Report of Progress

Situation

The past couple labs were spent completing the task of Performance Test 2 and R&D 3. The team chose R&D 3 to test the accuracy of breaking methods. Performance Test 2 was completed by coding the AEV to implement a reverse stop method before the gate, proceeding through the gate after it opens, connecting to the load with minimal recoil, pausing for 5 seconds until the load is secure to the AEV, and making it out of the loading dock. R&D 3 was completed by taking the first part of the code, the part before the gate, and testing which method is most accurate; increasing/decreasing the celerate() time or increasing/decreasing the goFor() time. The team had controls for the two types. These were important because Performance Test 2 will help the Team prepare for the Final Test, and R&D 3 will help the team get rid of stopping inconsistencies.

Results and Analysis

After Performance Test 1, the team realized that the method that was used for breaking, the brake() command, was not efficient enough. The AEV coasted to a stop, which made the location where it came to a stop unpredictable and unreliable due to the variance. In Performance Test 2, the team decided to incorporate reverse() commands to spin the propellers the opposite way, therefore contributing to the AEV coming to a quicker, more precise stop. This was not a requirement for Performance Test 2, but it was implemented to allow future runs to be more successful.

For Performance Test 2, the task was to first complete the tasks of Performance Test 1, which was to approach the gate in the range which would activate the sensors, wait for 7 seconds for the gate to open, then proceed through the gate. The tasks added to Performance Test 2 were after the gate, to run the AEV to the loading dock and attach to the caboose using a magnet. The AEV and the caboose stop in place for 5 seconds, and then move out of the loading dock while still connected. Team A was able to complete Performance Test 2. The code that the team used for this can be found in Appendix A. The track measurements are shown in Figure 1.

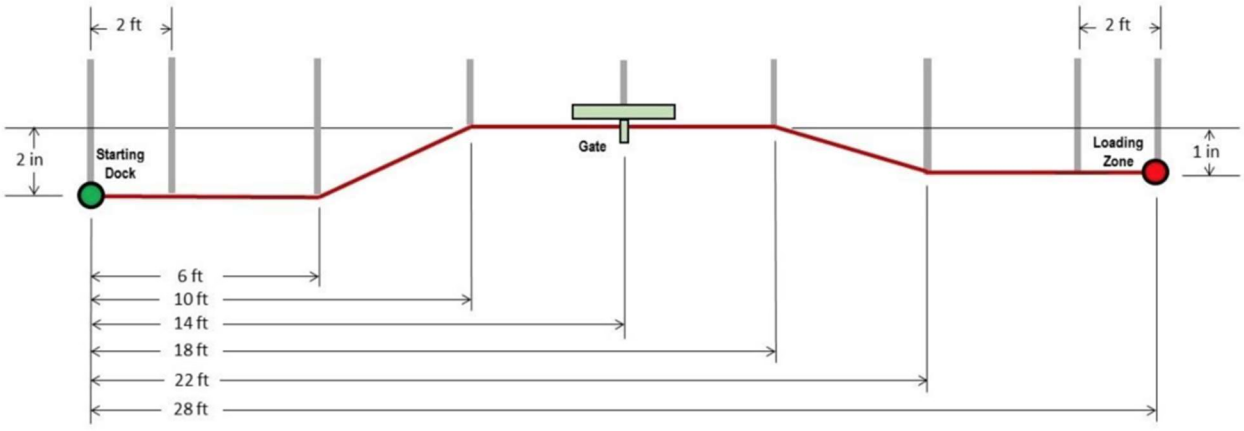

Figure 1. *AEV Track Measurements*

During the performance tests, the team decided that using a reverse command to brake the AEV was more effective than letting the AEV coast to a stop. The team used two commands, celerate() and goFor(), in combination to brake the AEV. The celerate() command controls how quickly the brake is applied and the goFor() command controls how long the brake is applied. For the third R&D, the team investigated which command has a greater effect on the braking accuracy. Since both commands have a time parameter, the team tested the impact of changing each command's time parameter. The first test focused on the celerate() command. The AEV was programmed to reverse power from 0 to 40% power in 0.25, 0.5, 0.75, and 1.0 seconds while the goFor() command was set at 1.0 second. As seen in Figure 2, the AEV travelled the farthest when the celerate() time parameter was set to 0.5 seconds.

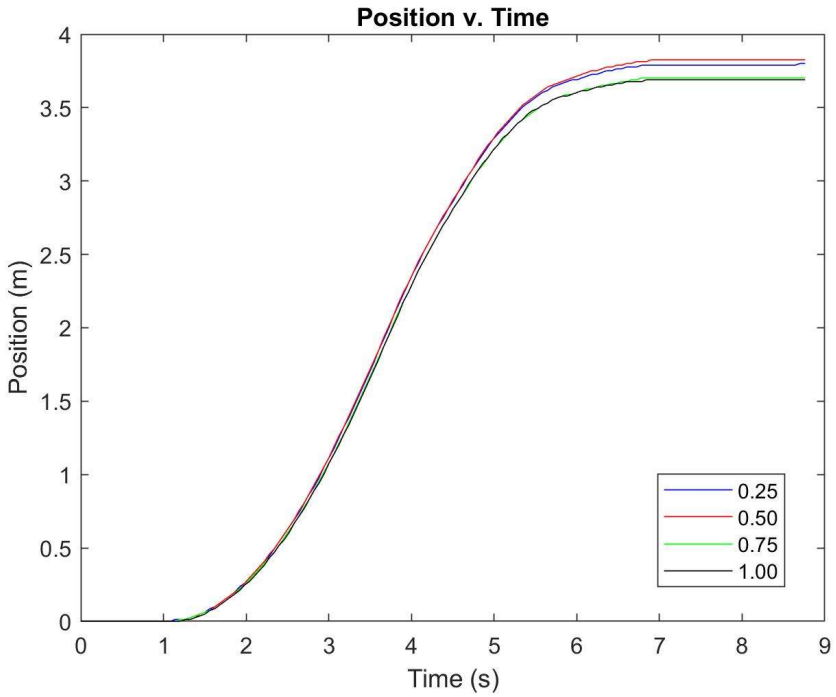

Figure 2. *Changes in celerate(4, 0, 40, t); time parameter*

Only when the time was set to 0.25 or 0.5 seconds did the AEV make it into the designated area. The other two times, 0.75 and 1.0, the AEV did not travel far enough to make it to the first sensor. Although both the 0.25 and 0.5 times made it between the starting and ending sensor, the 0.5 time made the AEV travel approximately 0.044 meters farther. This extra distance is preferred since slight variations, like lower battery voltage or variance in the track, may cause the AEV to travel a shorter distance than expected.

The second test focused on the goFor() command. The AEV was programmed to reverse power from 0 to 40% power in 0.5 seconds while the goFor() command's time parameter changed from 0.5, 0.75, 1.0 and 1.25 seconds. All of the code for both tests can be found in Appendix B. Figure 3 shows that the AEV made it within the designated area without bouncing off the stop sign when the goFor() time parameter was set to 1.0 second. All of the other time parameters either travelled too far and hit the stop sign, like the 0.5 and 0.75 times, or did not travel far enough to make it to the first sensor, like the 1.25 time.

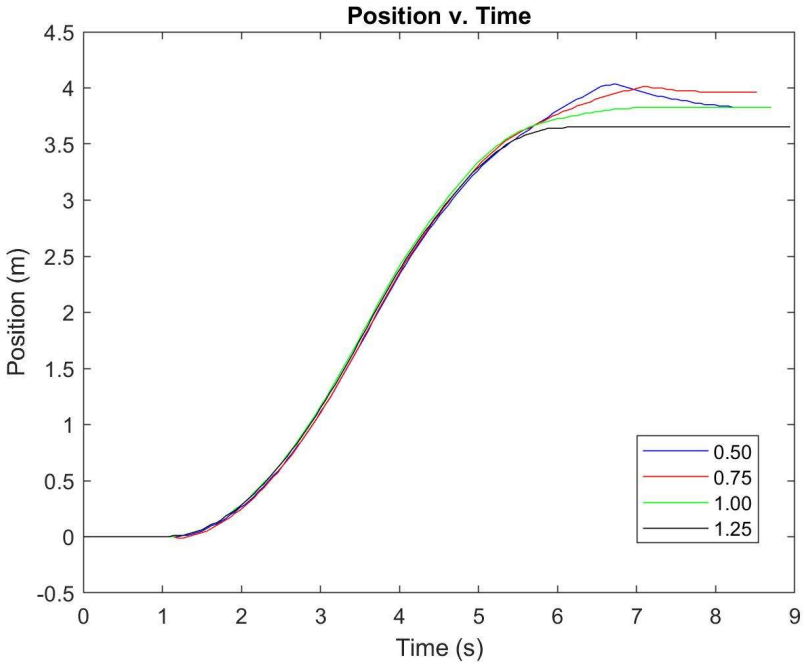

Figure 3. *Changes in goFor(t); time parameter*

All of the recorded time parameters and their respective ending positions on the track are recorded in Appendix C. When comparing the two commands, celerate() resulted in two successful runs while goFor() only resulted in one. The various ending positions of the celerate() command had a range of 0.136 meters and the goFor() command had a range of 0.31 meters. Since celerate() resulted in more successful runs and a smaller ending position range, the celerate() command seems to have a more consistent effect on AEV braking. However, if a more dramatic effect on braking is needed, changing the goFor() command is better.

Takeaways

The combination of Performance Test Two and R&D Three allowed the team to utilize the Engineering Design Process. During the Performance Tests, the team noticed that they were unsure of the best way to adjust the braking mechanism. This uncertainty was the inspiration for the R&D Three tests. These tests allowed the team to investigate the effect of the celerate() and goFor() commands on the AEV's braking system. The team discovered that the celerate() command is better for more controlled braking since this command had more runs make it within the designated area and a smaller ending position range. However, the goFor() command is better for larger braking adjustments since changing the time parameter by 0.75 seconds can result in a 0.31 meter difference in ending position. These results will be applied to the Final Performance Test and will allow the team to make more informed braking decisions based on the distance the AEV needs to travel to reach its designated braking location.

Future Work

Situation

In the next few weeks, final oral presentation draft, final performance test, critical design review, final website, and final oral presentation will be completed. For final oral presentation draft, the team will be required to make a poster on AEV design. For final performance test, the AEV can make it through the gate, pick up caboose, come back through the gate, and return to starting point. For critical design review (CDR), CDR will outline the entire AEV design and discuss the design development, research and development, and recommendations to the Smart City project team. For final website, the website will be up to date from last website update. For final oral presentation, the team will present on its findings and research process of the AEV project.

Upcoming Goals

Based on the collected data from advanced research and development three, the team will implement the results in the AEV program. The team investigated the celerate and goFor function. The date will help the team to successfully complete the final performance test. To prepare for the next few weeks, the team will create weekly updates on tasks. This weekly update will help the team to be on track to finish the upcoming assignments before the deadline.

Upcoming Schedule

Final oral presentation draft: Each member will complete part of the poster, decide on minutes per section, and order of presentation. The poster will be completed in lab and should take about an hour and 30 minutes.
Final performance test: Rachel and Miho will write the code for final performance test. Writing the code should take about 20 minutes, but testing and troubleshooting will take approximately an hour.
Critical design review: Each team member will fill in the section completed after the CDR draft and make any changes based on the draft comments from the grader. Since a majority of the CDR has already been completed, it should take about 3 hours.
Final website: Tatum is responsible for overseeing website update. The website has been regularly updated from the beginning of the project, so completing the final website will take an hour at the end to finalize.
Final oral presentation: Each team member will be assigned to talk about a section of the poster. Since the draft was completed, editing it will take about an hour.

Appendix A: Performance Test Code

Table A.1. *Code for Performance Test 2*

Code	Comments
reverse(4);	// Reverse all motors, pushes AEV forward
celerate(4, 0, 40, 1);	// Accelerate all motors from 0 to 40% power in 1 second
motorSpeed(4, 40); goToAbsolutePosition(160);	// Motors at 40% power for 8ft (midpoint of incline)
brake(4);	// Brake all motors
reverse(4);	// Reverse all motors
celerate(4, 0, 40, 0.25); goFor(0.9);	// Braking technique being tested. 0.25, 0.5, 0.75, and 1 all tested at bolded time.
brake(4);	// Stop reversing motors
delay(8000);	// Pause for 8 seconds
reverse(4);	// Reverse to move forward through gate
motorSpeed(4, 35); goToAbsolutePosition(405);	// Motor speed 35% until 22 foot mark
brake(4);	// Brake to cut power

reverse(4);
celerate(4, 0, 40, .25);
goFor(.8);
	// Reverse all motors, accelerate form 0% power to 20%, in 1/4th of a second, to stop before securing load

brake(4);	//Break
delay(6000);	// Pause for 5 seconds to secure load
celerate(4, 0, 40, 1);	// Increase motor speed 0% to 35% for 1 second
goToRelativePosition(-100);	// Move back towards gate

Appendix B: R&D Code

Table B.1. *Code to test celerate command*

Code	Comments
reverse(4);	// Reverse all motors, pushes AEV forward
celerate(4, 0, 40, 1);	// Accelerate all motors from 0 to 40% power in 1 second
motorSpeed(4, 40); goToAbsolutePosition(160);	// Motors at 40% power for 8ft (midpoint of incline)
brake(4);	// Brake all motors
reverse(4);	// Reverse all motors
celerate(4, 0, 40, ***time***); goFor(1);	// Braking technique being tested. 0.25, 0.5, 0.75, and 1 all tested at bolded time.
brake(4);	// Stop reversing motors

Table B.2. *Code to test goFor command*

Code	Comments
reverse(4);	// Reverse all motors, pushes AEV forward
celerate(4, 0, 40, 1);	// Accelerate all motors from 0 to 40% power in 1 second
motorSpeed(4, 40); goToAbsolutePosition(160);	// Motors at 40% power for 8ft (midpoint of incline)
brake(4);	// Brake all motors
reverse(4);	// Reverse all motors
celerate(4, 0, 40, 0.5); goFor(***time***);	// Braking technique being tested. 0.5, 1, 1.5, and 2 all tested at bolded time.
brake(4);	// Stop reversing motors

Appendix C: R&D Data Collection Tables

Table C.1. *Data for celerate command*

Time to celerate (secs)	Time (s)	Position (m)
0.25	8.763	3.801
0.5	8.763	3.826
0.75	8.763	3.702
1	8.763	3.690

Table C.2. *Data for goFor command*

Time to celerate (secs)	Time (s)	Position (m)
0.5	8.283	3.83
1.0	8.52	3.96
1.5	8.70	3.83
2.0	8.94	3.65

Appendix D: Team Meeting Minutes

Date: 5 – Mar – 2019
Time: 9:10 am-10:05 am
Location: HI 308
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: LAB 9
Objective: The main focus of this meeting was finish the methodology and code for testing servo motors.
To-Do/Action Items: Write procedure and methodology for servo motor lab (ALL); Update Website (TW); Write code for servo testing (PB & RR); Assign Roles for Progress Report (ALL)
Decisions: The team decided on increasing the power from the first lab so the ability to brake is clearer.
Reflections: The team learned about the purpose of the servo motor and how to attach it to the AEV in order to contribute to braking.

Figure D.1. *First team meeting minutes*

Date: 8 – Mar – 2019
Time: 9:35 am-10:55 am
Location: HI 224
Members Present: Paige Bormann, Rachel Roman, and Miho Kaburagi
Topics Discussed: Performance Test 1
Objective: The main focus of this meeting was to make the code and understand the task for Performance Test 1.
To-Do/Action Items: Write Code (ALL); Update Website (TW); Split up tasks for Progress Report 2 (ALL)
Decisions: The team decided to go forward with push motors.
Reflections: The team learned about the marks on the track, and brainstormed on how to brake the AEV quicker.

Figure D.2. *Second team meeting minutes*

Date: 19 – Mar – 2019
Time: 9:10 am-10:05 am
Location: HI 308
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: Performance Test 1
Objective: The main focus of this meeting was finish Performance Test 1 and get a grade.
To-Do/Action Items: Mess with code to get the AEV to work (ALL)
Decisions: The team decided on braking as the AEV is going uphill, so that it will coast until the gate.
Reflections: The team learned about how to execute this Performance Test.

Figure D.3. *Third team meeting minutes*

Date: 20 – Mar – 2019
Time: 3:00 pm-4:00 pm
Location: HI 316

Members Present: Rachel Roman, and Miho Kaburagi
Topics Discussed: Performance Test 1 Revisions
Objective: The main focus of this meeting was make a code that uses reverse the brake the AEV quicker.
To-Do/Action Items: Write code (ALL)
Decisions: The team decided on using the reverse function to help brake the AEV.
Reflections: The team brainstormed and began coding for Performance Test 2.

Figure D.4. *Fourth team meeting minutes*

Date: 21 – Mar – 2019
Time: 9:10 am-10:05 am
Location: HI 308
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: R&D Presentation
Objective: The main focus of this day was to present our findings from the R&D Labs.
To-Do/Action Items: Present to 3 other groups (ALL)
Decisions: The team decided who would talk about each topic. Tatum talked about the MCR, Miho talked about R&D 1, Paige talked about R&D 2, and Rachel talked about conclusions and feedback.
Reflections: The team got to learn information about other aspects of the AEV from other groups.

Figure D.5. *Fifth team meeting minutes*

Date: 22 – Mar – 2019
Time: 9:35 am-10:55 am
Location: HI 224
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: Performance Test 2
Objective: The main focus of this meeting was to begin Performance Test 2.
To-Do/Action Items: Finish code (ALL)
Decisions: The team decided that the Reflectance Sensors were messed up. A majority of the class was spent trying to fix them so that they read the marks correctly.
Reflections: The team learned how to fix the Reflectance Sensors if the same problem is to arise.

Figure D.6. *Sixth team meeting minutes*

Date: 25 – Mar – 2019
Time: 6:30 pm-7:30 pm
Location: HI 224
Members Present: Paige Bormann, Tatum Wilmes, and Rachel Roman
Topics Discussed: Performance Test 2
Objective: The main focus of this meeting was to improve code for Performance Test 1 and execute Performance Test 2.
To-Do/Action Items: Run AEV and use trial and error (ALL)
Decisions: The team decided on how to code the second Performance Test
Reflections: The team learned about the objectives of Performance Test 2 and what is expected.

Figure D.7. *Seventh team meeting minutes*

Date: 26 – Mar – 2019
Time: 9:10 am-10:05 am
Location: HI 308
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: Performance Test 2
Objective: The main focus of this meeting was finish Performance Test 2 and get a grade.
To-Do/Action Items: Update Website (TW); Work out bugs in the code (ALL)
Decisions: The team decided on getting a fully charge battery towards the end of the lab because the AEV was showing different performance as the battery died.
Reflections: The team learned the battery voltage affects how the AEV functions.

Figure D.8. *Eighth team meeting minutes*

Date: 29 – Mar – 2019
Time: 9:35 am-10:55 am
Location: HI 224
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: Advanced R&D 3
Objective: The main focus of this meeting was write methodology and start testing A R&D 3.
To-Do/Action Items: Update Website (TW); Work on Methodology (RR,MK); Run Tests and Collect Data (TW,PB)
Decisions: The team decided on testing how the AEV stops when utilizing the reverse(); function.
Reflections: The team saw some errors and inconsistencies in how the AEV ran which will be investigated next lab.

Figure D.9. *Ninth team meeting minutes*

Date: 2 – Apr – 2019
Time: 9:10 am-10:05 am
Location: HI 308
Members Present: Paige Bormann, Tatum Wilmes, Rachel Roman, and Miho Kaburagi
Topics Discussed: Advanced R&D 3
Objective: The main focus of this meeting was to finish testing and collecting data for Advanced R&D 3.
To-Do/Action Items: Update Website (TW); Work on code for Final Testing (RR,MK); Run Tests and Collect Data (TW,PB)
Decisions: The team decided on how to show the results for Advanced R&D 3.
Reflections: The team realized that the AEV ran different on the track in room 308 and 224. Since the Final Testing is in 308, all of the decisions and code will be based off of that track.

Figure D.10. *Tenth team meeting minutes*