

INVESTIGATION OF EFFICIENCY OF FLAPPING WING CREATING THRUST

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The investigation of flapping wing (FW) aerodynamic is today the one of popular problems (it can be concluded on the basis of number of articles in leading world scholarly journals). However the part of these publications concerning the flapping wing efficiency and its comparison with the other ways of the thrust creation remains small.

The aim of this work is to make the simplified model of FW aerodynamics and to develop the program complex for the investigation of flapping wing and equivalent propeller efficiency dependence on the parameters of motion. The results are assumed to be useful for facilitation of flapping wing characteristics choice at the first stages of aircraft design.

Considered is the task of the thrust creation by means of “flipper” type flapping wing, which perform plunging motion with the constant vertical speed and pitching motion so that the circulation over the wing varied according to sine law. The circulation along the wing span is assumed to be constant. The lift is considered to be created by the separate fixed wing. Also a set of assumptions was made for the simplicity of analysis.

The efficiency of the flapping wing η was found and the influence of such parameters as reduced frequency k , Strouhal number (St), power coefficient β (the full power divided by the dynamic pressure and swept area of the wing), wing aspect ratio λ , Reynolds number (Re) on the efficiency was investigated.

Efficiencies comparison of the wing and the propeller was made for the equivalence criterion of the same swept area.

For the model verification and the determination of its adaptability margins the comparison was carried out with the I.E.Garrick linear theory, experiments of J.M. Anderson et al. and the numerical results of J.Young. The analysis of the results clarify the necessity of some model updates (for example, the assumption modification of circulation constancy along the wing), however as a whole the model might be considered to give the results having satisfactory precision in the context of the goals marked.

References

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