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Progress Report #3
04/04/2019

Report of Progress

Situation

After AR&D 2 and 3 the team decided to create custom laser parts for the AEV to reduce costs and weight, and increase stability. The initial design sent to the public lab was incorrectly dimensioned, so to avoid waiting again for a laser part a local laser engraving company JC Engravers was contacted and they created the custom laser parts at an even lower cost with almost no wait time. The new design also implements zip-ties instead of rigid components which reduces weight and cost significantly. At least $6,000 worth of parts were eliminated with the design change.

The team presented the results of AR&D 2 and 3 to the company, and attended the presentations from the other teams in the company. The presentations allowed the teams in the company to share data and experiment takeaways. The other teams supplied the information about the efficiency of using propellers to push vs pull, which supported qualitative data observed by the team. The other teams also supplied data about the most energy efficient range of power usage by the motors, which is around 35 percent.

The team had to complete performance test 2, which they did so successfully. Performance test 2 was an extension of performance test 1, where after continuing past the open gate the AEV traveled down to the end of the track to gently attach to the load, stop for 5 seconds, and then move with the load. The code used is in Appendix B under performance test 1.

The goal of AR&D 3 was to completed code for performance test 3 with and without a servo motor. This was determined to be the most efficient test because it would develop code for performance test 3, but also the cost data would be the most relevant because the cost would be calculated under conditions which match the final conditions when the cost matters. The code used during AR&D is in Appendix B under AR&D 3. Due to time constraints tests as well as irregular battery behavior and code upload/data extraction related connectivity problems, with the servo have not yet been completed.

Results and Analysis

Since the incoming portions of the tests were inconsistent, only the outgoing portions of the tests were analyzed. In test one, the AEV used 64.81 J to reach the gate. The 1.2 seconds of reverse thrust expended 11.68 J. 50.34 J of energy were used to reach the caboose, and of that, 12.21 J were used to brake. The results of this test can be seen in the figure below.

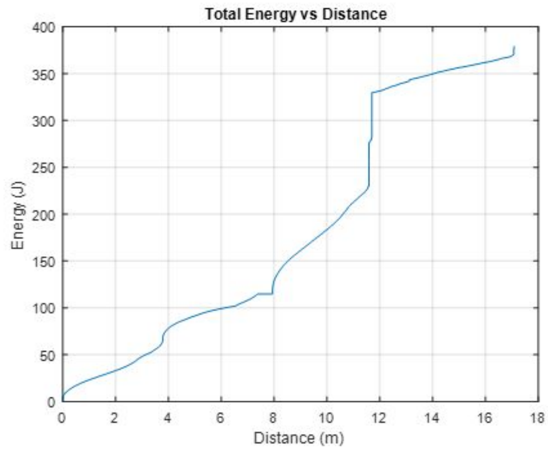

Figure 1: Test 1

In test two, the AEV used 60.13 J of energy to reach the gate and 11.89 J were used during the reverse thrust. From the gate to the caboose, 48.58 J were expended and 12.72 J were used to brake. The results for this test can be seen in the figure below.

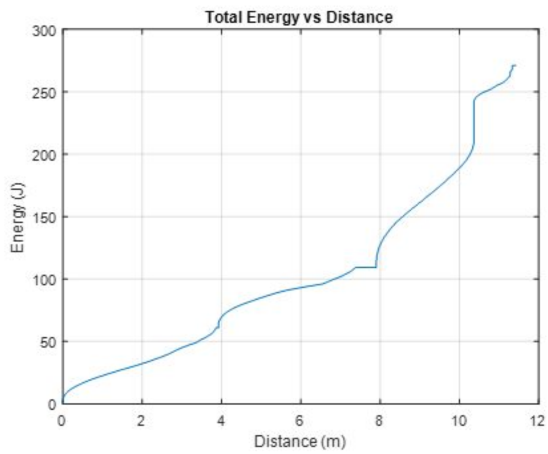

Figure 2: Test 2

In test three, the AEV used 60.03 J to reach the gate, and of that, 12.11 J were used for the reverse thrust. To reach the caboose, the AEV used 47.91 J of energy and 12.23 J were used to brake. The results for test three can be seen below.

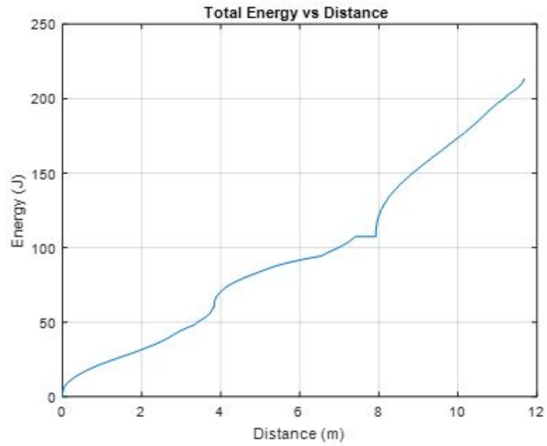

Figure 3: Test 3

The average energy expenditure of the reverse thrust used to brake at the gate was 11.89 J. The average energy expenditure to brake at the caboose was 12.39 J. Once the servo tests are completed, those results will be compared to the results of the reverse thrusts.

Takeaways

As was stated above, servo tests were not completed. Given this, conclusions have not been made in determining what braking method was more effective. Important lessons were learned in regard to AEV performance given different batteries. The same code used on different days led to significantly different results. This was seen as a major issue and the team determined that code that accounts for this should be developed. A discussion about testing parameters resulted from this. The entirety of performance test three was to be used as the baseline for all tests during AR&D 3. Given the variability of performance, it was determined that this was not feasible with the current code and time constraints.

Another takeaway was that the AEV seemed to be spending too much time on the track. This was particularly noticeable on the upwardly inclined portions of tests. The AEV exhibited a somewhat sluggish behavior. The team discussed this and it was determined that power could be increased. An increase of power would also align with results gathered from AR&D 2 which showed that higher powers tended to result in lower values of dollars per inch.

Future Work

Situation

For the upcoming labs and final performance test the team will be initially gathering data for AR&D 3. This will be done through completing trail runs with the AEV with and without and attached servo. This to figure out whether it would be more cost effective for the team to attach a servo for the final run along with getting the code necessary for the AEV to complete the course with and without a servo.

Upcoming Goals

The first goal the team has will be collecting data for trial runs for the AEV with a servo and be comparing that to data recorded for the AEV without the servo and decide whether or not to proceed with using a servo or not. The second goal for the team is to complete a full run of the track with or without the servo, as there have been numerous inconsistencies within the past runs that have made it difficult to complete a full run. Other than these two the team will be revising the Critical Design Review draft, begin working on the slide for the final oral presentation and finishing up the website.

Upcoming Schedule

The upcoming labs will consist of time spent preparing for the final performance test. This test will require the AEV to begin at the starting point, stop and then continue through the 'city,' pick up the caboose, go through the 'city' again, and return to the starting point from the other direction. This will take place across labs 21 and 22.

The group must also begin editing the Critical Design Review rough draft, start creating the slide for the final oral presentation, and finish the final touches on the website. This will be done starting from future labs until the final due date which is lab 25. The group needs to put together the final touches on the entire project and then the group will be finished with all of the AEV activities.

Appendix A: Team Meetings

03/18/2019
Members Present: All members present
Topics/Agenda: Analyze the data and performance test 01 prep.
Action Items:

- Website: Grace
- Prep: Ben, Maddy, Clark

Overview:
The team analyzed data from previous lab and and began preparations for performance test 01.
Upcoming Tasks:
Prepare for performance test 01.

Members Present: All members present
Topics/Agenda: Performance Test 01

Action Items:

- Website: Grace
- Performance Test: Everyone

Overview:
The team spent the majority of the class making adjustments for the performance test and then the test was completed successfully.
Upcoming Tasks:
Prepare for performance test 02.

Members Present: All members present
Topics/Agenda: R&D Oral Presentation
Action Items:

- Presentation: Everyone

Overview:
The team presented results gathered up until this point.
Upcoming Tasks:
Prepare for performance test 02.

Members Present: All members present
Topics/Agenda: Performance Test 02
Action Items:

- Website: Grace
- Test: Ben, Maddy, Clark

Overview:
The team spent the class fine tuning the code for the test and then it was completed successfully.
Upcoming Tasks:
Prepare for performance test 03 and committee meeting 02.

Members Present: All members present
Topics/Agenda: Committee Meeting 02
Action Items:

- Meeting: Everyone

Overview:

Upcoming Tasks:
Prepare for performance test 03

Members Present: All members present
Topics/Agenda: AR&D 03
Action Items:

- Website: Grace
- Research: Ben, Maddy, Clark

Overview:
Testing new AEV and preparing for performance test 03.
Upcoming Tasks:
Prepare for performance test 03.

Appendix B: Code

<u>Peformance Test 2</u>

```
//start to gate
celerate(4,0,28,1.5);
goToAbsolutePosition(260);
reverse(4);
motorSpeed(4,35);
goFor(1.2);
brake(4);
goFor(7);

//gate to caboose
reverse(4);
celerate(4,0,25,1.5);
goToAbsolutePosition(528);
```

```
reverse(4);
motorSpeed(4,35);
goFor(1.2);
brake(4);
goFor(5);

//caboose towards gate
motorSpeed(4,35);
goFor(2);
brake(4);
```

<u>AR&D 3</u>

```
//to gate
celerate(4,0,28,1.5);
goToAbsolutePosition(269);
reverse(4);
motorSpeed(4,35);
goFor(1.2);
brake(4);
goFor(7);

//gate to caboose
reverse(4);
celerate(4,0,22,1.5);
goToAbsolutePosition(528);
reverse(4);
motorSpeed(4,38);
goFor(1.2);
brake(4);
goFor(5);

//caboose to gate
celerate(4,0,44,2);
goToAbsolutePosition(380);
reverse(4);
motorSpeed(4,40);
goFor(1.2);
brake(4);
goFor(7);

//gate to end
```

```
reverse(4);
celerate(4,40,23,1.5);
goToAbsolutePosition(150);
reverse(4);
motorSpeed(4,35);
goFor(1.2);
brake(4);
```