Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

A versatile low-dimensional vortex model for investigating unsteady aerodynamics[1] DARWIN DARAKANANDA, JEFF D. ELDREDGE, University of California, Los Angeles — In previous work, we demonstrated a hybrid vortex sheet/point vortex model that captures the non-linear aerodynamics of a plate translating at a high angle of attack. We used vortex sheets to model the shear layers emerging from the plate, and point vortices to capture the effect of the coherent vortex structures. In this work, we introduce modifications that allow the model to work for a larger range of plate kinematics over longer periods of time. First, following the example of Ramesh et al., we relax the Kutta condition at the leading edge and determine vorticity flux based on a suction parameter instead. To prevent the vortex sheet from becoming unstable near the resulting singular edge, we explicitly filter out short-wave disturbances along the sheet while redistributing the sheet's control points. Second, by looking for intersections between the vortex sheets and any repelling Lagrangian coherent structures, the model can detect the formation of new coherent vortices. Trailing portions of the sheets that become dynamically distinct from the shear layers are rolled up into point vortices. We test these modifications on a variety of problems, including pitch-up, impulsive translation at low angles of attack, as well as flow response to pulse actuation near the leading edge.

[1]This work has been supported by AFOSR, under award FA9550-14-1-0328.

Darwin Darakananda
University of California, Los Angeles

Date submitted: 31 Jul 2016 Electronic form version 1.4