Mustafa Shaikh

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Robotics and machine learning practitioner with experience in object tracking, control, and motion planning. I have 5 years of industry experience working closely with business stakeholders. I can dive deep into the details, and I have lead projects end to end, from identifying a problem and designing a solution, to implementation and delivery.

EDUCATION

M.S. Electrical and Computer Engineering — San Diego, CA | 2022 - 2024
University of California, San Diego
Specialization: Robotics and Intelligent Systems

B.A.Sc. Engineering Science — Toronto, ON | 2013 - 2017
University of Toronto

WORK EXPERIENCE

RESEARCH ENGINEER | Salk Institute for Biological Studies — San Diego, CA | 2024 -

Key Skills: PyTorch, Lightning, Multi-object tracking, deep learning, encoder/decoder transformers, ResNet, DETr, rotary embeddings, segmentation, Kalman filters, Hungarian matching, video encoding, parallel video loading, ffmpeg

Open source project: https://dreem.sleap.ai

- Co-developed a transformer-based **multiple object tracker** for microscopy and animal videos, achieving **>98%** tracking accuracy
- Acquired and processed public cell tracking video datasets 50x larger than in-house data
- Created a **pretrained microscopy model** that **improved key metrics** by **>40%**, and beats state of the art by **>8%**
- **Optimized inference** code to reduce **GPU memory** and **runtime** by **40%** with only 5% decrease in accuracy
- Developed new **global tracking accuracy** metric to address gaps in existing multi-object tracking metrics
- Developed a **metrics pipeline** to enable fast model evaluation and development

GRADUATE RESEARCHER | Existential Robotics Lab, UC San Diego — San Diego, CA | 2023 - 2024

Key Skills: Model predictive control, control barrier functions (CBF), casADi, CVX, Extended Kalman Filter, RRT*, collision avoidance, ROS, Jackal robot, LiDAR, HectorSLAM

Publication: *"Control Strategies for Pursuit-Evasion Under Occlusion Using Visibility and Safety Barrier Functions"* accepted at the *IEEE International Conference on Robotics and Automation (ICRA) 2025*
Paper: https://arxiv.org/abs/2411.01321
Project Website: https://existentialrobotics.org/VisibilityControl/

- Implemented a **model predictive controller** with **control barrier** constraints for a robot to track a moving target
- Implemented **Extended Kalman Filter** to estimate target's state from camera detections
- Demonstrated **>95% tracking** in **real world experiments** with Jackal wheeled robot in a cluttered environment

SR. DATA SCIENTIST | Walmart Canada — Toronto, ON | 2019 - 2022

Key Skills: Natural Language Processing - Spacy, Named Entity Recognition, BERT, human-in-the-loop systems, AutoML, PySpark, SQL, MLOps, Python, Pandas, Numpy, Google Cloud Platform, Airflow

Project lead - Automated Attribute Assignment (2021-2022)
Goal: Improve search quality for customers by automatically populating product data for 3rd party sellers

- Developed **named entity recognition pipeline** to learn **context-aware** features from product descriptions; led to **>$1MM CAD revenue increase** annually by populating features for over 500,000 items
- Recognized need for **high quality custom annotated data**; pitched, acquired and integrated a **human-in-the-loop** annotation tool (Prodigy) with active labelling

- **Coordinated Jr. Data Scientist**, and guided the implementation of an **asynchronous orchestration layer**
- Worked closely with business stakeholders to guide problem framing, roadmap, execution and production support

Other Projects (Apr. 2019 to Jun. 2021)

- Developed and deployed **hierarchical model factory** to categorize 3rd party vendor items on walmart.ca; increased **categorization rate from 90% to 97%** which increased product views for previously 'unfindable' items
- Lead developer for **grocery substitutions recommendation** engine; **300bps improvement in customer satisfaction**
- Created and maintained **fulfillment centre forecast** to optimize labour; **>90%** accuracy up from 75% led to **$1MM CAD annual labour savings**

PROJECTS

ROBOTICS, DEEP LEARNING AND SOFTWARE

UC San Diego, 2023-2024

Key Skills: Extended Kalman Filter (EKF), Particle Filter, IMU, LiDAR, encoder, stereo camera features, instrinsics, sensor fusion, odometry, disparity, occupancy grid, texture map, SIFT, point cloud registration, PyTorch, C++, RAII, smart pointers, design patterns, templates, variants, STL

- **Visual-Inertial SLAM** for a car with an Extended Kalman Filter using **IMU** and **stereo camera** data
- Created a color texture map of an indoor environment using **particle filter SLAM** on a robot's sensor data
- Approached the **point cloud registration** problem using **PointNet**, and achieved performance close to Iterative Closest Point, on synthetic data
- (C++) **String library** with underlying buffer manager. **Achieved 25% lower memory usage than C++ std::string** for common string operations: append, replace, insert, erase, search
- (C++) Graph-based **in-memory JSON datastore** with query capability
- (C++) **Compressing archive tool** with add, extract, retrieve capability

SKILLS

Python, C++, SQL, PyTorch, JAX, Numpy, Pandas, Keras, CVX, CasADi, OpenCV, Open3D, GCP, PySpark, Hadoop, Airflow, ROS