Akshay Hinduja

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akshayhinduja.github.io

Education:

- Ph.D. Mechanical Engineering, Carnegie Mellon University
  Advisor : Dr. Michael Kaess
  Sept 2018 - May 2024 (anticipated) | Pittsburgh, PA
- M.S. Mechanical Engineering, Carnegie Mellon University
  Advisor: Dr. Kenji Shimada
  May 2017 | Pittsburgh, PA
- B.Tech Production Engineering, VJTI
  May 2014 | Mumbai, India

Research Interests and Expertise:

- Simultaneous Localization and Mapping (SLAM)
- Factor graph optimization
- Underwater robotics, acoustic localization and sonar perception
- Deep learning for vision
- 2D and 3D Perception
- Sensor fusion

Professional Experience and Research Projects:

- **Robot Perception Lab: Systems Engineer/Extern**
  June 2017 – August 2018 | Field Robotics Center, Pittsburgh
  - Setup and maintenance of software stack for multi-sensor pack used for recording data
  - Stereo vision-based dense reconstruction and damage detection. Using a combination of statistical feature descriptors and ML, a 3D classifier was developed to detect minor geometric anomalies.
  - Developed a feature-based SLAM technique using imaging sonars. Used A-KAZE features to perform real-time SLAM on simulated and real-world datasets.
- **Tsuneishi Shipbuilding Co Ltd.: Robotics Intern**
  May 2016 – June 2016 | Fukuyama, Japan
  - Robot localization using Velodyne VLP 16. Implemented ICP and NDT-based localization using pose updates.
- **Computational Engineering and Research Lab: Graduate Research Student**
  August 2015 – May 2017 | Pittsburgh, PA
  - Designed and built a prototype for an autonomous robot to weld ship hulls for commercial merchant vessels and tested the suitability of the design for its movements across the environment.
  - Developed a frame-to-frame,real-time odometry estimator using the Normal Distribution Transform and a Velodyne VLP-16
- **Pose-supervised Learning for Imaging Sonars**
  Ph.D. thesis research | Robot Perception Lab | 2023, Pittsburgh. PA
  - Developed a pose supervised network to learn viewpoint invariant feature correspondence between imaging sonar images of the same scene.
- **Using cGANs To Filter Imaging Sonar Data for Occupancy Mapping**
  Ph.D. research | Robot Perception Lab | 2022, Pittsburgh, PA
  - Use cGANs to train a network to recognize speckle noise in sonar images and to filter the image to give clean and robust information for generating accurate occupancy maps.
- **Acoustic Localization and Communication Techniques for Multiple, Low Power, Low-Cost Soft Robots**
  Ph.D. thesis research | Robot Perception Lab | 2021, Pittsburgh, PA
  - Develop acoustic techniques to localize and direct several soft robotic fish using a known network of speakers on the transmission side and a single MEMS Microphone on each robot agent.
- **Soft-Sensor Integration for Information Rich Mapping**
  Ph.D. thesis research | Robot Perception Lab | 2020, Pittsburgh, PA
  - Integrating custom "soft sensor" stickers onto existing underwater vehicles to obtain data pertaining to chemical properties and other modalities to integrate into the existing pipeline of 3D Map generation.

- **Degeneracy Aware Mapping for Underwater Robots**
  Ph.D. thesis research | Robot Perception Lab | 2019, Pittsburgh, PA
  - Developing SLAM optimization improvements for degenerate environments. Focus on methods to aid robots with low-quality sensors.
- **Development Of A Perception System For A Voice Controlled Husky**
  Robot Autonomy | Field Robotics Center | Spring 2017, Pittsburgh, PA
  - Development of a human detection and tracking package in ROS using an Adonis camera, Velodyne Lidar, and Hokoyu line scanner. Developed for the ClearPath Husky mobile robot platform.
- **3D Point Cloud NDT Odometry**
  Computer Vision | Fall 2016, Pittsburgh, PA
  - Developed a visual odometry package in ROS using a Velodyne Lidar VLP16. The algorithm was based on the use of the Normal Distribution Transform for scan matching.

Teaching Experience:
- **24-370** Engineering Design I: Methods and Skills
- **24-787** Machine Learning and Artificial Intelligence for Engineers

Publications:
- "SONIC: Sonar Image Correspondence using Pose Supervised Learning for Imaging Sonars" - S Gode*, **A Hinduja***, M Kaess: To appear in 2024 IEEE International Conference on Robotics and Automation (ICRA)
- "Multi-Radar Inertial Odometry for 3D State Estimation using mmWave Imaging Radar" - JT Huang, R Xu, **A Hinduja**, M Kaess: To appear in 2024 IEEE International Conference on Robotics and Automation (ICRA)
- "Conditional GANs for Sonar Image Filtering with Applications to Underwater Occupancy Mapping" - T Lin, **A Hinduja**, M Qadri, M Kaess: 2023 IEEE International Conference on Robotics and Automation (ICRA)
- "Acoustic Localization and Communication Using a MEMS Microphone for Low-cost and Low-power Bio-inspired Underwater Robots" - **A Hinduja**, Y Ohm, J Liao, C Majidi, M Kaess: 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- "Degeneracy-Aware Factors with Applications to Underwater SLAM" - **A Hinduja**, BJ Ho, M Kaess: 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- "Designing a Mobile Robot For Double Hull Welding" - CF Goh, **A Hinduja**, L Zhang, D Ajmani, R Song, K Shimada: 2019 Journal of Mechanisms and Robotics 11 (4).
- "Feature-based SLAM for imaging Sonars" - E Westman, **A Hinduja**, M Kaess: 2018 IEEE International Conference on Robotics and Automation (ICRA)

Skills:
- Programming: Python • C++ • MATLAB • ROS • OpenCV • Point Cloud Library (PCL) • ISAM/GTSAM PyTorch, Unreal Engine
- Design: SolidWorks • Inventor • ANSYS
- Rapid Prototyping: Metal Working • CNC Machining • 3D printing • Laser Cutting

Relevant Coursework:
- Engineering Computation
- Linear Systems
- Computer Vision
- Mobile Robots
- Kinematics, Dynamics and Control
- Robot Autonomy
- Robot Localization and Mapping
- Algorithms and Advanced Data Structures
- Artificial Intelligence and Machine Learning
- Learning for 3D Vision