IDENTIFICATION

FORTRAN Fourier Analysis Routine, MU FAM1
704 FORTRAN Program
H. L. Carlson - October 2, 1960
Midwestern Universities Research Association, Madison, Wisconsin

PURPOSE

To compute the Fourier coefficients for a given harmonic, m.

\[
a_m = \frac{S}{\pi} \int_{\theta_o}^{\theta_o + \frac{2\pi}{S}} f(\theta) \cos ms(\theta - \theta^*) d\theta
\]

\[
b_m = \frac{S}{\pi} \int_{\theta_o}^{\theta_o + \frac{2\pi}{S}} f(\theta) \sin ms(\theta - \theta^*) d\theta
\]

\[
c_m = \frac{1}{2} \sqrt{a_m^2 + b_m^2}
\]

\[
\beta_m = -\arcsin \left( \frac{b_m}{2c_m} \right)
\]

METHOD

The coefficients \( a_m \) and \( b_m \) are computed as follows:

\[
a_m = \frac{S\Delta}{\pi} \sum_{i=1}^{N_m} f(\theta_i) \cos ms(\theta_i - \theta^*) + \frac{1}{2} \left( f(\theta_o + \frac{2\pi}{S}) - f(\theta_o) \right) \cos ms(\theta_o - \theta^*)
\]

\[
b_m = \frac{S\Delta}{\pi} \sum_{i=1}^{N_m} f(\theta_i) \sin ms(\theta_i - \theta^*) + \frac{1}{2} \left( f(\theta_o + \frac{2\pi}{S}) - f(\theta_o) \right) \sin ms(\theta_o - \theta^*)
\]

\[
\theta_i = \theta_o + (i-1)\Delta
\]

Although this program has been carefully checked by its contributor, no guarantee is made of its correct functioning under all conditions, and no responsibility is taken by him in case of possible failure.
**USAGE**

MU FAN1 is available as a relocatable FORTRAN deck. It is called by

```
CALL (FM,S,THZ,THS,NINT,A,B,C,BE),
```

where

- \( FM = m \), the number of the harmonic desired,
- \( S = s \),
- \( THZ = \theta \), in radians,
- \( THS = \theta \), in radians,
- \( NINT = N_{INT} \), the number of computing intervals desired,
- \( A = a_m \),
- \( B = b_m \),
- \( C = c_m \),
- \( BE = \beta_m \), in radians.

The values of \( f(\theta) \) are obtained from a subroutine which FAN calls, for by the calling sequence

```
CALL FFAN (TH,F).
```

This subroutine, which must be coded by the user, must supply the value of \( F (=f(\theta)) \) for the argument \( TH (=\theta) \) by the evaluation of a function or by table lookup.

**CODING INFORMATION**

MU FAN1 requires 237 words of storage + \( \sin \), \( \cos \), \( \arcsin \), square root and FFAN subroutines.

Execution time is

\[
7.872 + t_{\sin} + t_{\cos} + t_{\text{FFAN}} + 2.24N_{\text{INT}} + (N_{\text{INT}} + 1)(t_{\sin} + t_{\cos} + t_{\text{FFAN}}) \text{ ms}
\]

where \( t_{\text{function}} \) is the time required for the function subroutine.
SUBROUTINE FAN(FM,S,THZ,THS,NINT,A,B,C,BE)

PI=3.1415926536
FLN=NINT
DELTA=2.0*PI/(S*FLN)
SUMA=0.0
SUMB=0.0
CALL FFAN(THZ,2.0*PI/S,F2)
CALL FFAN(THZ,F3)
DO 10 I=1,NINT
POS=I-1
THI=THZ+POS*DELTA
ARG=FM*S*(THI-THS)
CALL FFAN(THI,F1)
SUMA=SUMA+FM*COSF(ARG)
10 SUMB=SUMB+FM*SINF(ARG)
SDP=S*DELTA/PI
FF=0.5*(F2-F3)
FSTT=FM*S*(THZ-THS)
A=SDP*(SUMA+FF*COSF(FSTT))
B=SDP*(SUMB+FF*SINF(FSTT))
C=0.5*SQRT(A*A+B*B)
BE=-ASINF(B/(2.0*C))
IF (A) 12,13,13
12 BE=-BL-(B/ABSF(B))*PI
13 RETURN