Modeling and Analysis of Electric Vehicles

Objective

The goal of this project is to enable master students to model, simulate, and analyze electric vehicles (EVs) using tools and methodologies extracted from open-source repositories. Students will study the given repositories, reproduce the results, and perform in-depth analysis to understand EV dynamics, energy consumption, and design parameters.

Key Repositories for Study

1. **EVLibrary https://github.com/jdominguezj/EVLibrary/tree/master):**
   - Focus: Provides a library for EV modeling with MATLAB/Simulink.
   - Key Features: Predefined EV components (battery, motor, drivetrain).
   - Tasks:
     - Study the structure and usage of the library.
     - Reproduce simulations using MATLAB/Simulink.
     - Evaluate the accuracy and modularity of the library.

2. **EV_sim https://github.com/m0in92/EV_sim/tree/main:**
   - Focus: EV simulation in MATLAB.
   - Key Features: Dynamic simulations of EV performance.
   - Tasks:
     - Investigate simulation algorithms.
     - Reproduce vehicle dynamics simulations.
     - Analyze factors such as acceleration, energy consumption, and range.

3. **Electric All-Terrain Vehicle https://github.com/mathworks/electric-all-terrain-vehicle**:
   - Focus: Modeling and simulation of an electric all-terrain vehicle in MATLAB/Simulink.
   - Key Features: Multi-domain modeling (mechanical, electrical, thermal).
   - Tasks:
     - Analyze the design process of an electric ATV.
     - Reproduce the simulation and validate results.
     - Extend the model to include additional features like regenerative braking.

4. **EVAdoption (https://github.com/binDebug3/EVAdoption):**
   - Focus: Analyzing EV adoption trends.
   - Key Features: Data-driven analysis using Python and machine learning.
   - Tasks:
     - Study the provided datasets and analysis scripts.
     - Reproduce adoption trend analysis.
     - Correlate results with simulation outputs from other repositories.

Methodology

1. Repository Study
   - Analyze the purpose and structure of each repository.
   - Identify key tools, models, and methodologies used.

2. Simulation Reproduction
   - Reproduce all simulations and analyses provided in the repositories.

3. Comprehensive Modeling

   - Integrate components from multiple repositories to create a unified EV model.
   - Real-time energy management.
   - Advanced driving scenarios (e.g., urban vs. highway driving).
   - Analyze vehicle dynamics, powertrain efficiency, and energy consumption.
   - Compare different EV architectures (e.g., single motor vs. dual motor).

4. Result Documentation and Presentation
   - Compile detailed reports of findings.
   - Create visualizations (e.g., efficiency plots, energy usage graphs).
   - Prepare a final presentation showcasing key insights and improvements.