Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Spanwise gradients in flow speed and leading edge vortex attachment on low Reynolds number wings THIERRY JARDIN, ISAE, University of Toulouse, LAURENT DAVID, Institut Pprime, University of Poitiers — It is now accepted that the aerodynamic performance of low aspect ratio revolving wings, such as insect wings or maple seed membranes, largely relies on sustained leading edge vortex attachment. However, the mechanisms responsible for this sustained attachment are still poorly understood. Here, we compute the Navier-Stokes solution of the flow around a finite wing (i) subjected to a uniform oncoming flow, (ii) subjected to a spanwise varying oncoming flow and (iii) revolving about its root. Therefore, we are able to isolate the mechanisms associated with the spanwise gradient of the local wing speed from those associated with centrifugal and Coriolis effects. We show that over flapping amplitudes typical of insect flight the spanwise gradient of the local wing speed may suffice in maintaining leading edge vortex attachment. We correlate this result with the development of spanwise flow and we evaluate the sensitivity of such a mechanism to the Reynolds number. It is noted, however, that leading edge vortex attachment through the spanwise gradient of the local wing speed does not promote large lift, which ultimately arises from centrifugal and Coriolis effects.

Thierry Jardin
ISAE, University of Toulouse

Date submitted: 20 Jul 2014 Electronic form version 1.4