Accelerated Noncontact Guided Wave Array Imaging Via Sparse Array Data Reconstruction

Homin SONG, Yongchao YANG

Noncontact guided wave array imaging with a scanning laser Doppler vibrometer (SLDV) is an effective tool to detect and locate defects within a plate-like structure, as it obviates the need for installing, calibrating, and maintaining a transducer array. However, it requires collecting guided wave signals through scanning across dense spatial grid points to avoid non-defect artifacts in the array image, which is time-consuming. In this paper, we present an accelerated noncontact guided wave array imaging method using a limited number of measurement points of scanning array while providing defect imaging performance comparable to the dense scanning case. In our approach, sparse scanning measurements at only a small number of points are carried out first for fast guide wave data acquisition. Then, dense guided wave array data is reconstructed from these sparse array measurements using a sparsity-promoting optimization technique, followed by delay-and-sum (DAS) beamforming to image defects within a test structure. We conducted laboratory experiments on composite plate specimens with multiple defects and discuss in detail its performance in accelerated noncontact guided wave array imaging.