

Assignment 4 Vortex induced drag analysis of a wing



Requirements

- Personal or group task: personal
- Minimum/Maximum number of pages: 10 / 15 (excluding Title page)
- Font size: 10 – 12

Background

Examining aircraft performance enhancement, it is interesting to explore the optimization possibilities for the aerodynamics and associated structural loading of wings with non-planar configurations. Since Whitcomb's early work, winglets have been employed for decades to enhance the aerodynamic efficiency of aircraft. For a detailed understanding of the aerodynamic principles governing winglets, refer to [1]. In essence, a winglet generates a force, primarily forward due to the normalwash created by the circulation over the wing tip. This forward force acts as thrust, mitigating the induced drag of the aircraft, which constitutes approximately 40% of total drag during cruise and 80–90% during the second climb segment. While adding a winglet may seem appealing for aerodynamic performance, it has implications for the structural weight of the wing.

Consequently, a purely aerodynamic optimization might yield a winglet with an undesirable weight penalty. This additional weight could counteract the positive effects of drag reduction. Thus, designing a non-planar wing involves a complex multidisciplinary optimization process. In this assignment we only concentrate on the aerodynamics of non-planar wings and winglets. The structural aspects, that would change the optimum layout is left to other courses.

Vortex Assignment

Judd E. Hollander



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