ESTIMATION OF FATIGUE AND EXTREME LOAD DISTRIBUTIONS FROM LIMITED DATA WITH APPLICATION TO WIND ENERGY SYSTEMS

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ABSTRACT

An estimate of the distribution of fatigue ranges or extreme loads for wind turbines may be obtained by separating the problem into two uncoupled parts, (1) a turbine specific portion, independent of the site and (2) a site-specific description of environmental variables. We consider contextually appropriate probability models to describe the turbine specific response for extreme loads or fatigue. The site-specific portion is described by a joint probability distribution of a vector of environmental variables, which characterize the wind process at the hub-height of the wind turbine. Several approaches are considered for combining the two portions to obtain an estimate of the extreme load, e.g., 50-year loads or fatigue damage. We assess the efficacy of these models to obtain accurate estimates, including various levels of epistemic uncertainty, of the turbine response.