Three-dimensional elastic deformation and aerodynamic performance in insect-inspired flapping wings

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Abstract

The present work studies the aerodynamics of a flapping insect-inspired flexible wing. A network of veins confers the anisotropic rigidity of the wing in nature, which we represent with a two-vein pattern that mimics the elastic response of the insect wing in a simplified manner. In the experiments, the 3D deformation of the wings is captured by three high-speed cameras while the forces are being recorded by a force balance simultaneously. The analysis of the forces reveals a maximum peak in the propulsive force of the wings when the pair of veins form between 15 and 20 degrees, similar to what is found in nature. The aerodynamic forces produced by different beatting frequencies and separation angles between the pair of veins is further investigated at the same time as the deformation of the wing during the flapping cycle.

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