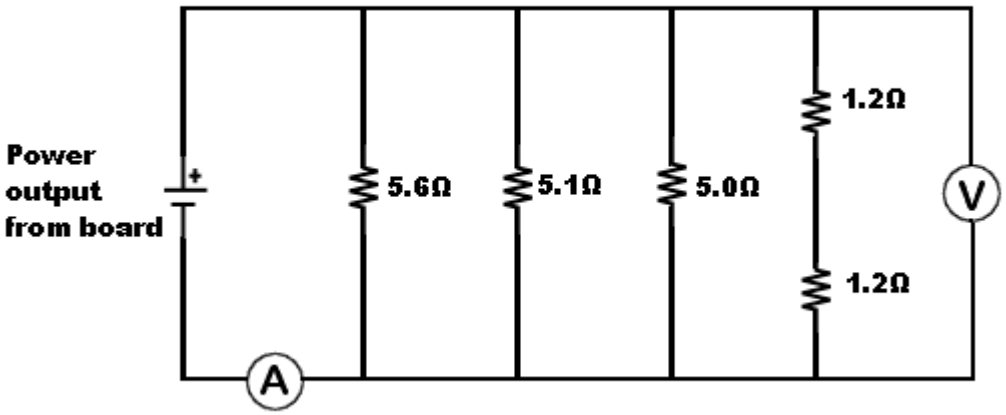
Setup:

Using several resistors provided by Jason Cortell, we created a circuit with equivalent resistance of ~0.7 ohms, and included a volt meter and amp meter to measure output voltage and current (fig. 1). This was done in order to simulate the resistance of one of the motors used in the Cornell Ranger, and so that large currents could be applied while forcing the failure point to be the overheating of the controlling H-bridge (model VNH2SP30).



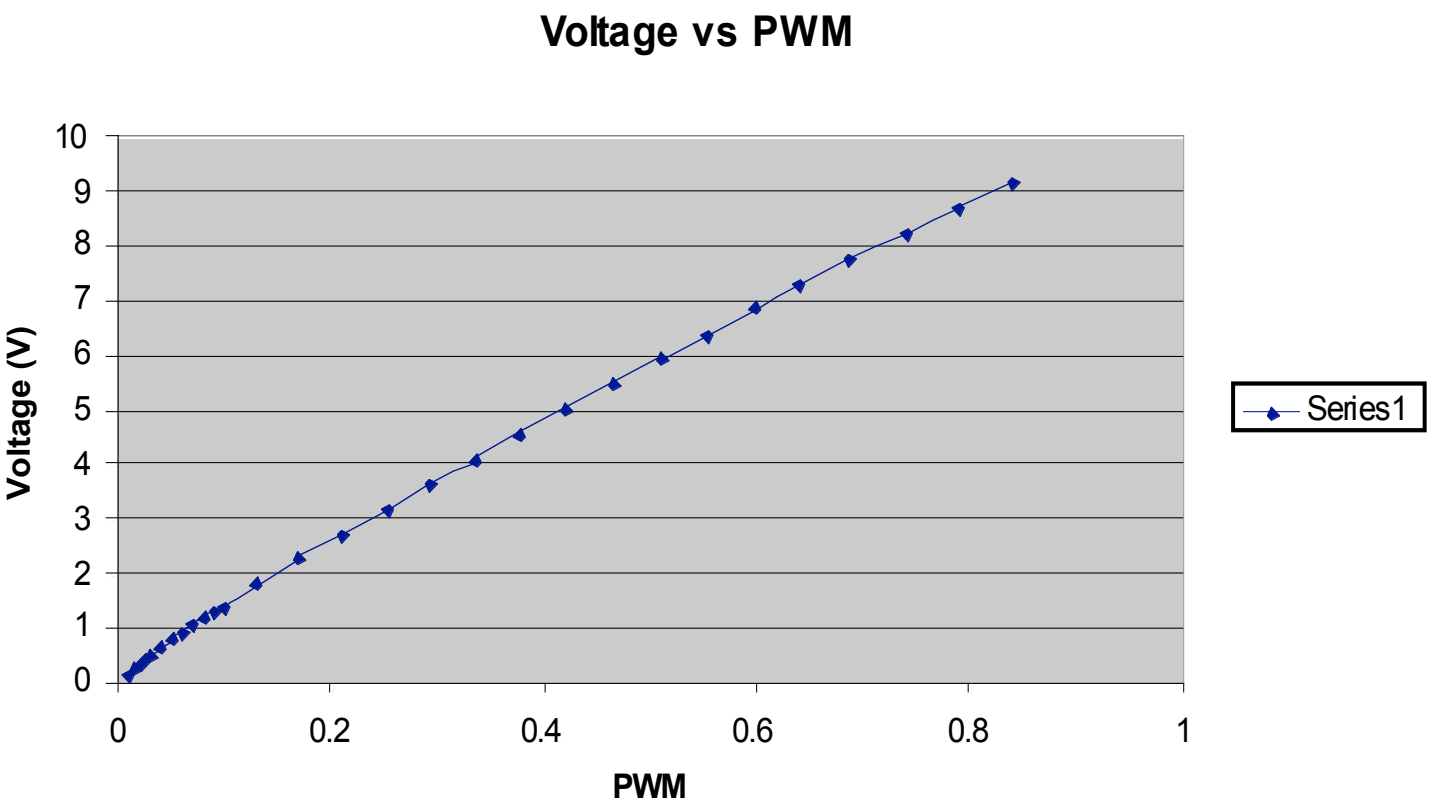
Procedure:

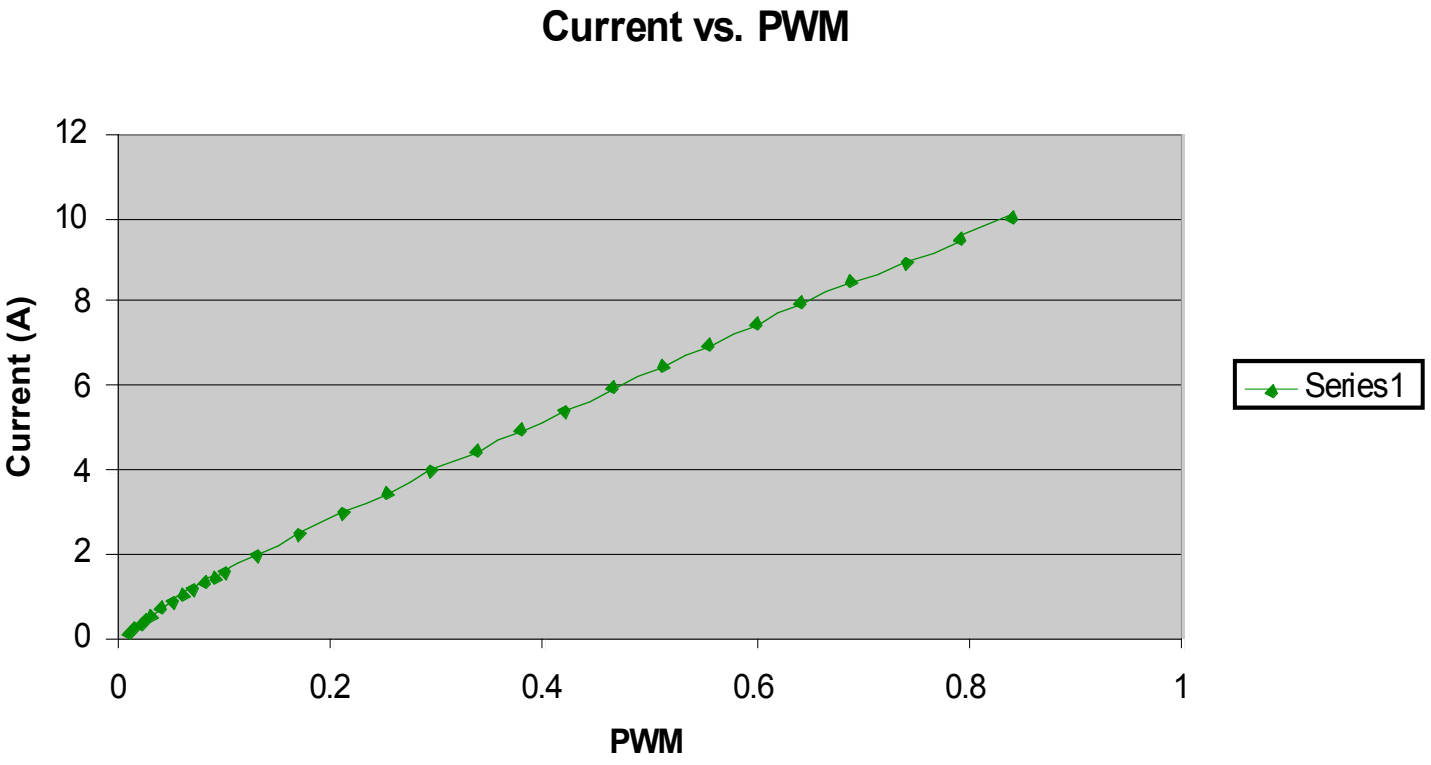
The Cornell Ranger daughter-board was connected to a computer running National Instruments LabVIEW 7.1. This computer sent a controlled the PWM signal to the H-bridge at 20 kHz. We started with a PWM setting of 1% and worked our way up to 5% by 0.5% increments and then to 10% in 1% increments to determine a relationship between PWM settings and output power. From then on we increased the PWM setting to achieve an output current, at intervals of 0.5 amps, pausing at each current for ~60 seconds to allow the temperature in the board to stabilize. Although we did not have a surface thermometer, we noticed the chip temperature increased with time, from barely warm at 1 amp to very hot at 10 amps. We continued to increase the current until we reached 10 amps of output current, and after 30 seconds the H-bridge shut down due to overheating

DATA:

PWM	Voltage	Current
0.01	0.17	0.17
0.015	0.26	0.28
0.02	0.34	0.37
0.025	0.42	0.46
0.03	0.5	0.56
0.04	0.67	0.74
0.05	0.82	0.9
0.06	0.95	1.05
0.07	1.08	1.19
0.08	1.22	1.34
0.09	1.34	1.48
0.1	1.41	1.61
0.13	1.82	2.01
0.169	2.28	2.51
0.21	2.73	3.01
0.252	3.18	3.5
0.292	3.65	4.01
0.335	4.1	4.5
0.377	4.56	5
0.419	5.01	5.46
0.464	5.48	6.01
0.51	5.94	6.51
0.553	6.39	7
0.598	6.88	7.51
0.639	7.32	8
0.686	7.79	8.5
0.739	8.25	9

Graphs:


Voltage vs PWM
Voltage (V)
10
9
8
7
6
5
4
3
2
1
0
0
0.2
0.4
0.6
0.8
1
PWM
Series1


Current vs. PWM
Current (A)
12
10
8
6
4
2
0
0
0.2
0.4
0.6
0.8
1
PWM
Series1

Conclusion:

Although this test allowed us to explore the maximum limitations of the H-bridges without risk of damage to the motors that will be used in the Cornell Ranger, further testing is necessary. Aside from resistance, the motors also have a certain inductance which affects the performance of the H-bridge. Future tests should model motor inductance or use the spare motor to further understand the behavior of the H-bridges under expected operating conditions.