ELE 302 Project #1 – Speed Control

**Due Friday, March 3, before 5pm**

**Overview:**

The main goal of this project is to allow your vehicle to autonomously control its speed at a rate of **4 feet per second**. Along with cars, you will receive a transmitter/receiver pair (for "testing" the car). However, you will also have hardware for building circuits such that you can control it autonomously, through speed sensors and PWM motor control. (You may NOT use the electronic speed control module that comes with the car kits as your demo). This project has one checkpoint that should be completed and demonstrated to Radd, to one of the GS TAs or to one of the two professors.

For the initial part of the project, you must demonstrate reliable operation of a sensor to measure the speed of your car. Trying to control speed with unreliable sensors is very painful. You don't want to do it!

When you attach the processor board, be sure to keep in mind how you will eventually run your power wires. For this checkpoint, you can still power your board with the bench power supplies. However, it is good to think ahead, such that you don't make a lot of unnecessary work for yourself. It may be advisable to put in an easily accessible switch so that you can turn your motor off at will.

Some of the wheels come pre-mounted with several magnets. Some are new, and you will have to mount the magnets. These magnets are intended to work in combination with a Hall Effect sensor (*careful: the direction of the magnetic field w.r.t. the Hall sensor matters!*). Keep in mind, these may differ from group to group and may not be positioned ideally. If you would like to modify the magnets in any manner (changing position, number of magnets, etc), or even using a different sensor altogether, please speak to Radd for further details. Even with pre-mounted magnets, you will need to wire up and position the sensor such that you can accurately detect the magnets. With the Hall Effect sensor, you will end up having to measure "ticks" of some kind as the wheel rotates, and then convert the "tick-rate" or "tick-period" to a speed.

The main portion of this project is to successfully demonstrate a vehicle that can properly control its speed on the “Official 302 Mountain Rally” course and on the flat course in the lab. This section must be demoed to either a professor, instructional staff member, or one of the graduate teaching assistants. Both team members must be present for the demonstration.

You must design and build the circuitry to drive the motor on your car with your processor. (Pulse-width modulation using a power MOSFET is strongly recommended; although not required, you may later want the capability of driving in reverse). Then you need to design and implement algorithms to control the speed of your car.

The actual demo consists of 3 individual tests that must all be completed using the same program, with no adjustments in between; flat ground, uphill and downhill. For all 3 tests, students must have the vehicle travel at a rate of 4 ft/sec. The first test will consist of traveling **40 feet** across a flat area. This will be set up in the undergraduate lab. The uphill and downhill portions are **40 feet** long and will be tested on the ramp leading to the lower level of the Energy Wing (G-wing) of the E-Quad -- near the loading dock. The ramp rises about 2 feet. The course looks approximately like:



The actual timed section starts and ends a few feet before and a few feet after the sloping part of the ramp, at the Start and Finish lines shown in the figure. There is at least 4 more feet on each end so that your car can accelerate, and there's room to catch it before it hits a wall. The times from start to finish (both uphill and downhill) will be measured. Do not rely on the distances shown above as being exact. You can only count on starting and finishing on a flat area, with a few feet to accelerate.

For successful completion of the demo, you must achieve 2% accuracy on flat ground (**9.8 to 10.2 seconds** elapsed time) and 10% accuracy on uphill and downhill (**9.0 to 11.0 seconds** elapsed time) to receive full credit for the demonstration. Remember, all 3 tests must be completed without any modifications to the vehicle or the code.

Afterwards, you will be required to submit a write-up which discusses the final hardware and software design, a commented program listing, etc. within one week of the demo deadline. Be sure to include any potential bugs and/or plans to modify your designs so we can assist you.

**Some final things to remember**

• Both members of a group must be present for the demo.

• The car cannot be modified between the three tests

• It must be demoed to a professor, instructional staff, or graduate teaching assistant

• Write-up is due within one week of the demo deadline.