Are Flexible, Flapping Flying Machines in our Future?

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Modern aircraft have been fabulously successful with rigid wings and rotors. But just imagine the flying machines that would be possible if we could understand and harness the most efficient and acrobatic airfoils in nature: the flexible wings of the bat.

The aerodynamics of "compliant" structures, such as bat wings, are very complicated because both the structure and airflow change and adapt to each other in a highly nonlinear way. Bats' wing bones are even flexible, unlike those of birds, which gives the mammals added control but is an additional challenge for scientists trying to understand them.

Kenny Breuer's research group at Brown University is designing a series of fundamental experiments that will allow scientists to isolate, observe and analyze a variety of specific flow-structure interactions that are important in understanding bat flight and, in general, the aerodynamics of compliant structures. Ultimately, Breuer expects that experiments like these will yield insights enabling new generations of flying machines that are impossible to consider today.

In his talk at the 61st Annual Meeting of the APS Division of Fluid Dynamics in San Antonio, Arnold Song, who is one member of this research group, will describe the basic motions -- and their aerodynamic implications -- that he and his colleagues at Brown have discovered so far by measuring how paddles and stretched ribbons of sailcloth vibrate in manmade breezes in a wind tunnel.

As the airflow increases, for example, a paddle on a post first twists and then flaps, like a stop sign being pummeled by hurricane-force winds. The ribbon's behavior is more complicated, but also essential for understanding how bat wings or other compliant structures generate lift so efficiently.

Song's talk, "On Vortex Induced Motion in Compliant Structures," will be held on Sunday, November 23, 2008 at the 61st Annual Meeting of the American Physical Society.

Source: American Institute of Physics