# Numerical and experimental investigation of local stress measurement based on zero group velocity Lamb mode

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Zero group velocity mode (ZGV), resulting from Lamb wave resonance, has been proven to be efficient for local material characterization of the plate-like structure. In this study, stress measurement based on ZGV technology in a thin aluminum plate was investigated theoretically and experimentally. Firstly, the Lamb wave's dispersive characteristics under initial stress were analyzed based on the Floquet-Bloch theory with Murnaghan hyperelastic material model. The obtained dispersion curves show that higher-order Lamb wave modes near the cut-off frequencies are sensitive to applied stress across the plate, indicating that the S1-ZGV mode has a high sensitivity to stress. Then, a series of numerical simulations were conducted to investigate the optimal incident angles and frequency to excite and detect the S1-ZGV mode by oblique incidence. Thus, a contact ultrasonic system with a tailor-made compact wedged transducer was built for experimental validation. Stress calibration and stress measurement were then carried out by standard tensile testing for aluminum plates. The stress coefficient between the frequency shift and the applied stress was obtained with a uniform plate. The stresses of the nonuniform plate at different positions were measured and the measurement error were discussed. This research proves that S1-ZGV method is effective for local stress measurement in plate-like structures.