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Kinematic Optimization of Energy Extraction Performances for Flapping Airfoil by Using Radial Basis Function Method and Genetic Algorithm

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Abstract : In this paper, numerical simulations have been carried out to study the performances of a flapping wing used as an energy collector. Metamodeling and genetic algorithms are used to detect the optimal configuration, improving power coefficient and/or efficiency. Radial basis functions and genetic algorithms have been applied to solve this problem. Three optimization factors are controlled, namely dimensionless heave amplitude h_0, pitch amplitude θ_0 and flapping frequency f. ANSYS FLUENT software has been used to solve the principal equations at a Reynolds number of 1100, while the heave and pitch motion of a NACA0015 airfoil has been realized using a developed function (UDF). The results reveal an average power coefficient and efficiency of 0.78 and 0.338 with an inexpensive low-fidelity model and a total relative error of 4.1% versus the simulation. The performances of the simulated optimum RBF-NSGA-II have been improved by 1.2% compared with the validated model.

Keywords : numerical simulation, flapping wing, energy extraction, power coefficient, efficiency, RBF, NSGA-II
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