Accuracy of current actuator-line modeling methods in predicting wind turbine blade loads

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Abstract
Actuator-line modeling has become a prominent method for computing individual wind turbine wakes and their interaction within large wind turbine arrays. The advantage of actuator-line modeling is rooted in representing wind turbine blades as compact lines of body forces within a RANS- or LES-type solver. This eliminates the need for prohibitively expensive fully-resolved and detailed blade flow simulations while retaining the prominent flow features in the wake such as blade tip vortices and the axial momentum deficit. However, the close linkage between sectional blade forces and their reactive momentum deficit distribution just behind the rotor and its evolution and recovery further downstream in the wake has not been addressed in much detail in the literature. We have observed that current actuator-line modeling largely overpredicts blade tip loads in comparison to blade-element momentum analyses and available data. This seminar presents some of the current efforts in our research group in quantifying and improving the predictive capability of actuator-line modeling used in the wind energy community.