Half-a-day on "COMPRESSIVE SENSING IN ELECTROMAGNETICS"

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Abstract

The widely known Shannon/Nyquist theorem relates the number of samples required to reliably retrieve a “signal” to its (spatial and temporal) bandwidth. Such a fundamental criterion yields to both theoretical and experimental constraints in several applications in the fields of inverse scattering, antenna synthesis and measurements, as well as adaptive array control. Indeed, there is a relation between the number of measurements/data (complexity of the acquisition/processing), the degrees of freedom of the field/signal (temporal/spatial bandwidth), and the retrievable information regarding the phenomena at hand (e.g., dielectric features of an unknown object, presence/position of damages in an array, location of an unknown incoming signal).

The new paradigm of Compressive Sensing (CS) is enabling an overall revision of such concepts by distinguishing the “informative content” of signals from their bandwidth. Indeed, CS theory asserts that one can recover certain signal/phenomena exactly from far fewer measurements than it is indicated by Nyquist sampling rate. To achieve this performance, CS relies on the sparsity/compressibility of the signal at hand, i.e., on the fact that most natural phenomena can be represented by few non-zero coefficients in suitable expansion bases, and on the use of aperiodic sampling strategies, which can guarantee, under suitable conditions a perfect recovery of the information content of the signal. Some interesting results have already been obtained by exploiting CS techniques to solve problems in non-uniform array design and analysis, microwave imaging of sparse scatterers, as well as failure detection in large arrays. However, further studies on the exploitation of CS techniques are of interest to investigate the features and potentialities of such an innovative paradigm in many applications of electromagnetics.

References


