Editorial

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This special issue on Animal Locomotion: The Physics of Flying follows a previous special issue of Experiments in Fluids on Animal Locomotion: The Hydrodynamics of Swimming (Volume 43, No. 5, November 2007). As pointed out in the Editorial at that time, the principles of fish and bird locomotion hold a special place in the field of biomimetics, because they are intriguingly different from the engineering principles applied in ships and airplanes. For many reasons, an experimental approach is often the most appropriate methodology to assess forces and energy expended at realistic Reynolds numbers. This holds as much for flying animals as it does for swimming animals, and similar experimental challenges apply—studying tethered as opposed to free flight, or studying the flow around robotic models as opposed to real animals.

From a biological perspective, the emphasis in experimental research of flying animals has shifted in recent years from an exploratory quest to identify “novel” mechanisms of unsteady lift production—clap and fling, leading-edge vortices, rotational mechanisms, wake capture—to more detailed examinations of the underlying flow physics. This shift has been enabled in large part by the widespread availability of Particle Image Velocimetry,

which has allowed new questions to be asked, for example, about the detailed wake structures of birds and bats, or of the importance of tandem wing interactions and aeroelastic deformation in insects. The volume therefore begins with a review article on PIV-Based Investigations of Animal Flight (Spedding and Hedenstrom). Other more classical techniques, such as smoke visualization and direct force or pressure measurements retain an important role in cases where PIV is impractical or uninformative, and all feature in this volume accordingly.

Many fundamental questions remain, and many more will doubtless arise, as an ever wider range of species and systems is studied. Here, in a single volume are measurements from multiple species of birds, bats and insects, offering a glimpse of the future possibilities opened by a comparative experimental approach, which asks not only how the aerodynamic principles operate, but also how they vary systematically with scale, form and function.

In preparing this special issue a special thanks goes out to all the authors and referees who made a great effort to deliver their manuscripts, reviews and revisions in a timely manner. Furthermore, it has been a pleasure to work together with the staff at Springer-Verlag, who helped coordinate the production of all contributions into a single volume.

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