

## Team Project #1 - Fabricating a Parabolic Mirror by John A. Pelesko

The Hubble Space Telescope, launched in 1990, has allowed us to see further in space and time than any previous scientific instrument. A key component of the telescope is its *parabolic mirror*. Some of you may recall that shortly after launch, it was discovered that the Hubble mirror was defective. The mirror deviated from a parabolic shape on its edges by approximately 1/50th of a human hair. This tiny deviation made it impossible for the Hubble to accurately focus on distant objects and greatly reduced the utility of the telescope. Fortunately, the telescope was designed to be accessible to shuttle astronauts and a successful repair mission was carried out to correct this flaw.

The Hubble mirror is large, approximately 95 inches across. As you might imagine fabrication of such large mirrors within tight tolerances provides a significant engineering challenge. One method of fabricating parabolic mirrors is the so-called *rotation* or *spin-casting* method. In this process, a cylindrical vat of liquid is rotated about its axis. This causes the free surface of the liquid to deflect. While rotating, the liquid is cured or hardened, the rotation stopped, and the shaped surface used as the base for the mirror.

In class, we will demonstrate this process using a small cylinder and water.

### Questions to consider:

1. What shape does the free surface of the liquid take?
2. What factors control the shape of this free surface?
3. What other applications require parabolic mirrors?



Figure 1: A photo of Saturn taken by the Hubble Space Telescope.