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

System Integration of a Wind Turbine Blade Acoustic Monitoring System

Principal Investigator:
Murat Inalpolat (University of Massachusetts Lowell)

Co-Principal Investigator:
Christopher Niezrecki (University of Massachusetts Lowell)
Yan Luo (University of Massachusetts Lowell)

Student Researchers:
Christopher Beale & Ioannis Smanis (University of Massachusetts Lowell)

IAB Mentors:
Ron Grife (Leeward Renewable Energy)
Adam Johs (EDP Renewables)
Ben Rice (Pattern Energy)
Nicholas Althoff (GE Renewable Energy)

High operational loads cause significant bending and shear and thus are detrimental to wind turbine blades. Currently available condition monitoring systems are not capable of detecting different types and severity levels of damage and defects such as leading and trailing edge splits, holes and cracks. A comprehensive damage detection system that can monitor the blades for leading and trailing edge splits, delaminations, cracks and holes is currently not available. Consequently, it is vital to provide a low cost yet highly capable condition monitoring solution that will reduce the need for unscheduled maintenance. Deployment of a previously developed wind turbine blade acoustic monitoring system requires complete understanding and mitigation of the mechanical, electrical and structural problems associated with the installation and operation of the system. The project team will continue the efforts from our previous project, which has successfully shown the feasibility of the proposed technique in the laboratory environment as well as in the field (at the WTTC). This year's project entails integration of this novel acoustic monitoring system on a full scale operational turbine blade and mitigating the potential problems with the system and the blade interface. Lessons learned will be leveraged in order to improve the current system design and its integration. In this project, acoustic sensing will be used to detect cracks, holes, delaminations and trailing edge splits. Acoustic speakers will be used to excite the blade's cavity from internally and aerodynamic noise due to wind from externally. Wireless microphones will be used for the cavity-internal passive detection and a single microphone located underneath the nacelle will be used for the external active detection of damage. Performance of the new approach to identify structural damage will be validated on a full-scale wind turbine blade. The team will focus on the field tests on a full-scale turbine as well as improving and implementing the developed signal processing and machine learning algorithms to enable this technology in the near future.

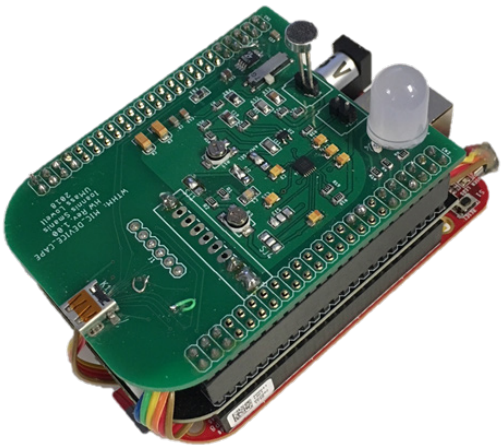

Figure 1: Acoustic sensing node circuitry.

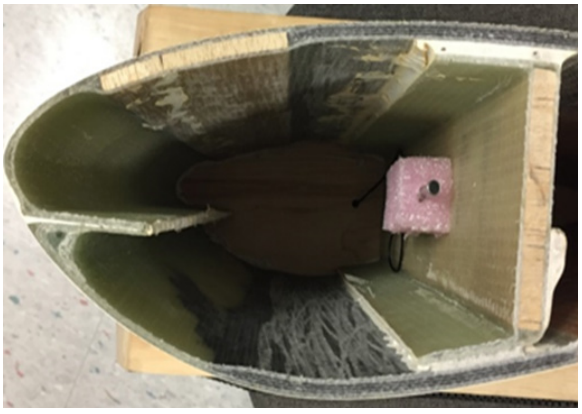

Figure 2. A close-up view of the blade-internal acoustic

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