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Instantaneous Online Monitoring of Unmanned Aerial Vehicles without Baseline Signals

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A structural health monitoring problem is often cast in the context of a statistical pattern recognition paradigm, where damage is inferred by comparing test signals with previously recorded baseline signals. However, operational and environmental variations of a system after the collection of the baseline signals can often mask signal changes caused by damage when the statistical pattern comparison is performed. To address this issue for continuous online monitoring, a damage detection technique, which does not rely on any past baseline signals, is proposed to assess damage in composite structures such as wings of an unmanned combat aerial vehicle Predator. A time reversal concept of modern acoustics has been adapted to guided-wave propagation to improve the delectability of local defects in composite structures. It is demonstrated that the original input waveform could be successfully reconstructed in a composite plate through the enhanced time reversal method. However, this time reversibility of Lamb waves is violated when wave distortion due to wave scattering is caused by a defect along a direct wave path. Examining the deviation of the reconstructed signal from the known initial input signal allows instantaneous identification of damage without requiring the baseline signal for comparison.