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Noise cross-correlation in a metamaterial: From laboratory to field data

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In this study, we use METAFORET data in which a dense array of sources and receivers are distributed over an area of 120m by 120m covering a field and a forest. This large experiment has a broad range of potential applications from studying the theory of ambient noise interferometry to seismic hazards application. We are mostly interested in implementing this dataset for interferometry applications. We calculate the cross-correlation of the recorded METAFORET data and evaluate the convergence of the results towards the Green's function. In parallel with METAFORET data analysis, we conduct a laboratory experiment with a setup similar to METAFORET where the ground and the trees in the forest are idealized by a thin elastic plate and an array of rods, respectively. While in the laboratory experiments we work with Lamb waves, in the real experiment we deal with Rayleigh waves but it should be noted that both these waves are inherently 2-D and significantly dispersive waves. Following the theory of ambient-noise interferometry and using the reciprocity theorem, we study the convergence of averaged cross-correlation of recorded data over all possible virtual noise sources towards the Green's function. We compare the results obtained with the METAFORET data with the ones obtained in the laboratory. Trees and rods in METAFORET and laboratory act as scatterers and this provides a unique chance to study directly the effect of scattering on the Green's function reconstruction. Especially due to the scatterers resonance, band gaps appear to which the noise cross-correlation seems to be significantly sensitive.