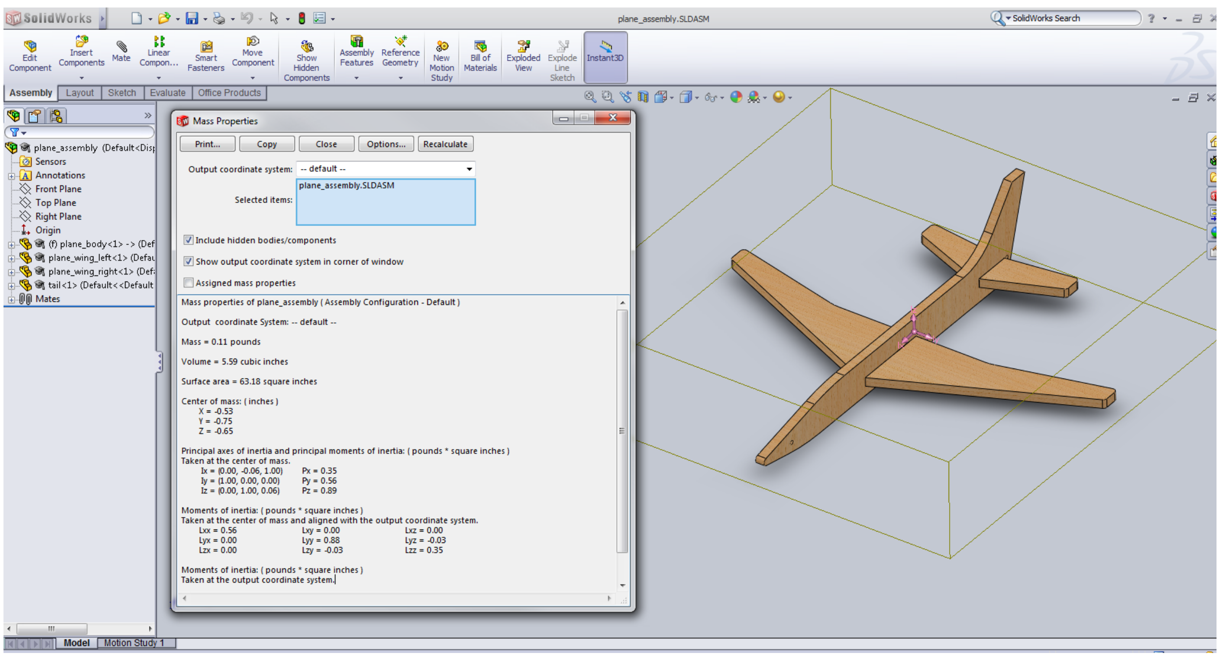
LAB 3: BIFILAR PENDULUM SUPPLEMENT
Applications to Aircraft

Having an accurate inertial matrix of an aircraft is imperative for an accurate control system because the inertial matrix is often hard coded into the software of an aircraft. But how do we find the values for this matrix?

To find the moments of inertia, we can use our knowledge of geometry to calculate it. For instance, we can do this for a simple rectangle. For more complicated geometries, the triple integral that must be solved does not simplify to clean equations. If we build a model in SolidWorks and assign density, we can have CAD software numerically compute this integral:



Here is what Solidworks gives us when we go to Tools >> Mass Properties:

Mass = 0.11 pounds

Center of mass: (inches)

X = -0.53

Y = -0.75

Z = -0.65

Moments of inertia: (pounds * square inches)

Taken at the center of mass and aligned with the output coordinate system.

Lxx = 0.56	Lxy = 0.00	Lxz = 0.00
Lyx = 0.00	Lyy = 0.88	Lyz = -0.03
Lzx = 0.00	Lzy = -0.03	Lzz = 0.35

Perform the bifilar pendulum test to compare real-world I_{yy} with Solidworks's analysis.

$$I_{yy} = \frac{m\,g\,D^2}{16\,\pi^2\,h}\,\tau_{period}{}^2$$

In reality, we are swinging this plane about 1 cm forward of its center of mass. Find the I_{yy} about its center of mass using the parallel axis theorem:

$$I_{yy}^{B/joint} = I_{yy}^{B/B_{cm}} + m\,d^2$$

I_{yy} =

Is this close to the Solidworks example? What might be causing these differences?