Design and Fabrication of a Flapping-Wing Robot Based on Slider-Crank Mechanism

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Tailless Flapping-Wing Micro Air Vehicles (FW-MAVs) have gained more attention recently because they utilize energy more efficiently compared to fixed-wing aircraft and rotorcrafts. FW-MAVs could be used commercially to explore confined spaces with insufficient air or serve as surveillance robots. However, due to their use of unsteady aerodynamics and small size, the research and design process is very complicated. In this paper, I propose a flight mechanism for a light-weighted, two-winged, hummingbird-inspired flapping-wing robot. Five versions of the robot were built; each version improved upon the issues of the previous one. Calculations were performed to optimize the stroke amplitude and the transmission ratio of the gears. Four groups of control experiments were conducted to investigate the relationship between different factors (voltage, motor type, wing area, and the number of veins) and the robot's lift, which was monitored by a pressure sensor. I analyzed the results from the experiments and built a final version of the robot based on a slider-crank mechanism. The main structure of the final version is made of three 3mm carbon fiber boards, and the wings are made of 0.025mm PET (polyethylene terephthalate) material, reinforced by three carbon fiber rods: two 0.5mm ones across the membrane and a 1mm one at the leading edge. The robot weighs 16.3g and can produce enough lift to overcome its gravity under 9V with an off-board power source by exhibiting an upward trend during a tethered flight test.

Awards Won:

American Institute of Aeronautics &amp
Astronautics: 2nd Prize of $1,500