

Longitudinal actuated abdomen control for energy efficient flight of insects

ABSTRACT

The actuated abdomens of insects such as dragonflies have long been suggested to play a role in optimisation and control of flight. We have examined the effect of this type of actuation in the simplified case of a small fixed wing aircraft to determine whether energetic advantages exist in normal flight when compared to the cost of actuation using aerodynamic control surfaces. We explore the benefits the abdomen/tail might provide to balance level flight against trim changes. We also consider the transient advantage of using alternative longitudinal control effectors in a pull up flight maneuver. Results show that the articulated abdomen significantly reduces energy consumption and increase performance in isolated manoeuvres. The results also indicate a design feature that could be incorporated into small unmanned aircraft under particular circumstances. We aim to highlight behaviours that would increase flight efficiency to inform designers of micro aerial vehicles and to aid the analysis of insect flight behaviour and energetics.

Keyword: Aircraft; Inertial; Dragonfly; Insect; Biological inspiration