someAWE Labs' continuous torsion-based power transfer from rotor to ground (10 March 2019)

Practical Experiences with a Torsion Based Rigid Blade Rotary Airborne Wind Energy System with Ground Based Power Generation

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Rotary airborne wind energy systems that use rotors similar to conventional wind turbines and ground based generators combine some of the known benefits of Loyd [1] based crosswind kite power systems with potential additional benefits such as continuous energy generation, no tether drag from crosswind flight, passive control, use of "cheap" lift and easier launch and landing.

Airborne wind energy systems without crosswind motion typically have a bad power/blade area ratio. The talk discusses a rotor design that can alleviate this disadvantage. It treats the blades of the rotary wing as independent airborne wings that are only connected for easier control and launch. The airfoils start at some distance from the hub thus achieving high tip speeds with smaller blade area than conventional rotors.

Our implementation of such a rotor uses rigid blades. The rigid design provides a better power coefficient and stable operation in turbulent air. Thereby allowing us to focus on the stability of the energy transmission.

For continuous torsion-based power transfer from the rotor to the ground a tensegrity based torsional stiff structure ("helix") has been developed and tested.

This design has been chosen over the pure Tensile Rotary Power Transmission (TRPT) of the DAISY system [2,3] as it allows for linear scaling with constant diameter. The power transfer lines are being held in a squared helix shape reducing twist induced lag and oscillations.

A 300 W demonstrator system with 60 cm blades, a rotor diameter of 4.8 m and a helix length of 30 m has been designed, build and tested for more than 10 hours.

This talk shares practical experiences with this torsion based rigid blade rotary airborne wind energy system.

The talk discusses the design rationale, lessons learned, successes and dead ends. It presents field test footage (also available here https://bit.ly/2maLiLs) and provides an outlook.

References:

*[1] Loyd, M. L.: Crosswind Kite Power. Journal of Energy **4**(3), 106-111 (1980)*

[2] Read, R.: Windswept and Interesting - Kite Power No Tower. [Online] https://www.windswept-and-interesting.co.uk/

[3] Tulloch, O.: Development of Safe and Efficient Operation for an Airborne Wind Energy (AWE) System - A Rotary Design, (2019)