WindSTAR
Wind-Energy Science, Technology, and Research
Industry/University Cooperative Research Center

Long Duration Testing of the Acoustic Blade Monitoring System

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Project B1-19 builds off previous projects to develop a low cost highly capable wind turbine blade structural health monitoring system. Wind turbine blade failures can be a significant contributor to the operation and maintenance expenses for wind farm operators. By identifying damage in the early stages, unscheduled blade replacements and major repairs can be replaced by scheduled minor repairs. This approach uses acoustic monitoring of the sound in the blade internal cavities to identify anomalies that could be indicative of damage and has been verified with a blade subsection in a wind tunnel. This project is focused on deployment of acoustic sensors to operational wind turbines for long-duration testing, as well as continued development of the machine learning techniques to identify damage and improvement of the sensor node. Sensors were first deployed inside blades undergoing fatigue testing at the WTTC. This allowed for testing of the node performance and provided valuable data for analysis. Analysis of this data demonstrated how machine learning could successfully identify clusters corresponding to different blade conditions. Improved performance of the machine learning algorithm was then achieved using data collected during wind tunnel experiments for a previous WindSTAR project. In this analysis, the anomaly identification capabilities of the machine learning algorithm were highlighted, as damage location and size could be identified, providing a valuable benchmark in preparing for operational wind turbine data. A new version of the sensor node has been developed that is more reliable, and its acoustic performance was tested and verified inside an anechoic chamber. The power supply plan was improved for implementation in the hub and blades of an operational wind turbine. Seven sensors have been shipped for a deployment on a wind turbine in Texas. According to the deployment plan, two sensor would be placed in each of the three blades of the turbine, and one sensor would be placed at the base of the tower. These will provide valuable data for analysis of wind turbine acoustics. In addition, the process of deploying at a wind farm resulted in answering practical questions regarding implementation which are being incorporated into an improved design. This project was successful in setting up long-duration testing, and the data collected will be of great value in future projects.

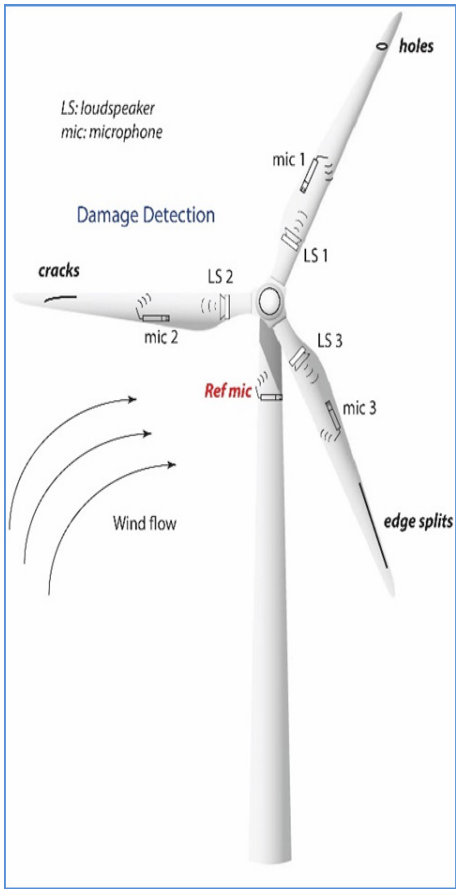

Figure 1: Acoustics based blade structural health monitoring approach. Microphones identify changes in sound pressure, which is used to detect damage.