Abstract Submitted for the DFD20 Meeting of The American Physical Society

Unsteady Dynamics of Upswept-Base-Cylinder Afterbody Flows¹ RAJESH RANJAN, DATTA GAITONDE, Ohio State Univ - Columbus — The flow behind bluff bodies similar to those behind cargo fuselages, automobiles, and other afterbody configurations results in separation from the upswept base and the ultimate reorganization of the vorticity into, depending on conditions, either a pair of streamwise counter-rotating vortices or a wake. Under certain conditions, hysteretic behavior is also possible. In this work, the unsteady dynamics in each regime (vortex or wake) are elucidated using a well-validated Large-Eddy Simulation (LES) database comprised of numerous upsweep angles. In the vortex regime, an increase in upsweep results in more intense vortex-shear layer interactions near the base and increased wandering of instantaneous vortices downstream of the body. The talk will also discuss the changes in the unsteady coherent structure dynamics with upsweep, using various modal decomposition techniques. Dynamic mode decomposition (DMD) has been employed to extract dominant frequency-segregated modes pertaining to both separation and vortex unsteadiness, while Proper Orthogonal Decomposition (POD) is used to extract energy-rich coherent structures and the rank behavior of the complex flow. These analyses from different upswept configurations are then put into context by examining the unsteadiness due to inclusion of a cavity in the base region.

¹Supported by the U.S. Air Force Office of Scientific Research (Grant: FA9550-17-1-0228).

> Rajesh Ranjan Ohio State Univ - Columbus

Date submitted: 30 Jul 2020

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