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Pumping Cycle Based on Elastic Tether

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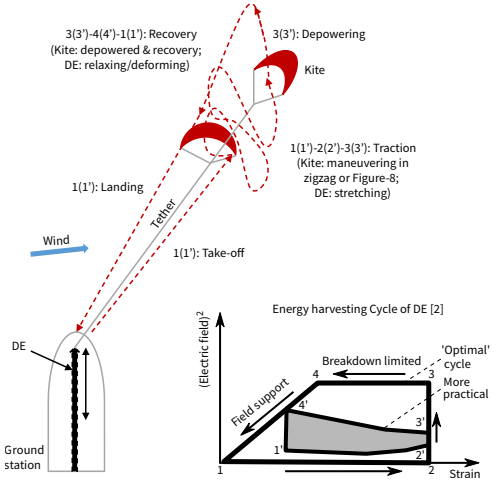
This work is focused on a Pumping Cycle (PC) Airborne Wind Energy System (AWES) concept for adopting a Dielectric Elastomer Generator (DEG) for Power-Take-Off (PTO) since a wind powered generation concept based on a fluttering flag made of Electro-Active Artificial Muscle appeared [1].

Reeling in the recovery phase is inherently required for a pumping AWES owing to the maximal tether length. To address this issue, a rubbery tether is applied in PC. Traction power to be generated in the traction phase is transferred to the rubbery tether and stored as tension power there. At the end of traction phase, a depowered kite is pulled towards the ground station by the tension power stored in the rubbery tether, resulting in less reeling and noise. Such PC can be applicable for an AWES at a Demilitarized Zone (DMZ) or close to a city.

The main features of the PC are as follow: (1) traction power is stored as tension power in an elastic tether, (2) output power is generated for the recovery phase if an elastomeric tether made of DEG is configured for PTO, and (3) the Energy Harvesting Cycle (EHC) of a DEG [2] for (2) depends the PC and can be optimized by kite control.

A hand-made toy kite system was used to observe the PC, as limited to validate only the PC concept. Thus, an engineered prototype of an AWES is further required to reveal some problems such as automatic control including take-off and landing, efficiency in energy conversion, continuous power generation, selection of DE materials, etc.



Observing a pumping cycle based on a toy kite and rubber tether.

References:

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[2] Perline R., Prahlad H.: Generator Mode – Devices and Applications. In: Carpi, F. et al. (eds.) Dielectric Elastomers as Electromechanical Transducers, Chap. 15, Elsevier (2007)