Wael Karkoub

https://waelkarkoub.github.io/

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Programming Skills

- **Languages**: Python, Rust, Bash, SQL **Technologies**: Kubernetes, Docker, ROS, ZeroMQ, Linux
- **Core Competencies**: Backend, Robotics, Optimal Controls Theory, Machine Learning, Middleware

Experience

- **Built Robotics (NDA)** San Francisco, CA
  Robotics Software Engineer *Sep 2021 - March 2023*
  - **System Identification**: Led the development of automating the calibration process of autonomous excavators. Reduced robot deployment time from days of tuning, to less than an hour.
  - **Controls Systems**: Led the development of novel data-based controls algorithms, to control the speed and the position of the CAT's excavator joints, significantly improving the accuracy of the motion.
  - **Deployment**: Deployed autonomous excavators in remote locations across the globe and in extreme weather.
- **Texas A&M University** College Station, TX
  Student Researcher *Mar 2017 - May 2021*
  - **System Identification**: Developed system and parameter identification algorithms for autonomous vehicles and differential drive robots. Used L1 and L2 regression ML models to optimize the model parameters. Improved the yaw model by 30% and the position model by 7% over the physics-based model, enhancing overall controller performance. The algorithm could be used for online or offline learning.
  - **Lateral and Longitudinal Controllers**: Developed a nonlinear high-level controllers for autonomous vehicles (AV) and differential-drive robots (DDR). Designed and implemented model predictive controllers (MPC) using CasADi. Achieved a cross-track error (CTE) for DDRs of 8 cm and a CTE for AVs of 0.3 m
  - **Throttle/Brake Controllers**: Developed a novel throttle/brake controller for autonomous vehicles. Used XGBoost to predict the nominal throttle/brake levels, and then is corrected by a PID controller. Achieved a velocity accuracy 0.33 m/s with high passenger comfort.
  - **Efficient Traffic Light Detection**: Developed an optimized CPU-based computer vision algorithm capable of accurately detecting traffic light position and the state, achieving a reliable accuracy rate of 91% using OpenCV and XGBoost. 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.
- **Texas A&M University at Qatar** Doha, Qatar
  Student Researcher *May 2019 - Aug 2019*
  - **Software Architecture**: Led the architecture design of an autonomous golf-cart (Polaris GEM E4). Deployed a microservice architecture using ROS and Docker to decouple the workflow of the engineers working on the project.
  - **Controls Systems**: Designed and implemented LQR lateral and PID longitudinal controllers to improve waypoint following, significantly reducing average cross-track error to 0.5 m. Additionally, I created an algorithm in C++ and Python to enable vehicle control using a gamepad, for an added safety measure.
  - **State Estimation**: Implemented mapping and localization algorithms for a LiDAR/GNSS systems to improve the vehicle's state estimation uncertainty from 4 m to 1 cm

Personal Projects

- **Robotics Middleware Platform**: Simplified robot software development, developed a lightweight Kubernetes-based alternative to ROS in Python and Rust.
- **RL Self-Driving Car**: Trained a robot golf cart in CARLA to follow paths and speed limits, using RL models (DDPG) that learn by trial and error, in Keras and PyTorch.
- **Flipping Cars**: Scrapes the Qatari car market data, and determines the purchase and the sale prices to optimize profits.

Education

- **Texas A&M University** College Station, TX
  Master of Science in Mechanical Engineering *Aug. 2018 – May. 2021*
- **Texas A&M University** College Station, TX
  Bachelor of Science in Mechanical Engineering; Magna Cum Laude *Aug. 2014 – May. 2018*