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Parameter identification for the mass-spring model of Calliphora wings using optimization with genetic algorithm and applications in flapping insect flight HUNG TRUONG, Institut de Mathématiques de Marseille (I2M), Aix-Marseille Université, CNRS and Centrale Marseille, France, THOMAS ENGELS, Institute of Biosciences, Animal Physiology, Rostock University, Germany, DMITRY KOLOMENSKIY, Tokyo Institute of Technology, Tokyo, Japan, KAI SCHNEIDER, Institut de Mathématiques de Marseille (I2M), Aix-Marseille Université, CNRS and Centrale Marseille, France — The secret to the spectacular flight capabilities of insects is hidden in their wings which can undergo significant deformation during flight. In the current work, we present detailed numerical simulations of fluid-structure interaction (FSI) modeling a tethered flapping fly with such deformable wings in both laminar and turbulent flows. The wing dynamics is taken into account by using a mass-spring model. The method is chosen because of its simplicity and computational efficiency. However, setting the optimal stiffness parameters for the mass-spring system plays a crucial role in obtaining a realistic wing model. To overcome this challenge, we propose an approach based on the covariance matrix adaptation genetic strategy (CMA-ES). These parameters are optimized using CMA-ES by comparing the static deformations of the wing model with the referenced deformations measured from experiments. The flexible wing model with the optimized parameters will be then coupled with the fly body for FSI simulation. The code, designed for running on massively parallel supercomputers, allows us to have some insights about the impact of wing flexibility on the aerodynamic performance of winged insects.

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