# 设计与制造Ⅱ（2025年度）课程项目展

**项目名称：** Bionic Butterfly

**组号：D02**

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**指导老师：** Liang Qing Hua

## Ⅰ、项目介绍

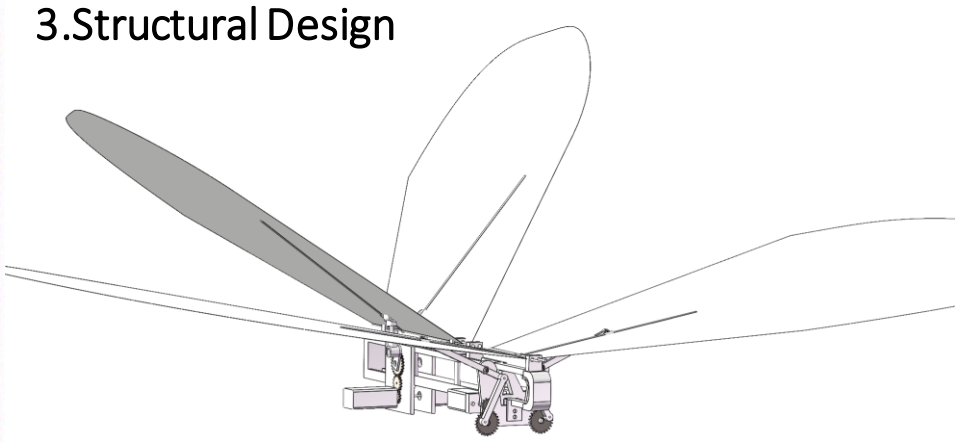
1. Background

With the rise of bio-inspired robotics, butterfly flapping mechanisms offer an ideal model for developing micro flying vehicles. This project designs a lightweight robotic butterfly to demonstrate basic flight, serving as a low-cost platform for research and education.

2. Product Solution & Positioning

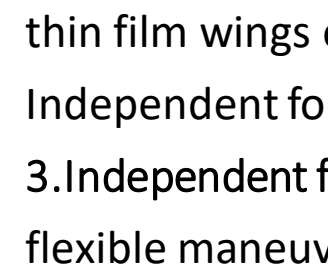
This project develops a lightweight bionic butterfly robot capable of stable indoor flight, designed as a multi-purpose platform for education, research, and exhibition. Compact, modular, and open-source, it bridges classroom learning, laboratory research, and public engagement through bio-inspired technology.

3.Structural Design



| | |
|---|---|
| Front Wing Mechanism | A four-bar quick-return mechanism driven by a motor and gearbox |
| Rear Wing Mechanism | A modified crank-slider mechanism converts rotary motion into flapping motion. |
| Frame Structure | 3D-printed hollow frame |
| Material Selection | Skeleton: Carbon rods<br>Wing membrane: Chlorinated polyethylene film |

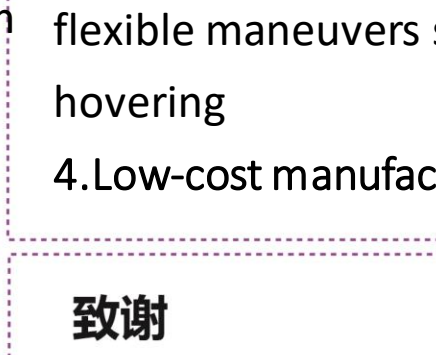
## Ⅱ、样机制作



1.Performance Test Results

Maximum flapping amplitude:73 ° (design target: 70°)

Operating frequency range: 3–7 Hz



2.Control Precision

Front-rear wing synchronization error: <4 ms

Current maximum effective payload: 5 g

## Ⅲ、创新点

1.Hybrid mechanism design:A four-bar linkage for front wings and a crank-slider mechanism for rear wings

2.Lightweight construction:Carbon rods and thin film wings optimize overall weight Independent four-wing control

3.Independent four-wing control:Enables flexible maneuvers such as turning and hovering

4.Low-cost manufacturing

## 致谢

- Thank Liang Qing Hua for the course delivery
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