Akshay Hinduja
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Expertise:

- Simultaneous Localization and Mapping
- Factor graph optimization
- Underwater robotics
- Acoustic Localization
- Sonar perception

Current Research Interests: Simultaneous Localization and Mapping, 3D Perception, Underwater Robotics and Sensing, Acoustic Methods for Localization, Learned methods for imaging sonar feature matching and sensor fusion

Education:

- Ph.D. Mechanical Engineering, Carnegie Mellon University
  GPA 3.84/4.0
  Sept 2018 - May 2024 (anticipated)
  Pittsburgh, PA
- M.S. Mechanical Engineering, Carnegie Mellon University
  GPA 3.82/4.0
  May 2017
  Pittsburgh, PA
- B.Tech Production Engineering, VJTI
  GPA 6.9/10.0
  May 2014
  Mumbai, India

Experience:

- **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 forits movements across the environment.
  • Developed a frame-to-frame,real-time odometry estimator using the Normal Distribution Transform and a Velodyne VLP-16

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: Under review
- “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: C++ • MATLAB • Python •ROS •OpenCV •Point Cloud Library (PCL) •ISAM/GTSAM
- DESIGN: SolidWorks • Inventor • ANSYS
- MANUFACTURING: Metal Working • CNC Machining • 3D printing • Laser Cutting

Relevant Coursework:

Engineering Computation
Special Topics in Finite Element Analysis
Linear Systems
Computer Vision
Mobile Robots
Kinematics, Dynamics and Control
Robot Autonomy
Robot Localization and Mapping
Design of Biomechatronic Systems
Algorithms and Advanced Data Structures
Artificial Intelligence and Machine Learning
Learning for 3D Vision

Academic Projects:

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.

Design Of A Lightweight Ankle Exo-Skeleton With An Energy Conserving Clutch

Experimental Biomechatronics Laboratory | Spring 2017, Pittsburgh, PA

- Design, manufacture, and controller design for a lightweight ankle exoskeleton that utilizes an electro adhesive clutch, enabling the walker to save on the muscle energy expended with each step taken.

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.

Design and Implementation of a Robust Quadcopter Controller

Kinematics, Dynamic Systems, and Control | Spring 2016, Pittsburgh, PA

- This project implements a quadcopter controller designed for fault tolerance and recovery. The implemented controller was built on top of a PID loop to generate the thrust and moment demands of the quadcopter.

Robot Maze Rumble

Engineering Computation | Fall 2015, Pittsburgh, PA

- Developed a C++ program as a team, using OpenGL to create a 3D robot maze solving game that utilizes the Rosetta algorithm for maze generation and the A-Star algorithm for path planning. Worked specifically on the A-star algorithm implementation.