Sahib Singh Dhanjal

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Education

University of Michigan, Ann Arbor Aug '17 - May '19

Masters of Science in Robotics | GPA - 3.55/4.00 | **Courses**: Artificial Intelligence, Machine Learning, SLAM, Self Driving Cars, Computer Vision

Birla Institute of Technology and Science, Pilani Aug '12 - May '16

Bachelors of Engineering in Mechanical Engineering | GPA - 9.05/10.00 | **Courses**: Image Processing, Mechanisms in Robotics

Work Experience

Magic Leap | Google: *Sr High Performance Software Engineer (Computer VIsion)* Oct '20 – Present

- Developed a variational autoencoder based extrinsics miscalibration detector, seamlessly integrated into the pose tracking pipeline using ONNX. The solution leveraged deep learning and computational geometric fundamentals to detect miscalibrations and trigger online calibration (OC), reducing computational overhead by ~30% per 10 min of device runtime.
- Engineered a dense photometric refinement based targetless depth-to-camera extrinsics calibration algorithm to compensate for manufacturing defects leading to deformations of upto 0.5º and 1.75mm causing failure of our world reconstruction pipeline. Algorithm demonstrated robust and real-time performance across KPI datasets, and was shipped to end-users as an OTA update.
- Lead development of a high precision marker tracking algorithm for a high-accuracy measurement application (1mm error over 50m) leveraging non-linear optimization techniques for single/multi-camera rigs. Achieved substantial accuracy improvements over OpenCV benchmarks (error: 40mm vs 5mm and 12 arcmin vs 4arcmin) across 500+ synthetic and real world datasets.
- Lead development of an online camera intrinsics calibration algorithm, enabling reliable device operation from -5ºC to 80ºC by compensating for focal length changes caused by temperature and humidity changes.
- Improved markerless extrinsics camera calibration algorithm by ~40% incorporating key ideas from Ling et al's work [1] .
- Improved scale and epipolar error for the factory calibration pipeline by ~1% by unifying lens correction and rectification.
- Established a CI-based automated testing framework covering on-device, cloud-based integration, and unit testing pipelines.
- Developed a unified metrics API, device telemetry API and web dashboard, enabling visualization, benchmarking and data-driven decision-making across workflows, datasets, and software builds.
- Keywords – nonlinear optimization, online calibration, 3D computational geometry, linear algebra, deep learning, sensor fusion, SLAM, photometric refinement, pose tracking, PyBind, PyTorch, Python/C++

Magna | Lyft Level 5: *Software Engineer (Deep Learning, Localization and Mapping)* Jul '19 - Oct '20

- Led the development of a deep learning solution for dirty lens and pedestrian detection on highly constrained ARM DSPs (< 2Mb) achieving ~15FPS. Designed, pruned (network slimming [2]) and quantized (hybrid quantization [3]) the neural network, reducing model size by ~70% with a minimal drop in model accuracy/mAP. Deployed the same on CEVA DSP using ONNX Runtime, proprietary kernels in ArmNN [4], and model compilation and flashing using CDNN [5].
- Developed monocular visual SLAM based auto-pilot/auto parking systems for Tier I/II OEMs achieving 30cm/50m accuracy.
- Implemented a 2.5D lane geometry generation algorithm to create semantic map from OSM (Open Street Map)
- Streamlined HD map validation pipelines, reducing runtime from 24 hrs to < 3 hrs using Flyte [6], Docker, Botocore [7] and gRPC.
- Keywords – deep learning, pruning, quantization, object detection, sensor fusion, Visual SLAM, ONNX, OSM, Python/C++, gRPC

Research Experience

Perpetual Robotics Lab: *Radio-Visual-Inertial Positioning System, IROS 19* Aug '18 – May '19

- Developed a radio-visual-inertial localization framework for robust navigation in indoor environments under Dr. Maani Ghaffari
- Designed deep learning classifier to distinguish LOS/NLOS radio packets to validate Friis Free Space Model (95% accuracy)
- Conducted extensive simulations in MATLAB and Python to validate the framework and performed real-world experiments on the Fetch Mobile Manipulator. Published findings in IROS' 19 [8] showcasing advancements in multi-modal localization
- Keywords – deep learning, radio localization, Fast SLAM, particle filter, non-linear optimization, ROS, Python/C++, Matlab

Distributed Aerospace Systems and Controls Lab: *NASA Astronet, ICRA '19, TARDEC Project* Apr '18 - May '19

- Implemented advanced control algorithms and VR simulations for NASA's Astronet project in ROS [9]/Gazebo [10].
- Developed an unsupervised learning approach for multi-tasking environments and used Microsoft Hololens to provide augmented vision of the not-in-focus tasks using a quadrotor streaming video feed. Published this work in ICRA' 19 [11]
- Worked on multi-robot localization and collision avoidance algorithms with a swarm of Crazyflies and AION R1 rovers
- Keywords – unsupervised learning, swarm localization, AR/VR applications, ROS, rViz, Gazebo Python/C++

Publications

[i] DeepLocNet: Deep Observation Classification and Ranging Bias Regression for Radio Positioning Systems: IROS 19

[ii] Unsupervised Learning of Assistive Camera Views in Augmented Reality Multitasking Environments: ICRA 19

[iii] PoseNet++: A CNN framework for online pose regression and robot re-localization