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# FATIGUE MODELING OF LARGE COMPOSITE WIND TURBINE BLADES

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Fatigue lifetime prediction of wind turbine blades is a challenging task because it requires not just the identification of the different factors that are involved in it but also how they interact with each other. Some of these factors are, among others: the intrinsic fatigue behavior of composite materials, the presence of adhesive joints and sandwich components, the multiaxiality and high variability of loading conditions, the high number of load cases and load combinations, the effects of manufacturing defects, the stochastic nature of loads, material properties and geometry. Most of these factors are not considered in commonly used lifetime prediction methods suggested by IEC 61400-1 international standard and DNV GL certification and design guidelines. In these methods, linear, uniaxial and mainly deterministic approaches are implemented, leading to inaccurate lifetime predictions.

In the present work, initial efforts toward improved fatigue models that consider the aforementioned factors during the fatigue design of wind turbine blades are presented. Both linear and non-linear interpolation in the constant lifetime diagrams and multiaxial fatigue failure criteria are implemented in blade structure examples by following fatigue lifetime methods. The applied loads to the blades are based on aeroelastic simulations performed with the horizontal axis wind turbine simulation code HAWC2. The three-dimensional stresses at each point of the blade cross-sections are obtained by using a cross section analysis tool called BECAS. The stochastic behavior of the material properties is also considered by taking into account both the physical and statistical uncertainty.