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A Deep Neural Network (DNN) Model for Predicting the Propulsive Performances of 3D Printed Tandem Flapping Wings with Stroke Time-Asymmetry[1] GUANGJIAN WANG, ZHEN WEI TEO, BING FENG NG, Nanyang Technological University — The applications of tandem flapping wings on the design of micro aerial vehicles are inspired by birds and flying insects, which normally operate their wings in time-asymmetric strokes. Previous numerical and experimental studies have demonstrated that such stroke time-asymmetry could augment the aerodynamic forces. However, the computational overheads are prohibitively high, while experiments are restricted by lab settings. Consequently, only a few cases were investigated, leaving the stroke time-asymmetry not well understood. To efficiently calculate the wing thrust forces with different asymmetry ratios (ε), a deep neural network (DNN) model was trained using validated numerical data. Specifically, the simulation results with various ε were verified by experiments and collected as the training data. To improve the practicality, the inputs were limited to the wing kinematics and phase angles, while the outputs were the temporal distributions of the aerodynamic forces and the flow velocities. Subsequently, the wing performances with different ε can be evaluated by the DNN model. Variations of thrust coefficients and propulsive efficiencies against ε were used to optimize the wing performances.

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