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## Modeling and Control of Magnus Effect-Based AWE Systems

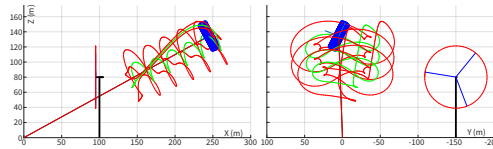
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At GIPSA-lab, EOFLY is a multi-disciplinary research group working on the development of airborne wind energy systems, drones, and conventional wind turbines [1].

Our current research work is focused on the modeling and control of Magnus effect-based AWE systems. In our approach, a rotating cylinder designed as an aerostat is used to drive a ground-based generator. Our choice of Magnus based aerostat stems from various factors such as high lift coefficient, naturally robust and stable design, and lighter than air capabilities. A study about experimental data available on Magnus cylinders has been done in order to validate the aerodynamic model [2].

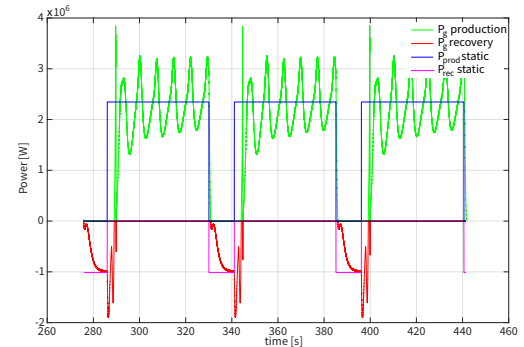


*Trajectory and swept area of Magnus based AWE system in xz plane (left) and yz plane (right) with crosswind manoeuvre in comparison to a 1.5MW conventional wind turbine.*

Then, a point-mass dynamic model of the Magnus based AWE system is developed and validated in a simulation environment.

A bang-bang control strategy is applied to control the trajectory of an airborne module that performs crosswind maneuvers. Simulation results show that a 500 m<sup>2</sup> Magnus based AWE produces a net output power around 1.5

MW for a wind speed of 10 m/s. In other terms, the production is 3 kW/m<sup>2</sup>. Finally, a simplified model of the whole cycle is proposed and validated with dynamic simulations. This model is then used to generate a power curve, compared to that of a conventional wind turbine.



*Simulated output power during production and recovery phases with a comparison with a simplified model ( $P_{static}$ ).*

References:

[1] <http://www.gipsa-lab.fr/projet/EOFLY/>

[2] Y. Gupta, J. Dumon, and A. Hably, "Modeling and control of a Magnus effect-based airborne wind energy system in crosswind maneuvers", IFAC world congress, Toulouse, France, 2017. <https://hal.archives-ouvertes.fr/hal-01514058/>