimization method in AirSim (Microsoft Simulator) to train a quadrotor equipped with cameras on the left and right sides to autonomously navigate the corridor without colliding. The optical flow map from the left and right camera was the observation, which was processed and fed to the PPO network; the quadrotor's position and collision information was the state

Jan. 2022 - May. 2022	**UW Formula Motorsports(UWFM)** - Driverless	WA, USA

Implemented MPC-based nonlinear vehicle-bicycle-model in Python to find an optimal set of control inputs to go around the track

Jan. 2022 - Mar. 2022	**Denoising Image for Classification using Autoencoders** (CSE455)

Developed and trained a Convolutional Autoencoder to denoise an image for classification(MNIST Dataset) using Pytorch(project) with a minimum classification accuracy of **76.5%** at a noise factor of 0.9(Gaussian noise)

Aug. 2016 - May. 2017	**Design Optimisation of a Car Underbody Diffuser for Obtaining Maximum Downforce**	JH, IND

(Undergraduate Thesis) **Advised by**: Dr. Sudip Das, Professor,

Conceptualized and Simulated the undertray design with the car in optimum lap, demonstrating an improvement of 2.5% in a lap time of the car without undertray

May. 2014 - May. 2016	**Design of a formula student chassis according to lateral load transfer distribution**	JH, IND

Team Srijan(Formula Student)

Determined the chassis members based on FEM simulations on ANSYS APDL that have the major contribution in torsional stiffness and Optimized the weight of the chassis by varying the cross-section and relocating the tubes while maintaining the stiffness.

INDUSTRY EXPERIENCE

Jun. 2022 - Sep. 2022	**Monarch Tractor** - Controls Engineering Intern(HW)	CA, USA

Performed system identification of an Electro-Hydraulic Steering Actuator and used it to design a feedforward steering controller, which improved the steering response by 100 ms

2017 - 2021	**Tata Motors Ltd**	MH, IND

Jul. 2018 - Jul. 2021   **Senior Manager | Cost Engineering**

Led Cross-Functional Team for Gearbox and Engine Cooling System of Bharat Stage 6 vehicles and identified cost reduction opportunities through DFMA, cost-driver analysis, Linear Performance Pricing, and VAVE with key contributions worth $ 2 million in potential savings for commercial and passenger vehicle

Aug. 2017 - Jul. 2018   **Graduate Engineer Trainee | Sales & Marketing**

Oversaw sales team of 3 dealerships and facilitated sales of Buses and small commercial passenger vehicles in Gujarat, contributing to an increase in market visibility from 80% to 92% and an increase in market share by 4%

ACADEMIC SERVICE

REVIEWING

IEEE Robotics and Automation Letters (RA-L)

MENTORING

Edgerton M Cook, University of Washington
Phuong Le, University of Washington

SKILLS

PROGRAMMING

Competent with `C/C++`, `Python`, `MATLAB`, `Simulink`

LIBRARIES

Competent with `Eigen`, `PCL`, `CVXPY`, `OpenCV`, `Open3D`

DESIGN/SIMULATION

Competent with `AirSim`, `Rerun`, `Solidworks`, `AutoCAD`, `ANSYS`

MATHEMATICAL SKILLS

Competent with `Linear Algebra`, `Convex Optimization`

REFERENCES

BEHÇET AÇIKMEŞE

- **Position:** Professor, Aeronautics and Astronautics Department, University of Washington
- **Relationship:** Master's Advisor, Autonomous Controls Lab PI
- **Email:** behcet@uw.edu

SANTOSH DEVASIA

- **Position:** Professor, Mechanical Engineering Department, University of Washington
- **Relationship:** Professor, Precision Controls Lab PI
- **Email:** devasia@uw.edu

SUDIP DAS

- **Position:** Professor, Space Engineering and Rocketry, Birla Institute of Technology, Mesra
- **Relationship:** Undergraduate Advisor
- **Email:** sudipdas@bitmesra.ac.in