Computational Biomechanics and Biomimetics of Flying and Swimming

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ABSTRACT

The advantages of flying and swimming over other forms of locomotion lead to the prosperity and diversity of insects, birds, and fishes all over the globe [1]. For example, these biological flyers and swimmers can perform extremely robust agility and maneuverability in various complex environments using flapping wings and fins as well as tails [2]. Their flying and swimming capabilities have been increasingly refined through a long period of natural selection [3], presenting an exciting venture in biomimetics. Therefore, it is expected that through emulating nature's time-tested forms, functions, and strategies in flying and swimming animals, we can uncover their sophisticated underlying principles and mechanisms, and further explore sustainable solutions as engineering alternatives to nature's solutions to solve the practical problems in industry [4].

Biomechanics and biomimetics are a rapidly growing research area of interdisciplinary and high integration, and computational approaches are considered an essential and powerful tool to tackle the multidisciplinary problems. This mini-symposium aims to focus on computational models, numerical algorithms and methods, and computer software and framework in biomechanics and biomimetics of biological flying and swimming, and their applications. The topics of interest include, but not limited to:

- Computational fluid dynamics with geometrical and kinematical complexities of a body, wings, and fins
- Numerical algorithms and methods for coupled multiphysics such as wing-air and fin-water interactions
- Modeling for wings, fins, and joints, which consist of complex and multiscale structures, such as reduced order modeling and multiscale modelling
- Complementary methodologies such as scaling laws
- Computer software and framework for coupled multiphysics and large-scale analyses
- Passivity of flexible structures
- Control and maneuverability in flying and swimming
- Simulation-based biomimetic design for flying and swimming biorobots

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