Dual-Cylinder Magnus Effect Kite: Fixed-Distance Flight Tests at Wind Fisher

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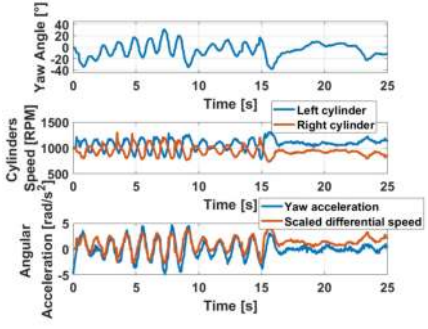
Today, most of the systems that we see in the Airborne Wind Energy landscape use similar designs based on soft or rigid kites. At Wind Fisher, we are working on a different system based on a dual-cylinder Magnus effect kite. Two helium-inflated balloons driven in rotation from the ground using the same drive-train units used to generate electricity. This pitchless, lighter-than-air cylindrical design provides a better gust response [1] and greatly simplifies the takeoff and landing phases. Moreover, it offers a good compromise between the performance of a rigid kite and the practicality of a soft kite [2].

Fixed-distance flight test with Wind Fisher's developmental prototype towed by a vehicle (left). Prototype ground-station (right).

Given that limited research has been conducted on this type of architecture. One of Wind Fisher's initial priorities was to design and build a small-scale prototype, in collaboration with the Gipsa-lab for the instrumentation and control aspects. The prototype is used as a test-bed to study the kite's behavior, test control algorithms, collect data, and validate simulation models. Fixed-distance flight tests were carried out either in real wind conditions or with artificially generated wind using a mobile wind tunnel setup where the ground station is attached to the roof of a vehicle, and the kite is towed at a constant speed, allowing to generate a more predictable wind. During the last flight tests, the prototype was successfully stabilized using a yaw control loop, previously validated in simulation. The presentation will give an overview of prototyping and flight testing at Wind Fisher, along with test results and conclusions.



Flight data showing the control of the yaw angle, the differential rotational speed acts on the angular acceleration and approximately stabilizes the yaw around 0° despite turbulent wind conditions.

References:

[1] Seifert, J.: A Review of the Magnus Effect in Aeronautics. In: Progress in Aerospace Sciences 2012, vol. 55, pp.17-45.

[2] Bergeson, L.,Greenwald, C.K.: Sail Assist Developments 1979–1985. In: Journal of Wind Engineering and Industrial Aerodynamics 1985, vol. 19, pp. 45–114.