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Improving defect detection in wind turbine blades with psychoacoustic means and prediction models

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ABSTRACT

Wind power plants, and particularly their blades, must withstand significant environmental stresses. Regular inspections of the blades' structural integrity are essential to ensure a projected lifetime of fifteen to twenty years. Besides a visual inspection, experienced engineers tap on the blades surface with a suitable tool to detect invisible defects inside the blade's cross-section. By listening to the emitted tap sounds, the human inspector can assess the material integrity.

This work aims at identifying acoustic features that are key to building an acoustic analysis algorithm of tap test recordings. The process involved two approaches: 1) Listening tests with ten engineers familiar with the inspection of blades, in which audible differences between tap test recordings from intact and defective material were rated using a set of defined adjectives (semantic differential rating). 2) Correlation of acoustic features, which were extracted with our Matlab toolbox, with a detailed assessment of defects in the vicinity of the respective tap points. As a result, an informed (based on the inspectors' knowledge), multi-layered regression algorithm could be built, which takes single-valued acoustic features as inputs and successfully rates the material integrity and damage size around a tap point.

Keywords: perception model, non-destructive testing, machine learning

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