Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Bio-inspired turbine blades offer new perspectives for wind energy BENJAMIN THIRIA, VINCENT COGNET, PMMH-ESPCI, SYLVAIN COURRECH DU PONT, MSC-UPD, PMMH TEAM, MSC TEAM — The efficiency of wind turbines is especially poor if the wind speed is too low for the working range of the rotor, or if the oncoming wind has a too large incident angle with respect to the rotor axis. The consequence is that a large amount of potential available wind energy is not converted by the turbines, leading to heavy energetic and economic losses. The present work introduces a solution to overcome this technological limitation, using new types of blades connected to the rotors. This new type of blades is inspired by recent studies showing how insects improve flight performance by taking benefit from the flexibility of their wings (Ramananarivo et al. PNAS, 2011). Here, we show that, by bending along the chord under the action of the wind, the deformable blade plays the role of a shape factor to reorientate the torque in the direction of the rotation of the rotor, an especially helpful feature for critical wind conditions. The flexibility of the wing can significantly extend the performance range of wind turbines to low wind speeds and high azimuthal incoming wind directions, solving the technological barrier specific to this type of machines. The consequences of the presented results are outstanding for renewable solutions. Our estimation based on real wind data predicts a large increase in energy production, which is drawn using passive, non-consuming mechanisms, from the reservoir of energy available at critical wind conditions.

Benjamin Thiria
PMMH-ESPCI

Date submitted: 02 Aug 2014 Electronic form version 1.4