Detection of Manufacturing Defects via Wavefield Image Processing Techniques: An Experimental Study

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Defects that occur during the manufacturing of a composite can have drastic effects on the intended strength or durability of composite structures. These defects include gaps and overlaps in the prepreg tow-tape that can occur during Automated Fiber Placement (AFP) system operations, as well as unintended fiber waviness caused by differential thermal loading during curing cycles. Wavefield imaging offers a non-contact method of detecting various anomalies in composites, and emerging technologies can enable rapid wavefield acquisition. In this work, composite samples were created with intentional and analogous manufacturing defects such as the ones mentioned, and full guided wavefield data was captured using a Laser Doppler Vibrometer (LDV) while guided waves were excited in the sample. Studies of the data were performed using wavenumber analysis methods, such as Multi-Frequency Local Wavenumber Technique which has been used to detect delamination in composites. Other wavenumber analysis methodologies were developed guided by finite-difference simulation results. The results of these wavenumber analysis methods will be presented, as well as a brief discussion of the defect simulations.