Fast and numerically stable algorithms for discrete cosine and Hartley transforms

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Discrete trigonometric transforms are widely used in signal processing and image compression. Examples of such transforms are discrete cosine transforms (DCT) and discrete Hartley transforms (DHT).

In this talk, we present DCT- and DHT–algorithms of radix–2 length, which are based on real factorization of the corresponding transform matrices into products of sparse, orthogonal matrices. Here sparse means two nonzero entries per row and column at most. These algorithms are completely recursive and use only permutations, scaling with $\sqrt{2}$, butterfly operations, and plane rotations. The sparsity joint with the orthogonality of the matrix factors is the key for proving that these algorithms have low arithmetical costs and an excellent numerical stability.

Finally, we consider the matrix algebras related to DHT and improve previous results of D. Bini & P. Favati (1993) and A. Bortoletti & C. Di Fiore (2003).

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