MOSES CHUKA EBERE

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OBJECTIVE

Aspiring Robotics PhD candidate with a deep focus in Intelligent Field Robotic Systems, eager to advance research in robotic applications. Passionate about integrating deep learning for real-time task planning and execution in autonomous (mobile) manipulation, adapting to complex and dynamic environments, and blending visual cues alongside constrained optimization in SLAM for improved navigation and mapping.

EDUCATION

Joint Master's in Intelligent Field Robotic Systems, Universitat de Girona, University of Zagreb 2022 - Present
Expected Graduation: June 2024
Semesters I & II in Girona: Autonomous Systems, Machine Learning, Multiview Geometry (Computer Vision), Probabilistic Robotics (Kalman Filtering and SLAM), Path planning and Exploration, and Robot Manipulation.
GPA: 9.68/10
Semester III in Zagreb: Aerial Robotics, Multi-Robot Systems, Human-Robot Interaction, Robotic Sensing, Perception, & Actuation, Deep Learning, and Ethics & Technology.

Master of Science (MSc.) in Mechatronics Engineering, Sabancı University 2021 - 2022 (**Incomplete**)
*(Left program halfway to pursue a better opportunity)
GPA: 3.86/4

Bachelor of Science (B.S.) in Mechanical Engineering, Çukurova University 2017 - 2021
GPA: 3.94/4

SKILLS

Technical Skills	ROS, Python, PyTorch, Tensorflow, MATLAB/Simulink, C++, OpenCV, Catia V5
Engineering	Reinforcement Learning, Simultaneous Localization and Mapping (SLAM), Computer Vision, Visual/LiDAR Odometry, Path Planning, Machine/Deep Learning, Industrial Robots
Soft Skills	Research, Problem-Solving, Critical Thinking, Communication, Teamwork, Independence

PROJECTS

Controlling a Swarm of Omnidirectional Robots in a Simulator Using Reynolds' Rules. This project involved implementing and extending Reynolds Rules for Flocking to guide a swarm of sphero robots to "flock", avoid obstacles, and migrate to set points in simple-to-complex simulation environments.

Reinforcement Learning-Based Path Planning for Autonomous Robots in Static Environments. This project involved implementing the Q-learning algorithm on a point (omnidirectional) robot for path planning and navigation purposes.

Task Planning and Control for a Differential Drive Robot Fitted with a Manipulator. Developed a task-priority redundancy resolution control algorithm for a Turtlebot2 robot fitted with a 4DOF manipulator. This project entailed control architecture design, modeling with URDF, kinematic derivations, in-depth task-priority design, ROS-based developments, simulations in Stonefish, and hardware experimentations.

Pose-based EKF SLAM on a Kobuki Turtlebot2. A comprehensive ROS-based project that involved developing and implementing a pose-based SLAM algorithm for the robot (in simulation and the real world) where the iterative closest point (ICP) algorithm was used for registering LiDAR scans. By fusing the registration outcome with data from the robot's IMU, the robot's pose was updated promptly. Additionally, we developed an algorithmic method of constraining the size of the state vector while maintaining the fidelity of the robot's entire trajectory.

Autonomous Robot Exploration on a Kobuki Turtlebot2. Developed frontier-based exploration using Multiple-RRT*'s and Mean Shift clustering for Next-Best View (NBV) determination. Implemented collision-free path planning with OMPL and Dynamic-Window Approach for smooth navigation and obstacle avoidance. Fully developed in ROS, the algorithm was sufficiently tested in Stonefish and Gazebo before successfully deploying it on real hardware.

Event-Based Feature Tracking Using the Iterative Closest Point Algorithm (for a DAVIS event camera). Implemented an ICP-based pipeline that detects traditional features from grayscale images of a DAVIS camera and tracks the features using the asynchronous events generated by the camera's DVS sensor.

Autonomous Robot Exploration, Perception, Localization, Mapping, and Manipulation. Combined modules from the above 4 projects into a unified behavior-tree-based framework in the ROS ecosystem on the Turtlebot2 to autonomously explore its environment, locate objects of interest, pick transport, and place them in desired locations.

Machine Vision Application with the Staubli TX60 Robot. A lab project that involved combining (by means of a TCP socket connection) a Python-based perception system for part detection with the TX60 robot as the manipulation system for picking and stacking parts detected by the camera in a desired location.

Stereo Visual Odometry for Grizzly Robotic Utility Vehicle This project involved designing a VO pipeline for the Grizzly Robotic Utility Vehicle. It involved stereo camera calibration, feature extraction, and matching using SURF features and utilizing bucketing strategies and circular matching for accurate apparent motion computation and effective noise/outlier rejection, Structure from motion (2D-to-2D, 3D-to-2D, and 3D-to-3D) for triangulation and refinement using bundle adjustment. The final VO trajectory was also extensively compared with GPS-generated ground truth data.

Design and Simulation of a Closed-Loop Controller for Balancing a Robot Butler (with a compliant element). Derived a Control Law for the Robot Butler by cleverly combining Input-State Linearization and Backstepping methodologies, which successfully handled impulse disturbances and ensured robust balance. Simulated the closed-loop system in the MATLAB/Simulink environment, and presented the comprehensive report as a term project.

Lane Detection and Distance Estimation using a Monocular Camera. Using OpenCV's Python library alongside other libraries, a scene-geometry-based algorithm was developed for distance estimation while Haar Features and Hough transform were used for object and lane detection. The developed solution was tested on make-shift lanes and some road datasets before deploying on a Raspberry Pi. Finally, a research-style report was presented on the work done.

EXPERIENCE

Deep Learning and Neuromorphic Vision Intern Jun 2023 - Sep 2023
ViCOROB *Girona, Spain*

- Explored deep learning architectures such as SNNs, Recurrent ViTs, and Asynchronous CNNs, that leverage the asynchronous nature of event data from event-based vision sensors for object detection using PyTorch.
- Curated underwater object-detection and optical flow datasets with a remotely operated underwater vehicle fitted with a DAVIS camera at the research pool and natural lake.
- Developed a modular event data preprocessing and visualization pipeline for the underwater perception group in Python.
- Conducted experimental validation of optimization-based methodologies for annotating event-object-detection datasets.

Graduate Teaching Assistant Sep 2021 - Aug 2022
Sabancı University *Istanbul, Turkey*

- Instructed undergraduate students in mathematical courses (Differential Equations and Introduction to Probability), demonstrating strong communication skills and teaching abilities.
- Provided grading and proctoring support to faculty members.

AWARDS

Erasmus Mundus Joint Masters Scholarships, Erasmus+ (EU) Apr 2022

Fully-funded Masters Scholarship, Sabancı University Aug 2021

Best Graduating Student, Department of Mechanical Engineering, Çukurova University Jul 2021

Second Best Graduating Student, Faculty of Engineering, Çukurova University Jul 2021

Fully-funded Undergraduate Türkiye Scholarships, Government of Turkey Sep 2016 - Jun 2021