

Development of a Toolchain for Aero-structural Design of Composite AWE Kites

Candade, Ashwin; Ranneberg, M.; Schmehl, Roland

Publication date 2019 **Document Version** Final published version

Citation (APA)

Candade, A., Ranneberg, M., & Schmehl, R. (2019). *Development of a Toolchain for Aero-structural Design of Composite AWE Kites*. 128-128. Abstract from 8th international Airborne Wind Energy Conference (AWEC 2019), Glasgow, United Kingdom.

Important note

To cite this publication, please use the final published version (if applicable). Please check the document version above.

Copyright Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights. We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology For technical reasons the number of authors shown on this cover page is limited to a maximum of 10.



Ashwin Candade

PhD Researcher Faculty of Aerospace Engineering Delft University of Technology EnerKíte GmbH

> Fichtenhof 5 14532 Kleinmachnow Germany

a.a.candade@tudelft.nl a.candade@enerkite.de www.enerkite.de



Development of a Toolchain for Aero-structural Design of Composite AWE Kites

Ashwin Candade^{1,2}, Maximilian Ranneberg¹, Roland Schmehl²

¹EnerKíte GmbH

²Faculty of Aerospace Engineering, Delft University of Technology

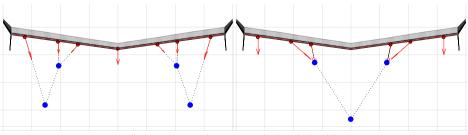
The earlier in the design process the trade-offs between a system's cost and its performance can be determined, the easier it is to narrow in on an optimal final design. In order to explore the initial design space for composite carbon kites, it is imperative to assess the load couplings effects and its impact on the aerodynamics of the wing, and ultimately the performance of the system's yield. CFD and 3D finite element methods are currently too computationally expensive to efficiently explore the design space at such an early stage of the design process. This leads to the need for a toolchain that has sufficient modelling fidelity while being efficient enough to be used for conceptual design. An efficient aero-structural toolchain is the focus of this work.

In order to analyse the composite structure of the kite efficiently, instead of a traditional 3D finite element method, a 2+1D method that can capture the effects of fibre orientation, stack up sequence, and other aspects of the internal structure of the wing with sufficient fidelity, while being computationally efficient is employed[1]. This structural model is coupled with the aerodynamics of the kite via a 3D nonlinear vortex step method[2]. The toolchain also includes the effects of the underwing bridle configuration and is able to model the influence of different bridle and pulley configurations on the aero structural performance of the kite. A design space exploration exercise using the toolchain is carried out for a typical EnerKíte wing.

References:

[1] A. A. Candade, M. Ranneberg, R. Schmehl: Structural Analysis and Optimization of a Tethered Swept Wing for Airborne Wind Energy Generation. Wind Energy (in review), 2019.

[2] M. Ranneberg, "Direct Wing Design and Inverse Airfoil Identification with the Nonlinear Weissinger Method," Cornell Physics. Flu-Dyn, pp. 1–13, Jan. 2015.



Bridle design space exploration using the described toolchain.