Jagatpreet Singh Nir

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Accomplished Robotics Engineer | Ph.D. in Computer Engineering (Robotics) | SLAM Expert

Ph.D. in Computer Engineering (Robotics) with a dedicated focus on Simultaneous Localization and Mapping (SLAM), showcasing over 8 years of successful industry projects in robotics. Proven expertise in the development and optimization of cutting-edge SLAM algorithms for real-time applications. Proficient in C++ and Python. Adept in systems design, sensing, perception, planning, and controls with strong analytical and problem-solving skills. Notable contributions to the esteemed conference and journal publications.

EDUCATION

Northeastern University (NU), Boston, MA May, 2024
Ph.D., Computer Engineering (Robotics)

Indian Institute of Technology (IIT), Delhi, India May, 2013
B.Tech., Production and Industrial Engineering

TECHNICAL SKILLS

SLAM:	Visual SLAM, LiDAR SLAM, Visual-Inertial SLAM, Kalman Filtering, Bundle Adjustment,
Programming:	C++, Python, Java, Matlab, Simulink, Labview, Linux, Yocto, Windows, Git, Docker, PyTest, GTest, CMake
Libraries:	ROS, OpenCV, Numpy, Scipy, GTSAM, CERES, OpenCv, Scikit, Eigen, pytorch
Sensors:	GPS, RTKGPS, Lidar, RGB-D-IR camera, IMU.
Mathematics:	Geometric computer Vision, feature detectors and descriptors, Sensor Fusion, Optimization Algorithms, Linear and Non-linear control, Robot kinematics and Dynamic modeling, Trajectory and Path planning, Signal Processing, Statistics.
Hardware:	Pixhawk PX4, NVIDIA Jetson, Raspberry Pi, Arduino.

PROFESSIONAL EXPERIENCE

Graduate Research Assistant, NU Field Robotics Lab — 2018 - present, Boston, USA

Ph.D. research on improving visual SLAM in visually degraded situations leveraging inertial navigation methods and deep learning-based pipelines.

- Formulated and implemented custom factors in GTSAM for fusing the visual odometry solution of a deep learning visual odometry pipeline (DROID SLAM) with IMU factors.
- **Designed, developed and benchmarked** a sub-meter accuracy monocular VIO system; with hardware multi-sensor synchronization and extrinsic sensor calibration;
- Led the development approach to develop newer systems: **Underwater VIO system on Blueye ROV** and **infrared camera-based VIO system on ModalAi quadcopter** to perform SLAM in visually degraded situations.
- **Experimented and characterized** different stochastic noises of MEMS IMUs using **Allan deviation**; **performed Monte-Carlo simulations** for modeling and quantification of error; resulting in novel covariance models for IMU error characterization in sensor fusion.

- **Implemented** ROS-based device driver for the VIO system leading to ease of data acquisition and interoperability with different Linux-based OS; **characterized and validated** accuracy of the designed VIO system with mm level accurate Optitrack's ground truth.

Algorithm Engineer - Internship, Humatics **2022, Waltham, USA**

- **Engineered seamless software integration** of onboard IMU data into the Humatics Rail Navigation System, following industry-standard software development practices, to ensure precise along-track positioning. **showcasing applicability of solution in a sparser set of UWB beacons**.
- **Led the IMU noise modeling characterization** effort to model covariances of IMU and error growth of IMU dead-reckoning; extensively used **agile software development** practises and tools.

Research Assistant, PAR Lab, IIT Delhi, India **2016-2018, IIT Delhi, India**

- **Modeled the coordinated dynamics** of 3 - Delta manipulators hand system for grasping a cube
- **Formulated a grasp force calculation algorithm** assuming a 3-point no-slip contact model
- **Implemented joint control algorithms** in Matlab using **feedback linearization methods**; **robust control** under **parameter uncertainties**.
- **Demonstrated control procedures and grasp force computing algorithms through simulations**.

Systems Design Engineer, Faros Simulation Systems Ltd. **2014 - 2015, Gurgaon, India**

- **Conceptualized and designed an excavator simulator** - hardware interfaces and simulation software.
- Designed, developed and tested **a low-cost data acquisition board** to interface product hardware.
- Implemented and tested **motion washout filters to improve user experience** of a motion simulator.

Assistant Manager, Vehicle Testing, Hero Moto Corp. Ltd., **2013 - 2014, Gurgaon, India**

- **Supported vehicle testing team with execution of test plans** for new motorcycle models.
- **Evaluated testing specifications** for new parts for **performance, durability and NVH assessment**.

AWARDS and ACCOMPLISHMENTS

- **Outstanding Teaching Assistant Award**, Electrical Engineering Dept., NU, 2021.
- **Elite Robotic Summer School Scholarship, SDU**, Innovation Center Denmark, Boston, 2021.
- **Suresh Chandra Memorial Award**, Best Undergrad B.Tech. Project, Mechanical Dept., IIT, 2013.

PUBLICATIONS

- Pushyami Kaveti, Aniket Gupta, Denis Giaya, Madeline Karp, Colin Keil, **Jagatpreet Nir**, Zhiyong Zhang, Hanumant Singh, **"Challenges of Indoor SLAM: A multi-modal multi-floor dataset for SLAM evaluation"** (Accepted - CASE)
- **Jagatpreet Nir**, Benjamin Deming, Hanumant Singh, " **High Fidelity Inertial Measurement Unit (IMU) Modeling for Underwater Visual Inertial Navigation**", 2021, OCEANS Conference and Exposition SanDiego - Porto, 2021.
- Pushaymi Kaveti, **Jagatpreet Nir** and Hanumant Singh, "**Towards Robust VSLAM in Dynamic Environments: A Light Field Approach**," 2021, IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI), 2021.
- Vikrant Shah, **Jagatpreet Nir**, Pushyami Kaveti, Hanumant Singh, "**Performance Analysis of Feature Detectors and Descriptors in Underwater and Polar Environments**", 2021, OCEANS Conference and Exposition SanDiego - Porto, 2021.