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Optimisation of a Dragonfly-Inspired Flapping Wing-Actuation System

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Abstract : An optimisation method using both global and local optimisation is implemented to determine the flapping profile which will produce the most lift for an experimental wing-actuation system. The optimisation method is tested using a numerical quasi-steady analysis. Results of an optimised flapping profile show a 20% increase in lift generated as compared to flapping profiles obtained by high speed cinematography of a Sympetrum frequens dragonfly. Initial optimisation procedures showed 3166 objective function evaluations. The global optimisation parameters - initial sample size and stage one sample size, were altered to reduce the number of function evaluations. Altering the stage one sample size had no significant effect. It was found that reducing the initial sample size to 400 would allow a reduction in computational effort to approximately 1500 function evaluations without compromising the global solvers ability to locate potential minima. To further reduce the optimisation effort required, we increase the local solver's convergence tolerance criterion. An increase in the tolerance from 0.02N to 0.05N decreased the number of function evaluations by another 20%. However, this potentially reduces the maximum obtainable lift by up to 0.025N.

Keywords : flapping wing, optimisation, quasi-steady model, dragonfly
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