1 Setting up the problem

We have three angles, x, y and z. These can be represented as three components of a vector:

$$r = \langle x, y, z \rangle$$

The magnitude of this vector should be *approximately* equal to the acceleration due to gravity, 9.8m/s^2. I can compute the magnitude of the vector as follows:

$$|r| = \sqrt{x^2 + y^2 + z^2}$$

In case the magnitude of the vector is different than the acceleration due to gravity, we should use this value instead. Also, we should report if this value is outside of some sort of tolerance. Perhaps we'll be a bit liberal on this and use a value of about 10%.

In order to find the angle of the panel, we'll want to reparameterize this in spherical coordinates.

$$\rho = \sqrt{x^2 + y^2 + z^2}$$
$$\theta = \arctan\left(\frac{y}{x}\right)$$
$$\phi = \arctan\frac{\sqrt{x^2 + y^2}}{z}$$

These two angles will correspond to the direction the tracker is pointing.

2 Using the sun data

We can setup and calibrate the tracker using the highest position in the sky of the sun, which will be at 1:00 PM on the day of the competition. This means the tracker will have a permanently fixed axis at a downard angle of 17.01 degrees, and will be pointed toward 197.9 degrees on a compass heading. We will calibrate, if necessary, an offset for θ that corresponds to $\theta = 0$ in this position. Then, the only variable we have to worry about is ϕ! We can set the tracker to detect θ as a quality control, and use the magnetometer as another check.