JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

SPRING 2021 CEAFM VIRTUAL SEMINAR SERIES

"The Force Partitioning Method: Dissecting Fluid Dynamic Forces in Vortex-Dominated Flow"

Presented by Karthik Menon

Johns Hopkins University – Department of Mechanical Engineering
Hosted by Prof. Rajat Mittal (JHU - MechE)

Winner of the 2020 Corrsin-Kovasznay Outstanding Paper Award

The dynamics of fluid-structure interaction in vortex-dominated flows are notoriously hard to predict for several reasons. Chief amongst these is the presence of multiple distinct mechanisms for force production on immersed surfaces and the dominant influence of several vortices, their interactions, and the non-linear loads they induce. These combined effects lead to complex responses of unsteady surfaces within the flow which are often difficult to predict. In this talk I will discuss a novel Force Partitioning Method (FPM) which allows us to rigorously disentangle and quantify the roles that various physical mechanisms as well as individual flow features (such as vortices and shear layers) play in generating pressure-induced loads on immersed surfaces. I will also describe a physics-based and data-driven analysis framework that facilitates the efficient use of this method in complex time-varying vortex-dominated flow-fields. This formulation is applied to two canonical problems in unsteady aerodynamics: vortex-induced vibration of cylinders and dynamic stall of unsteady wings. We show that in both cases, FPM leads to new and somewhat counterintuitive insights into the dynamics of these flows.

Friday, April 16, 2021 at 3:00 PM (EDT)
https://wse.zoom.us/j/93762992307