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Drivetrain Concepts for Pumping Airborne Wind Energy Systems

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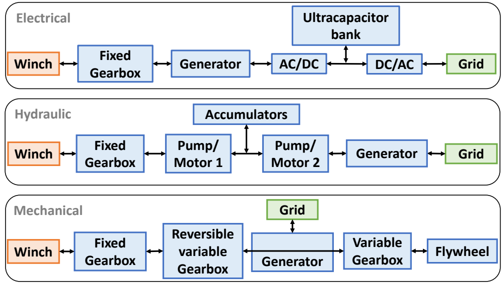
Airborne wind energy (AWE) systems with crosswind flight operation and ground based electricity generation have alternating reel-out and reel-in phases, which are also known as the pumping cycles due to their cyclical nature. These cycles lead to an oscillating power profile which needs to be smoothened out before it can be supplied to the electricity grid.

Power smoothing essentially means providing a constant power output to the grid irrespective of the fluctuations in one full cycle operation. This can be done by maintaining the net cycle average to the grid at all times. The intermediate energy storage for power smoothing must be capable of delivering high number of charge-discharge cycles with a fast response time. Conventional electrical energy storage batteries are not suitable for such heavy operation.

This work proposes three drivetrain concepts which can fulfil this purpose. The three concepts are based on three different types of storage technologies: ultracapacitors, hydro-pneumatic accumulators and flywheels. Techno-economic models of these drivetrains have been developed and a case-study on sizing and costing of the three drivetrain concepts for a MW scale AWE system is evaluated. The results indicate that it is essential to capture the effect of the drivetrain in the scaling and system sizing studies of AWE.

Since most of the AWE companies are now entering the commercialization phase, it is necessary for them to include drivetrain in their design process. The objective of this study is to provide guidance to the AWE developers for choosing a suitable drivetrain concept for their systems. Detailed analysis can be found in [1].



Architectures of the three potential drivetrain concepts for pumping AWE systems

References:

*[1] Joshi, R., Schmehl, R., Kruijff, M., Von Terzi, D. Techno-economic analysis of power smoothing solutions for pumping airborne wind energy systems. Journal of Physics: Conference Series **2265**, 042069, 2022. doi:10.1088/1742-6596/2265/4/042069*