Lei Kites Research at ENSTA Bretagne - Application to Vessels Auxiliary Propulsion by Lift-To-Drag Ratio Estimation and Velocity Prediction Program

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The Leading Edge Inflatable kites research is one of the activities of the Naval and Offshore Structures research department of the ENSTA Bretagne graduate and post graduate school of engineering located in Brest Brittany. This college of engineering is one of the technical universities of the French ministry of defense. The team is formed of four associate professors, one Ph.D. student, two master students (naval hydrodynamics). The team was launched in 2011 to work closely with the French sailor Yves Parlier on his "Beyond the Sea" project, a nature sensitive innovative approach for sea-users developing traction by 100% natural energy. Indeed, the request in reducing the CO2 emissions and the increasing oil prices affect all transportation industries and especially the maritime industry.

In this context, taking advantage of wind energy by using kites as auxiliary propulsion device is considered as a promising solution. The complexity to numerically simulate the flight of a kite requires the development of computationally efficient models, such as those based on the lifting line theory to evaluate the aerodynamic characteristics of the kite. This presentation highlights a 3D lifting line model approach, which takes into account the three-dimensional shape of the kite and the viscous drag [1, 2]. The methodology exposed was applied to a F-one Revolt LEI kite to predict its lift-to-drag ratio. Results appear to be in very good agreement with RANSE simulations in the case of a paragliding wing, but need much less computational effort. Consequently, the modeling approach was successfully integrated into a velocity prediction program loop to assess kite auxiliary propulsion efficiency for merchant vessels. Effects on propulsion energy benefits are presented and discussed according to true wind angle. These results are expected to be extended to the flying shape identification for future structural analysis required by the design of huge kites.

References:

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