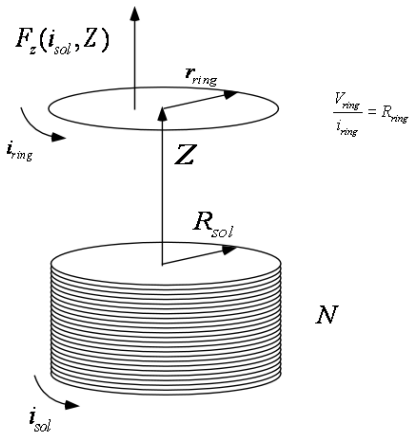
Richard Metzler
E90: Topic Selection Memo
Advisor: Erik Cheever

The Gloglobe

The goal of this project is to simultaneously levitate and power an autonomous device in a controlled manner. The system of particular interest—a conductive ring, driven by a solenoid—could be used to power machinery mounted on the ring without the means of an onboard power supply. An alternating current $i(t)$ is driven through the solenoid. This current will produce a force F_z on the ring that is proportional to the current and to the height Z of the ring itself. The induced power is supplied by the stored momentum in the magnetic field generated by the solenoid which also induces a current into the suspended ring. Once rectified, this current will be harvested to power an onboard LED. The light output will be monitored using a photodetector to determine the ring's height and velocity. This data can be into a feedback loop system with the current supplied to the solenoid such that the position of the ring can be controlled based on the input voltage across the solenoid. Difficulties arise due to nonlinearities in the inherent in the system's behavior. The equation of motion can be approximated by



$$\ddot{z} = \frac{D}{m}\frac{i(t)\cdot i'(t)}{Z} - g \cdot$$

Where D is a lump constant and m is the mass of the ring. This equation can be linearized about an equilibrium point and the appropriate state estimator implemented. Another consideration is the fact that the ring rests in an unstable equilibrium with respect to its horizontal degrees of freedom. This might require a counterweight or a multi-solenoid solution but also allows for the possibility of designing a multi-dimensional control system.

Applications for such a system range from powering and controlling small sensor devices to explore tight spaces such as vertical pipes or ducts where defects must be mapped, to uses as discreet surveillance systems. Expansion of the idea to a three-dimensional control system could be advantageous to applications requiring minimal friction as in bearings or transport systems.