Theoretical and computational aspects of statistically stable adaptive coherent interferometric imaging in random media

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Abstract

I will discuss a robust, coherent interferometric approach for array imaging in cluttered media, in regimes with significant multipathing of the waves by the inhomogeneities in clutter. In such scattering regimes, the recorded traces at the array have long and noisy codas and classic imaging methods give unstable results. Coherent interferometry is essentially a very efficient statistical smoothing technique that exploits systematically the spatial and temporal coherence in the data to obtain stable images. I will describe in some detail the resolution of this method for two types of cluttered media: (1) isotropic, weakly scattering clutters, where waves are scattered mostly forward and (2) layered, strongly fluctuating clutters, where back scattering is strong. I will show that in spite of such opposite wave scattering regimes, coherent interferometry behaves equally well, which indicates its wide applicability. In coherent interferometry, there is a delicate balance between having stable and sharp images and achieving the optimal resolution depends on our knowledge of the clutter dependent spatial and temporal decoherence parameters. I will explain briefly how we can estimate these parameters efficiently during the image formation process, as we do in adaptive coherent interferometry.