Low-complexity Walsh-Hadamard Transform (WHT) for sparse data

Key words: Signal processing, computing algorithm, signal subsampling, Walsh-Hadamard


Ref: 6.1309

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The discrete Walsh-Hadamard transform is a known signal processing tool with multiple and diverse applications. However, some of its useful properties, especially those related to signal subsampling have remained underdeveloped.

A low-complexity algorithm to compute the length \( N \) Hadamard transform of data \( K \)-sparse in the Hadamard domain.

- Improved algorithm complexity \( \sim K \log^2 N \)
- Reduced number of samples \( \sim K \log N \)

On the left, bipartite graph representation of the WHT for \( N = 8 \) and \( K = 3 \). On the right, the underlying bipartite graph after applying \( C = 2 \) different hashing produced by plugging \( \Sigma_1, \Sigma_2 \) in (6) with \( B = 4 \)