A boomerang is a rigid body that undergoes rotation and translation in a coupled manner, leading to circular motion that can be controlled by appropriate design. The goal of this project is to design a symmetric boomerang that, when thrown appropriately, flies around a pole located at a distance D=7m from the thrower and returns to the thrower.
The design of the boomerang involves several pieces of the dynamics of rigid bodies and some aerodynamics. You will proceed through the design in steps, as follows:

1. Given a law for the aerodynamic lift force of an airfoil, determine the forces and moments acting on a symmetric “cross” boomerang that is spinning at rate $\omega$ and translating at speed $v_G$, as shown in the figure.

2. Using Euler’s equations for rigid body motion, determine the relationship between the velocity and the processional circular motion of the boomerang.

3. Relate the radius of the orbit to the motion and the design parameters of the boomerang (size, airfoil shape, density of material, etc.) and the throwing conditions (initial velocity, initial rotation rate).

4. Use an airfoil lift simulator to design the airfoil shape needed to obtain the desired radius of orbit (D/2 above). Consider various likely choices of material from which the airfoil will be constructed.

5. Perform preliminary design calculations to understand tradeoffs in various parameters on performance.

6. Build a boomerang according to the selected design.

7. Test boomerang performance and empirically address issues not dealt with in the design (e.g. gravity, air resistance).