Developing a Model for Flapping Wing Flight Mechanics

Background:

Flapping wing aircraft are the focus of a new generation of research, fuelled simultaneously by the emerging fascination with the mechanisms of the natural world and the need for small, unobtrusive surveillance aircraft. Despite being so common among birds, insects and bats, well-developed models that successfully simulate a flapping micro-aircraft remain a rarity in the aerospace community. Developing a baseline model utilising conventional aerodynamics that can be validated using experimental data would pave the way for the implementation of more complex aerodynamic phenomena. For example, the bumblebee advantageously utilises the dynamic stall phenomena – something that helicopters avoid at all costs due to its unpredictability – to increase its lift production every wingbeat cycle. Your model could lay the framework upon which this increased complexity could be built.

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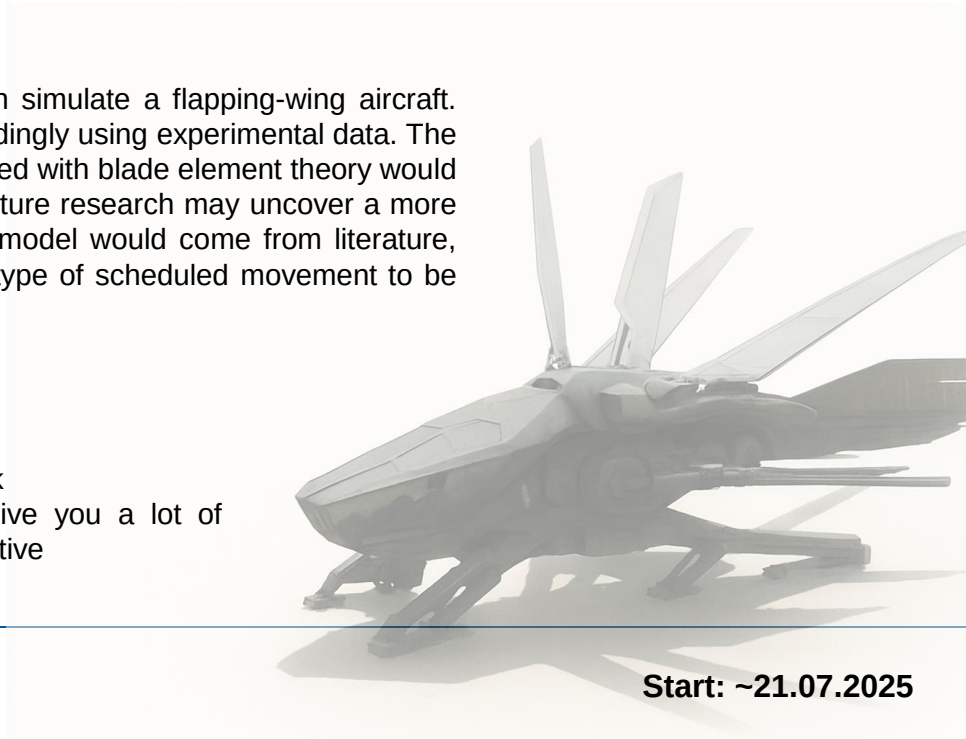
Project Goal:

Ultimately the product of the project would be a model that can simulate a flapping-wing aircraft. Time-dependently, this may then be validated and tweaked accordingly using experimental data. The frame of this product is largely open ended – while Simulink coupled with blade element theory would be the obvious choice for which simulation software to use, literature research may uncover a more suitable candidate. The experimental data used to validate the model would come from literature, hence the availability of publicly available data may dictate the type of scheduled movement to be simulated.

Prerequisites:

- Understanding of lift generation in periodic systems
- Ideally experience with Simulink or similar modelling framework
- Confidence with open-endedness: this project is likely to give you a lot of freedom to experiment, so you'd need to be decisive and proactive
- English Language fluency



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Structure:

- Literature Research
  - Determining which software is commonly used for flapping-wing modelling
  - Determine which experimental data set can be used for validation
  - Milestone 1: establishing which is most appropriate for our use case

- Familiarisation with software
  - Ideally you have some experience with similar modelling software, but some preliminary work will likely be required
  - Milestone 2: Submission of Exposé outlining plan

- Developing Aerodynamic Model
  - Utilising conventional aerodynamic formulae to set up an initial model
  - Milestone 3: Have a functional model capable of simulating vertical take-off and landing

- Validating model values against experimental data
  - Depending on time available, parameter tweaking and optimisation approaches may be employed
  - Milestone 4: Simulation results match experimental data within a TBC tolerance