

A Computational Acoustic Interrogation of Damage to Wind Turbine Blades

R. Canturk¹, M. Inalpolat¹

¹University of Massachusetts - Lowell, Lowell, MA, USA

Abstract

Modern wind turbine blades consist of composite airfoil shaped structures that form a hollow acoustic cavity. Because of continually varying aerodynamic forces, gravitational loads, lightning strikes, and weather conditions, all blades will experience leading and trailing edge splits, cracks, or holes. Acoustic sources (speakers and wind flow) excite this dynamic cavity structure.

The blade damage will manifest itself in changes to the acoustic cavity frequency response functions and to the blade acoustic transmission loss. One of the most robust tools for modeling acoustic phenomena in real structures is finite element analysis (FEA). The multiphysics modeling capability of COMSOL Multiphysics® software enables us to model complex structures and acoustic wave propagation through blade surface with damage and help improve the non-destructive testing (NDE) technology as proposed in this study.