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Estimation of guided waves from cross-correlations of diffuse
Wavefields for passive Structural Health Monitoring

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Recent theoretical and experimental studies in a wide range of applications (ultrasonics, underwater acoustics, seismic...) have demonstrated that Green's functions (impulse responses) can be extracted from cross-correlation of diffuse fields using only passive sensors. The technique, whose validity is supported by a physical argument based on time-reversal invariance, effectively uses a correlation process between the point source and points located in the focal zone. Indeed, the coherent noise source distributions can be considered as a time-reversal mirror and the cross-correlation operations gives the field measured at one receiver after refocusing on the other receiver. Passive-only reconstruction of coherent Lamb waves (80-200 kHz) in an aluminum plate and thickness comparable to aircraft fuselage and wing panels will be presented. In particular, the influence of the noise source characteristics (location, frequency spectrum) on the signal-to-noise ratio the emerging coherent waveform will be investigated using a scanning laser Doppler velocimeter. This study suggests the potential for a structural health monitoring method for aircraft panels based on passive ultrasound imaging reconstructed from diffuse fields.