MIT Edgerton Center Summer Engineering Workshop
Program Description prepared by Shane Colton

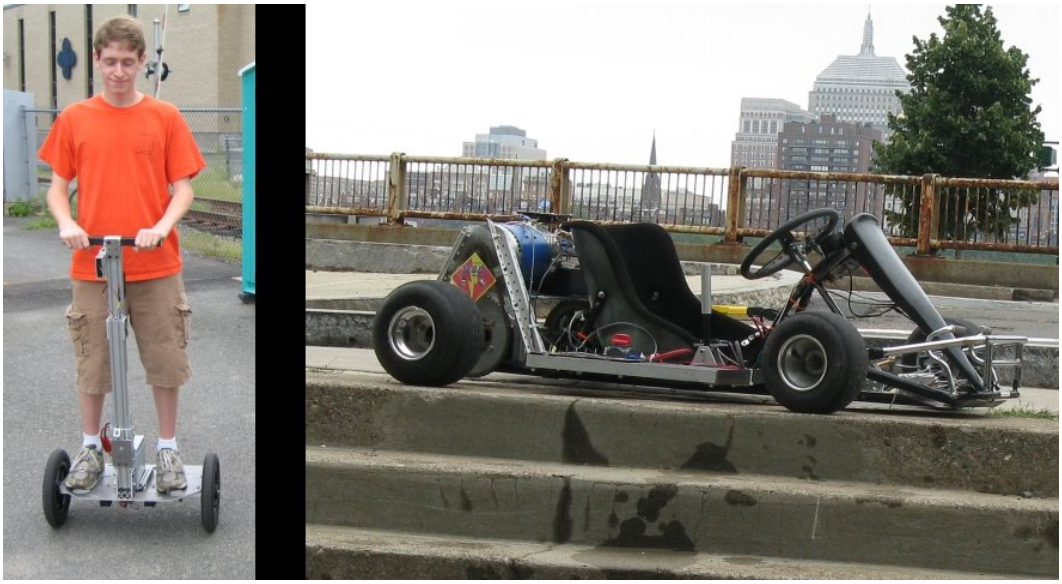
The 2008 Crew.

About Me
I'm the guy in the lower left. I am a second-year Master's student in Mechanical Engineering at MIT. I did my undergraduate work here as well. I started out in robotics/controls and slowly discovered a passion for optimizing simpler, single-output systems such as motors and vehicles. My experience with EE is more experiential, although I have taken a course in power systems now.

About the Edgerton Center
The Edgerton Center at MIT carries the name of the late Harold "Doc" Edgerton, an Institute Professor famous for his work in strobe photography. His famous works include the milk drop and bullet-through-apple photographs. The Center was established in his memory to promote hands-on education at MIT and, through outreach, elsewhere.

An interesting and relevant fact is that Edgerton first started using strobes to study synchronous motors after noticing interesting visual affects that occurred when the motor was lit only with flashes of light from a mercury arc rectifier controlling it.

About the Summer Engineering Workshop
The workshop is a program I started after working with a group of high school students through FIRST, an international robotics competition. They wanted to continue working on projects after the FIRST season ended, so we set up a summer project workshop. They are a fairly advanced group of students who have already been exposed to concepts of engineering and design, if not to all the physical theory that goes with it. The group that's been in this program since 2007 has a strong affinity for "things you can ride," which has led us to take on two vehicular projects so far:



The “DIY Segway” and the “Cap Kart.”

The first, in 2007, was a functional home-made version of the Segway self-balancing scooter. It weighs about 50 lbs, with the battery, and is powered by two 12V/400W DC motors. The controller was custom, programmed by one of the students to do simple PD feedback for balancing. The web site for it, which was featured on several technology blogs, has nearly 100,000 hits since it was created.

The second, in 2008, was a converted electric go-kart. We did a number of interesting and unique things with it. The most interesting is the use of a 110F/16V ultracapacitor, effectively in series with the motor, to provide battery- and switching-free regenerative braking and boost. The motor is a 7kW separately-excited brushed DC motor. One of the students built a “manual transmission” system for it that varies the field voltage in steps based on a stick shifter, rather than continuously, purely for fun. We wrote up the project as a technical paper and presented in Monaco (of all places) at the EVER 2009 conference this spring.

This year’s project is an electric Razor-style scooter. We are on a bit of a tighter budget. (The kart was funded by a $6,000 research grant from MIT; the balancing scooter cost less than $800 to make.) We were inspired by a design from another MIT student who built a scooter hub motor. The motor is an “LRK,” which is a 12-slot/14-pole BLDC outrunner design. Strangely enough, one of the presenters at EVER 2009 talked about exactly this type of motor and its cogging torque-canceling capabilities. The idea is to make the scooter as compact as possible, since we are all tired of carrying around a 350-lb go-kart. The in-wheel motors will go a long way toward this.