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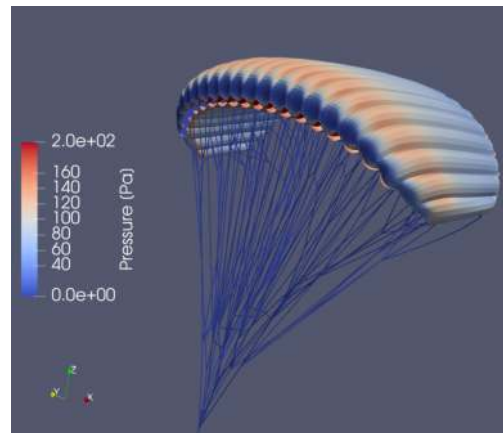
Towards an Optimal Ram-Air Kite Design for AWE: Recent Advances in the Coupled Aero-Structural Model

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SkySails Power utilises tethered ram-air kites to harvest wind energy. During the power phase the kite is trimmed for maximum lift while the control pod steers the kite's trajectory. During the reel-in phase, the kite is depowered to reduce lift and minimise the glide ratio, ultimately shortening the reel-in time and minimising tether force.

The design of the canopy and bridle system is of paramount importance for an efficient power cycle and minor alterations can yield unintended canopy geometries and flight behaviours. Thus, the process of crafting an effective canopy and bridle design is an iterative process that blends analytical approaches, field testing, and simulation.

A sophisticated simulation environment based on a coupled aero-structural model [1-2] has been developed over the years and it is capable of modelling our kite's performance and structural deformations. Introducing new features to refine our model and achieve more accurate results throughout all flight phases is an ongoing process. During the presentation, we will showcase our most recent findings, comparing them with field measurements to validate our model. With our evolving simulation capabilities, we aim to gain a deeper understanding of how design modifications impact the entire airborne system and further integrate the simulation environment in the design process loop.



FSI simulation of the depowered SkySails kite.

References:

- [1] Thedens, P.: An integrated aero-structural model for ram-air kite simulations: with application to airborne wind energy. Dissertation, TU Delft (2022). doi:10.4233/uuid:16e90401-62fc-4bc3-bf04-7a8c7bb0e2ee
- [2] Thedens, P., Schmehl, R.: An Aero-Structural Model for Ram-Air Kite Simulations. *Energies*, **16**(6), 2603 (2023). doi:10.3390/en16062603