Abstract Submitted
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A Hybrid Vortex Sheet / Point Vortex Model for Unsteady Separated Flows[1] DARWIN DARAKANANDA, JEFF D. ELDREDGE, University of California, Los Angeles, TIM COLONIUS, California Institute of Technology, DAVID R. WILLIAMS, Illinois Institute of Technology — The control of separated flow over an airfoil is essential for obtaining lift enhancement, drag reduction, and the overall ability to perform high agility maneuvers. In order to develop reliable flight control systems capable of realizing agile maneuvers, we need a low-order aerodynamics model that can accurately predict the force response of an airfoil to arbitrary disturbances and/or actuation. In the present work, we integrate vortex sheets and variable strength point vortices into a method that is able to capture the formation of coherent vortex structures while remaining computationally tractable for control purposes. The role of the vortex sheet is limited to tracking the dynamics of the shear layer immediately behind the airfoil. When parts of the sheet develop into large scale structures, those sections are replaced by variable strength point vortices. We prevent the vortex sheets from growing indefinitely by truncating the tips of the sheets and transfering their circulation into nearby point vortices whenever the length of sheet exceeds a threshold. We demonstrate the model on a variety of canonical problems, including pitch-up and impulse translation of an airfoil at various angles of attack.

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