

## **Milestone #2 – Motor and Drivetrain analysis; Component selection, first-pass**

**DUE: 20 February (along with Milestone 1)**

### **DESCRIPTION:**

After the Drivetrain & Motors mini-lecture on 13 February, you will have enough information to start refining your design sketches with math and physics. Along with your results from Milestone 1, you should have an idea of which major parts (motors, controllers, wheels, how many batteries, etc.) you plan to use in your vehicle by the end of this lab week. You are welcome to start pricing things out to reconcile them with your \$500 budget.

You should consider, and be prepared to answer, the following questions about your drivetrain:

- How fast is your vehicle going to go? What's the theoretical no-load (frictionless, dragless) speed? 20mph may not be the best answer for everyone!
- Factoring in wind resistance and rolling resistance, what is a more reasonable speed estimate? How much power will your vehicle consume at full speed, given those non-ideal inefficiencies? Is this speed near the motor's peak efficiency speed or current?
- Given this power consumption estimate, how far would you be able to travel on flat ground? You can assume that the batteries can give out their full 4.5Ah capacity.
- How fast do you plan on accelerating? Are you going to need more current than the batteries can supply, with their 40A fuses, in this state? If your controller choice is one that can perform current control, what's the maximum acceleration you can get from its max current?
- At maximum acceleration, are you going to flip over backwards? (Try drawing a force diagram with your vehicle on the ground and accelerating in this condition) It's not very helpful if your vehicle will just throw you off!

Begin to narrow down the important components of your vehicle, especially the motor and controller selection. Refer to the Instructable documents and the 2.007 EV Resource Presentation as needed to help your selection process. (Keep in mind the selection now is not a commitment, but you should be able to justify any changes)

Some other practical considerations you should keep in mind include:

- What kind of power transmission (e.g. chain, belt, shaft, spur gears....) are you planning on using? Can you fit your desired gear ratio in 1 stage? (Multiple stages of reduction are acceptable, just harder to make and more expensive.)
- How will the parts be mounted to your frame? What major parts will you need to make or buy for your frame? Will you be making appendages for an existing vehicle frame?

These don't have to be 'notebooked', but it doesn't hurt to do so, for your own records. Next week you will spend time integrating your sketches and calculations into physical things you want to order!

**FORMAT OF DELIVERABLE:** 4-6 pages in your Design Notebook showing your motor and drivetrain analysis and choices of parts and materials, and any other design considerations if applicable.

**OTHER ACTIVITY:** Friday (22 Feb.) office hours will focus on part selection questions and helping you narrow down motors, wheels, controllers, etc. and answering specific implementation questions if you have them. Bring a concise list of parts you want to pick through.

**RESOURCES:**

Scooter Power Systems instructable document, sections 1 through 8 may help you in deciding on motor and controller choices. Be aware that it is biased strongly towards brushless power systems, since that is the main topic for the Instructable.

Estimation and Approximation of DC motor Parameters may be helpful in deducing motor torque constants and resistance from commercial datasheets.