Udit Singh Parihar

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Education

International Institute of Information Technology — Hyderabad, India
MS By Research Computer Science; ***GPA: 8.67/10.00*** — *2019 – 2021*

Indian Institute of Technology — Jodhpur, India
B. Tech Mechanical Engineering; ***GPA: 7.1/10.0*** — *2014 – 2018*

Work Experience

Qualcomm — Bangalore, India
Computer Vision, DL and SLAM Research Engineer — *July 2023 – Present*

Multi-camera Visual-Inertial SLAM (shipped in Google AndroidXR & Samsung Moohan):

- Designed architecture for multi-camera support in 6DoF Visual-Inertial SLAM; integrated multi-camera constraints into tracker and pose graph optimizer, improving robustness and accuracy by 2×
- Simplified pose graph optimizer by removing redundant nodes and leveraging camera extrinsics

Patents (6 Accepted) – Deep Learning & SLAM:

- ***Hybrid Classical-DL Feature Tracking:*** Combining CV tracking with DL-based feature matching using IMU priors for lower power and higher accuracy in Visual-Inertial SLAM
- ***VLM Semantic Priors for SLAM Perception:*** Incorporating semantic and user-context information from Vision-Language Models into SLAM perception for improved accuracy and power efficiency
- ***Illumination-Robust Feature Matching:*** Fusing IMU and DL-based feature matching to handle scene lighting changes when patch descriptors fail under varying illumination
- ***Uncertainty-Aware Feature Matching for Pose Estimation:*** Dual-head network predicting correspondences and matching uncertainties jointly; uncertainty fused into EKF-based pose estimation for reduced latency and power

Visual-Inertial Odometry Optimizations:

- Studied IMU intrinsic calibration and camera-IMU clock offset in EKF-based VIO; concluded both can be removed from the state vector, saving latency and power — validated over 15 datasets × 5 runs each
- Identified suboptimal Hermite spline representation of camera distortion; derived analytical closed-form warping matrix, reducing projection function calls in the highest power hotspot

Ground-Truth Infrastructure for 6DoF Accuracy Evaluation:

- Built a mechanically constrained setup for ground-truth pose collection in scenarios where motion capture is unavailable; integrated into CI pipeline for continuous accuracy validation
- Designed 360°-spanning 4-ChArUco board rig with unique markers, achieving sub-mm circle-fit accuracy for drift estimation in outdoor HDR and moving-shadow scenarios

OLA Electric — Bangalore, India
Computer Vision, DL and SLAM Research Engineer — *July 2021 – July 2023*

Autonomous agent development:

- Developed multimodal network to predict Semantic occupancy grid and drivable waypoints directly from camera and GPS Coordinate
- Develped simulation in loop and hardware in loop testing for the autonomous agent
- Converted the pytorch model to TensorRT and developed a ROS wrapper to deploy on Mahindra E2O car achieving final control prediction at 25 HZ, in a zero shot paradigm

Lidar based mapping and localization:

- Extended the Lidar based SLAM LeGO-LOAM for the Ouster lidars and ported ROS1 to ROS2 in C++
- Calibrated the Lidar and IMU/GNSS sensors for extrinsic calibration

Kaggle Image Matching Challenge:

- Won the silver medal in the Kaggle Image Matching Challenge 2022
- Developed an Ensemble of Deep feature matching algorithm of SuperGlue and LoFTR

Research Publications

1. **Estimation of Appearance and Occupancy Information in Bird's Eye View from Surround Monocular Images** | *OLA Electric*
   International Conference on Robotics and Automation (ICRA), Autonomy 2.0, ***2022***
   Sarthak Sharma, Unnikrishnan R. Nair, ***Udit Singh Parihar*** *, Midhun Menon S and Srikanth Vidapanakal*

2. **RoRD: Rotation-Robust Descriptors and Orthographic Views for Local Feature Matching** | *IIITH*
   International Conference on Intelligent Robots and Systems (IROS), ***2021***
   Udit Singh Parihar*, Aniket Gujarathi*, Kinal Mehta*, Satyajit Tourani*, Sourav Garg, Michael Milford and K. Madhava Krishna*

3. **Early Bird: Loop Closures from Opposing Viewpoints for Perceptually-Aliased Indoor Environments** | *IIITH*
   International Conference on Computer Vision Theory and Applications (VISAPP), ***2021***
   Satyajit Tourani, Dhagash Desai*,* ***Udit Singh Parihar****, Sourav Garg, Ravi Kiran Sarvadevabhatla, Michael Milford and K. Madhava Krishna*

4. **Topological Mapping for Manhattan-like Repetitive Environments** | *IIITH*
   International Conference on Robotics and Automation (ICRA), ***2020***
   Sai Shubodh Puligilla , Satyajit Tourani* , Tushar Vaidya* ,* ***Udit Singh Parihar**** *, Ravi Kiran Sarvadevabhatla and K. Madhava Krishna*

Projects

Tutorial on Pose Graph Optimization | *Project Link*
Teaching Assistant in Mobile Robotics course | Sep 2020

- Created Open source tutorials for 2D pose graph optimization with loop closure and 3D pose graph optimization with landmarks using g2o library
- Obtained more than 50 stars and forks on GitHub for the tutorials

Development of Robotics Toolbox | *Project Link*
Mobile Robotics Coursework | Aug 2019

- Implemented Bundle Adjustment from scratch. Compared performance of Gauss Newton and LM algorithm for optimization
- Implemented Extended Kalman Filter algorithm on the standard *"Lost in the Woods"* dataset

Development of Parallel Computing Toolbox | *Project Link*
Parallel Scientific Computing Coursework | Jan 2019

- Implemented PCA algorithms for image compression using C++/Cuda. Compared performance against MATLAB standard PCA implementation
- Implemented parallel Monte Carlo algorithm for calculation of digits of *PI* using OpenMP and MPI

Skills

Programming: C++, Python, C, MATLAB

Libraries: PyTorch, Keras, CUDA, TensorRT, ROS1/ROS2, Ceres, GTSAM

Relevant Coursework

Major coursework: Computer Vision, Mobile Robotics, Topics in Applied Optimization, Introduction to Parallel Programming, Deep Learning Theory and Practices, Probability and Statistics, Programming and Data Structures