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Passive tomography of the oceanic environment using ambient noise cross-correlations

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The random nature of noise and scattered fields tends to suggest limited utility. Indeed, acoustic fields from random sources or scatterers are often considered to be incoherent, but there is some coherence between two sensors that receive signals from the same individual source or scatterer. An estimate of the Green's function (or impulse response) between two points can be obtained from the cross-correlation of ambient noise recorded at these two points. Recent theoretical and experimental studies in ultrasonics, civil engineering, underwater acoustics and seismology have investigated this technique in various environments and frequency ranges. These results provide a means for passive tomography of the ocean environment using only the ambient noise field, without the use of active sources. The coherent wavefronts emerge from a correlation process that accumulates contributions over time from noise sources whose propagation paths pass through both receivers. We will examine the background physics of extracting these coherent structures and present experimental results confirming these theoretical arguments. Further we will present experimental results such as using noise for time synchronization and localization of unconnected acoustic receivers, and for constructing passive tomographic images of the environment.