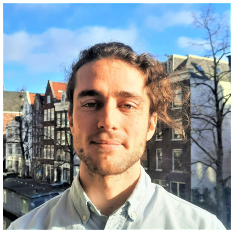

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Multidisciplinary design, analysis and optimization of fixed wing AWES

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To enter the market successfully, AWES need to prove reliability and robust operations over long time frames, on top of being competitive in the energy market. To consider these requirements at the design stage, a new multidisciplinary design and optimization framework *T-GliDe* (*Tethered Gliding system Design*) [1] is being developed. In *T-GliDe*, the AWES is designed based on market metrics, while ensuring good flight mechanics characteristics which may enhance reliability by relieving the control system. This approach differs from optimization approaches based on low-fidelity models, which typically do not include flight dynamics, and from approaches which find power output and loads by running time simulations, which include active control.

The architecture of *T-GliDe* is showed in Figure 1: it features an optimization module and a uncertainty quantification module, allowing for a number of algorithm-based design techniques. The physical model is based on *LT-GliDe* (*Linearized Tethered Gliding system Dynamics*) [2], which is used to find loads and power production. *LT-GliDe* assumes the dynamic problem to be axial-symmetric by considering the fluctuating terms over the circular loop as disturbances. In this way, the AWES states over the trajectory can be described with a unique steady state, which is considered representative of the dynamics over the loop. The dynamics of the system is then linearized about the steady state, thought the use of analytical aerodynamics theories. *T-GliDe* is then ensuring good dynamic characteristics by constraining the eigenvalues of the linearized problem.

Even though the framework is not restricted to any crosswind generation type (Fly-Gen or Ground-Gen), the features of the proposed approach will be presented through the analysis of a Ground-Gen AWES.

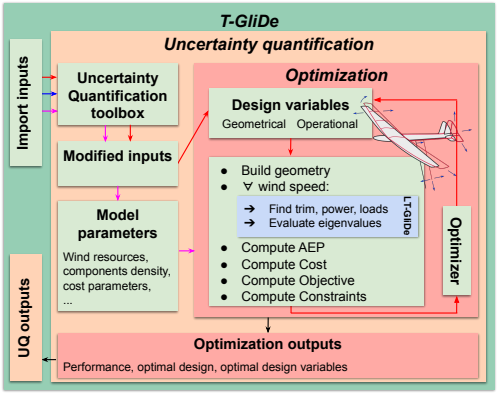

Figure 1: T-GliDe (Tethered Gliding system Design) architecture.

References:

[1] Trevisi F, Croce A, Riboldi CED. Sensitivity analysis of a Ground-Gen Airborne Wind Energy System design. Submitted to: TORQUE22 Conference. Delft, The Netherlands; 2022.

[2] Trevisi F, Croce A, Riboldi CED. Flight Stability of Rigid Wing Airborne Wind Energy Systems. Energies. 2021; 14(22):7704.