Course Project

Learning Objectives

- Understand how batteries, motors, power electronics, and drivetrains all come together to realize an electric vehicle
- Gain confidence in developing and evaluating your own custom electric vehicle model in Python
- Gain confidence in using existing FastSim electric vehicle models and real world testing
- Expand your LinkedIn and GitHub profiles to help you get a job

Project Overview

The course project allows you to combine your knowledge from all aspects of the course. In this project you will develop a custom high-fidelity electric vehicle model of an existing real world electric vehicle of your choice. Your model must include a battery, motors, power electronics, and a drivetrain at a minimum and must be evaluated for dynamics, controls, or systems-level performance. Your model must be validated using either FastSim or real world data. In total the course project is worth half your grade in this course and is composed of two parts: (1) the half-way project report and presentation and the (2) final project report and presentation. Presentation slides and reports are turned in as *.pdf files through Elearning by their associated deadline. Presentations will be during class time as shown in the syllabus.

Half-Way Project Requirements

1. *Real-World Vehicle*: As a team, choose an existing real-world electric vehicle to create a model of. Provide the reason the vehicle was chosen, pictures, and show all published specifications you can find of the vehicle's parameters.

2. *Component Analysis*: Show how the specs of your chosen electric vehicle are incorporated into battery, motor, power electronics, and drivetrain analytical equations. Use the equations and example problems from the lectures and homeworks.

3. *Component Modeling*: Develop analytical equation solutions in Python and show the results in Python plots. Show how the individual components are connected together as one cohesive electric vehicle. Provide preliminary overall electric vehicle results.

4. *FastSim Model*: Show overall results in Python plots from an electric vehicle model in FastSim with custom parameters for your chosen electric vehicle.

5. *Real World Data*: Document any existing real world data that will be relevant for validation of your model. If none exists, state how real world data could be collected.

6. *Next Phase Planning*: Document what is needed to further improve your electric vehicle model. Students registered at the 6950 level are responsible for adding and quickly describing 5+ peer-reviewed publication references that justify your approach. Show your team's GitHub page.

Final Project Requirements

1. *Real-World Vehicle*: Show your team's chosen electric vehicle with its known specs. Describe why the vehicle was chosen to model.
2. *Model Development*: Document your vehicle's components and governing equations. Describe how your vehicle's components were developed and how they fit together.
3. *Model Validation*: Document validation of your model with FastSim and/or real world data. At a minimum, your model needs to match within 6% for one drive cycle.
4. *Exercise the Model*: Use your custom electric vehicle model to evaluate an interesting (ME5950) or novel (ME6950) scenario inspired by the vehicle dynamics, vehicle controls, or systems-level analysis from the lectures and homeworks. Students registered at the 6950 level are responsible for adding and quickly describing 5+ more peer-reviewed publication references about your approach.
5. *Final Recommendations*: State what your overall conclusion is for the project (what is the one interesting thing you want people to take away from your project?). State what your conclusion means for future electric vehicle engineering, usage, etc. State if any future work is required. Show your team's GitHub page.

Half-Way and Final Project Deliverables

1. Provide a 10 minute team presentation of the requirements above where each team member must speak for a portion of the presentation. Presentations are done live in class on the days shown in the syllabus and will be followed by 5 minutes of Q&A. Slides must be turned in via the Elearning dropbox by the due date in *.pdf format.
2. Provide a team report of 6 pages or less in the SAE template of the requirements above. Append team member task assignments and team member reviews; these do not count towards the page limit. Turn the report in via the Elearning by the due date in *.pdf format. All reports will be shared with the class via Elearning. Reports are due 1 business day in advance of the presentation so I can distribute them before class starts.

Half-Way Project Grading

Presentation: *50 pts total*

- Real-World Vehicle *6 pts*
- Component Analysis *12 pts*
- Component Modeling *12 pts*
- FastSim Model *8 pts*
- Real World Data *6 pts*
- Next Phase Planning *6 pts*
- Lacking professionalism, organization, formatting, etc. -20 *pts*

Report: *50 pts total*

- Real-World Vehicle *6 pts*
- Component Analysis *12 pts*
- Component Modeling *12 pts*
- FastSim Model *8 pts*
- Real World Data *6 pts*
- Next Phase Planning *6 pts*
- Lacking professionalism, organization, unlabeled axes, missing captions, wrong template, missing tasks or minutes, etc. -20 *pts*

Final Project Grading

Presentation: *50 pts total*

- Real-World Vehicle *8 pts*
- Model Development *12 pts*
- Model Validation *12 pts*
- Exercise the Model *12 pts*
- Final Recommendations *6 pts*
- Lacking professionalism, organization, formatting, etc. -20 *pts*

Report: *50 pts total*

- Real-World Vehicle *8 pts*
- Model Development *12 pts*
- Model Validation *12 pts*
- Exercise the Model *12 pts*
- Final Recommendations *6 pts*
- Lacking professionalism, organization, unlabeled axes, missing captions, wrong template, missing tasks or minutes, etc. -20 *pts*

Individual Grade Adjustments

Each team member must take responsibility for a significant and important portion of the project and document this in a responsibility matrix. Each team member must also describe in their own words what they did for their assigned task(s). Other group members should only verify completion by initialing if that team member did their fair share of the work. Potential grade adjustments include:

- Communication to instructors from other group members documenting a lack of contribution: up to -50% of project grade
- Not attending team meetings: up to -20% of project grade
- No show or not speaking during presentation: -20% of project grade
- Team members stuck with a non-participating member(s): up to +20% project grade

Tips for Success

Start early and develop aspects of your project as they are covered in class to save time. Collaborate on homework with your team. Reach out to friends on other teams for assistance/advice. Set up recurring meetings with your team and hold each other accountable for completing tasks. Consider assigning two people to each requirement to ensure progress is maintained and results meet the standards of everyone else on the team. Ask the instructors questions early and often.

Appendix: Team Templates

Responsibility Matrix Template

Requirement Number	Group Member Name 1	Group Member Name 2	Group Member Name 3	Group Member Name 4
Req. 1	X		X	
Req. 2	X	X		
Req. 3		X		X
Req. 4			X	X

Group Member Name 1 – Tasks Descriptions

Hello, I am group member 1 and I was in charge of ... I completed these requirements by first completing task 1 as defined below….. through task 5 (continue to expand upon tasks).

- Task 1: ……
- ……
- Task 5: …..

We (the other group members) agree that this student completed their responsibilities with minimal intervention (initial on line) _____.

Meeting Minutes Template

Meeting details: *date, location, in-person/virtual, etc.*

Who was in attendance:

What was discussed:

What are the next steps: