RFSTFT	CERN Program Library	D705

Author(s) : K.S. Kölbig, H.-H. Umstätter **Library:** MATHLIB

Submitter : **Submitted:** 22.04.1996

Language : Fortran **Revised:**

Real Fast Fourier Transform

Subroutine `RFSTFT` calculates the finite Fourier transform of a real periodic sequence $y_0, y_1, \ldots, y_{n-1}$, whose period n must be a power of two. Either the direct transform

$$C_j = \frac{1}{n}\sum_{k=0}^{n-1} y_k \exp\left(\frac{-i2\pi jk}{n}\right), \qquad (j = 0, 1, \ldots, n/2), \tag{1}$$

or the inverse transform

$$y_k = \sum_{j=0}^{n-1} C_j \exp\left(\frac{i2\pi jk}{n}\right), \qquad (k = 0, 1, \ldots, n-1), \tag{2}$$

where y_k are real and C_j are complex numbers, may be calculated. Note that $C_j = \overline{C_{n-j}}$, $(j = n/2 + 1, \ldots, n-1)$, where $\overline{\alpha}$ denotes the complex conjugate of α. Thus, only the numbers C_j for which $0 \le j \le n/2$ are calculated.

Structure:

`SUBROUTINE` subprogram
User Entry Names: `RFSTFT`
External References: `CFSTFT` (D706)

Usage:

```
COMPLEX C(0:..)
REAL Y(0:..)
EQUIVALENCE (C,Y)
...
CALL RFSTFT(M,C)
...
```

`M` (`INTEGER`) On entry, n is determined by the absolute value of `M` via $n = 2^{|\mathtt{M}|}$.
`M` $<$ `0` : The direct transform (1) is calculated.
`M` $\ge$ `0` : The inverse transform (2) is calculated.
Unchanged on exit.

`C` (`COMPLEX`) One dimensional array of dimension `(0:d)`, where `d` $\ge$ `n/2`.

`Y` (`REAL`) One dimensional array of dimension `(0:d)`, where `d` $\ge$ `n + 1`.
`M` $<$ `0` :
On entry, $\mathtt{Y}(k) = y_k$, $(k = 0, 1, \ldots, n-1)$.
On exit, $\mathtt{C}(j) = C_j$, $(j = 0, 1, \ldots, n/2)$, as defined by (1).
`M` $\ge$ `0` :
On entry, $\mathtt{C}(j) = C_j$, $(j = 0, 1, \ldots, n/2)$.
On exit, $\mathtt{Y}(k) = y_k$, $(k = 0, 1, \ldots, n-1)$, as defined by (2).

Method:

The subroutine uses `CFSTFT` (D705) with sequences reduced to half of their length as explaind in Ref. 1.

References:

1. E.O. Brigham, The fast Fourier transform, (Prentice-Hall, Englewood Cliffs, 1974) Ch. 10, Sect. 10, Fig. 10-10.

•