Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

**Unique stability modes of low aspect ratio wings** KAMRAN MOHSENI, MATT SHIELDS, University of Florida — The unique aerodynamic regime of low aspect ratio (LAR) wings is strongly affected by the phenomenon of roll stall. In this study, it is shown that roll stall induces inherently aerodynamic stability modes on a flat plate wing with an aspect ratio of unity. These modes are seen to create divergent oscillations in the lateral state variables even for minor perturbations from equilibrium flight. Furthermore, the nature of the response is fundamentally altered in the presence of angle of attack variations; if the frequency of the angle of attack oscillations is close to the natural frequency of the lateral response, the bank angle $\phi$ is seen to drift away from equilibrium in a manner not well modeled by a linear stability analysis. This newly considered mode, inherent to LAR wings, is referred to as the roll resonance mode due to its dependence on the frequencies of lateral and longitudinal motion. A linear time invariant model is shown to accurately represent the initial condition response of the pure lateral mode, and a linear time variant model in which the roll stability derivative is updated at every time step captures the divergent response of roll resonance. Understanding these modes is critical for implementation of improved control laws for Micro Aerial Vehicles.

Matt Shields
University of Florida

Date submitted: 02 Aug 2013 Electronic form version 1.4