Armin Lotfy

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SUMMARY

Ph.D. graduate in Electrical Engineering with a focus on Digital Systems, Reinforcement Learning, Deep Learning, and Energy Management for electric vehicles and smart grids. Experienced in developing advanced control strategies using MATLAB/Simulink and Python-based frameworks including TensorFlow, Stable-Baselines3, and Ray.
Proven track record in modeling, simulation, and optimization of RL-based solutions—ranging from single-agent to multi-agent systems—along with CNN-LSTM architectures and state estimation using Extended Kalman Filters. Adept at translating cutting-edge research into practical, high-impact applications across energy and mobility domains

SKILLS

Technical Skills

- **Machine Learning:**
  K-means Clustering, Regression Trees, Principal Component Analysis (PCA), Predictive Modeling, Time Series Forecasting
- **Reinforcement Learning & Deep Learning**:
  TD3, MATD3, DDPG, PPO, MAPPO, SAC, CNN, RNN, LSTM
- **Programming & Frameworks**:
  Python, MATLAB, Simulink, TensorFlow, Stable-Baselines3, Ray, NumPy, SciPy, Pandas, Matplotlib, Git, LaTeX, VS Code, Linux, VHDL

Specialized Knowledge

- Developed intelligent, real-time **energy management controllers** for **Electric Vehicles** (EVs) and **smart grid** applications, with a focus on performance, scalability, and **energy efficiency**.
- Built and validated simulation models for battery **Equivalent Circuit Models (ECMs)** and **supercapacitor** systems to support accurate control and prediction.
- Designed custom reinforcement learning environments for **solving multi-objective optimization** problems in complex, real-world control tasks.

PROJECTS

Multi-Agent Energy Management System for BEVs
Project: Developed an energy management system using **Multi-Agent Reinforcement Learning (MARL)** for battery electric vehicles (BEVs).

- Designed a custom simulation environment based on **Markov Decision Processes** (MDP), incorporating dynamic system states, action spaces, and a tailored reward function.
- Implemented and trained two **Twin Delayed Deep Deterministic Policy Gradient (TD3)** agents to achieve optimal control of power flow and SOC balancing under varying load conditions.
- Successfully reduced the initial **12.47% SOC imbalance** among battery packs to **nearly zero**, achieving a final disparity of **0.3%**, **without requiring prior knowledge of the environment**, demonstrating the robustness and generalizability of the proposed control strategy.

Centralized Multi-Agent SOC Control for Battery Health Using Proximal Policy Optimization in EVs
Project: Designed and implemented a **Centralized Training with Decentralized Execution (CTDE)** architecture to enable multi-agent coordination for battery State-of-Charge (SOC) and State-of-Health (SOH) equalization in intelligent battery management systems.

- Utilized **Proximal Policy Optimization (PPO)** to solve a **multi-objective optimization** problem, dynamically balancing current allocation across cells to improve both system performance and battery lifespan.
- Engineered a **shared reward mechanism** to promote collaborative behavior among agents for this **multi-objective problem**

Proximal Policy Optimization-Based Power Sharing Controller for Smart Grids:
Project: Designed and implemented a **smart grid control system** using **Proximal Policy Optimization (PPO)**, enabling real-time adaptation of control signals based on dynamic grid variables.

- Applied advanced RL techniques to **optimize power distribution**, resulting in improved grid efficiency and reduced energy losses.
- Enhanced system **resilience and responsiveness** to demand-supply fluctuations, enabling intelligent decision-making in dynamic energy networks.

Predictive Smart Energy Management for BEVs with Hybrid Storage via Reinforcement Learning
Project: Developed and trained a **Reinforcement Learning-based controller** for Battery Electric Vehicles (BEVs) with hybrid energy storage systems using **Python**.

- Modeled the dynamic behavior of a **battery-supercapacitor hybrid storage system**, enabling realistic simulation and training of **Soft Actor-Critic (SAC)** algorithms incorporating both historical and predicted future states, enabling more informed decision-making and improved policy performance using Ray library..
- Designed and implemented a **CNN-LSTM predictive model** to forecast future vehicle operating conditions, enhancing the agent's situational awareness and control accuracy.

PROFESSIONAL EXPERIENCE

Researcher Assistant (ML researcher) 2020 – present
Carleton University Ottawa, Canada
- Developing **smart reinforcement learning-based controllers** to optimize energy management in electric vehicles
- Implementing **predictive models** for real-time estimation of battery parameters and system states
- Applying **reinforcement learning** and **deep learning** algorithms using **Python** and **MATLAB/Simulink** for control and optimization tasks

Teaching Assistant 2022 – 09/2024
Carleton University Ottawa, Canada
- Mentored **600+** students in **Mechatronics (Python)**, **Switching Circuits and Digital Design (VHDL)**, **Circuits**

VOLUNTEERING

IEEE Vehicle Power and Propulsion Conference (VPPC) 2025 Reviewer
IEEE
Contributed as a Technical Reviewer for IEEE VPPC 2025, an internationally recognized conference in electric mobility and powertrain systems

Member of the Technical Program Committee, IEEE 102nd Vehicular Technology Conference (VTC2025)
IEEE
Served as a Technical Program Committee (TPC) Member for the IEEE 102nd VTC2025, contributing to the peer-review process of vehicular technologies and intelligent transportation systems.

IEEE Vehicle Power and Propulsion Conference (VPPC) 2022 Reviewer
IEEE
Served as a Technical Reviewer for the IEEE Vehicle Power and Propulsion Conference (VPPC) 2022, evaluating technical papers related to electric vehicles, hybrid powertrain systems, battery and energy storage management, and intelligent control strategies.

PUBLICATIONS

Enhancing Energy Management Strategy for Battery Electric Vehicles: Incorporating Cell Balancing and Multi-Agent Twin Delayed Deep Deterministic Policy Gradient Architecture 2024
IEEE Transaction on Vehicular Technology

Centralized Multi-Agent SOC Control for Battery Health Using Proximal Policy Optimization in EVs 2025
IEEE Transactions on Vehicular Technology

EDUCATION

Ph.D. in Electrical Engineering 2020 – 2025
Carleton University Ottawa, Canada