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 organized by GM 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.
- Led a team to write the **Software Requirements and Specification (SRS)** for **perception, planning, and control** modules and supervised testing to ensure compliance, improving system reliability and integration.
- As Vice Captain, coordinated cross-team efforts and managed project timelines, validation testing, 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*
- Fine-tuned **YOLO** on custom dataset (15 classes, e.g., 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
Texas A&M University

Apr. 2025 – Present

College Station, TX

- Implemented a **Siamese** RGB–LiDAR detector (YOLOv8 backbone); converted the 3D pointcloud to a 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
Texas A&M University

Jan. 2024 – May 2024

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
Data Scientist

Aug. 2022 – Nov. 2022

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.
- Trained and deployed on **Databricks** (**Spark**/**PySpark**); achieved **99.5%** accuracy (597/600) on ∼500 labeled datasets.

RESEARCH PROJECTS

Energy-Aware Path Planning for Hybrid UAVs
Graduate Research Assistant / Texas A&M University

Feb. 2024 – Jan. 2025

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 significantly lower computation.

Formation Control with Vision-based Collision Avoidance
Graduate Research Assistant / IISc Bangalore

Mar. 2020 – Jul. 2022

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, Linux

- **Perception:** Object detection, Segmentation, Multi-object tracking, Camera calibration, LiDAR clustering, Camera-LiDAR fusion

- **Data Systems:** 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.