Mass detection, localization and estimation for wind turbine blades based on statistical pattern recognition

A method for mass change detection on wind turbine blades using natural frequencies is presented. The approach is based on two statistical tests. The first test decides if there is a significant mass change and the second test is a statistical group classification based on Linear Discriminant Analysis. The frequencies are identified by means of Operational Modal Analysis using natural excitation. Based on the assumption of Gaussianity of the frequencies, a multi-class statistical model is developed by combining finite element model sensitivities in 10 classes of change location on the blade, the smallest area being 1/5 of the span. The method is experimentally validated for a full scale wind turbine blade in a test setup and loaded by natural wind. Mass change from natural causes was imitated with sand bags and the algorithm was observed to perform well with an experimental detection rate of 1, localization rate of 0.88 and mass estimation rate of 0.72.

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