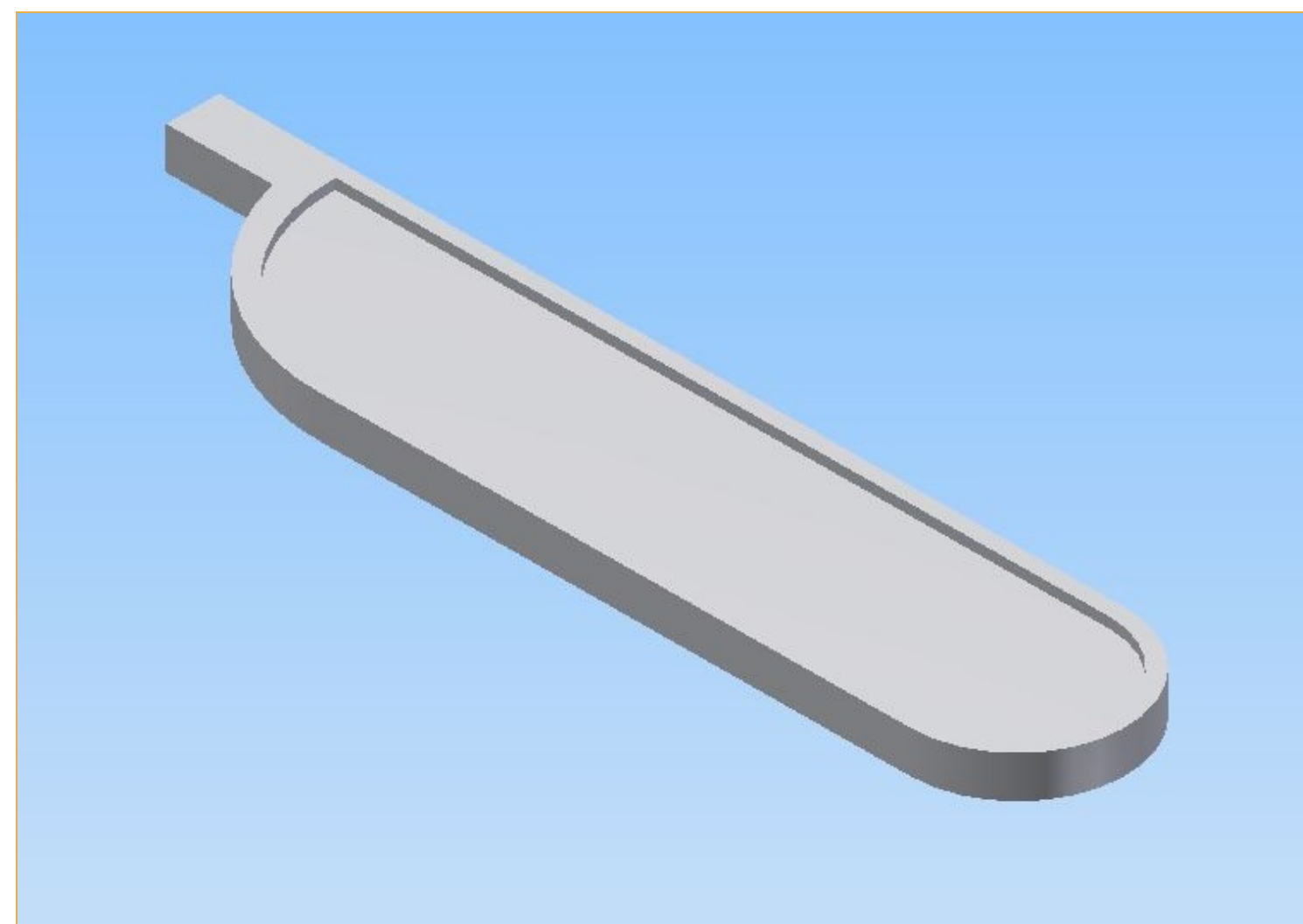


Deformable Micro Air Vehicle Wings

By Sharan Patel
Advisor: Dr. Mayuresh Patil

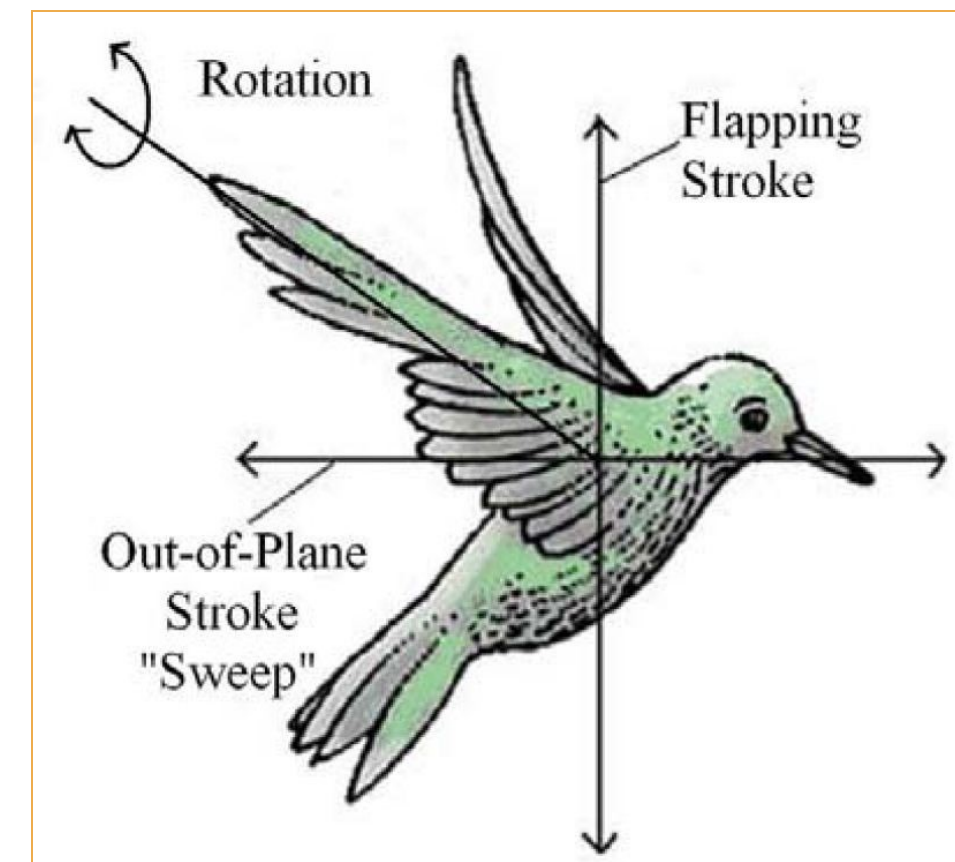
Motivation

MAVs have a wide range of applications that make them useful. They can be implemented in a battlefield where a soldier needs to see behind a wall to check for traps or enemies. They can be used by search and rescue parties who need to see under the rubble or inside a burning building for any trapped people.



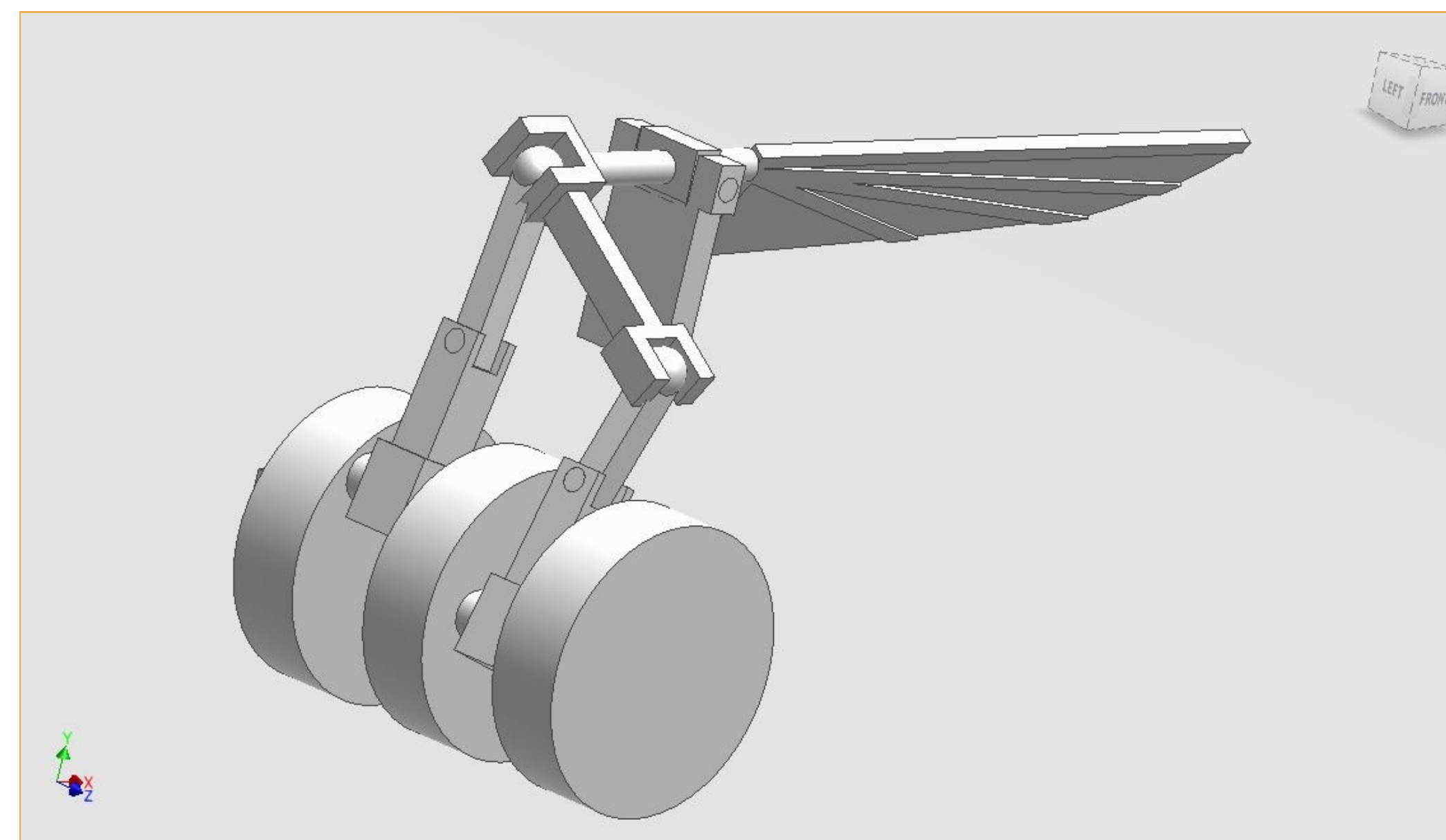
Morphing Wings

Animals can actively morph or their wings undergo passive deformations to adjust to wind streamlines during flight. MAVs operate at low Reynolds number, and thus any drag or wind has a huge impact on the performance. By adjusting to the wind streamlines, MAVs can save energy and glide through the air longer. The proposed wings are designed to imitate this physical phenomenon, which significantly increase a MAV's performance.



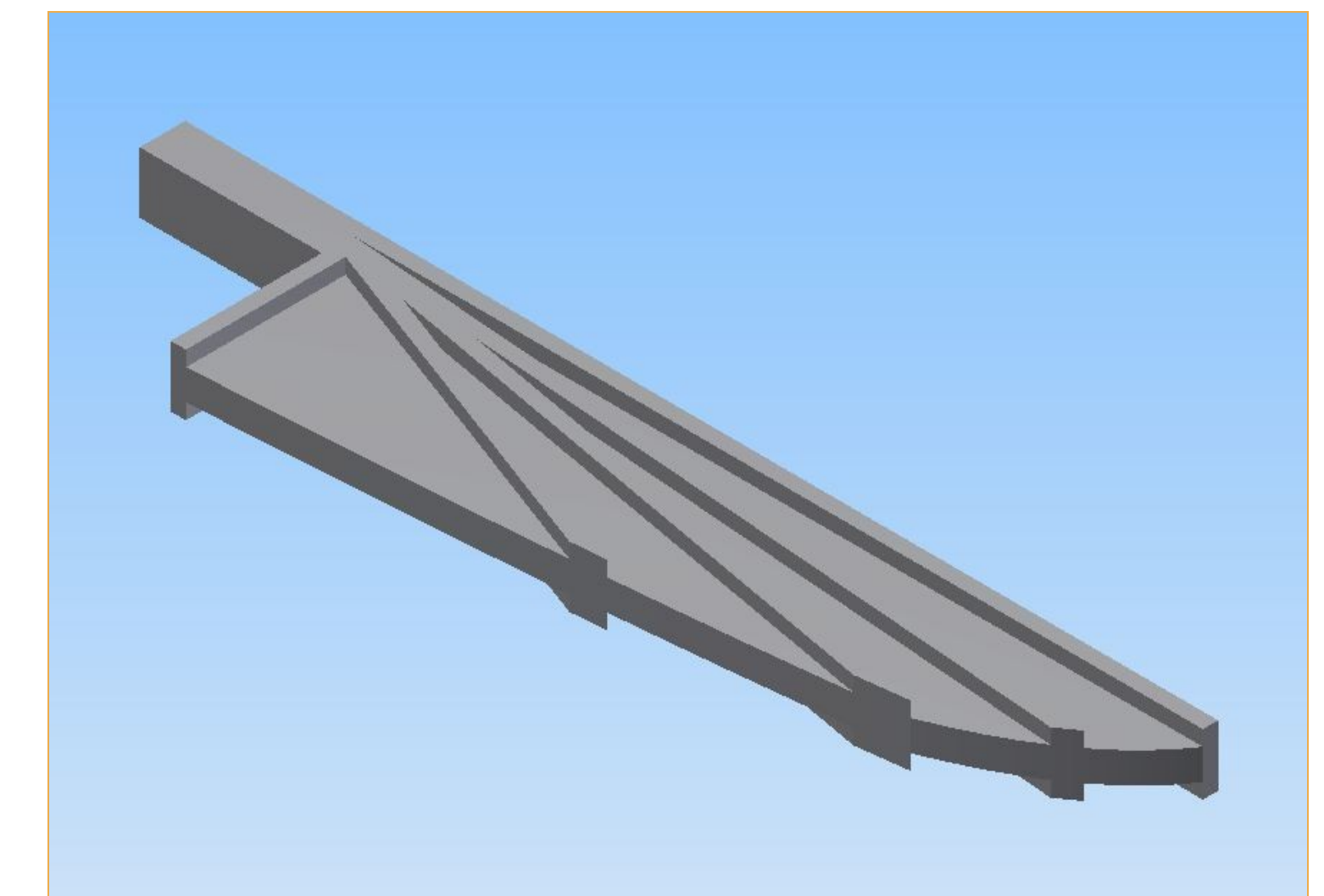
Lifting Abilities

Since the MAVs are designed for surveillance, they are required to hover in place. Hovering in place is a physical phenomenon that is rarely found in nature. Hummingbirds are well known for their hovering abilities. They create a ∞ -shape motion to hover in place. The proposed mechanism below creates a flapping motion with two of the three degrees of freedom required to imitate the hovering motion. Using a six-axis force sensor, a model can be generated to correlate the membrane and stiffener thickness to the lifting force generated by the flapping motion. Some insects and birds flap their wings at their natural frequency. The resulting mode shape morphs their wings to increase flight performance. A model can also be created to relate all these values to better design a MAV wing.



Influences From Nature

Insects and birds have been flying for several millennia even in terrible wind conditions. They use wings with stiffeners and a thin membrane connecting the membranes. The membranes allow the creatures to actively change the shape of their wings while being stiff enough to still generate lift.



Fly and Bat Wings

Bats have the ability to contract and expand their wing surface area and they are significantly thinner than those of other birds, giving them far more maneuverability during flight and gives them the ability to glide through wind currents. Flies have the ability to quickly lift off and do complex flight maneuvers because of their thin wings that are held together by a surrounding thicker frame.