ME Seminar

Two tales of unsteady fluid interactions with soft compliant membranes

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ABSTRACT

Elastic bodies, when immersed in a flow, can experience violent flow-induced-oscillations due to unsteady forces generated by vortex shedding. These tightly-coupled fluid-structure interactions (FSI) lead to large-scale elastic deformation of the structure, which, in turn, changes the nature of the vortex shedding, as well as the lift and drag forces experienced by the body. In this talk I will present two tales of FSI. The first describes the deformation of a soft membrane disk oriented perpendicular to the flow. The membrane deforms, much like a soap bubble and vibrates due to the unsteady vortex shedding. Using a combination of experiments and theory we describe the membrane deformation and the changes in the steady and unsteady drag forces experienced by the disk. The second tale addresses the use of a soft membrane airfoil heaving and pitching in a freestream used to harvest energy from the flow. The elastic deformation of the membrane wing generates an adaptive camber which enhances the lift generation and leads to a greatly enhanced power coefficient. Again, we will use a mixture of experiments with some theoretical modeling to understand the behavior of this FSI system.

ABOUT THE SPEAKER

Prof. Kenny Breuer received his BSc from Brown and his MSc and PhD from MIT. He spent nine years on the faculty of MIT in the department of Aeronautics and Astronautics, before returning to Brown in 1999. His research interests are in Fluid Mechanics covering a wide range of topics, including the physics of flows at micron and nanometer scales, animal flight (bat flight in particular), energy harvesting, vortex dynamics, and the physics and control of turbulent flows. He is author of over one hundred refereed technical publications, has edited and co-authored several books, including "Microscale Diagnostic Techniques", "A Gallery of Fluid Motion" and "Multimedia Fluid Mechanics". He is a fellow of the APS, ASME and Associate Fellow of AIAA.

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