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Fluid Dynamics of a Plunging Wing in Presence of Karman Vortex Street Shedding.[1] HANKUN DENG, BO CHENG, AZAR ESLAM-PANAH, Penn State University — Humanity's understanding of flapping wing aerodynamics has increased dramatically over the past few decades – from not being able to accurately calculate forces generated by such wings, to building small-sized robots that can fly almost as well as their biological inspiration in laminar flows. Despite the great progress in their design and control, these robots are tremendously troubled while flying in turbulent environments. A nominally 2D plunging wing, the simplest case possible designed and built in-house, was tested in the presence of unsteady wake to investigate the effect of the flow disturbances on vorticity fields. The unsteady wake in the form of von Karman Vortex Street was generated by a cylinder located upstream of the plunging wing at different distances. The plunge amplitude and frequency of the oscillation were adjusted to bracket the range of Strouhal numbers relevant to the biological locomotion at Reynolds number of 10,000. First, the dye flow visualization technique was used to qualitatively observe the wake behind the cylinder, mainly to position the wing with respect to the upstream vortical structure. Second, time-resolved Particle Image Velocimetry (PIV) was employed to quantitatively study the effect of unsteady wake on the flow measurements of the plunging wing. This research and its successive investigations may eventually lead to more efficient or better-performing Unmanned Aerial Vehicles, along with a better understanding of their fluid dynamics.

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