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Flight Path Optimization for Airborne Wind Energy Applications Using Multiple Tethered Aircrafts

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Generating electricity can be more efficient and cost-effective through the utilization of multi-aircraft systems in the process of airborne wind energy (AWE) applications. This approach involves the operation of multiple tethered aircraft connected by a shared main tether. In this way, the lateral motion of the shared tether is reduced, thereby minimizing aerodynamic drag and maximizing the harvested energy. Extensive research on tethered multi-aircraft systems has revealed significant efficiency improvements. These conceptual extensions offer advantages such as scalability, more consistent power output profiles, and increased power densities within the entire farm structure. However, they are accompanied by a set of challenges, including increased complexity, optimization of path trajectories of the system to avoid collisions during flight, and handling the process of reeling in and out of the tether during take-off and landing.

For any AWE system, efficient flight paths are critical for path planning, system optimization, and controller design. While previous research in this area has been primarily conducted through simulations, our work introduces practical outcomes derived from real-world experiments to optimize the flight trajectory of two tethered unmanned aerial vehicles (UAVs).

In this talk, I will present the initial setup of our multiple-tethered aircraft system, including the hardware configuration of each tethered UAV, controller design, and optimization of their flight paths to maximize lift when flying across the wind in a figure-of-eight pattern. Furthermore, I will discuss the conclusions obtained from our work with this configuration and outline future steps to enhance our model to maximize its power generation capabilities.

References:

[1] De Schutter, Jochem, et al. "Optimal control of stacked multi-kite systems for utility-scale airborne wind energy." 2019 IEEE 58th Conference on Decision and Control (CDC). IEEE, 2019.

[2] De Schutter, Jochem, et al. "Awebox: An optimal control framework for single-and multi-aircraft airborne wind energy systems." Energies ***16****(4), 1900, 2023.*

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