An analysis of block sampling strategies in compressed sensing

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Compressed sensing (CS) is a theory which guarantees the exact recovery of sparse signals from a few number of linear projections. The sampling schemes suggested by current CS theories are often of little relevance since they cannot be implemented on practical acquisition systems. In this paper, we study a new random sampling approach that consists in selecting a set of blocks that are predefined by the application of interest. A typical example is the case where the blocks consist in horizontal lines in the 2D Fourier plane. We provide theoretical results on the number of blocks that are required for exact sparse signal reconstruction in a noise free setting. We illustrate this theory for various sensing matrices appearing in applications such as time-frequency bases. A typical result states that it is sufficient to acquire no more than $O\left(s \ln^2(n) \right)$ lines in the 2D Fourier domain for the perfect reconstruction of an s-sparse image of size $\sqrt{n} \times \sqrt{n}$. The proposed results have a large number of potential applications in systems such as magnetic resonance imaging, radio-interferometry or ultra-sound imaging.

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