

An experimental study on the identification of the root bolts state of wind turbine blades using blade sensors

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April 29, 2023

Abstract

Bolt looseness may occur on wind turbine (WT) blades exposed to operational and environmental variability conditions, which sometimes can cause catastrophic consequences. Therefore, it is necessary to monitor the loosening state of WT blade root bolts. In order to solve this problem, this paper proposes a method to monitor the looseness of blade root bolts using the sensors installed on the WT blade. An experimental platform was first built by installing various blade sensors for monitoring bolt looseness. Through the physical experiment of blade root bolts looseness, the response data of blade sensors were then obtained under different bolt looseness degrees. Afterwards, by analyzing the sensitivity of the response signal to the looseness of blade root bolts, the types and number of sensors that can judge the looseness of blade root bolts were determined. Finally, the multi-domain sensitive features of response signals were fused to construct a hybrid domain feature set of bolt looseness. The LightGBM classification algorithm was applied to identify different bolt loosening states for this hybrid domain feature data. The identification results of experimental data showed that the proposed method can accurately determine the loosening state of single or multiple WT blade root bolts.

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