

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Vortex force generation of an impulsively started wing at high angle of attack¹ XIANG FU, FUXIN WANG, HONG LIU, SUYANG QIN, YANG XIANG, Shanghai Jiaotong Univ — A wing at high angle of attack (AoA) impulsively started from rest is a fundamental motion employed by insects during flight. Previous studies have almost solely focused on the lift enhancement by the leading-edge vortex (LEV). However, the influences of the starting vortex and secondary vortex on both the lift and drag generation have been less studied. In this paper, the vorticity fields for three AoAs of 45, 58.5 and 72 are obtained numerically. The roles of the LEV, starting vortex and secondary vortex in generating the lift and drag are quantitatively studied using the vorticity moment theory. It is revealed that the LEV provides positive lift whereas the starting vortex and secondary vortex provide negative lift during the whole motion. The negative lift produced by the starting vortex or secondary vortex is not trivial and cannot be ignored. Regarding the drag, the LEV reduces the total drag whereas the starting vortex, the secondary vortex increases the total drag. As the AoA increases, the drag resulting from the starting vortex increases quickly and comprises almost all the total drag for the AoA of 72. The relations between the motion of the vortical structures and the forces are also investigated.

¹Financial support from the State Key Development Program of Basic Research of China (2014CB744802) is gratefully acknowledged.

Xiang Fu
Shanghai Jiaotong Univ

Date submitted: 27 Jul 2015

Electronic form version 1.4