# Design and aerodynamic analysis of a flapping-wing micro aerial vehicle

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## Abstract

This paper presents the design and aerodynamic performance of a planar membrane wing as shape airfoil
for the micro aerial vehicle. This simulation calculates the average lift force, L as the criteria weight of
the flapping wing (weight must be lower than 8.78 g), to make one ultra-light, small size flapping wing
MAV. In here two phases are discussed. First, the 3D aerodynamic calculation and flow field simulation
of a planar membrane wing as shape airfoil for a MAV were studied. Analyzing the flapping wing under
different frequencies and angles of attack, investigates the pressure distribution, the airfoil-tip vortex and
the up-wash situation of the air flow. Second is to average lift force, L 8.78 g for designing weight limit
of the MAV. The specifications of flapping wing MAV are 8 g gross weight, the 15 cm wingspan, and
5 cm chord length. In this vehicle, we employed the concept of four-bar linkage to design a flapping
mechanism which simulates the flapping motion of a bird. The angles of upstroke and downstroke can
be varied in the design. The total flapping angle is 73. The flapping frequency of wing is 25.58 Hz.
The power source comes from motor with a Li-H battery. A simple flight test was carried out and the
result of the flight is going well. The actual flight distance is approximately 8 m, and the primary goal is
achieved. By the way, we found the rigidity of tail wing is crucial and should be enhanced to prevent the

flapping-wing MAV will be unable to revise if the MAV in a crooked condition and it will cause a crash.

Keyword：Planar membrane wing , Flapping wing, MAV