Nefelie Hemrich

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EDUCATION

Master of Engineering in Maritime Engineering | University of Southampton, UK *Sept 2020 - Jun 2024*
Grade: First Class Honours (average: 79%) + Best Performing Student prize 2023
Specialised in Robotics (Maritime Robotics, Intelligent Mobile Robotics, Machine Learning, Ship Manoeuvring and Control).
Master's Group Design Project: *Perception System Design for an Autonomous Surface Vessel*

- Designed a photorealistic simulator to develop and test a perception system using stereo cameras and LiDAR in Gazebo with ROS2, enabling collision avoidance in marine environments.
- Developed object detection algorithms for vision and point cloud data under varying sea states based on self-attention mechanisms from the DINO vision transformer, and computed disparity maps for depth estimation.
- Integrated the perception system with obstacle avoidance sub-systems in a multidisciplinary team.

Bachelor's Thesis: *"Constructing a Global Shipping Network Using AIS Data and Graph Theory to Enhance Maritime Situational Awareness"* (see link)

- Developed an unsupervised graph-extraction methodology using machine learning (KNN, DBSCAN) and graph theory to model maritime routes and analyse global traffic patterns, presented to the UK Government Department for Transport.
- Designed and implemented a data processing pipeline to clean AIS data and compress vessel trajectories.
- Analysed maritime traffic variability and congestion to provide insights into global shipping routes and supply chains.

WORK EXPERIENCE

Research Assistant Intern | Marine & Maritime Institute, University of Southampton, UK *Jul 2023 - Aug 2023*
Generated a global marine corrosion map for shipping using AI/machine learning for integration into a digital twin for marine structures, supporting improved ship design and maintenance strategies to reduce costs. Implemented and trained an artificial neural network, employing k-fold cross validation to predict corrosion depth based on geospatial ocean datasets.

Research Assistant Intern | Marine & Maritime Institute, University of Southampton, UK *Jun 2022 - Sep 2022*
Produced a technical report and concept design for Shell Shipping & Maritime on a net-zero LCO2 bulk carrier with a carbon capture system to support UK's decarbonisation targets and developed a 3D model and render in Rhinoceros 3D.

PROGRAMMING SKILLS

Programming Languages: Python, C++, Java, MATLAB
Machine Learning: Keras, Pytorch, Scikit-learn, OpenCV, YOLO
Data Manipulation & Management: Pandas, Numpy, Scipy, SQL
Robotics: ROS2, Gazebo
Web Development: Typescript, HTML, CSS, FastAPI, Svelte
Other: OOP, Windows, Linux, Git, Docker

PROJECTS

Marine Autonomy Challenge 2023 | Society of Maritime Industries, UK
Led the University of Southampton team to 3rd place in a competition, developing software for an autonomous vessel to map and detect hydrocarbon pollution and ocean plastic. Tested path planning, obstacle detection & avoidance algorithms (based on TTM), dynamic positioning, and used network systems and NMEA/serial protocols for hardware communication (GPS, AIS, camera).

Guidance, Navigation & Control Software for an Autonomous Vessel | University of Southampton, UK
Implemented PID control, artificial potential fields (path planning), line of sight guidance (path following), and an Extended Kalman Filter (probabilistic localisation/sensor fusion) through python simulations. Worked with actuators (differential thrust motors) & sensors, including an IMU (heading control) and ArUco markers for localisation, to implement the software on the vessel.

SLAM and Perception System Development for an Intelligent Wheeled Robot | University of Southampton, UK
Developed a graph-based simultaneous localisation and mapping (SLAM) algorithm to integrate perception and control systems for autonomous navigation. Implemented trajectory planning, state-space control, probabilistic localisation (particle filter), and interpreted live LiDAR data using a Gaussian Process Classifier and Regressor.

ACHIEVEMENTS

- *Prize for Best Performing Student in MEng Ship Science*, Worshipful Company of Shipwrights, UK, 2023
- *Prize for Highest Achievement in Ship Structural Design & Production* module, Babcock International, 2022
- *Publication in The Naval Architect:* "Southampton Student Team Designs a Net-Zero Liquid CO2 Gas Carrier for Future UK CCUS Projects," 2022, pp. 38-41
- *Honourable mention* in the 2023 *Worldwide Fully Electric Ferry Safety Association Design Competition*

LANGUAGES

English (native), German (fluent), Italian (fluent), Greek (fluent speaker, basic writing), Spanish (basic)