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Flow Structure on a Flapping Wing: Quasi-Steady Limit CEM OZEN, DONALD ROCKWELL, Lehigh University — The flapping motion of an insect wing typically involves quasi-steady motion between extremes of unsteady motion. This investigation characterizes the flow structure for the quasi-steady limit via a rotating wing in the form of a thin rectangular plate having a low aspect ratio (AR =1). Particle Image Velocimetry (PIV) is employed, in order to gain insight into the effects of centripetal and Coriolis forces. Vorticity, velocity and streamline patterns are used to describe the overall flow structure with an emphasis on the leading-edge vortex. A stable leading-edge vortex is maintained over effective angles of attack from 30° to 75° and it is observed that at each angle of attack the flow structure remains relatively same over the Reynolds number range from 3,600 to 14,500. The dimensionless circulation of the leading edge vortex is found to be proportional to the effective angle of attack. Quasi-three-dimensional construction of the flow structure is used to identify the different regimes along the span of the wing which is then complemented by patterns on cross flow planes to demonstrate the influence of root and tip swirls on the spanwise flow. The rotating wing results are also compared with the equivalent of translating wing to further illustrate the effects of the rotation.

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