Yashom Dighe

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Education

University at Buffalo, The State University of New York **Jan. 2024 – Current**
Ph.D. Computer Science & Engineering *Buffalo, New York*

University at Buffalo, The State University of New York **Aug. 2022 – Dec. 2023**
M.S. in Robotics *Buffalo, New York*

Technical Skills

Specializations:Motion Planning and Control for Robotics, End-to-End Robot Learning, Machine Learning, Deep Learning, Trajectory Generation, Optimal Control
Languages: Python (opencv, numpy, PyTorch, TensorFlow), C/C++
Technologies/Frameworks: ROS, ROS 2, Gazebo, Nvidia Omniverse, Pytorch, Linux, MacOS, Windows
Developer Tools: VS Code, Docker, Version Control (git)

Research Projects

- **3D-GCRL – Spatial Change Representation Learning for Robot Policy Design** Proposes a novel reinforcement-learning framework that uses 3D geometric change as the core observation and reward signal for embodied agents. Enables policies to reason about structural transformations in the scene—rather than relying on pixel or proprioceptive deltas—leading to improved generalization and interpretability in manipulation and navigation. Currently under active development as part of my Ph.D. research, the method builds a foundation for scalable, spatially-grounded robot learning.
- **VISION - Language-in-the-Loop Inspection system** [1] Enables autonomous culvert inspection by pairing foundation models for open-vocabulary defect detection with constrained viewpoint optimization on Boston Dynamics Spot. Utilizes stereo for scale-aware re-imaging and reasoning over structural anomalies. Achieved 80% alignment with expert assessments, establishing a practical benchmark for language-guided robotic inspection in real infrastructure.
- **QuayPoints** [2] improves high-speed autonomy by linking global trajectory optimization to local planning through a sparse set of time-critical keypoints that preserve time-optimal context. Strengthens local planner awareness of global intent, leading to smoother overtakes and reduced trajectory deviation in key regions. Currently under review, this method fosters tighter coupling between offline reasoning and online control.
- **KFC** [3] introduces a kinematics-only differential-flatness-based controller that achieves NMPC-level tracking accuracy while using 50% less CPU on embedded Jetson hardware. Validated on seven simulated and real F1Tenth racetracks. Published at IROS 2023, this work demonstrates an analytically grounded, lightweight controller for real-time racing.
- **TERA: A simulation environment for terrain excavation robot autonomy** [4] simulates soil–robot interaction with high fidelity to advance autonomous excavation research. Models terrain deformation, resistive forces, and bucket–soil contact dynamics directly from real-world excavation data to reproduce material behavior under varying soil conditions. Contributed in an advisory capacity to developing the data-driven modeling and calibration pipeline that aligns simulation physics with field measurements. The platform enables scalable learning, safe motion planning, and control policy validation for fully autonomous excavation systems.

Publications

[1] Y. Dighe, Y. Turkar, and K. Dantu, "Language-in-the-loop culvert inspection on the erie canal," *arXiv preprint arXiv:2509.21370*, 2025.

[2] Y. Dighe, Y. Kim, and K. Dantu, "Quaypoints: A reasoning framework to bridge the information gap between global and local planning in autonomous racing," *arXiv preprint arXiv:2510.10886*, 2025.

[3] Y. Dighe, Y. Kim, S. Rajguru, Y. Turkar, T. Singh, and K. Dantu, "Kinematics-only differential flatness based trajectory tracking for autonomous racing," in *2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 1629–1636, IEEE, 2023.

[4] C. Aluckal, R. V. K. Lal, S. Courtney, Y. Turkar, Y. Dighe, Y. Kim, J. Gemerek, and K. Dantu, "Tera: A simulation environment for terrain excavation robot autonomy," in *2025 IEEE International Conference on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR)*, pp. 1–6, IEEE, 2025.

[5] C. A. Y. A. S. S. Yashom Dighe, Yash Turkar, "Path planning system for uav remote sensing in urban environments," in *National Symposium on Innovations in Geospatial Technology for sustainable Development with special emphasis on NER, ISG, ISRS, 2019*, 2019.

[6] C. Aluckal, B. Mohan, Y. Turkar, Y. Agarwadkar, Y. Dighe, S. Surve, S. Deshpande, and B. Daga, "Dynamic real-time indoor environment mapping for unmanned autonomous vehicle navigation," in *2019 International Conference on Advances in Computing, Communication And Control (ICAC3)*, pp. 1–6, IEEE, 2019.

[7] Y. Turkar, C. Aluckal, Y. Dighe, S. Deshpande, and Y. Agarwadkar, "Conceptualization of uav based waypoint generation for precision horticulture," in *2020 IEEE India Geoscience and Remote Sensing Symposium (InGARSS)*, pp. 150–153, IEEE, 2020.

[8] Y. Turkar, S. Sreedharan, C. Aluckal, I. Malhotra, R. V. K. Lal, J. Jain, Y. Dighe, Y. Kim, J. Gemerek, and K. Dantu, "Excavation autonomy with resilient traversability and handling,"

Experience

DRONES Lab, University at Buffalo **Aug 2022 - Current**

Research Assistant/ PhD Research *Buffalo, New York*

- Led **UB's F1Tenth team** at the 2023 IROS Grand Prix achieving a **top 10** finish.
- Developed a novel control algorithm based on differential flatness for F1Tenth Autonomous Racing that performs **15%** better than the SOTA Model Predictive Control Algorithm while reducing the required compute by **more than 50%** *(published at **IROS 2023**)*. This controller was deployed on the F1tenth team's racing stack.
- Supervised the development of a time optimal path generation algorithm *(under review at **RAL 2024**)* and currently extending this research by incorporating the differential flatness of a kinematic bicycle model.
- Leading a team of 6 under the EARTH (Excavation Autonomy with Resilient Traversability and Handling) project. This three-year project, funded by **MOOG** and undertaken in collaboration with the Center for Embodied Autonomy and Robotics (CEAR), is a groundbreaking framework for autonomous excavators and earth-movers that integrates several novel perception, planning, and hydraulic control components that work in synergy to enable autonomous operation.

University at Buffalo **Aug 2024 - Dec 2024**

Teaching Fellow/ Instructor *Buffalo, New York*

- Instructor for CSE568 Robotics Algorithms a graduate level course at UB taken by **50+ students**. Designed a comprehensive syllabus to provide hands on experience with first principles of perception, estimation, planning and control.

Intelligent Autonomous System (IAS), TU Darmstadt **May 2024 - Aug. 2024**

Visting Researcher under Prof. Jan Peters *Darmstadt, Germany*

- Developed a novel approach to extend visual planning methods into 3D spaces using **Gaussian Splatting** for **robotic manipulation**, driving collaboration between CEAR, UB, and IAS, TUD to advance research in **end-to-end robot learning**.
- Successfully incorporated explicit 3D information Devised and prototyped a 2 step pipeline that "imagines" a motion plan in 3D visual space and executes it on a real robot.

SLB **Jun. 2023 - Aug. 2023**

Digital Technology Intern *Menlo Park, California*

- Played a vital role in the identification of critical tasks in oil and gas operations for automation with robots, reducing safety risks and operational hazards.
- Implemented state-of-the-art imitation learning methods, selecting the best methods through comprehensive research.
- Successfully fine-tuned and deployed the chosen methods to obtain the best performer which demonstrated more than **90% success rates** on 5 different robotic tasks.
- Evaluated 3 simulators: **Omniverse Isaac, Gazebo & CoppeliaSim** on various fronts for developing digital twins of oil and gas plants thus accelerating the design decisions of development team.

Bernhard Schulte (Singapore) Holdings Pte. Ltd. **Aug. 2021 - Jun. 2022**

Robotics Intern *Singapore (Remote)*

- Made a 3D physics enabled simulation using ROS and Gazebo from scratch to test the localisation algorithms on an underwater autonomous rov. Added the capacity to simulate sensor noise to narrow down the sim-to-real gap and eliminate need for domain adaptation.
- Designed the visualization tools for the ground control station and developed a communication interface between the ground station and a ROS based robot enabling live testing and onsite qualitative evaluations.
- Optimized the **Extended Kalman filter** for localization to give **less than 2 percent error**, which was crucial for the performance the control algorithms.