Week 5:

Situation:

Last week, Team H did a test run of the AEV and downloaded the data that was acquired from the AEV's test run. Team H had the code ready ahead of time for the test run, so they focused on getting the data from the test run. Then they used excel to place the data and make the tables and observe the data. Then, they began setting up the equations and sample calculations for the data. Learning how to complete the data and download it will help Team H in making coding decisions that involve conserving the energy and tracking how far the AEV travelled and for how long it ran. Team H felt that last was productive and successful, therefore they do not have any recommendations.

Results and Analysis:

Team H acquired data for the test run using two different methods: system analysis using the eeprom data from the Arduino, and then using the design analysis tool on MATLAB. Looking at the data Team H acquired from the test run, there were three speeds tested. The motors were tested at 25%, 20%, and 30%. All graphs and tables can be found in appendix D. Comparing the three, 30% was the least effective of the three. The most effective of the three tested speeds was the 20%. When the data was compiled, it was noticed that the AEV ran at 20% over a period of 11.14 seconds and it only consumed 49.176 joules. This averaged out to about 4.414 joules per second. The AEV ran at 30% for 5.04 seconds and used about 7.692 joules per second. Team H concluded that running the AEV at 20% is more efficient than 25% and 30%. They will continue to test different speeds to find the most energy efficient speed for their AEV.

Phase	Arduino Code	Time (s)	Total Energy (J)
1	motorspeed(4,25) goFor(2)	2.00	11.31374177
2	motorspeed(4,20)gotoAbsoluteposition(332)	11.14	49.17611859
3	reverse(4) motorspeed(4,30) goFor(5)	5.04	38.76805687
4	brake(4)	3.00	0

Table 1

Using the design analysis tool, graphs of energy vs. time, and energy vs. distance were obtained. These two graphs looked identical to each other, and both mirrored the graph obtained by using the eeprom data. This graph can be found under *graph 3* in appendix D.

Takeaways:

-Among tested motor powers, 20% motor speed seems to be the most efficient

- Run motor in reverse for less time to stop the AEV, and prevent it from travelling so far backwards

-Start AEV once on the track to shave off additional seconds of running motor and not moving

Week 6

Situation

During Week 6, the primary focus of the group will be directed towards developing a concept screening/scoring matrix, which is a quick way to down-select ideas. Completing this task is crucial because this type of decision making process will play a key role later in the Semester when considering the Preliminary Design Report and the Performance Tests. This process will be repetitive throughout the rest of the AEV project. THe group plans on comparing and contrasting designs from Lab 4 to begin the above process. Team H will consider design methods such as aerodynamics, external design, product champion, intuition, multi-voting, etc.

To conclude Week 6, Team H will write a program to perform the sample AEV operation on the straight track. After the completion of this task, the team will make sure the code works statically using the desktop. The team will end the ab period by discussing criteria to test in future screening matrix tests.

Weekly Goals

1. AVE- become familiar with process of design decision making
2. AVE- Develop the program to run of straight track
3. AVE- begin considering criteria to test comparisons between individual designs
4. General- Team Thursday evening in Thompson library as routine

Weekly Schedule

Task	Team Members	Start	Due	Approx. Time
Lab 5	All	2/15/17	2/15/17	1 hour
Progress Report 6 Meeting(split up tasks for progress report 6)	All	2/19/17	2/19/17	2-3 hour
Progress Report 6	All	2/19/17	2/22/17	5-6 hour

Appendix:

Appendix A: Arduino Code

<u>Inside Track</u>

```
motorspeed(4,25);              //Set all motors to 25% power
goFor(2);                      //Runs last command (all motors 25% power) for 2
                               sec

motorspeed(4,20);              //Set all motors to 20% power
goToAbsolutePosition(332);  // Continue previous command (all motors at
20%)
                               until the vehicle reaches 332 marks (13.5 ft) relative to the
                               absolute starting position
reverse(4);                    //Reverse polarity of all motors
motorspeed(4,30);              //Run all motors at 30%
goFor(1);                      //Run last command (all motors 30% power) for 1 sec
brake(4);                      //Stop all motors
```

Appendix B: Team Meeting Notes

Date: 2/12/2017
Time: 5:00-7:00PM/18th Avenue Library
Members Present: Josh Anson, Jesse Noble, Bret Ricklic (Nate was absent because of an illness)
Topics Discussed: Progress Report 5

Objective:
Begin working on progress report 5
Compile data from lab 4
Split up roles for this report and going forward
To Do/Action Items:
Begin progress report 5
Complete calculations to convert eeprom data to physical parameters
Begin individual sample calcs
Decisions:
Report was split evenly among members
Beginning work was done
Reflections:
Group study rooms in libraries continue to work very well for us

Also, Sundays generally work better than Thursdays

Productive meeting despite the missing member

Appendix C: Sample Calculations:

Josh:

(Time=2.7 seconds)

Time:

$$time = t_e/1000$$
$$= \frac{2700}{1000}$$
$$= 2.7\ seconds$$

Distance:

$$Distance = 0.0124 * marks(cumulative)$$
$$= 0.0124 * 5$$
$$= 0.062\ meters$$

Position:

$$Position = 0.0124 * marks(position)$$
$$= 0.0124 * 5$$
$$0.062 meters$$

Current:

$$current = \left(\frac{I_e}{1024}\right) * V_e * \left(\frac{1\ Amp}{0.185\ Volts}\right)$$
$$= \left(\frac{44}{1024}\right) * 550 * \left(\frac{1}{0.185}\right)$$
$$= 0.57137\ A$$

Voltage:

$$V = \frac{15 * V_e}{1024}$$
$$= \frac{15 * 550}{1024}$$
$$= 8.05664\ V$$

Supplied Power:

$$SP = V * I$$

$$= 8.05664 * 0.57137$$

$$= 4.60331\ Watts$$

Incremental Energy:

$$IE = \frac{P_j + P_{j+1}}{2} * \left(t_{j-1} - t_j\right)$$

$$= \frac{4.60331 + 4.19243}{2} * (2.76 - 2.7)$$

$$= 0.26387\ J$$

Jesse:

Time: $t = \frac{t_e}{1000}$

Where: $t = time\ (seconds)$

$t_e = EEPROM\ time\ (Milliseconds)$

$t = \frac{2760}{1000}$

$t = 2.76\ seconds$

Distance: $d = 0.0124 * Marks$

Where: $d = distance(meters)$

$marks = wheel\ counts$

$d = 0.0124 * 5$

$d = 0.062\ meters$

Position: $s = 0.0124 * pos$

Where: $s = AEV\ position$

$pos = Wheel\ Counts$

$s = 0.0124 * 5$

$s = 0.062\ Meters$

The distance and position of the AEV are calculated when the reflectance sensors record marks.

Current: $I = \left(\frac{I_e}{1024}\right) * V_R * \left(\frac{1amp}{0.185volts}\right)$

Where: $I = current(amps)$

$I_E = EEPROM\ current(adc\ count\ )$

$V_R = 2.46\ volt$

$I = \left(\frac{40}{1024}\right) * 2.46 * \left(\frac{1amp}{0.185volts}\right)$

$I = 0.519\ amps$

Voltage: $V = \frac{15 * V_e}{1024}$

Where: $V = voltage$

$V_e = EEPROM\ voltage\ (adc\ count)$

$V = \frac{15*551}{1024}$

$V = 8.071\ marks$

Supplied Power: $P = V * I$

Where: $P = input\ power$

$V = voltage$

$I = current$

$P = 0.519 * 8.071$

$P = 4.189\ watts$

Incremental Energy: $E_j = \frac{P_j + P_{(j+1)}}{2} * \left(t_{j-1} - t_j\right)$

$E_j = \frac{4.189+4.708}{2} * (2.82 - 2.76)$

$E_j = 0.267$

Bret:

1) Time: $t = tE1000$

where: t = time (seconds)

tE = time (milliseconds)

$t = 172201000$

t = 17.22 seconds

2) Distance: $d = 0.0124 * marks$

where: d = distance (meters)

marks = wheel counts accumulated by reflectance sensors

$d = 0.0124 * 426\ counts$

d = 5.29 total meters traveled

3) Position: $s = 0.0124 * pos$

where: s = AVE position (meters from starting point)

pos = wheel counts recorded by reflectance sensors

$s = 0.0124 * 336$

$s = 4.17\ meters\ from\ starting\ point$

4) Current: $I = (IE1024) * VR * (1\ amp 0.185\ Volts)$

where: I = current (amps)

IE = EEPROM current (ADC counts)

VR = 2.46 Volts = AVE reference voltage

$I = (751024) * 2.46 * (1\ amp 0.185\ Volts)$

$I = 0.974\ amps$

5) Voltage: $V=15*VE1024$

where: V = voltage (volts)

$VE=EEPROM\ voltage\ (ADC\ counts)$

$V=15*5421024$

$V=7.94\ volts$

6) Supplied Power: $P=V*I$

where: P = Input power (watts)

V = Voltage (volts)

I = Current (amps)

$P=7.94*0.974$

$P=7.73\ watts$

7) Incremental Energy: $Ej=Pj+Pj+12*(tj+1-tj)$

$Ej=7.73+7.672*(17.60-17.22)$

$Ej=2.93$

Nate:

Time:

$$t = \frac{t_E}{1000}$$

$$t = \frac{180}{1000} = .18\ s$$

Current:

$$I = \frac{I_E}{1024} * V_R * \frac{1\ Amp}{0.185\ Volts}$$

$$I = \frac{53}{1024} * 2.46 * \frac{1\ Amp}{0.185\ Volts} = 0.688\ Amps$$

Voltage:

$$V = \frac{15 * V_E}{1024}$$

$$V = \frac{15 * 549}{1024} = 8.04\ counts$$

Distance:

$$d = 0.0124 * marks$$

$$d = 0.0124 * 0 = 0\ m$$

Position:

$$s = 0.0124 * pos$$

$$s = 0.0124 * 0 = 0\ m$$

Power:

$$P = V * I$$

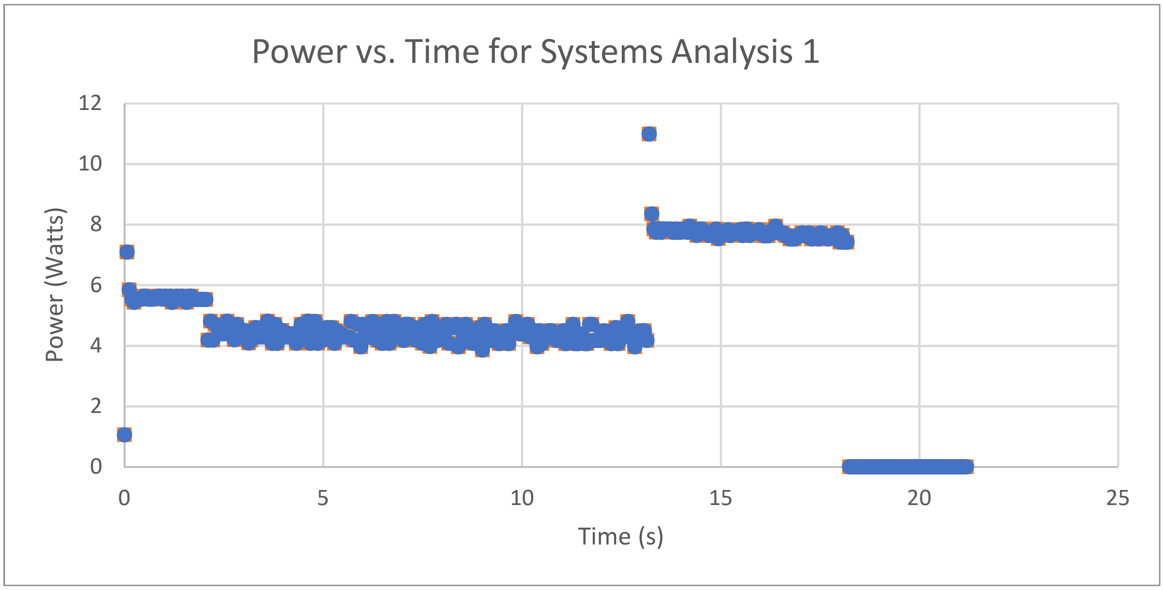
$$P = 8.04 * 0.688 = 5.53\ Watts$$

Incremental Energy:

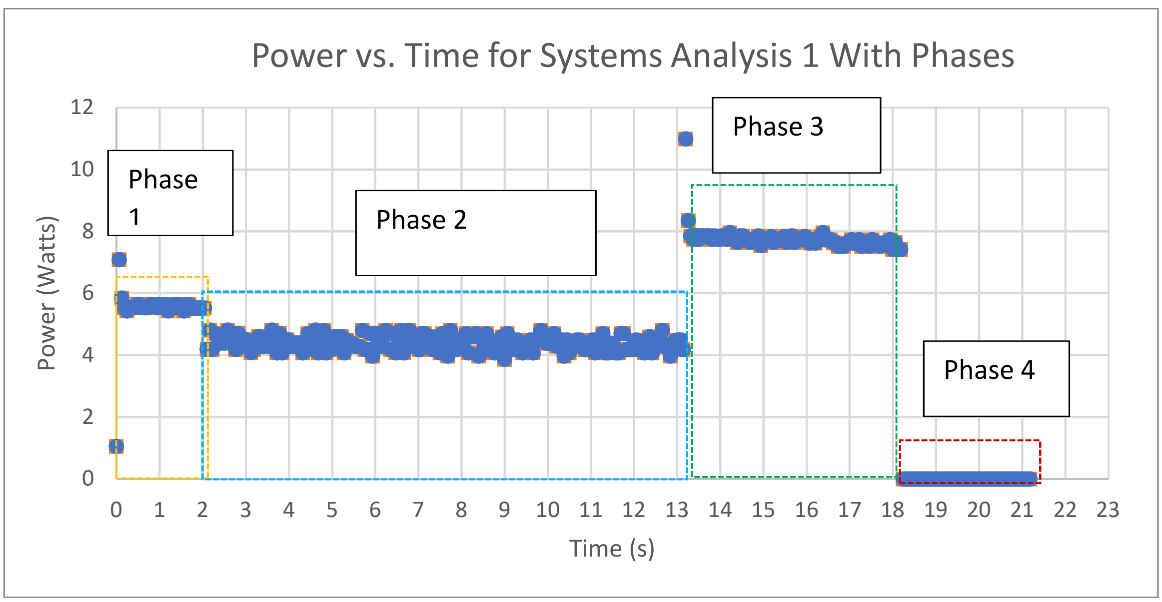
$$E_j = \frac{P_j + P_{j+1}}{2} * (t_{j+1} - t_j)$$

$$E_j = \frac{5.53 + 5.43}{2} * (.24 - .18) = .328\ J$$

Appendix D: Graphs and Figures



Graph 1



Graph 2

Phase	Arduino Code	Time (s)	Total Energy (J)
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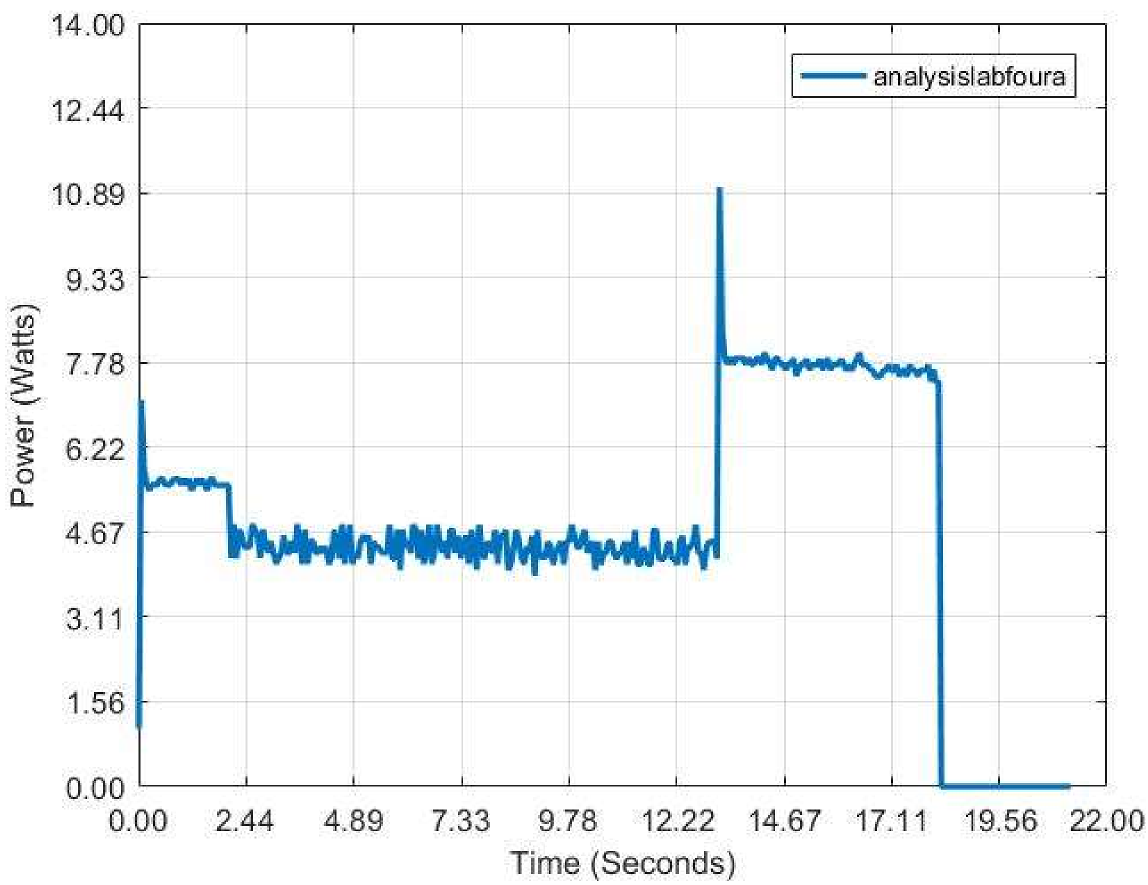
Table 1



Graph 3