Abstract Submitted
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On the leading edge vortex of thin wings[1] ABEL ARREDONDO, IGNAZIO MARIA VIOLA, University of Edinburgh — On thin wings, the sharp leading edge triggers laminar separation followed by reattachment, forming a Leading Edge Vortex (LEV). This flow feature is of paramount importance because, if periodically shed, it leads to large amplitude load fluctuations, while if stably attached to the wing, it can provide lift augmentation. We found that on asymmetric-spinnaker-type yacht sails, the LEV can be stable despite the relatively low sweep (30°). This finding, which was recently predicted numerically by Viola et al. (Ocean Eng., 2014; 90:93-103), has been confirmed through current flume tests on a 1:115th model scale sail. Forces were measured and Particle Image Velocimetry was performed on four horizontal sail sections at a Reynolds number of 1.7×10^4. Vortex detection revealed that the LEV becomes progressively larger and more stable towards the highest sections, where its axis has a smaller angle with respect to the freestream velocity. Mapping the sail section on a rotating cylinder through a Joukowski transformation, we quantified the lift augmentation provided by the LEV on each sail section. These results open up new sail design strategies based on the manipulation of the LEV and can be applicable to the wings of unmanned aerial vehicles and underwater vehicles.

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