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Curtis

MURA-603

IDENTIFICATION

FORTRAN Fourier Analysis Routine, MU FAN1
704 FORTRAN Program
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PURPOSE

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

$$a_m = \frac{S}{\pi}\int_{\theta_0}^{\theta_0+\frac{2\pi}{S}} f(\theta)\cos ms(\theta-\theta^*)\,d\theta$$

$$b_m = \frac{S}{\pi}\int_{\theta_0}^{\theta_0+\frac{2\pi}{S}} f(\theta)\sin ms(\theta-\theta^*)\,d\theta$$

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

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

METHOD

The coefficients a_m and b_m are computed as follows:

$$a_m = \frac{S\Delta}{\pi}\left[\sum_{i=1}^{N_{INT}} f(\theta_i)\cos ms(\theta_i-\theta^*)+\frac{1}{2}\left(f\left(\theta_0+\frac{2\pi}{S}\right)-f(\theta_0)\right)\cos ms(\theta_0-\theta^*)\right]$$

$$b_m = \frac{S\Delta}{\pi}\left[\sum_{i=1}^{N_{INT}} f(\theta_i)\sin ms(\theta_i-\theta^*)+\frac{1}{2}\left(f\left(\theta_0+\frac{2\pi}{S}\right)-f(\theta_0)\right)\sin ms(\theta_0-\theta^*)\right]$$

$$\theta_i = \theta_0+(i-1)\Delta$$

$$\Delta = \frac{2\pi}{S\,N_{INT}}$$

DISCLAIMER
Although this program has been carefully tested 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	= Θ_0, in radians,
THS	= Θ^*, in radians,
NINT	= N_{INT}, the number of computing intervals desired,
A	= a_m,
B	= b_m,
C	= c_m,
BE	= β_m, in radians.

The values of f (Θ) 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(Θ)) for the argument TH (=Θ) 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

$$7.872 + t_{\sin^{-1}} + t_{\sqrt{\ }} + t_{FFAN} + 2.24 N_{INT} + (N_{INT}+1)(t_{\sin} + t_{\cos} + t_{FFAN}) \text{ ms}$$

where $t_{function}$ is the time required for the function subroutine.

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C       F15     FOURIER ANALYSIS 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+F1*COSF(ARG)
 10     SUMB=SUMB+F1*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*SQRTF(A*A+B*B)
        BE=-ASINF(B/(2.0*C))
        IF (A) 12,13,13
 12     BE=-BE-(B/ABSF(B))*PI
 13     RETURN
```