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Multifidelity Design Optimisation Models for Composite AWE Wings

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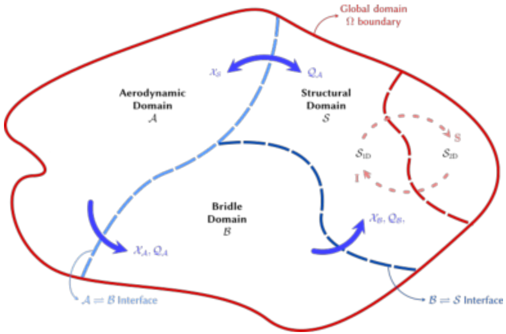
Composite materials are the standard choice for fixed-wing AWE wings, given their high stiffness-to-weight ratios. These anisotropic materials typically undergo complex load-deflection couplings, further complicated by the wing geometry. These complicated deflections could give rise to undesirable aeroelastic phenomena and hence require consideration, already in the initial design stages. EnerKíte utilises ultra-light, slender carbon composite wings to minimise airborne mass. A set of multifidelity models is presented that builds upon the toolchain consisting of a group of 2+1D solvers for the aerodynamic A, bridle B and structural S domains [1,2]. The aeroelastic response is determined by a steady-state coupling of the solvers [3]. An approach is suggested that describes the structural domain S in varying levels of complexity, facilitating solving for the complex lamination layer plan only as the final step. This allows for the rapid screening of design candidates without having to prescribe detailed lamination layups and other manufacturing constraints that are typically unknown at the initial design stage. This proposed method can thus probe the vast initial design space, considering configurations in the aerodynamic A, bridle B and structural S domains [4].



Partitioned approach and information exchange for coupling of the different AWE domains.

References:

*[1] Candade, A.A., Ranneberg, M., Schmehl, R.: Structural analysis and optimization of a tethered swept wing for airborne wind energy generation. Wind Energy, **23**(4), 1006–1025, 2020. doi:10.1002/we.2469*

[2] Ranneberg, M.: Direct Wing Design and Inverse Airfoil Identification with the Nonlinear Weissinger Method. arXiv:1501.04983 [physics.flu-dyn], 1–13, 2015. doi:10.48550/arXiv.1501.04983

*[3] Candade, A.A., Ranneberg, M., Schmehl, R.: Aero-structural Design of Composite Wings for Airborne Wind Energy Applications. Journal of Physics: Conference Series, **1618**(3), 032016, 2020. doi:10.1088/1742-6596/1618/3/032016*

[4] Candade, A.A.: Aero-structural Design and Optimisation of Tethered Composite Wings: Computational Methods for Initial Design of Airborne Wind Energy Systems. PhD Dissertation, TU Delft, 2023. doi:10.4233/uuid:c706c198-d186-4297-8b03-32c80be1c6df