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DEVELOPMENT OF AERODYNAMIC SHAPE OPTIMIZATION METHODS FOR AEROELASTIC WING DESIGN

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Abstract: Aerodynamic shape optimization studies will be presented with a primary focus on aircraft wing design. Naturally, shape optimization problems experience drastic changes in geometry, which means versatile parameterization techniques are required to maximise the available design space. Different methods of parameterization will be presented including standard aerofoil definitions and nodal control methods. These methods will be compared based on their ability to achieve complex geometry from initial basic wing configurations (e.g. rectangular wing) and the performance of subsequent designs. A typical objective function is to minimize the drag to lift ratio integrated over the wing surface subject to geometric constraints. The aerodynamic problem is solved using a modified version of MIRAS [1]. MIRAS is a software developed for wind turbine performance analysis based on a three-dimensional panel method. Our analysis assumes the flow is inviscid, steady and incompressible. The code is modified to calculate the gradients necessary for sensitivity analysis which is based on an adjoint formulation. The motivation for this work is to develop shape optimization tools that can be applied to future aeroelastic studies within the TopOpt research group. The long-term goal is to combine these tools with structural optimization techniques to simultaneously produce external geometric and internal structural designs with optimized aerodynamic and structural performance. [1] Ramos-García N, Sørensen JN, Shen WZ (2016) Three-Dimensional Viscous-Inviscid coupling method for wind turbine computations. Wind Energy 19:67-93