Progress Report 2 3/6/18

ENGR 1182 with Dr. Bixler
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Backward Looking Summary

Situation

Multiple advanced tests were completed in the last two weeks in order to learn more about how the AEV can become more productive and efficient. In order to do this, testing was focused on the concepts of power braking in contrast to coasting and battery testing. For the power braking and coasting tests, two sets of code were written for each braking mechanism. The difference between the two was for coasting, the motors stopped and the AEV was allowed to slow to a stop, and for the power braking the motors reversed direction to counteract the force of the forward motion. The data collected from this was then used to determine which type of stopping method would be most effective for the design being used based on energy consumption, distance travelled, and time needed. For battery testing, a simple code was written for the AEV to run and then stop. The voltage of the battery was recorded before and after the run and recorded. This was done in order to determine how much of an effect did the change in voltage, if any, affected the distance traveled and if this should be considered moving forward. With the observations and data collected across these two tests, the team was able to draw conclusions about what methods should be used moving forward, and how to increase the efficiency of the AEV.

Results and Analysis

When comparing the results from the two braking mechanisms, the team had two factors in mind: energy consumption and total distance traveled. Time and energy are valuable assets and in order to obtain maximum efficiency, the two must be minimized. Energy costs money to use and when time wasted is money wasted. In this advanced test the team collected data to determine which technique, or a combination of both, would be the most efficient. The first test compared the two methods in terms of power used.

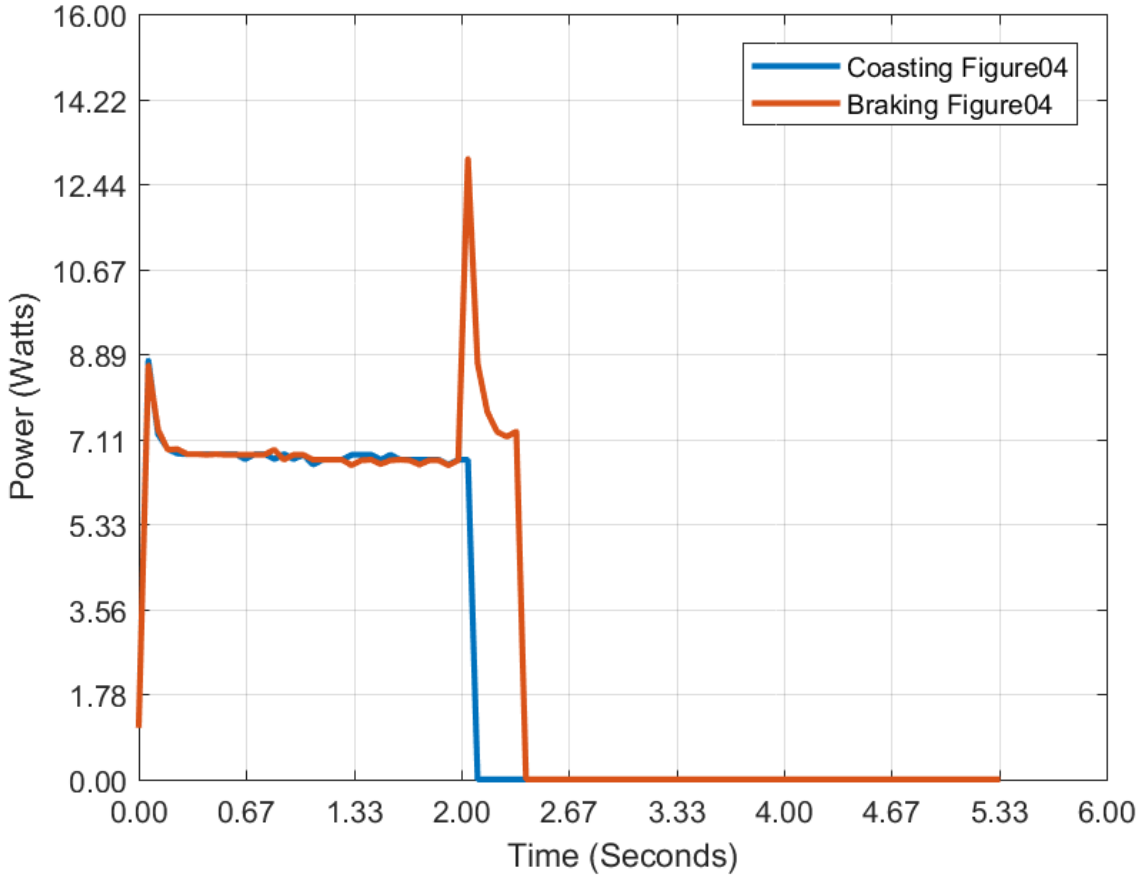

Figure 1: Power used over Time of AEV Motor Use

Figure 1 above represents the work done by the AEV for power braking and coasting. In order to compare the energy consumption between the two methods, the area underneath the curves was analyzed. The area underneath the power braking curve is greater than the area underneath the coasting curve. Although it can be assumed that power braking would inevitably use more energy than coasting, it was important to see how much more energy it would consume to determine whether it was an acceptable cost to incur.

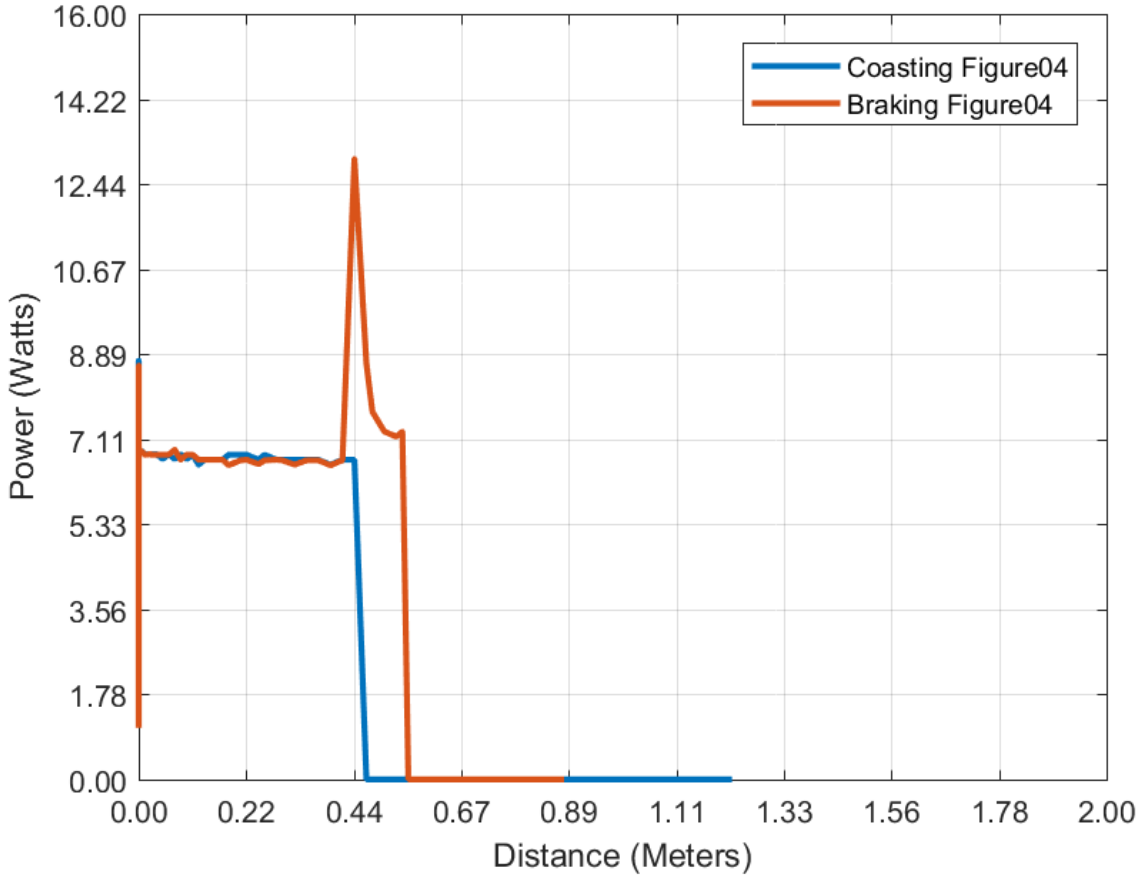

Figure 2: Power used over Distance AEV Traveled

Figure 2 above displays the results from the same advanced test, however in this graph it is comparing power in relation to distance. As shown in the graph, the power breaking took a significantly shorter distance to come to a rest than the coasting technique. This data indicates that utilizing power breaking allows the AEV to come to a stop in a much shorter time period. Power braking allows for more control over the AEV, therefore the team can better predict what how the code will affect the performance of the AEV. If the team is able to have more control over the AEV, the team can more accurately code the AEV to perform the designated task for the final performance test.

The vehicle uses power every time it runs and every run it does not do the exact same thing. There are multiple variables that could affect the vehicle every run, however the battery is an aspect that can be monitored and controlled. It is important to know and understand everything that the vehicle is doing to better control it. The team tested this with two predictions: by find if there is a relationship between the distance traveled and the voltage, and if there is correlation between the number of runs of the vehicle and the voltage. The team decided to analyze the voltage usage of the battery to see if it had

any correlation to the performance of the AEV. The voltage of the battery was measured before and after each run with a multimeter and the data was graphed.

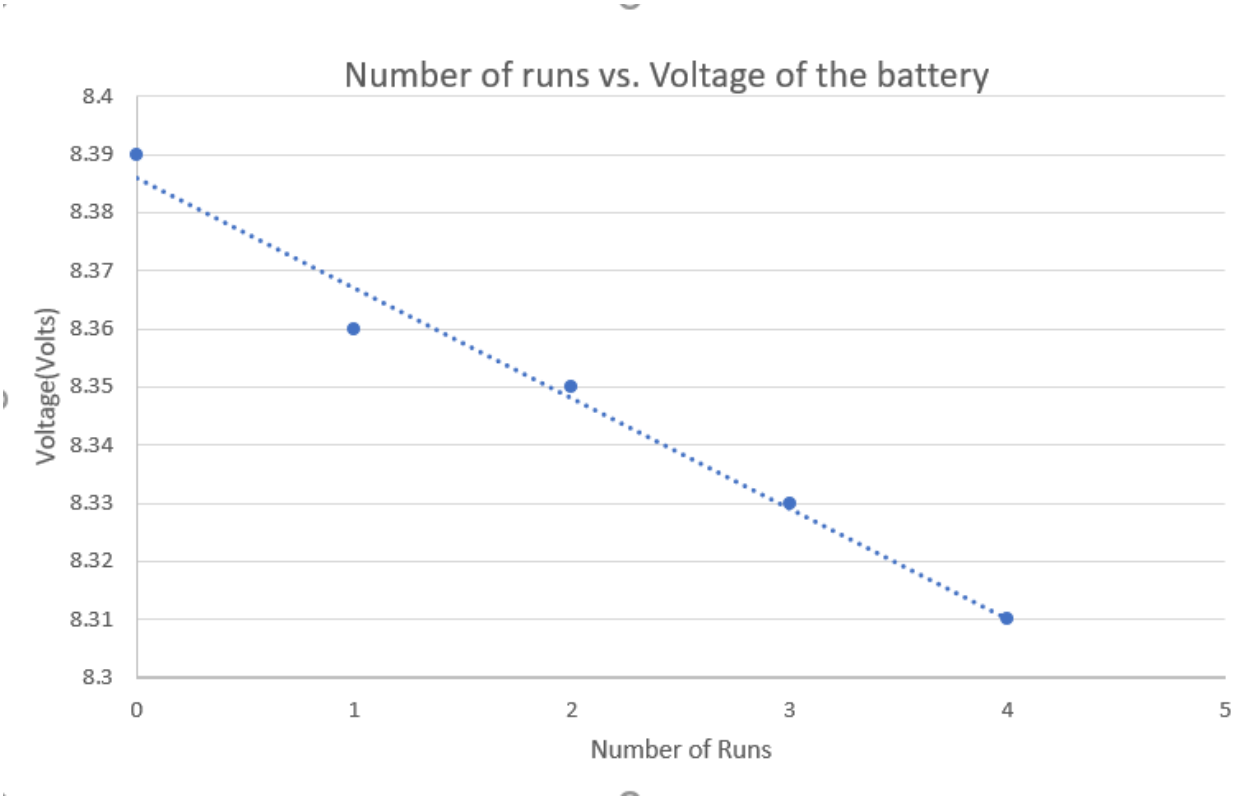

Figure 3: Battery Voltage Relation with Number of Test Runs

In Figure 3 above, the data shows a strong linear trend between the number of runs and the voltage consumed. After each run, the voltage went down by about the same amount every time, confirming that the number of runs does have an effect on the voltage of the battery. However, this drop in voltage is not very significant and therefore has a negligible effect on the performance of the AEV. Nevertheless, it is best to be able to control the AEV as much as possible, so the data that was collected will make an impact on how the team decided to prepare for the final performance test.

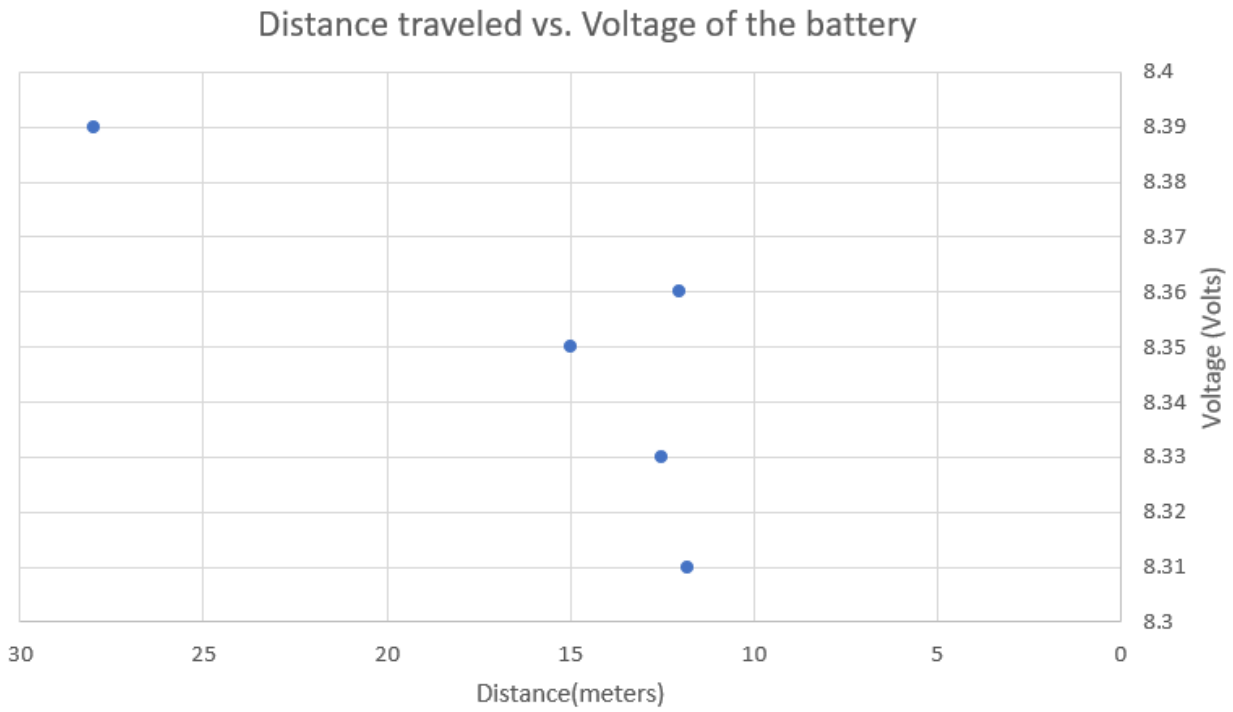

Figure 4: Voltage of the Battery in Relation with Distance Traveled

Figure 4 above, the distance traveled in relationship to the voltage was graphed. As shown, there is no correlation between the distance traveled by the vehicle and the voltage consumed. Considering this, the team does not have a concern in regards to the distance the AEV travels. The distance traveled by the vehicle may have an impact on the voltage if the distance was appreciably increased, however for the purposes of the this specific vehicle and its task, it is not a cause for concern.

Takeaways

Our groups biggest takeaways from what was completed were that power breaking will be more cost and time efficient, and that the voltage of the battery being used has little effect on the performance of the AEV. Power breaking consumed more energy, but the extra energy that was used costs less than the extra time that the AEV used when the coasting method was implemented. In the power braking method, even though it requires more energy, is the better choice over coasting because it offers greater control over the AEV by shortening the braking distance. The control for AEV's motion is essential because it not only reduces the time taken for the final run, but also creates more accurate results. It was found in battery testing testing that there was little correlation in the data between battery used and distance travelled, leading to the determination that it should not be a main focus moving forward.

In order to complete these tasks, the team chose which performance tests would benefit the team the most, in order to best prepare for the final testing. The team worked

together and and each member contributed his or her input, and the team collectively and respectfully chose these two tests to perform. The teamwork process went very smoothly and each member was satisfied with the performance tests and the results.

Looking Forward

Moving forward, the team will focus on performance tests. The most nearest one will be the first performance test, which is about vehicle design. The basic goal is figuring out which configuration was the best. In order to do this we need to use effective prototype codes from different aspects: energy consumption, energy efficiency, stability and AEV controllable degree(like braking distance, temperature and so on). Then we can analyze the performance of two designs based on the data collected from the analysis tool and the figures generated by MATLAB. Finally, we make the final selection after considering all the factors. Also, the second committee meeting is coming soon, which is also important because an efficient group meeting helps the team summarize its progress and check the remaining parts of the project. Each team member is required to take responsibility for her/his division in committee meeting individually and display the work of himself/herself recently.

Goals in the upcoming weeks:

- Proceed to Performance Test 1 and focuses on how to use code to display the performance of the two designs effectively.
- Proceed to Performance Test 2 in the week after the spring break and focuses on code optimization.
- Complete CDR Draft which is coming on March 23
- Prepare for the incoming Midterm and practice with Solidworks which comes April 06.
- Prepare Committee Meeting 2, which comes March 30, which focuses on advanced R&D and the performance tests.

Appendices

Team Meeting Minutes

Meeting 5:
Date: 02/07/2018
Time: 12:40pm
Location: Hitchcock 224
Members Present: All

Objective:
Today we need to document Meeting Notes 5 and complete the Coasting v. Power Braking trials, record the data, and create the corresponding graphs. We also need to decide each individual role for the upcoming Committee Meeting.

Topics Discussed:
- Coasting and Power Braking R&D Exercises
- Upcoming Committee Meeting

To Do:
- Prepare for the Grant Proposal meeting by making the powerpoint (Everyone) and preparing for the presentation - Kia
- Prepare for the Committee Meeting by obtaining the specific material required for each role - Everyone

Meeting 6:
Date: 02/21/2018
Time: 12:40pm
Location: Hitchcock 224
Members Present: All

Objective:
Today we need to complete Battery testing and record the data, and with any left over time, begin Website Update 3 and document Meeting Notes 6. We also need to prepare for the R&D Presentation by beginning to thinking about what we would like to present.

Topics Discussed:
- Battery R&D Exercise
- Upcoming R&D Presentation
- Website Update 3

To Do:
- Graph the data from the Battery R&D Exercise - John

- Document Meeting Notes 6 - Kezia
- Update the website - Everyone

Arduino Code

Power Braking v. Coasting Code

```
// Coasting code
// reflectanceSensorTest();
//Run all motors at a constant speed of 30% power for 2 seconds.
motorSpeed(4,30);
goFor(2);
//Brake all motors.
brake(4);

// Braking code
// reflectanceSensorTest();
//Run all motors at a constant speed of 30% power for 2 seconds.
motorSpeed(4,30);
goFor(2);
reverse(4);
motorSpeed(4,30);
goFor(0.3);
//Brake all motors.
brake(4);
```

Battery Testing Code

```
// Accelerate motor one from start to 0% power in 3 seconds
celerate(4,0,25,3);
// Run all motors at a constant speed (25% power) for 2 second.
motorSpeed(4,25);
goFor(2);
brake(4);
```