

Flapping Wing Air Vehicles at KAIST

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ABSTRACT

The flapping wing flight has superior maneuverability and aerodynamic advantages in a low Reynolds number regime. Nature's flyers generate aerodynamic forces and moments from the various wing motions such as flapping and pitching to fly and sustain its stability. Bio-inspired design of flapping air vehicle is one of the effective ways to exploit such a complex system. The flapping flight has been investigated mostly using computational fluid dynamics and wind tunnel testing but not fully understood yet. In this talk, we propose a bio-inspired flapping air vehicle design framework considering fluid-structure interaction of flexible flapping-wing.

I. INTEGRATED SIMULATION

To successfully predict the flight characteristics of flapping air vehicles, the following three items need to be considered: 1) The structural wing deformation (finite element model of the flexible wing) and the kinematic motion of the ornithopter wing (flexible multi-body dynamics), 2) The flapping-wing aerodynamics, and 3) The fluid-structure interaction approach.

In this study, we proposed the time-efficient integrative simulation framework for the longitudinal flight of model ornithopter considering fluid-structure interaction (See Fig. 1).

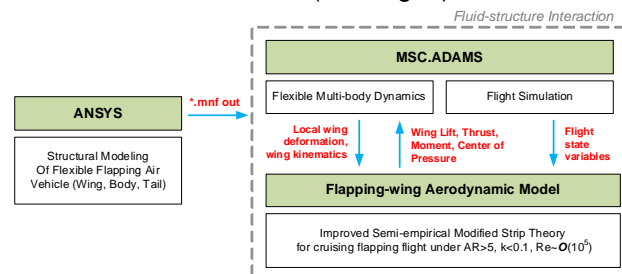


Fig. 1 Simulation flowchart of proposed efficient flapping-wing flight simulation framework

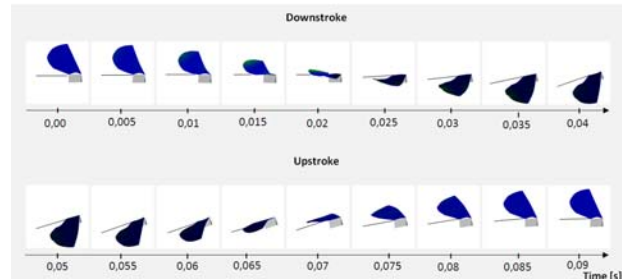


Fig. 2 Typical flight characteristics of a flapping vehicle

Using the developed simulation framework, we can successfully analyze the flight characteristics of flapping vehicles (See Fig. 2). Especially, the effects of wing flexibility on the overall flight performances can be investigated. We observed the limit-cycle-oscillation during the trimmed longitudinal flight of the model ornithopter.

II. FLAPPING AIR VEHICLES

In addition to the analytical works, a series of model flappers, developed at SSS lab. of KAIST, will be introduced in this talk (See Fig. 3). The development process as well as flight and wind tunnel test results will be presented.



Fig. 3 Flapping air vehicles at KAIST

REFERENCES

1. Research area at <http://sss.kaist.ac.kr>