Progress Report 3 4/5/2018

ENGR 1182 Dr. Bixler
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Backwards looking Summary

Situation

In the past couple of weeks Group O has primarily focused on being able to complete Performance Tests 1 and 2 in order to become fully prepared for the Final Performance Test. To compete these tests as instructed and as quickly as possible, we focused on creating a code that could maintain a high power throughout, while also coasting for minimal distance. For Performance Test 1, we were relatively unsuccessful because of the way out code was written. Instead of braking both motors before reversing direction, the brake command was not used which led to a sharp transition in the motors, leading to the test not successfully being completed on time. Once this was fixed, the trials for the AEV became much more consistent, which led to Performance Test 2 being completed for full credit on the first attempt. This method of braking both motors before changing the motor direction will be applied to our code as a function of time to provide consistent results as we move in to the final phase of performance testing.

Results & Analysis

When comparing the results from the two codes design, the team had two factors in mind: energy consumption and controllability. Time and energy are valuable assets and in order to obtain maximum efficiency, the two must be minimized. The graphs represented a physical quantity, the area under the graph has an important contextual meaning; in the case of the graph of power vs time, the area under the graph provided the energy generated by motors.
For the first test (Performance Test 01), we prefered to use the control-time method (goFor) instead of control-distance method (goToRelativePosition()) because the control-time method gave us greater controbility while the other one do not have great consistency. We measured the distance between the stop-point and the gate before crossing of the two methods with the collected data from AEV.

From the Figure 01 and Figure 02, we clearly observed that the time-control method is more consistent compared with distance-control method. The data for Figure 01 fluctuated sharply in the interval from 6.3 to 16 (inches). The distance of the third time and seventh time were so close to the gate that the sensor has no reaction to the AEV, which led to the failure of opening the gate. As a consequence, the test failed. Besides, the result was obviously unpredictable when using the distance control method - one can not know how the AEV will behave for the next experiment (one may get a higher distance or lower distance than before), which means the

repeatability and reproductivity of this method-controlled experiment is poor. So the distance-control method would not have a qualified controbility on AEV and thus would not accomplish the goal of crossing the gate safely. By comparison, the data displayed in Figure 02 fluctuate slightly in the interval from 6.4 to 9.7 (inches) and all the runs made the sensor of gate react to the AEV successfully. Although the result were still not unpredictable, the fluctuation could be controlled over a smaller interval (-2.9 to 2.4 inches) compared to the distance-control method(-6.5 to 7.2 inches). Therefore ,we decided to use the time-control method.

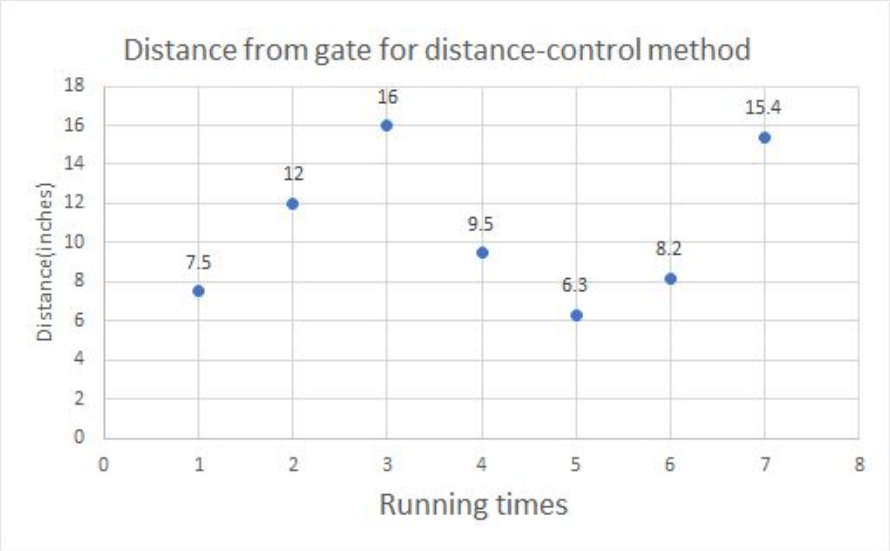

Figure 01: Distance from the gate with distance-control method vs running times

Figure 02: Distance from the gate with time-control method vs running times

Figure 03 below represented the change in power input by the motors (Watts) over time (seconds). This figure showed that the time-control method can have a good controbility on the AEV - the code made the power of motor change greatly in a tiny time interval, which meant that the AEV could consecutively make different movements without considering too much on the effects of the previous actions. And we could use the brake method instead of the coasting method because we needed to control the sliding distance rigorously to make the AEV entered in the sensored distance at the gate, which matched the requirements of reliable controbility.

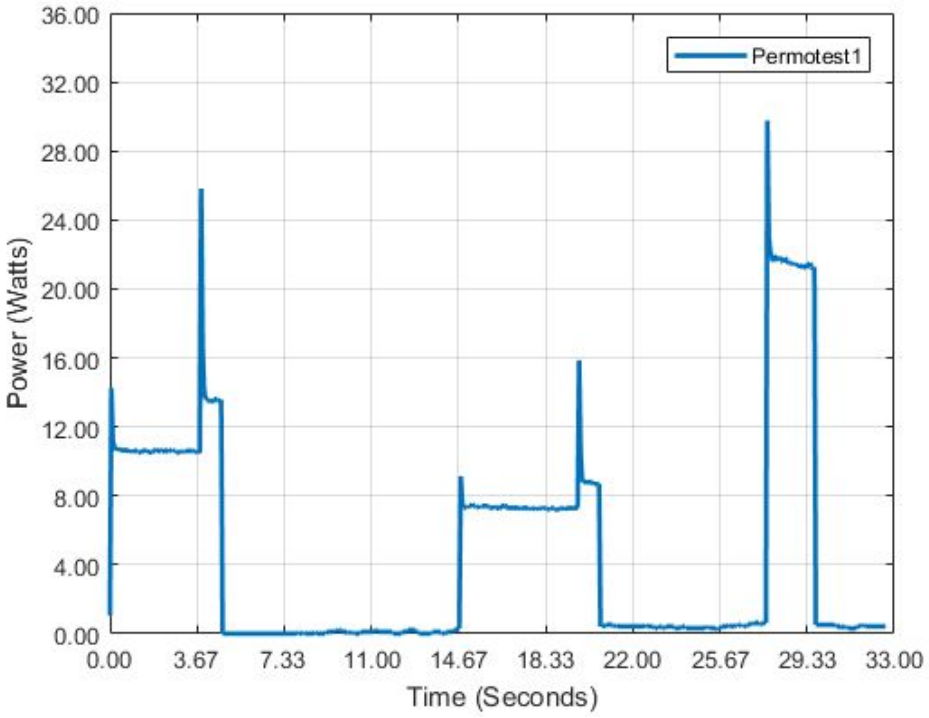

Figure 03: Power vs. Time for Performance Test 01 with time-control method

For the second test (Performance Test 02), we prefered to use the control-time method (goFor) instead of control-distance method (goToRelativePosition()) for the same reasons mentioned above. The goal of this test was pick up the caboose after crossing the gate and then make the AEV and caboose (connected together) move reversely a little bit before re-crossing the gate. We used two types of code to finish this test - the majority of the parts of the two code were the same, the only difference was the final braking distance after the AEV had picked up the caboose traveled a specific distance.

Figure 05 shows the difference of the two code patterns. It can be easily observed that the behavior of the most part of the two runs was almost identical, which not only shows the code patterns owed by both had a steady controbility and repeatability over AEV, even after the AEV picked the caboose, but also verified choosing the braking method and time-control method were

more applicable ways to control the AEV. For the different part of the figure, the red curve used less motor power to brake the AEV compared with the blue curve. Although the red curve consumed less energy, this is not the best result for the final performance test - we need to recross the gate. The red curve made the AEV run out of the sensored distance of the gate, while the the blue curve could stop at the position that lies in the sensored distance of the gate. Besides, there is an important factor that should be considered when designing the code for the part that the AEV and caboose travel reversely together as the return on an uphill course. Therefore, we not only need more motor power to generate the forward force but also need enough time to let the AEV pass the uphill, which is why we used the bigger parameter for moterSpeed() method in coding design.

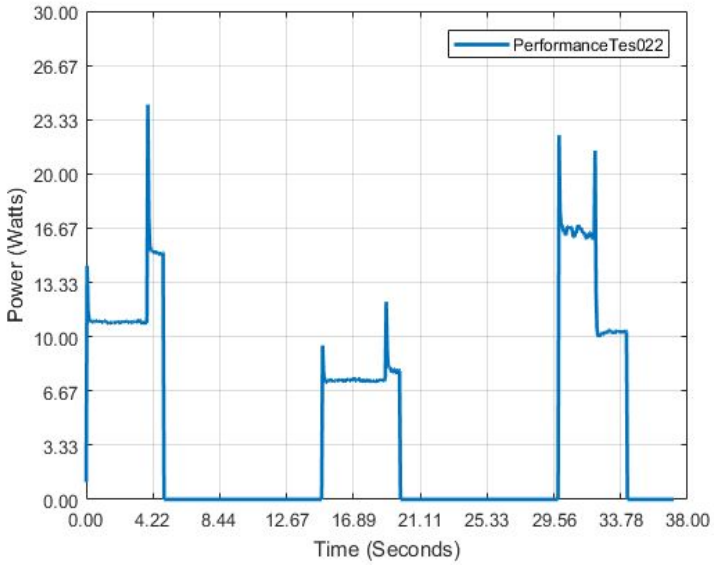

Figure 04: Final code for testing design for Performance Test 02

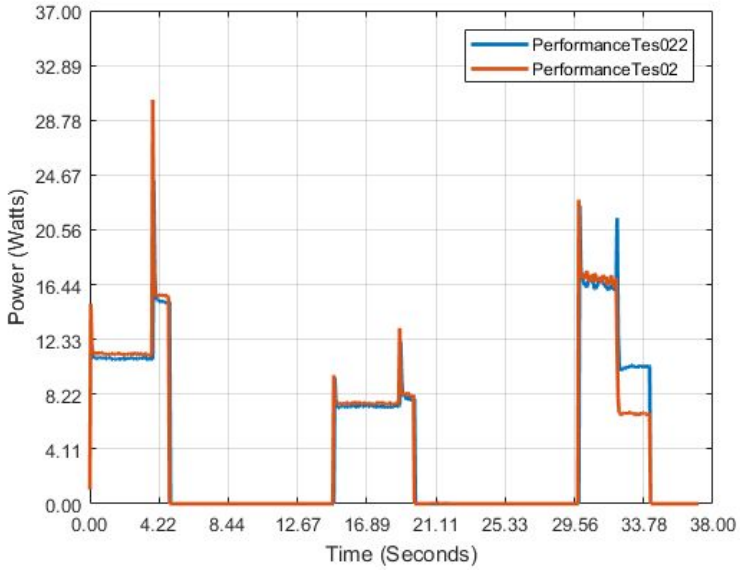

Figure 05: Comparing code for Performance Test 02

Takeaways

Our groups biggest takeaways from what was completed were that time-control method is more controllable for the distance compared to the distance-control method. Also, we needed to design some code, even if it consumed more energy for the qualified repeatability and controbility. The reproductivity and consistency were two crucial factors that determined the final result of tests. We failed on the official Performance Test 01 because of the consistency problems, which made us consider how to improve the code in Performance Test 02. We found that we should change the arguments of the motorSpeed() method when we wanted to make a big change for the distance because it would affect the accuracy of the result when we change the arguments of the goFor() method - the completivity would increase and the controbility would decrease as the time changed greatly. However, we decided it was better to change the arguments of goFor() method when we wanted to make small change of the distance because the total distance would change drastically if we changed the arguments of motorSpeed() - the accumulation effect would have been great as even a tiny change (+1 or -1) on the code could cause this.

During the experimental process, the team chose which method would benefit the performance tests and team efficiency 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. The AEV design was done by correcting things as needed, which included choosing the proper arm and arduino placement, adding brackets so that the magnet could pick up the caboose, and adjusting the propellers so that the AEV could operate with and without the caboose in the forward and reverse direction in order to complete all of the necessary tasks.

Looking Forward

Situation

Now that the team has completed the first and second performance tests, the team will prepare for the Final Performance Test. This is the last step in the project, separate from technical communications, and the team will use all the acquired knowledge thus far to successfully complete the final performance. The ultimate goal of this project was to create a vehicle that could transport people from Linden to Polaris and Easton. The Final Performance Test will provide the company with a working prototype, that can move onto further testing to one day be able to safely and successfully transport people to their destination in a time and cost efficient manner. The team already has a final design and a successful code for the vehicle to pick up the caboose, so the last task is to complete the code for the vehicle to transport the

caboose back to the starting dock. The team will complete this by analysing the code for the vehicle that allowed it to travel to the loading dock and because the track is symmetric, the team will just modify the code to account for the extra weight provided by the caboose. Trial and error will be a main strategy to complete this task. Considering the team has had much experience with programming the advanced energy vehicle and how it responds to the code, the team should be able to successfully complete the final performance test.

Upcoming Goals

As we continue to enhance our code for our Final Performance Test, we continually work towards consistent results that are efficient in energy, time, and budget. We aspire to create a sufficient and affordable transportation device for those in Linden. Each aspect of our research, design, and coding will be clearly documented on paper, our website, as well as presented orally. This will be done in order to share our research and design within and between companies.

Upcoming Schedule

Task	Sub-Task	Start Date	Completion Date	Due Date	Members	Time	% Complete
Performance Test 1				3/21/18			100%
	Code	3/7/18	3/20/18		Everyone	5hr	
Performance Test 2				3/28/18			100%
	Code	3/21/18	3/27/18		Everyone	3hr	
CDR Draft				3/25/18			100%
	AEV Designs in Solidworks	3/21/18	3/25/18		Jacob	2hr	
	Abstract/Introduction/ Formatting	3/21/18	3/25/18		Kezia	2hr	
	Experimental Methodology/Results	3/21/18	3/25/18		Kia	2hr	
	Discussion/Appendix	3/21/18	3/25/18		John	2hr	

Committee Meeting 2				3/30/18		1hr	100%
	Gather needed Materials	3/28/18	3/29/18		Everyone	.5hr	
Progress Report 3				4/8/18			100%
	Looking Back Summary/Takeaways	3/30/18	4/8/18		Jacob	2hr	
	Results/Analysis	3/30/18	4/8/18		John	2hr	
	Looking Forward Goals	3/30/18	4/8/18		Kia	2hr	
	Schedule/Meeting Notes	3/30/18	4/8/18		Kezia	2hr	
	Appendix/Formatting	3/30/18	4/8/18		Kezia	2hr	
Final Performance Test				4/13/18			75%
	Code	3/28/18	4/11/18		Everyone	2hr	
Final Oral Presentation				4/18/18			0%
	Draft	4/8/18	4/10/18		Everyone	2hr	
CDR				4/18/18			0%
	Update Abstract/Introduction	4/8/18	4/17/18		Kezia	2hr	
	Update Experimental Methodology	4/8/18	4/17/18		Kia	2hr	
	Update Results	4/8/18	4/17/18		John	2hr	
	Update Discussion/Appendix	4/8/18	4/17/18		Jacob	2hr	
Final Website Update				4/20/18			75%
	Meeting Notes	Daily	4/19/18		Kezia	.5hr	

	Schedule	4/17/18	4/19/18	Kezia	1hr
	Code/Graphs/Budget	4/17/18	4/19/18	John	1hr
	Update Approach/Sales Pitch/Research	4/17/18	4/19/18	Jacob & Kia	2hr

Appendix

Team Meeting Minutes:

Meeting 7
Date: 03/07/2018
Time: 12:40 pm
Location: Hitchcock 224
Members Present: All

Topics Discussed:
Performance Test 1

Objectives:
- Write and test code to complete Performance Test 1

To Do:
- Do the Performance Test next lab period
- Document Meeting Notes

Meeting 8
Date: 03/20/2018
Time: 12:40 pm
Location: Hitchcock 224
Members Present: All

Objectives:
Today, our objective is to rework our code before we complete Performance Test 1. We also need to document meeting notes for today's lab.

Topics Discussed:
- Performance Test 1

To Do:
- Make sure code is CONSISTENT!

- Complete Performance Test 1 next lab period
- Document Meeting Notes - Kezia

Meeting 9
Date: 03/21/2018
Time: 12:40 pm
Location: Hitchcock 224
Members Present: All

Objectives:
Today's objective is to make sure our code is consistent before we complete the second trial of Performance Test 1. We also need to document meeting notes for today's lab.

Topics Discussed:
- Performance Test 1

To Do:
- Begin Code for the next Performance Test
- Complete CDR Draft – assign who does what as a group
- Document Meeting Notes - Kezia

Meeting 10
Date: 03/23/2018
Time: 12:40 pm
Location: Hitchcock 308
Members Present: All

Objectives:
Today's objective is to complete two working codes for Performance Test 2 as well as assign roles for each team member for the CDR.

Topics Discussed:
- CDR
- Performance Test 2

To Do:
- Complete CDR Draft - everyone
- Document Meeting Notes - Kezia
- Assign Roles for CDR
    - Jacob – Create the 2 solidworks AEV designs, Conclusion
    - John – Discussion, Appendix
    - Kia – Experimental Methodology, Results
    - Kezia – Abstract , Introduction, Formatting

Meeting 11

Date: 03/27/2018
Time: 12:40 pm
Location: Hitchcock 224
Members Present: All

Objectives:
Today's objective is to complete our code for Performance Test 2, and complete the performance today as well if possible.

Topics Discussed:
- Performance Test 2

To Do:
- Document Meeting Notes - Kezia
- Complete Performance Test 2

Meeting 12
Date: 03/28/2018
Time: 12:45 pm
Location: Hitchcock 224
Members Present: All

Objectives:
Today's objective is to continue developing our code for the Final Performance Test as well as prepare for Committee Meeting 3.

Topics Discussed:
- Committee Meeting 2
- Final Performance Test

To Do:
- Come prepared for Committee Meeting 3 - everyone
- Document Meeting Notes - Kezia

Meeting 13
Date: 04/03/2018
Time: 12:45 pm
Location: Hitchcock 224
Members Present: All

Objectives:
Today's objectives is to tweak our code for the track conditions today in order to get consistent code for the final performance test run.

Topics Discussed:

- Final Performance Test
- Progress Report 3

To Do:

- Document Meeting Notes - Kezia
- Progress Report 3 - everyone

Meeting 14
Date: 04/06/2018
Time: 12:40 pm
Location: Hitchcock 308
Members Present: All

Objectives:
Today's objectives are to continue to refine our code to be consistent for the Final Performance Test as well as work on our Progress Report 3.

Topics Discussed:

- Final Performance Test
- Progress Report 3
- Final Oral Presentation Draft

To Do:

- Document Meeting Notes - Kezia
- Progress Report 3
- Final Oral Presentation Draft (after Progress Report 3) - everyone

Arduino Code:

Performance Test 1 for distance-control method:

```
// Setup motors, go to the gate
 motorSpeed(4,20);
 goToRelativePosition(298);

 // Stop motors, wait for 7 seconds
 motorSpeed(4,0);
goFor(7);
```

```
// Go past the gate
 motorSpeed(4,20);
goToRelativePosition(100);
brake(4);
```

Performance Test 1 for time-control method:

```
// Setup motors, go to the gate
motorSpeed(4,42);
goFor(3.8);

//Reverse the motors for braking to control the sliding distance
reverse(4);
motorSpeed(4,35);
goFor(0.9);
reverse(4);

// Stop motors, wait for 7 seconds
motorSpeed(4,0);
goFor(10);
motorSpeed(4,40);
goFor(2);
brake(4);
```

Performance Test 2: Code for Figure 04 (which is the final code used)

```
// Setup motors, go to the gate
motorSpeed(4,43);
goFor(3.8);

//Reverse the motors for braking to control the sliding distance
reverse(4);
motorSpeed(4,54);
goFor(1);
reverse(4);

// Stop motors, wait for 7 seconds
motorSpeed(4,0);
goFor(10);

//Run the AEV
motorSpeed(4,32);
goFor(4);
brake(4);

//Braking for stopping the AEV
```

```
reverse(4);
motorSpeed(4,32);
goFor(0.9);
brake(4);

//Stop 5 seconds
motorSpeed(4,0);
goFor(10);

//Keep going
motorSpeed(4,60);
goFor(2.3);

//Braking the AEV
reverse(4);
motorSpeed(4,42);
goFor(2);
brake(4);

// Reverse the direction for backing
reverse(4);
```

Code for Figure 05 Red Curves (which is the initial code used for Performance Test 02)

```
// Setup motors, go to the gate
motorSpeed(4,43);
goFor(3.8);

//Reverse the motors for braking to control the sliding distance
reverse(4);
motorSpeed(4,55);
goFor(1);
reverse(4);

// Stop motors, wait for 7 seconds
motorSpeed(4,0);
goFor(10);

//Run the AEV
motorSpeed(4,32);
goFor(4);
brake(4);

//Braking for stopping the AEV
reverse(4);
```

```
motorSpeed(4,32);
goFor(0.9);
brake(4);

//Stop 5 seconds
motorSpeed(4,0);
goFor(10);

//Keep going
motorSpeed(4,60);
goFor(2.3);

//Braking the AEV
reverse(4);
motorSpeed(4,30);
goFor(2);
brake(4);

//Reverse the direction of AEV motors for next step
reverse(4);
```