Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Biomimetic individual pitch control for wind turbines[1] MARION COQUELET, UCLouvain - UMONS, LAURENT BRICTEUX, Universite de Mons (UMONS), MAXIME LEJEUNE, PHILIPPE CHATELAIN, Universite catholique de Louvain (UCLouvain) — Individual Pitch Control (IPC) has proved efficient in reducing fatigue loads on wind turbines. As 1P (once-per-revolution) blade loads are significant due to wind shear or tower shadow effect, their alleviation implies a rhythmic behavior in the changes of the blade pitch angles. This work relies on Large Eddy Simulations (LES) to demonstrate the effectiveness of a biomimetic architecture for IPC. The high-fidelity simulation of the flow physics is essential to assess the performances of the controller. It is performed by an in-house lifting-lines-enabled Vortex Particle-Mesh method, dealing with synthetic turbulence and wind shear at the inflow. The individual pitch controller is based on Central Pattern Generators (CPGs). CPGs produce, from very simple inputs, rhythmic outputs that drive repetitive motions like walking or breathing. The specificity of these networks is their ability to operate autonomously. They are here implemented as coupled non-linear oscillators, capable of producing coordinated rhythmic patterns and driven by a knowledge of the upstream flow conditions. The latter are reconstructed online by an Extended Kalman Filter processing the loads experienced by the individual blades.

[1]Funding from the European Research Council under the European Unions Horizon 2020 research program. Computational resources made available on the Tier-1 supercomputer funded by the Walloon Region.

Marion Coquelet
UCLouvain - UMONS

Date submitted: 30 Jul 2019 Electronic form version 1.4