Saurabh Belgaonkar

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EDUCATION

Texas A&M University Aug. 2023 – Present
Ph.D., Mechanical Engineering | CGPA: 4.0/4.0 *College Station, TX*

– **Coursework:** Control Systems, Intelligent Systems & Robotics, Convex Optimization, Reinforcement Learning

Indian Institute of Science (IISc) Bangalore Oct. 2020 – Jul. 2022
M.Tech, Mechanical Engineering | CGPA: 9.2/10 *Bangalore, India*

National Institute of Technology (NIT) Warangal Aug. 2015 – May 2019
B.Tech, Mechanical Engineering | CGPA: 8.92/10 *Warangal, India*

EXPERIENCE

SAE AutoDrive Challenge Oct. 2023 – Present
Vice Captain; Perception Lead *College Station, TX*

SAE AutoDrive Challenge is a multi-year collegiate competition where university teams develop and demonstrate Level-4 autonomous driving on urban courses.

– Led the perception team and delivered a real-time **camera–LiDAR perception stack** (object, lane, traffic-light detection; fusion; tracking) in **C++/ROS2**, providing accurate environment understanding for planning and obstacle avoidance.
– As Vice Captain, led cross-team coordination and project management, overseeing validation testing, timelines, and deliverables across perception, planning, and controls, resulting in **2nd** (2024) and **3rd** (2025) overall finishes.

Atlas Copco India Aug. 2022 – Jul. 2023
Data Scientist *Pune, India*

– Built end-to-end **ML pipelines** for **machine health monitoring** using **CNNs, GANs**, and signal-processing techniques, reducing manual inspection effort and enabling early fault prediction.
– Engineered data workflows using **SQL** and **Azure Databricks** to extract and transform equipment data; built dashboards and analytics pipelines that improved diagnostic visibility and predictive maintenance accuracy across monitored assets.

PUBLICATIONS

[1] J. Keshavan, **S. Belgaonkar**, S. Murali, "Adaptive Super-Twisting Control of a First-Order Sliding Mode with an Output Constraint," *IEEE Access*.

[2] Under Review: **S. Belgaonkar**, D. Kumar, S. Rathinam, S. Darbha, T. Bihl, "A Path Planning Algorithm for a Hybrid UAV Traveling in Noise Restricted Zones," *IEEE Transactions on Aerospace and Electronic Systems*.

Perception & Sensing Projects

Real-time Perception stack Feb. 2024 - Dec 2024
Texas A&M University *College Station, TX*

– Finetuned **YOLO** on custom dataset (15 classes—pedestrians, traffic signs/lights, barrels etc) achieving **mAP = 0.85** and deployed in **C++/ROS2** via **OpenVINO** for real-time inference on Intel GPU.
– Processed LiDAR point clouds with ground removal, voxel filtering, and Euclidean clustering to form 3D object clusters; used a **Kalman** filter for multi-object tracking to support speed estimation and obstacle-aware planning.
– Calibrated Camera–LiDAR extrinsics and projected clustered 3D LiDAR points onto the image plane and matched them with 2D detections via **IoU** to assign class labels and recover object distances.
– Performed camera–LiDAR calibration and timestamp sync; deployed as **ROS2** nodes and validated in real-time closed-loop tests with rviz/rosbag replay and latency profiling to ensure stable throughput.

Lane segmentation based on UNet Jun. 2025 - Present
Texas A&M University *College Station, TX*

– Built an end-to-end **UNet** lane detector, implemented as **multi-class segmentation** to output reliable lane **geometry**, **type**, and **color** for enabling lane centering, safe lane-change decisions, and curvature-aware speed planning.

– Trained on **BDD100K** (day/night, weather, **faded/occluded** markings) with robust augmentations; deployed with **TensorRT** in **C++** for **real-time** performance, with lightweight post-processing (mask thinning + polyline fit).

Feature level Camera–LiDAR Fusion Apr. 2025 – Present
Texas A&M University *College Station, TX*

– Implemented a **Siamese** RGB–LiDAR detector (YOLOv8 backbone); converted 3D pointcloud to 2D image, and performed feature-level cross-fusion, enhancing detection reliability under lighting and occlusion challenges.
– Evaluated on **KITTI**; benchmarked against a **camera-only** baseline, showing stronger performance under lighting variation, glare, and occlusion while retaining real-time inference.

Obstacle Avoidance Behavior planning Jan. 2024 – May 2024
Texas A&M University *College Station, TX*

– Integrated perception outputs (object class, pose, velocity) into an **HD-map**–derived **local semantic map**, providing a unified view of the driving environment for planning.
– Built a layered **occupancy grid** combining **static** (barricades, barrels) and **dynamic** (pedestrians, vehicles) obstacles with class-aware motion prediction, enabling the planner to generate safe, lane-respecting paths.

Speed Estimation of a Compressor using Vibration Data Aug. 2022 – Nov. 2022
Data Scientist *Atlas Copco, Pune*

– Built a vibration data based speed estimator to replace manual estimation on machines lacking sensors.
– Computed the **FFT** of vibration signals to derive harmonic peaks and generate likely speed candidates; used **1D CNN** spectral–temporal features and a **LightGBM** binary verifier (correct/incorrect) per candidate; at inference, scored all candidates and chose the highest-probability speed.
– Deployed on **Databricks** (**Spark**/**PySpark**); achieved **99.5%** accuracy (597/600) on ∼500 labeled datasets.

Domain Adaptation for Machine Health Monitoring Jan. 2023 - Jul. 2023
Data Scientist *Atlas Copco, Pune*

– Built a **domain-adaptation** framework to transfer a CNN trained on source compressors to new machines with minimal target labels using vibration data; achieved ≈ 96% valve-damage detection across varying operating conditions.
– Aligned source/target feature distributions with adversarial training (**GAN**) and statistical criteria (MMD, class-prototype cosine, Mahalanobis) while preserving class separability.
– Interpreted model behavior with **tSNE** -and **SHAP**, confirming focus on fault-relevant time–frequency signatures.

RESEARCH PROJECTS

Energy-Aware Path Planning for Hybrid UAVs Feb. 2024 – Jan. 2025
Graduate Research Assistant | Texas A&M University *College Station, TX*

– Developed a **continuous-space** planning algorithm for route and energy optimization, minimizing fuel consumption while satisfying battery and noise constraints.
– Formulated the problem as a **Mixed-Integer Convex Program** solved with **Gurobi**, achieving a 10× speedup vs. SOTA.
– Designed a heuristic for a **TSP** variant achieving near-optimal (within 2%) results with drastically lower computation.

Formation Control with Vision-based Collision Avoidance Mar. 2020 – Jul. 2022
Graduate Research Assistant | IISc Bangalore *Bangalore, India*

– Developed a **vision-based formation control** algorithm using a **super-twisting** controller (finite-time convergence) that maintained formation and avoided obstacles using only visual feedback, without inter-robot communication.
– Implemented and validated the controller on physical robots in **Python**/**ROS**, matching performance benchmarks from MATLAB simulations, demonstrating scalable and communication-free coordination.

SKILLS

– **Languages/Frameworks:** Python, C++, ROS2, PyTorch, Tensorflow, TensorRT, CUDA, OpenCV, Gurobi
– **Perception:** Object detection, Segmentation, Multi-object tracking, Camera calibration, LiDAR clustering, Camera-LiDAR fusion
– **Data system:** Azure Databricks, Spark/PySpark, SQL, Pandas

HONORS and AWARDS

– Overall 2nd (2024) and 3rd (2025) in SAE AutoDrive Challenge .
– S. V. Sastry Memorial Gold Medal, IISC, 2022.