

INTERNSHIP PROPOSAL: Design of bio-inspired flapping wings micro aerial vehicles

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Background:

Small birds like hummingbirds or flying insects like dragonflies, flies, bumblebees are able to couple hovering ability with the ability for a quick transition to forward flight. Therefore they represent a valuable source of inspiration for the development of new concepts for micro-aerial vehicles like the flapping wings mini-drones (Fig. 1). The development of this emerging concept for drones will be oriented towards the application in horticulture: swarms of flapping wings mini-drones, deployed in a greenhouse for example, can perform monitor and control operations and eventually be used to facilitate the cross-pollination.



Figure 1: Bio-inspired mini-drones; from inspiration to application.

Inholland pioneered the use of propeller based drones inside the greenhouse in the HiPerGreen project [<https://www.inholland.nl/onderzoek/onderzoeksprojecten/hipergreen/>]. The results of this research project are finding their way into practical application via a startup company (ADI).

Propeller based drones have limitations due to their strong downwash, which can be harmful for delicate plants, such as seedlings and flowers. Due to the limited maneuverability, propeller based drones can only be applied to fly high over sturdy crops which are horizontally distributed in the greenhouses. With the flapping wing mini-drones, we want to get close to and interact with individual plants and flowers.

This project aims at characterizing the aerodynamic performance of different types of bio-inspired wings. The achievement of this goal will imply the design and the realization of an experimental set-up and a data acquisition system to measure lift, drag, energy consumption and other relevant data.

Proposed activities:

- 1) Literature survey and familiarization with previous works and theory (**1 month**):
 - a. review the previous work done in the field and prepare a project plan;
 - b. understanding of the aerodynamic mechanisms underlying the flapping wings based flight;
 - c. shape, geometry and size definition of the flapping wings to be investigated;
 - d. investigate the basic components of the test unit and materials (multiple projects exist already).
- 2) Experimental setup design (**3 months**):
 - a. Design the test rig, data acquisition system and perform a CATIA 3D drawing;
 - b. Commissioning, ordering and setup assembling.
 - c. Manufacture a the prototype of a flapping wing geometry
- 3) Experimental measurements and data analysis of a flapping wing prototype (**1 months**):
 - a. Collect data related to lift, drag, energy consumption and other relevant parameters;
 - b. Analysis and data interpretation.
- 4) Write report and present results (**in parallel with the rest of the activities**)

(Some) Student requirements:

- 1) interest in innovative propulsion systems;
- 2) good background in aerodynamics and mechanical design;
- 3) proactive and capable to work independently;
- 4) willing to collaborate with a biologist

Interested students send your CV to Dr. Mauro Gallo (mauro.gallo@inholland.nl) for an interview/discussion