WAEL KARKOUB

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CANDIDATE FOR DEVOPS ENGINEER

Master's and undergraduate degrees in mechanical engineering with a focus on robotics from Texas A&M University. Successfully conducted research projects in areas such as computer vision and robot controllers. Previously employed at Built Robotics as a robotics engineer specializing in calibration and controller design. Recognized for meticulous attention to detail and strong technical understanding, with a background in math-intensive fields. A team player with a background in competitive team sports, skilled in collaborating with diverse teams. Passionate about continuous learning, experimentation, and solving challenging problems to contribute to technological advancement and societal improvement and seeking a collaborative, fast-paced environment with technically demanding projects for constant growth and advancement.

PROFESSIONAL EXPERIENCE

BUILT ROBOTICS, San Francisco, CA — Sep 2021 – Mar 2023

Based in San Francisco, California, Built Robotics specializes in developing and implementing the Exosystem™, which enables excavators to operate autonomously. Recognized for its ground-breaking innovation, the company is at the forefront of automated construction equipment. Established and tested by industry experts, the Exosystem™ integrates cutting-edge technology to enhance the efficiency and safety of construction sites through autonomous excavation capabilities.

Robotics Engineer

Designed and implemented a sophisticated low-level control system for CAT excavators. Developed advanced motion-planning algorithms to enable autonomous digging operations—crafted precise algorithms to autonomously calibrate the excavator's joints and other parameters.

- **Successfully developed and deployed a fully automated calibration algorithm for autonomous excavators, demonstrating complete project ownership.**

RESEARCH EXPERIENCE

UNMANNED SYSTEMS LAB, College Station, TX — Mar 2017 – May 2021

A Texas A&M lab based in College Station, Texas, that is dedicated to advancing the algorithms that enable autonomous ground and aerial vehicles to map their surroundings, pinpoint their location, navigate with precision, and maneuver safely.

Student Researcher

Developed Model Predictive Controllers (MPC) for Clearpath Robotics' Husky and Warthog vehicles. Led the setup and development of sensor drivers onboard the robots, including GNSS and IMU.

- **Successfully implemented MPCs for the Husky and the Warthog robots, enhancing their navigation and control capabilities.**
- **Developed machine learning based system identification algorithms for differential-drive robots, utilizing a data-driven approach to improve accuracy and performance.**

Modeled heavy-duty truck dynamics with odometry data, improving bicycle model using data-driven techniques. Developed an MPC MIMO controller for waypoint following and a longitudinal controller using XGBoost. Implemented Stanley and Pure Pursuit controllers for lateral control. Developed a ROS bridge for CARLA Simulator and ATS to simulate the CAN bus interface and the onboard sensors.

- **Improved the yaw model by 30% and the position model by 7%, enhancing overall controller performance.**

Developed efficient computer vision algorithms to detect road signs, and implemented them on a Lincoln MKZ.

- **Created and optimized a CPU-based computer vision algorithm capable of accurately detecting road signs and traffic lights, achieving a reliable accuracy rate of 91%.**
- **Demonstrated a 50-fold speed improvement compared to "Faster R-CNN" through rigorous testing on a quad-core Intel i7, ensuring the algorithm's real-time execution speed and efficiency.**

SMART SYSTEMS LAB, Doha, Qatar **May 2019 – Aug 2019**

A Texas A&M lab based in Doha, Qatar, that focuses on developing localization, guidance, navigation, and control algorithms for autonomous ground and underwater vehicles.

Student Researcher

Architected the robot's software infrastructure using ROS for the Polaris GEM E4, including implementing mapping and localization algorithms for a LiDAR system to enhance the vehicle's state estimation uncertainty from 4 m to 1 cm. Additionally, I created an algorithm in C++ and Python to enable vehicle control using a gamepad.

- **Designed and implemented LQR lateral and PID longitudinal controllers to improve waypoint following, significantly reducing average cross-track error to 0.5 m.**

SELECTED PERSONAL PROJECTS

ROBOTICS MIDDLEWARE PLATFORM **Mar 2023 – Present**

Simplified robot software development: Developed a lightweight Kubernetes-based alternative to ROS, reducing complexity and resource usage while ensuring seamless build and deployment with Bazel. Developed a middleware that extends ZeroMQ capabilities and is being migrated to Zenoh to simplify the codebase even further.

- **Python-based containers are ~55 Mb, while a comparable highly optimized ROS container is >500 Mb.**
- **Developed a CLI to improve developer experience; e.g. remote development and remote testing. Built on top of DevSpace and vCluster.**
- **Successfully integrated CARLA into the platform to develop autonomous vehicles; Integrated Foxglove to visualize the sensors on the vehicle.**

RL SELF-DRIVING CAR **Jan 2019 – May 2019**

Trained a robot golf cart in Unreal Engine 4 (UE4) to follow paths and speed limits, using an RL model that learns by trial and error. Modeled the cart's real-world behavior for accurate simulation. Built a custom training environment using OpenAI Gym.

- **Successfully trained a reinforcement learning agent capable of autonomously navigating a golf cart and meeting pre-set navigational objectives.**
- **Effectively implemented Deep Deterministic Policy Gradient (DDPG) algorithms using Keras and TensorFlow to refine the agent's decision-making processes.**

SKILLS

Python / Rust / Bazel / Git / Linux / Bash / Docker / Kubernetes / LaTeX / ROS / Protobuf / Zenoh / ZeroMQ / Keras / PyTorch / Unreal Engine 4 / OpenAI Gym

EDUCATION

Master of Science in Mechanical Engineering, Texas A&M University, College Station, Texas, Aug 2018 - May 2021
Bachelor of Science in Mechanical Engineering, Texas A&M University, College Station, Texas, Aug 2014 - May 2018

PUBLICATIONS

- W. Karkoub, **"System Identification of Autonomous On and Off-Road Vehicles with Non-linear Model Predictive Control for Path Tracking,"** MSc Thesis, Texas A&M University, College Station, May 2021
- M. Karkoub, C.-L. Yang, W. Karkoub, and M. Raslan, **"Undergraduate Cross-Class Research Projects For Deep Learning In Engineering Education,"** AEE Journal, vol. 8, no. 2, 2020, doi: 10.18260/3-1-1114-36024
- W. Karkoub and S. Saripalli, **"Efficient Traffic Light Detection for Autonomous Vehicles,"** FAST-zero, Sep. 2019