Pushkal Mishra

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Biography

My research focuses on developing scalable deep learning systems that perceive and reason about the physical world. I work at the intersection of multi-modal perception, sensor fusion, vision-language, and large-language models for autonomous driving, emphasizing frameworks that unify simulation, real-world sensing, and language grounding for robust scene understanding. I specialize in building large-scale foundation models on distributed GPU clusters (Kubernetes), advancing radar and vision fusion, spatial reasoning, and interpretable multi-modal learning for reliable, real-world conditions.

Education

University of California San Diego   San Diego, CA, USA
PhD in Electrical and Computer Engineering   *Aug 2024 – Present*

– Advisor: Prof. Dinesh Bharadia, WCSNG Lab ⬀
– Research Topics:
  Radar Sensing, Multimodal Representation Alignment, Large-Language Models, Autonomous Driving

Indian Institute of Technology Hyderabad   Hyderabad, India
B.Tech in Electrical Engineering and Minor in Computer Science   *Nov 2020 – May 2024*

– PIs: Prof. Aditya Siripuram, Prof. Ayon Borthakur
– Graduated with CGPA: **9.33 / 10** (Rank 4 out of 62)

Royale Concorde International School   Bangalore, India
High School and Senior Secondary (CBSE)   *Jun 2005 – Aug 2020*

– Grade 12: **96.2%**, Grade 10: **90%**

Research Projects

Scaling Foundation Models for Radar Scene Understanding   Jan 2025 – Present
With Prof. Dinesh Bharadia at UCSD

- Built the first vision-language foundation model for radars in autonomous driving scenes that unifies perception tasks through structured spatial language supervision.
- Introduced a new contrastive learning framework to learn precise spatial distinctions critical for safety-aware perception.
- Designed novel localization-aware evaluation metrics to assess spatial reasoning accuracy.
- Scaled pre-training across distributed GPU clusters using Kubernetes. **Submitted to CVPR 2026**.

Plug-n-Play Sensor Fusion Framework (P2SIF) for Autonomous Driving   Jun 2025 – Present
With Prof. Dinesh Bharadia at UCSD

- Developing a modular framework for fusing Radar, LiDAR, and Camera via text-based specialist models.
- Designing knowledge fusion mechanisms that decouple domain expertise (sensor processing) from generalist reasoning, to improve robustness and interpretability in autonomous driving. This enables LLM-driven decisions.
- Currently evaluating system performance under adverse weather, plug-n-play sensor addition, and error injection cases, with focus on reliability and scalability.

Realistic Radar Simulation Framework for CARLA (C-Shenron)   Aug 2024 – Feb 2025
With Prof. Dinesh Bharadia at UCSD

- Developed a high-fidelity radar simulation framework integrated into CARLA simulator for autonomous driving.
- Incorporated material-aware reflectivity, configurable radar parameters and built scalable data collection pipelines (850K+ frames across diverse towns, weather, and sensor setups) using Kubernetes for large-scale parallel simulation.
- Trained and evaluated multi-radar fusion strategies.
- Published results in ACM SenSys'25 (Demo) and IEEE VTC'25 (Full Paper).

Graph Learning and Data Inpainting via Deep Neural Networks Sept 2022 – Jan 2024
With Prof. Aditya Siripuram at IIT Hyderabad

- Devised an algorithm for simultaneous data restoration and constructing a pertinent graph structure.
- Implemented a closed-loop feedback mechanism for graph learning guided by the inpainting performance.
- Achieved highest F1-Score of 0.92 (learned and actual graph) among existing methods on synthetic data.
- Published in IEEE Signal Processing Letters (10.1109/LSP.2024.3501273 ↗) and presented at ICASSP 2025.

Novel Training Algorithm for Deep Neural Networks Jan 2023 – Jun 2024
With Prof. Ayon Borthakur at IIT Hyderabad

- Proposed a novel backpropagation-free training algorithm using a single forward pass with local loss functions.
- Eliminates gradient propagation and activation storage, yielding significant memory and computational savings.
- Implemented on Multilayer MLPs, CNNs and LSTMs, and showcased equivalent performance with backpropagation on benchmarks such as MNIST, CIFAR-10, CIFAR-100, and SVHN.
- Published in Transactions on Machine Learning Research (TMLR, openreview ↗)

Selected Publications

A Realistic Radar Simulator for End-to-End Autonomous Driving in CARLA ↗ Oct 2025
IEEE 102nd Vehicular Technology Conference Chengdu, China
Satyam Srivastava,[*] Jerry Li,[*] *Pushkal Mishra*,[*] Kshitiz Bansal, Dinesh Bharadia

Demo: Radar Simulator for CARLA ↗ May 2025
23rd ACM Conference on Embedded Networked Sensor Systems (SenSys) Irvine, USA
Pushkal Mishra, Satyam Srivastava, Jerry Li, Kshitiz Bansal, Dinesh Bharadia

Learning Using a Single Forward Pass ↗ Jun 2025
Transactions on Machine Learning Research
Aditya Somasundaram[*], *Pushkal Mishra*[*], Ayon Borthakur

Inpainting-Driven Graph Learning via Explainable Neural Networks ↗ Apr 2025
IEEE Signal Processing Letters, Presented at IEEE ICASSP 2025 Hyderabad, India
Subbareddy Batreddy[*], *Pushkal Mishra*[*], Yaswanth Kakarla, Aditya Siripuram

[*] Equal Contribution.

Awards

Electrical and Computer Engineering Department Fellowship 2024
Awarded full tuition support and stipend for five years of PhD at UC San Diego.

IEEE Signal Processing Cup 2023
Achieved rank 30 in the IEEE Signal Processing Cup challenge held worldwide.

Andy Grove Scholarship Award 2022
Recipient of the scholarship from Intel among 1800 competitive applicants to support undergraduate study.

All India Rank of 1910 in JEE Advanced 2020
JEE Advanced examination among 1 Million candidates

Skills

Programming Languages	Python, C/C++, MATLAB, Bash, Zsh, LaTeX, HTML, Verilog.
Tools & Frameworks	PyTorch, Docker, Kubernetes, Git, TensorFlow, CUDA, ROS2, MATLAB, Cadence, LTSpice, KiCAD.
Systems Skills	Low-level systems programming, Scripting Automation, Embedded Programming (ESP32, Jetson Nano), CARLA Simulation framework.

Work Experience

Signal Processing Intern   May 2023 – July 2023
Texas Instruments   *Bangalore*

- Designed a cross-talk cancellation algorithm for spatial audio playback with an efficient low-order filter approximation.
- Developed a cross-talk cancellation architecture effective across diverse listener angles, introducing novel metrics to evaluate spatial image reconstruction.
- Fully implemented solutions in MATLAB's Signal Processing and Deep Learning toolbox.
- Received a return job offer to work at TI Bangalore.

Senior Member   June 2021 – May 2023
Epoch(ML) and Robotix Club   *IIT Hyderabad*

- Built a mini-bipedal robot from scratch using 3D-printed parts, servo motors, and Arduino drivers.
- Developed hand gesture recognition using motion sensors and DNN for time-series action classification.
- Conducted workshops and hands-on sessions on Arduino and motor drivers.
- Organized hackathons and knowledge-sharing sessions for the IIT Hyderabad community.

Selected Course Projects

Autonomous Driving with UWB and Aruco Marker using NVIDIA Jetson   Apr 2025 – Jun 2025
ECE-148: Intro to Autonomous Driving Project at UCSD (Team of 4)

- Designed and implemented an autonomous car-following system integrating real-time UWB-based triangulation, IMU fusion, and Aruco marker vision for robust localization and tracking even under non-line-of-sight conditions.
- Built ROS2 perception with: OAK-D Lite for marker detection, UWB based anchor triangulation, and Aruco-based following with curved-path obstacle navigation.
- Project webpage: https://github.com/UCSD-ECEMAE-148/148-spring-2025-final-project-team-10/ ☑

Anchor-based Wi-Fi CSI Localization   Aug 2024 – Dec 2024
ECE-257A: Modern Communication Networks Project at UCSD (Team of 3)

- Proposed a novel Anchor-based CNN architecture, incorporating anchor-assisted features to achieve sub-meter accuracy in dynamic multipath environments.
- Built an end-to-end data collection and preprocessing pipeline using Turtlebot, Raspberry Pi anchors, and SLAM for ground-truth alignment; performed CSI phase/magnitude calibration and ToF correction.
- Collected and trained on vast amounts of real-scenario data in dynamic environments.
- Demonstrated that DL with CSI significantly outperforms RSSI and classical approaches for indoor localization.

Image Deblurring for Video Frame Prediction   Jan 2023 – May 2023
EE6310: Image and Video Processing at IIT Hyderabad

- Video frame prediction models predicts the future frames of a video from past input frames.
- Used **image deblurring** on predicted frames to improve the performance and extended their relevance to multiple predicted frames.
- Implemented next frame prediction and video deblurring models based on **convolutional LSTMs** using PyTorch.
- Used the two models in cascade for prediction on Moving MNIST and KTH walking datasets.