ENGR 1182 Progress Report 2 - Group C

Matthew Zirbel, Jacob Manion, Nick Folino, Joe Jerig

Lab 6:

Backwards Looking Summary:

In preparation for this lab, the team held their sixth meeting at Smith-Steeb where all members were present in order to discuss and brainstorm designs that could be used for the upcoming grant proposal. The idea that the team agreed on and brought to fruition was Jacob's aileron idea that he also designed. The team also worked on preparing for the committee meeting that took place in lab 6. The team built Jacob's AEV idea in preparation for the testing component of the lab.

During the testing lab time, the team's goal for research was to determine whether power braking or coasting would be better for the AEV strategy. Two systems used to determine which system works better are power used and accuracy. Power used can be measured by the integral of power over time during the test, and accuracy can be measured by comparing standard deviations of distances travelled. Minimizing power use is important to ensure the lowest cost runs for the AEV. Increasing the accuracy of the AEV is vital to ensure that it can stop in the correct place. Using coasting and power braking correctly is important to ensure minimal power usage and maximum accuracy.

The team ran two different types of tests, for eight runs each, to determine the proper system for power braking and coasting. The strategy for coasting was to run the propellers at 40% power for 1.5 seconds before cutting the power, then recording the distance and power usage. The system used for power braking was to run the propellers at 40% power until reaching 80 in down the track, before reversing the propellers and running them at 40% until the AEV came to a stop. Using the code in **Code 1**, the team tested coasting first. **Figure 1 and 2** are two representative graphs of the results for the Power vs. Time and Power vs. Distance respectively for the coasting tests. Using the code in **Code 2**, the team next tested power braking. **Figure 3 and 4** are representative graphs of the Power vs. Time and Power vs. Distance respectively for the power braking tests. As these graphs show, the coasting runs used significantly less power than the power braking runs. **Figure 5** has a table of the distances that each test ended at, and the summary results are below:

Coasting:

- Mean: 89.5 in
- Standard Deviation: 2.01 in

Power Braking:

- Mean: 79.2 in
- Standard Deviation: 0.35 in

A general summary of the power braking and coasting results:

Power Braking

- Reverse power was determined to be more effective than simply shutting off the motors
- Much more time effective

- Able to move quicker with more control

Coasting

- Much more power efficient
- Safety hazard from uncertain stop point due to coasting
- Difficult to account for stopping in planned route of AEV, while maintaining good speed and precision

Some conclusions the group came to in the group research of coasting vs power braking are that coasting was a much less effective way of stopping the AEV accurately. As shown above, the standard deviation for coasting was many times higher than the standard deviation from power braking, meaning that power braking is more accurate than coasting. The group found that coasting caused an unnecessary safety hazard in that it could easily run off the track. Although coasting is less accurate, it is much better in terms of power efficiency. Due to the significance of the inaccuracy of coasting and the large use of power in power braking, the group concluded that a hybrid of the two braking types, using coasting to slow the AEV without using too much power, and a power braking for accuracy to stop all the way, is likely to be the best possible option.

Forwards Looking Plan:

In the next lab, the team needs to collect more data for the Power Braking vs. Coasting lab, ensuring the data is repeatable. In addition, the team needs to prepare for the Servo Function lab, continuing aR&D into section 2. This entails figuring out how to mount the servo, as well as creating temporary ailerons to stand in for the part while it is not yet printed, which have the intended purpose of adding more air resistance to assist in the braking procedure. More thought must also be had about other possible functions the servo may have that would help to create a more efficient AEV. This, combined with the data from the Power Braking vs. Coasting lab may help in additional power reduction.

The current plan for the servo function is to mount the servo with some sort of aileron somewhere on the AEV, rotating it to increase or decrease air resistance. This is to both streamline the AEV while it is in motion, and create a foil that would block air flow when braking, acting as an aerial brake. The problem presented by the servo is a lack of compatibility with any screws currently provided in the AEV kit, and upon asking the professor, it was discovered no screws in the department exist that would fit the holes. The current method to apply the servo is decided to be tape, and/or any zip ties that are necessary for added strength. Additional research needs to be placed into other uses, including, but not limited to a caliper arm that would function as a brake in a similar manner to the brakes in cars' wheels. This could be used either on the wheels directly, or potentially more effectively, using the wheels as one side of a vice, the servo as the other, and sandwiching the track between the two in order to generate frictional force on the track itself. The current manner of attaching the servo, however, does not support this very well, as the rotational forces acting upon the servo would place strain on the tape and/or zip ties that are planned for use, perpendicular to the direction in which the tape is strongest.

The group also must add any updates to the website that are necessary at this time, including meeting minutes, graphs, and changes since last lab. The central goal is to finish any and all R&D testing, including both the additional Power Braking vs. Coasting data and Servo

Function tests. Both of these sections need to be finished before Lab 8, as the group will be presenting the results of these labs.

Lab 7:

Backwards Looking Summary:

To prepare for this lab, the team discussed what work had to get done for the completion of the Power Braking vs. Coasting Lab. The team planned that from the previous lab, not enough data was collected about how coasting vs power braking differentiated in consistency. The team also determined that the purposes for the servo needed to be determined during the lab as well as a possible configuration that could be tested.

The lab period consisted of the team finishing up the data collection for the Power Braking vs. Coasting. In addition to data collection the team decided to determine the setup and use of the Servo motor. Whilst working on the possible designs and uses for the servo motor, the team first assessed the limitations of what the servo could do. One limitation that was immediately obvious that the servo could only rotate 180 degrees. This eliminated the possibility of using the servo to drive the wheels. In addition it also eliminated the possibility of using the servo to turn the AEV around to achieve an exclusively push or pull propulsion. Another limitation that appeared was the holes on the servo itself. The servo's holes that are used to mount itself to the AEV are too small to be able to be of use. The only way to attach the AEV to the servo is by screwing the AEV to the servo's center hole. The only viable way to mount the servo is using tape and brackets.

After considering the limitations that using the servo presented, the group next had to determine what it could be used for. Because the servo cannot drive the wheels of the AEV propulsion would be out of the question, and the only thing the team needed for the AEV was efficient braking, the group concluded that using as an assisted braking system would be simple yet energy efficient as it would use less power than power braking and would allow the AEV to brake faster than coasting. To assist with braking the group thought of the "air-brakes" often used on sports cars. Pictured in **Figure 6** and **Figure 7** the servo is able to flip 90 degrees when the AEV wants to brake. This allows the AEV to keep an aerodynamic profile while moving down the track and then produce high drag when slowing down.

The groups research about the servo led the team to become aware of some issues in mounting it. There is a lack of useable holes on the servo that would otherwise allow it to be mounted with provided screws, so we've come up with a fix by using brackets and tape to attach it to the AEV. The groups main use for the servo is assisted braking using ailerons as an air brake system. The group decided against using the servo as a contact brake because it has a lot of potential for safety hazards.

Forwards Looking Plan:

To prepare for the next lab, an oral presentation needs to be prepared in order to convince the rest of the company to fund the development of the division's specialized part, as well as presenting the data collected in the Power Braking vs. Coasting lab. A group meeting is to be held outside of lab, to both update the website and prepare the presentation.

In upcoming labs, the team will need to move the AEV to between the first set of sensors, and wait there for seven seconds. To prepare for this, the team will need to ensure that the AEV and the code are ready to test. The AEV will need to have the battery holder repositioned, as the current system has the battery’s wires directly next to the propellers, which could easily catch. The AEV power braking code will need to be fixed, as the current code overshoots and rolls back. Although this is normally minor enough to be ignored, it may hit the stop sign if left untouched. To fix this, a more advanced power braking strategy will be needed, which does not roll the AEV backward. Matthew will need to write the code for this function ahead of time, to ensure there is enough time in class to test it.

Appendix:

Figure 1 - Power vs. Time for Coasting Test

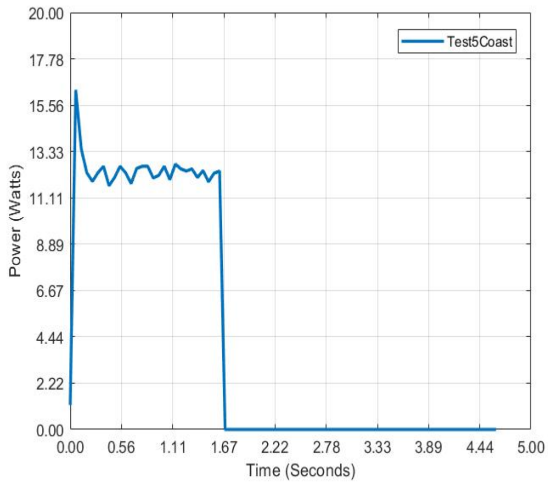

Figure 2 - Power vs. Distance for Coasting Test

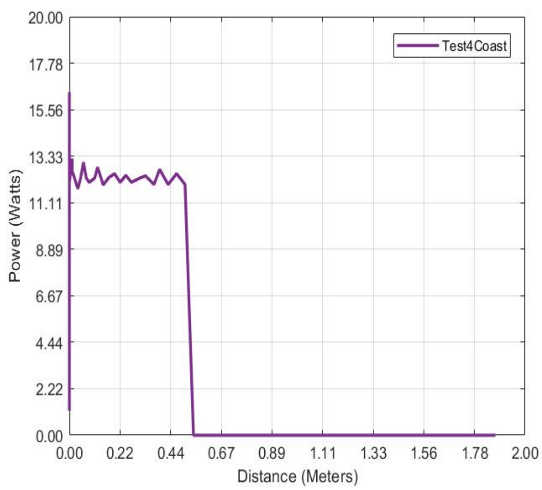

Figure 3 - Power vs. Time for Power Braking Test

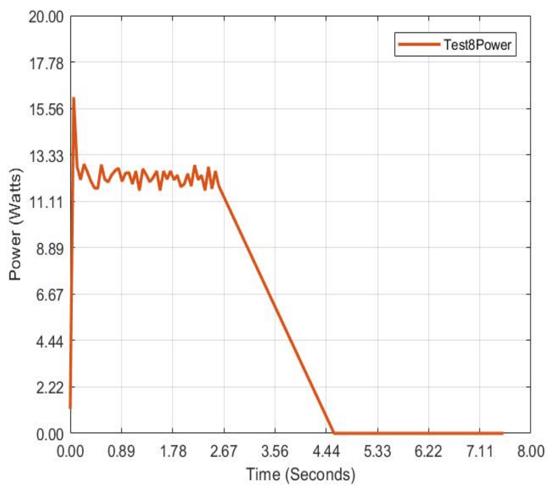

Figure 4 - Power vs. Distance for Power Braking Test

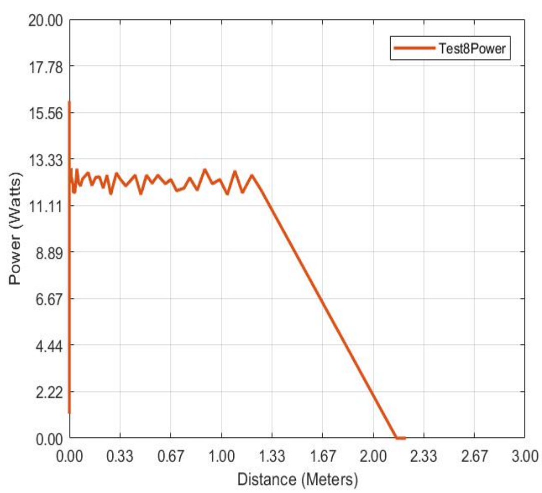

Figure 5 - Stopping Distances

	Power distance (in)	Coasting distance (in)
Test 1	79	88
Test 2	79	91
Test 3	79	91
Test 4	79	91
Test 5	79	86
Test 6	79	89
Test 7	80	92
Test 8	79	88

Figure 6

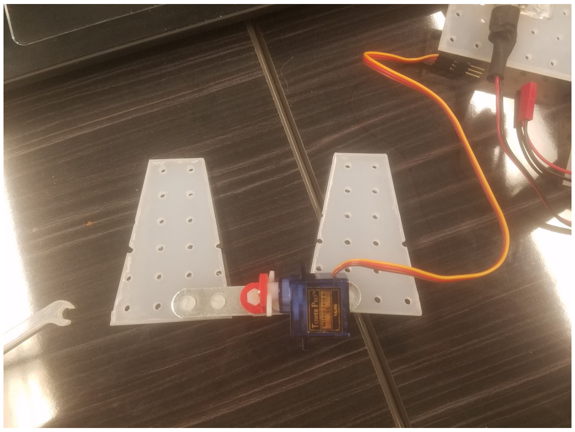

Figure 7

Code 1 - Coasting Tests

```
// Sets motor speed to 40 for 1.6 seconds to test coasting
motorSpeed(4, 40);
goFor(1.6);
brake(4);
```

Code 2 - Power Braking Tests

```
// This code runs the motor until it reaches 6.5ft (78in) then power brakes the AEV
motorSpeed(4, 40);
goToAbsolutePosition(156); // 6.5ft (78in)
reverse(4);
motorSpeed(4, 40);
brakeAEV(); // I defined this function (see below)
brake(4);
```

```
// This function waits until the AEV is travelling in a different direction, at which point we know
// it has turned around. This has the effect of stopping, as the AEV will be travelling very slowly
// the moment it turns around.
void brakeAEV() {
  int currentDir = dir; // dir is a global variable which holds the direction
  int delayFor = 70;
  while (currentDir==dir){
    delay(delayFor);
  }
}
```

Team Meeting Notes:

Lab Week 6:

February 13, 2018
Time: 9:35 AM – 10:55 AM
Location: Hitchcock 224
Members present:

Nick Folino, Joe Jerig, Jacob Manion, Matthew Zirbel

Activities:

1. Grant Vote Presentation
2. Committee Meeting
3. Continued research of Coasting vs. Power Braking Topic

Goals for Next Meeting:

- Finish research on Coasting vs. Power Braking
- Finish research on Servo Function

Lab Week 7:

February 20, 2018
Time: 9:35 AM – 10:55 AM
Location: Hitchcock 224
Members present:

Nick Folino, Joe Jerig, Jacob Manion, Matthew Zirbel

Activities:

1. Testing new code for braking
2. Preparing for lab 08 aR&D Presentation
3. Constructing new AEV design
4. Completed Servo Function Research

5. Completed Coasting vs. Power Braking Research

Goals for Next Meeting:

- Website Update 3
- Meet to complete Oral Presentation

February 25, 2018
Time: 4:00 PM -8:00 PM
Location: Smith-Steeb Conference Room

Members Present:

Nick Folino, Joe Jerig, Jacob Manion, Matthew Zirbel

Activities:

1. Worked on Application for 3D model of our AEV design
2. Created Powerpoint slides for Oral R&D Presentation
3. Practiced the presentation
4. Worked on Website Update and Progress Report

Goals for Next Meeting:

- Finish Progress Report
- Continued discussion about research in using the servo and ailerons

Lab Week 8:

February 27, 2018
Time: 9:35 AM – 10:55 AM
Location: Hitchcock 224

Members Present:

Nick Folino, Joe Jerig, Jacob Manion, Matthew Zirbel

Activities:

1. R&D Oral Presentation

Goals for Next Meeting:

- Testing on Main Track
- Complete Progress Report