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IDENTIFICATION

MU CAD 1, Complex Addition Subroutine
704 Fortran II Program
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Madison, Wisconsin

PURPOSE

To compute the sum of two complex numbers in the form

$$a_3 e^{i\varphi_3} = a_1 e^{i\varphi_1} + a_2 e^{i\varphi_2} ,$$

whenever the values a_1, a_2, φ_1 and φ_2 are given.

RESTRICTIONS

The value of a_3 is always taken to be positive.

METHOD

A special test is made for both a_1 and a_2 identically zero in which case a_3 is set to O and φ_3 is given the value of φ_1. Normally, a_3 is given by the cosine law.

$$a_3 = \sqrt{a_1^2 + a_2^2 + 2a_1a_2 \cos(\varphi_2 - \varphi_1)} ,$$

where φ_1 and φ_2 have been reduced modulo 2π.

To obtain φ_3, one considers rotating the usual x, iy coordinate system so that the x-axis lies along a_1. Then the projection of a_3 on a_1, is

$$a_3 \cos\theta = a_1 + a_2 \cos(\varphi_2 - \varphi_1) ,$$

or

$$\theta = \cos^{-1}\left(\frac{a_1 + a_2 \cos(\varphi_2 - \varphi_1)}{a_3}\right).$$

It follows that

$$\varphi_3 = \varphi_1 - \theta ,$$

Where the sign of θ is taken as the sign of

$$a_2\left[(\varphi_2 - \varphi_1)(\mathrm{mod}\ \pi)\right].$$

USAGE

Calling Sequence: Entry to this subroutine is made via the Fortran statement

CALL CAD(A 1, PH 1, A 2, PH 2, A 3, PH 3)

where the variables

A 1	represents	a_1
PH 1	"	φ_1
A 2	"	a_2
PH 2	"	φ_2
A 3	"	a_3
PH 3	"	φ_3

Space required:

MU CAD 1 uses 157 storage locations not including space used by the COS, ACOS, and SQRT subroutines.

```
      SUBROUTINE CAD(A1,PH1,A2,PH2,A3,PH3)                              CAD1  0001
      IF (A1) 13,14,13                                                  CAD1  0002
14    IF (A2) 13,15,13                                                  CAD1  0003
15    A3=0.0                                                            CAD1  0004
      PH3=PH1                                                           CAD1  0005
      GO TO 16                                                          CAD1  0006
13    PH1=MODF(PH1,6.283185307)                                         CAD1  0007
      PH2=MODF(PH2,6.283185307)                                         CAD1  0008
      T=PH2-PH1                                                         CAD1  0009
      PH3=COSF(T)                                                       CAD1  0010
      A3=SQRTF(A1**2+A2**2+2.0*A1*A2*PH3)                               CAD1  0011
      PH3=ACOSF((A1+A2*PH3)/A3)                                         CAD1  0012
      IF (T) 17,18,18                                                   CAD1  0013
17     T=T+6.283185307                                                  CAD1  0014
18      PH3=PH1-SIGNF(PH3,A2*(T-3.14159265))                            CAD1  0015
16    RETURN                                                            CAD1  0016
      END (0,1,1,0,1)                                                   CAD1  0017
```