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Comparison of theory and large-eddy simulations with experiments of flow over a wing[1] LUIS MARTINEZ, MARC HENRY DE FRAHAN, GANESH VIJAYAKUMAR, SHREYAS ANANTHAN, National Renewable Energy Laboratory — In this work, we compare experimental measurements of the force distribution along the span of a NACA-0015 wing at low angles of attack to: 1) filtered-lifting-line-theory, 2) large-eddy simulations (LES) using the actuator line model, and 3) blade resolved detached-eddy simulations (DES). These techniques are often used to model wind turbine blades in computational fluid dynamics. Filtered-lifting-line-theory is a semi-analytical solution to the blade forces along the blade from the actuator line model. The results from filtered-lifting-line-theory and LES using the actuator line model are in excellent agreement, as expected, and agree well with the measurements. The results suggest that when computing the forces along the blade, filtered-lifting-line-theory, LES using the actuator line model, and blade resolved DES agree well with the experiment and the differences between each method are small. However, when comparing the flow fields downstream, blade resolved simulations are able to accurately capture the tip-vortex, whereas the actuator line model cannot always capture the flow details from the tip vortex.

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