Deterministic Compressed Sensing Matrices from Multiplicative Character Sequences

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(Submitted on 11 Nov 2010)

Compressed sensing is a novel technique where one can recover sparse signals from the undersampled measurements. In this paper, a $K \times N$ measurement matrix for compressed sensing is deterministically constructed via multiplicative character sequences. Precisely, a constant multiple of a cyclic shift of an M-ary power residue or Sidelnikov sequence is arranged as a column vector of the matrix, through modulating a primitive M-th root of unity. The Weil bound is then used to show that the matrix has asymptotically optimal coherence for large K and M, and to present a sufficient condition on the sparsity level for unique sparse solution. Also, the restricted isometry property (RIP) is statistically studied for the deterministic matrix. Numerical results show that the deterministic compressed sensing matrix guarantees reliable matching pursuit recovery performance for both noiseless and noisy measurements.

Subjects:	**Information Theory (cs.IT)**
Cite as:	**arXiv:1011.2740v1 [cs.IT]**

Submission history

From: Nam Yul Yu [view email]

[v1] Thu, 11 Nov 2010 19:16:33 GMT (417kb)