NASA TECH BRIEF

NASA Pasadena Office

Multi-Dimensional Real Fourier Transform

The problem:

To compute the one-dimensional and multi-dimensional Fourier transforms for real data, the multi-dimensional complex Fourier transforms, and the multi-dimensional sine, cosine, and sine-cosine transforms.

The solution:

Four subroutines, each of which performs the required calculation for one of the four problems given. Each subroutine uses the Cooley-Tukey Fast Fourier Transform (FFT), and, in all but the one-dimensional case, the transforms are calculated in up to six dimensions.

How it's done:

The Cooley-Tukey algorithm is an efficient computational procedure for evaluating expressions of the form:

$$X_j = \sum_{k=0}^{N-1} a_k W^{jk}, \quad \begin{array}{l} j = 0,1\ldots N-1 \\ W = e^{2\pi i/N} \\ i^2 = -1 \end{array}$$

where x_j and a_k are complex, and N is composite. If the calculations were to be carried out in a straightforward manner, with an operation defined as one complex multiplication and addition, a total of $N(N-1)$ operations would be required; i.e., $N-1$ operations for each value of j. The Cooley-Tukey al-

gorithm, however, organizes the calculations in such a way that only $(N \log_2 N)$ operations are required, which represents a significant savings for large N.

Notes:

1. These programs are written in FORTRAN V for use on the UNIVAC-1108 computer.

2. The specific subroutines are as follows: NPO-11648, Multi-Dimensional Real Fourier Transform; NPO-11649, One-Dimensional Real Fourier Transform; NPO-11651, Multi-Dimensional Complex Fourier Transform; and NPO-11652, Multi-Dimensional Sine, Cosine, and Sine-Cosine Transforms.

3. Inquiries concerning these programs should specify the program desired, and may be directed to:
   COSMIC
   Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B71-10133

Patent status:

No patent action is contemplated by NASA.

Source: Fred T. Krogh of
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