Structural Dynamics and Acoustic Systems Laboratory
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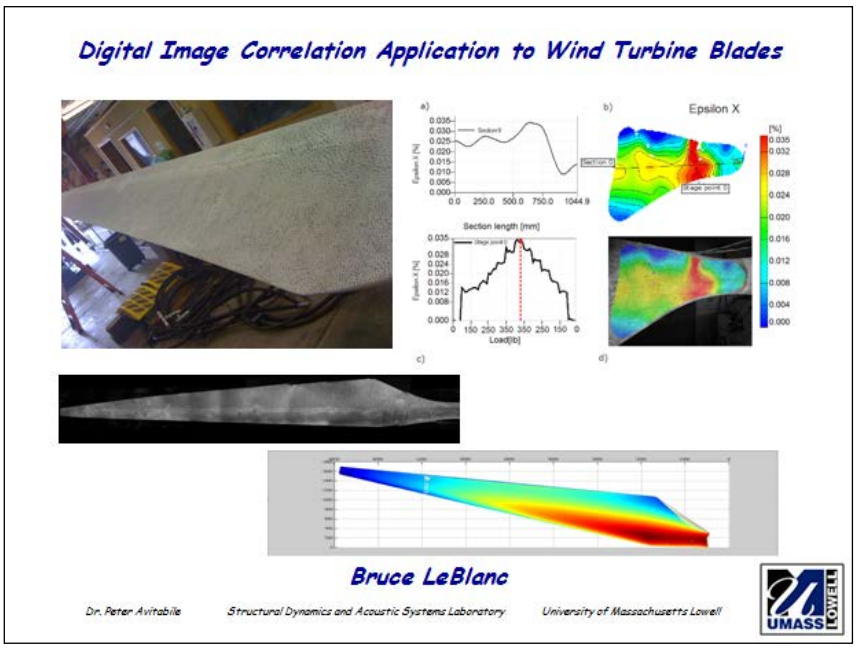
MASTER'S THESIS – BRUCE LEBLANC

NON DESTRUCTIVE INSPECTION OF WIND TURBINE BLADES WITH 3D DIGITAL IMAGE CORRELATION



Growing demand and deployment of wind power has led to a significant increase in the number of wind-turbine blades manufactured globally. As the physical size and number of turbines deployed grows, the probability of manufacturing defects being present in composite turbine blade fleets also increases. As both capital blade costs and operational and maintenance costs increase for larger turbine systems, the need for large-scale inspection and monitoring of the state of structural health of turbine blades during manufacturing and operation increases. One method for locating and quantifying manufacturing defects, while also allowing for the in-situ measurement of the structural health of blades, is three-dimensional digital image correlation (3D DIC). Several tests were performed on composite coupon specimens, including quasi-static and fatigue, to demonstrate the ability of the technique to measure strain and detect manufacturing defects in a non-destructive way. A nine-meter CX-100 composite turbine blade platform was used to extract full-field displacement and strain measurements across an entire blade surface using 3D DIC in order to identify defects within the blade. Post-processing of the data using a stitching technique enables the shape and curvature of the entire blade to be observed for a large-scale wind turbine blade. The overall results indicate the measurement approach can clearly identify failure locations, discontinuities in the blade curvature under load, and manufacturing defects, therefore demonstrating the great potential of the optical measurement technique and its capability for use in the wind industry for large-area inspection.

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