Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Spontaneous motion of flapping wings driven by hydrodynamic instability OLIVIER MARQUET, ONERA, JUAN GUZMAN INIGO — Recent experimental [1] and numerical [2] studies have examined the dynamics of rigid symmetric wings flapping vertically in a quiescent fluid and free to move in the horizontal direction. It has been observed that above a critical flapping frequency the flow loses its symmetry while the wing starts to move horizontally and eventually reaches a quasi constant horizontal speed. The present work reconsiders this problem from an hydrodynamics instability point of view. The basic flow is periodic and symmetric, the periodicity being imposed by the vertical forcing frequency while the symmetry of the velocity field ensures no motion in the horizontal direction. The linear stability is examined using the Floquet theory, with the assumption of asymmetric perturbations to explain the onset of horizontal forces. Numerical results of the stability problem will be shown. The cases of wings fixed or free to move will be analyzed and compared.

[1] Vandenberghe N., Zhang J. & Childress S., "A symmetry-breaking leads to forward flapping", Journal of Fluid Mechanics, 506, 147 (2004)
[2] Alben S. & Shelley M. "Coherent locomotion as an attracting state for a free flapping body", Proc. Natl. Acad. Sci., U.S.A., 102, 11163 (2005)

Olivier Marquet
ONERA

Date submitted: 12 Aug 2011 Electronic form version 1.4