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Abstract:

The Diagonal multidimensional FFT – versus the Polynomial transform

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The Diagonal FFT multidimensional transform was developed by the authors. Asymptotically for large transforms it reduces the multiplication count in an *m*-dimensional FFT using classical methods by a factor *m*. This can, however, be achieved with a Polynomial FFT as well.

It is well known that the multiplication count has become a less relevant measure of the efficiency of FFT algorithms than it formerly was.

This work compares the performance of our C++ implementation of the Diagonal transform with that of the Polynomial transform. Neither transform is optimized for a given computer architecture.

For our own PC environment, the Diagonal transform outperforms the polynomial transform, but the programs will be tested on other computers as well, including high performance multi-processor machines at NTNU in Gjøvik.

The Diagonal transform is derived from the FFT vector transforms. Our implementation uses the complex-conjugate transform originally developed by one of the authors and published as part of new algorithm at a conference on fishery management [1] (equivalent to the Split Radix FFT in the number of arithmetic operations).

TABLE 1
Value of the constant a in the dominant term $aN \lg N$ of complex multiplications for very large FFTs.

Algorithm	2D	3D	*m-dimensions*
Row-Column Radix 2	0.500	0.500	1/2
Row-Column Radix 4	0.375	0.375	3/8
Row-Column Split Radix	0.333	0.333	1/3
Vector Radix 2	0.375	0.292	$(1/m)\,(1\text{-}2^{-m})$
Vector Radix 4	0.234	0.164	$1/(2m)\,(1\text{-}4^{-m})$
Vector Split Radix	0.214	0.156	$\frac{1}{2m}\cdot\frac{2^{m+1}-2}{2^{m+1}-1}$
Diagonal Radix 2	0.250	0.167	$1/(2m)^a$
Diagonal Radix 4	0.188	0.125	$3/(8m)^a$
Diagonal Split Radix	0.167	0.111	$1/(3m)^a$

The talk will explain the main idea behind the Diagonal transform and its potential. An article with a description of the Diagonal transform is available from the authors.

[1] 1984. Þorgeir Sigurðsson. A New Method for Smoothing Length Distributions of Fish and Sharpening Peaks due to Different Year Classes. International Council for the Exploration of the sea. C.M.1984/ D:7 Statistics Committee.