```
C
C      12元行列式の応力公式の係数, 応力を求め,
C         H2.FOR  より特異解を求める
C         NGRAPH で出力できるように分類する.
C
C      <941111><951018><951119>
C                                              Program by H.HAMANO
C
       IMPLICIT DOUBLE PRECISION(A-H,O-Z)
       REAL*8 PSI1,PSI2,G1,G2,G3,C1,C2,FAI,RRL,RIL,PO,PI,
     1        FAII(500),RRE(500),RIM(500)
       COMPLEX*16 A33
       CHARACTER*15 NAME,NAM,NA
       WRITE(6,'(A¥)')' INPUT FILE NAME ( Ex. P605.DAT ) =?'
       READ(5,50) NAME
*       WRITE(6,'(A¥)')' OUTPUT FILE NAME( Ex. GO.DAT   ) =?'
*       READ(5,50) NA
    50 FORMAT(A)
       NA='GO.DAT'
       WRITE(6,'(A¥)')' 領域角  =?'
       READ(5,*) KAKU
C
C      読み込み用ファイルオープン
C
       OPEN(2,STATUS='OLD',FILE=NAME)
C
       PI=3.141592653589793
       II=0
       A33=(1.0D0,0.0D0)
       PO=0.3D0
C
C      データの読み込み
C
*      READ(2,*) PSI1,PSI2,G1,G2,G3,C1,C2
       READ(2,*) PSI1,G1,G2
       PSI1=-PSI1
       PSI2=PSI1+180.D0
       G3=G1
       C1=1000
       C2=C1
C
       DO 100 I=1,1000
       READ(2,*,END=110) FAII(I),RRE(I),RIM(I)
       II=I
*       WRITE(6,*) FAII(I)
   100 CONTINUE
   110 CLOSE(2)
C
C      出力用ファイルオープン
C
       OPEN(3,STATUS='UNKNOWN',FILE=NA)
       DO 120 J=1,II
       KFAI=FAII(J)
       IF (KFAI.EQ.KAKU) THEN
         IF (FAII(J).EQ.180.5) FAII(J)=180.0
         IF (FAII(J).EQ.359.5) FAII(J)=360.0
```

```
        WRITE(3,*) PSI1,PSI2,G1,G2,G3,C1,C2,FAII(J),RRE(J),RIM(J)
        FAI=FAII(J)
        RRL=RRE(J)
        RIL=RIM(J)
        CALL FD1(FAI,RRL,RIL,PSI1,PSI2,G1,G2,G3,C1,C2,PO,A33)
      ENDIF
  120 CONTINUE
C
      CLOSE(3)
C
      OPEN(2,STATUS='OLD',FILE='GO.DAT')
      OPEN(3,STATUS='UNKNOWN',FILE='URO.DAT')
      OPEN(4,STATUS='UNKNOWN',FILE='USO.DAT')
      OPEN(7,STATUS='UNKNOWN',FILE='SRO.DAT')
      OPEN(8,STATUS='UNKNOWN',FILE='SSO.DAT')
      OPEN(9,STATUS='UNKNOWN',FILE='TRSO.DAT')
C
      DO 208 J=1,2
      READ(2,*)PSI1,PSI2,G1,G2,G3,C1,C2,FAI,RE,RI
      DO 108 I=0,KAKU
      READ(2,*)SIT
      READ(2,*)URR,URI,USR,USI
      WRITE(3,29)SIT,URR
      WRITE(4,29)SIT,USR
      READ(2,*)SRR,SRI,SSR,SSI,TRSR,TRSI
      WRITE(7,29)SIT,SRR
      WRITE(8,29)SIT,SSR
      WRITE(9,29)SIT,TRSR
      READ(2,*)Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z10
  108 CONTINUE
      IF(J.EQ.2)GO TO 208
      WRITE(3,*)'     =            ='
      WRITE(4,*)'     =            ='
      WRITE(7,*)'     =            ='
      WRITE(8,*)'     =            ='
      WRITE(9,*)'     =            ='
  208 CONTINUE
   29 format(1H , 2E15.8)
C
      STOP
      END
C
C
C     １１行１２列の行列
C
      SUBROUTINE FD1(FAI,RR,RI,PSI1,PSI2,G1,G2,G3,C1,C2,PO,A33)
      IMPLICIT DOUBLE PRECISION(A-H,O-Z)
      INTEGER ERR,L,K,N
      REAL*8 FAI,FA,RR,RI,G1,G2,G3,AR(11,12),AI(11,12),EPS,PI
     1 ,PSI1,PSI2,C1,C2,PO,QK,T1,T2
      COMPLEX*16  RAM,A(11,12),
     1 RP,RM,RK,RL,P,Q,R,A1,A2,A4,B1,B2,B4,SA1,SA2,SA4,SB1,SB2,SB4,
     2 CA1,CA2,CA4,CB1,CB2,CB4,BB1,BB2,BB3,A11,A12,A13,A14,A21,A22,
     3 A23,A24,A31,A32,A33,A34
      DATA L,K,N,EPS/11,11,12,1.E-12/
*
```

```
      RAM=DCMPLX(RR,RI)
      PI=3.1415926D0
      QK=3.0D0-4.0D0*P0
      RP=RAM+1.0D0
      RM=RAM-1.0D0
      RK=RAM-QK
      RL=RAM+QK
      P=RP/RK
      Q=RM/RK
      R=RL/RK
      FA=FAI*PI/180.0D0
      T1=(FAI/2.0D0+PSI1)*PI/180.0D0
      T2=(FAI/2.0D0+PSI2)*PI/180.0D0
      A1=RP*T1
      A2=RP*T2
      A4=RP*FA
      B1=RM*T1
      B2=RM*T2
      B4=RM*FA
      SA1=CDSIN(A1)
      SA2=CDSIN(A2)
      SA4=CDSIN(A4)
      SB1=CDSIN(B1)
      SB2=CDSIN(B2)
      SB4=CDSIN(B4)
      CA1=CDCOS(A1)
      CA2=CDCOS(A2)
      CA4=CDCOS(A4)
      CB1=CDCOS(B1)
      CB2=CDCOS(B2)
      CB4=CDCOS(B4)
      BB1=CA4/(Q*SB4)
      BB2=-SA4/(Q*SB4)
      BB3=CB4/SB4
*
      DO 30 L1=1,K
         DO 40 L2=1,N
            A(L1,L2)=(0.0D0,0.0D0)
   40    CONTINUE
   30 CONTINUE
*
      A(1,2)=1.0D0
      A(1,4)=P
      A(2,1)=1.0D0
      A(2,3)=Q
      A(3,1)=G1  *SA1
      A(3,2)=G1  *CA1
      A(3,3)=G1*P*SB1
      A(3,4)=G1*P*CB1
      A(3,5)=-G2  *SA1
      A(3,6)=-G2  *CA1
      A(3,7)=-G2*P*SB1
      A(3,8)=-G2*P*CB1
      A(4,1)=   CA1
      A(4,2)=  -SA1
      A(4,3)= R*CB1
```

```
      A(4,4)=-R*SB1
      A(4,5)=  -CA1
      A(4,6)=   SA1
      A(4,7)=-R*CB1
      A(4,8)= R*SB1
      A(5,1)= 2.0D0*G1  *CA1-C1*SA1
      A(5,2)=-2.0D0*G1  *SA1-C1*CA1
      A(5,3)= 2.0D0*G1*Q*CB1-C1*SB1
      A(5,4)=-2.0D0*G1*Q*SB1-C1*CB1
      A(5,5)=C1*SA1
      A(5,6)=C1*CA1
      A(5,7)=C1*SB1
      A(5,8)=C1*CB1
      A(6,1)=-C1*SA1
      A(6,2)=-C1*CA1
      A(6,3)=-C1*SB1
      A(6,4)=-C1*CB1
      A(6,5)= 2.0D0*G2  *CA1+C1*SA1
      A(6,6)=-2.0D0*G2  *SA1+C1*CA1
      A(6,7)= 2.0D0*G2*Q*CB1+C1*SB1
      A(6,8)=-2.0D0*G2*Q*SB1+C1*CB1
      A(7, 5)=-G2  *SA2
      A(7, 6)=-G2  *CA2
      A(7, 7)=-G2*P*SB2
      A(7, 8)=-G2*P*CB2
      A(7, 9)= G3*(SA2+BB1*P*CB2)
      A(7,10)= G3*(CA2+BB2*P*CB2)
      A(7,12)=-G3*P*(SB2+BB3*CB2)*A33
      A(8, 5)=   CA2
      A(8, 6)=  -SA2
      A(8, 7)= R*CB2
      A(8, 8)=-R*SB2
      A(8, 9)=  -CA2+BB1*R*SB2
      A(8,10)=   SA2+BB2*R*SB2
      A(8,12)= R*(CB2-BB3*SB2)*A33
      A( 9, 5)= 2.0D0*G2  *CA2-C2*SA2
      A( 9, 6)=-2.0D0*G2  *SA2-C2*CA2
      A( 9, 7)= 2.0D0*G2*Q*CB2-C2*SB2
      A( 9, 8)=-2.0D0*G2*Q*SB2-C2*CB2
      A( 9, 9)=C2*(SA2+BB1*CB2)
      A( 9,10)=C2*(CA2+BB2*CB2)
      A( 9,12)=-C2*(SB2+BB3*CB2)*A33
      A(10, 5)=-C2*SA2
      A(10, 6)=-C2*CA2
      A(10, 7)=-C2*SB2
      A(10, 8)=-C2*CB2
      A(10, 9)= 2.D0*G3*CA2+C2*SA2-2.D0*BB1*G3*Q*SB2+BB1*C2*CB2
      A(10,10)=-2.D0*G3*SA2+C2*CA2-2.D0*BB2*G3*Q*SB2+BB2*C2*CB2
      A(10,12)=-(2.D0*G3*Q*CB2+C2*SB2-2.D0*BB3*G3*Q*SB2+BB3*C2*CB2)*A33
      A(11, 9)=BB1
      A(11,10)=BB2
      A(11,11)=-1.0D0
      A(11,12)=-BB3*A33
C
      DO 10 I=1,K
        DO 20 J=1,N
```

```
          AR(I,J)= REAL(A(I,J))
          AI(I,J)=AIMAG(A(I,J))
   20 CONTINUE
   10 CONTINUE
      CALL CGAUJ(AR,AI,L,K,N,EPS,ERR)
C      WRITE(6,*)' ERR=',ERR
C         WRITE(6,*)' RAM=',RAM
            A11=DCMPLX(AR(1,N),AI(1,N))
            A12=DCMPLX(AR(2,N),AI(2,N))
            A13=DCMPLX(AR(3,N),AI(3,N))
            A14=DCMPLX(AR(4,N),AI(4,N))
            A21=DCMPLX(AR(5,N),AI(5,N))
            A22=DCMPLX(AR(6,N),AI(6,N))
            A23=DCMPLX(AR(7,N),AI(7,N))
            A24=DCMPLX(AR(8,N),AI(8,N))
            A31=DCMPLX(AR(9,N),AI(9,N))
            A32=DCMPLX(AR(10,N),AI(10,N))
            A33=(1.0D0,0.0D0)
            A34=DCMPLX(AR(11,N),AI(11,N))
            CALL F12(G1,G2,G3,PO,RAM,A11,A12,A13,A14,
     1       A21,A22,A23,A24,A31,A32,A33,A34,FAI,PSI1,PSI2)
      RETURN
      END
C
C     １２元の場合の応力と変位
C
      SUBROUTINE F12(G1,G2,G3,PO,RAM,A11,A12,A13,A14,
     1 A21,A22,A23,A24,A31,A32,A33,A34,FAI,PSI1,PSI2)
      REAL*8 G1,G2,G3,FAI,PSI1,PSI2,SIT,HAN1,HAN2,PO,QK
      COMPLEX*16 RAM,A11,A12,A13,A14,A21,A22,A23,A24,A31,A32,A33,A34,
     1 UR,US,SR,SS,TRS,UX,UY,SX,SY,TXY
      QK=3.0D0-4.0D0*PO
      HAN1=FAI/2.0D0+PSI1
      HAN2=FAI/2.0D0+PSI2
      IBEG=0
      IEND=INT(FAI)
      DO 10 I=IBEG,IEND
        SIT=FLOAT(I)
        IF (SIT.GE.0.0.AND.SIT.LE.HAN1) THEN
          CALL UST(RAM,A11,A12,A13,A14,G1,QK,SIT,UR,US,SR,SS,TRS)
        ENDIF
        IF (SIT.GT.HAN1.AND.SIT.LT.HAN2) THEN
          CALL UST(RAM,A21,A22,A23,A24,G2,QK,SIT,UR,US,SR,SS,TRS)
        ENDIF
        IF (SIT.GE.HAN2.AND.SIT.LE.FAI) THEN
          CALL UST(RAM,A31,A32,A33,A34,G3,QK,SIT,UR,US,SR,SS,TRS)
        ENDIF
       WRITE(3,600) SIT
       WRITE(3,601) UR,US
       WRITE(3,602) SR,SS,TRS
      CALL HXY(SIT,UR,US,UX,UY)
      CALL OXY(SIT,SR,SS,TRS,SX,SY,TXY)
       WRITE(3,601) UX,UY
       WRITE(3,602) SX,SY,TXY
   10 CONTINUE
  600 FORMAT(F8.3)
```

```
  601 FORMAT(4E15.7)
  602 FORMAT(6E15.7)
      RETURN
      END
C
C     応力及び変位の公式（すべり問題における）
C
      SUBROUTINE UST(R,A1,A2,A3,A4,G,QK,SI,UR,US,SR,SS,TRS)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      REAL*8      G,QK,S,SI,PI
      COMPLEX*16 R,R1,R2,A1,A2,A3,A4,UR,US,SR,SS,TRS,B,F11,F12,F13,
     1           F14,F21,F22,F23,F24,C,F31,F32,F33,F34,D,F41,F42,
     2           F43,F44,E,F51,F52,F53,F54,RK
      PI =3.1415926D0
      S  =SI*PI/180.0D0
      R1 =R+1.0D0
      R2 =R-1.0D0
      RK =R-QK
      B  =(R+QK)/RK
      C  =2.0*R*(R-3.0D0)/RK
      D  =2.0*R*R1/RK
      E  =2.0*R*R2/RK
      F11=A1*CDSIN(R1*S)
      F12=A2*CDCOS(R1*S)
      F13=A3*CDSIN(R2*S)
      F14=A4*CDCOS(R2*S)
      F21=A1*CDCOS(R1*S)
      F22=A2*CDSIN(R1*S)
      F23=B*A3*CDCOS(R2*S)
      F24=B*A4*CDSIN(R2*S)
      F31=2.0*R*F11
      F32=2.0*R*F12
      F33=C*F13
      F34=C*F14
      F41=-2.0*R*F11
      F42=-2.0*R*F12
      F43=-D*F13
      F44=-D*F14
      F51=2.0*R*F21
      F52=2.0*R*(-F22)
      F53=E*A3*CDCOS(R2*S)
      F54=E*(-A4)*CDSIN(R2*S)
      UR =F11+F12+F13+F14
      US =F21-F22+F23-F24
      SR =G*(F31+F32+F33+F34)
      SS =G*(F41+F42+F43+F44)
      TRS=G*(F51+F52+F53+F54)
      RETURN
      END
C
C  サブルーチン　ＣＧＡＵＪ
C  複素係数連立１次方程式の根を得る
C
      SUBROUTINE CGAUJ(AR,AI,L,M,N,EPS,ERR)
      IMPLICIT DOUBLE PRECISION(A-H,O-Z)
      INTEGER WORK(500),I,IW,J,K,K1,L,LC,LR,M,M1,M2,N,ERR
```

```
      REAL*8 AR(L,N),AI(L,M),EPS,WMAX,W,PIVOT,WR,WI,W1,W2
      IF (M.LT.2.0.OR.M.GT.500.OR.M.GE.N.OR.EPS.LE.0.0) THEN
        ERR=999
      ELSE
        DO 10 I=1,M
          WORK(I)=I
10      CONTINUE
        DO 110 K=1,M
          WMAX=0.0D0
          DO 30 I=K,M
            DO 20 J=K,M
              W=AR(I,J)**2+AI(I,J)**2
              IF (W.GT.WMAX) THEN
                WMAX=W
                LC=J
                LR=I
              ENDIF
20          CONTINUE
30        CONTINUE
          PIVOT=AR(LR,LC)**2+AI(LR,LC)**2
          IF (PIVOT.LE.EPS) THEN
            ERR=1
            RETURN
          ENDIF
          IF (K.NE.LC) THEN
            IW=WORK(K)
            WORK(K)=WORK(LC)
            WORK(LC)=IW
            DO 40 I=1,M
              WR=AR(I,K)
              WI=AI(I,K)
              AR(I,K)=AR(I,LC)
              AI(I,K)=AI(I,LC)
              AR(I,LC)=WR
              AI(I,LC)=WI
40          CONTINUE
          ENDIF
          IF (K.NE.LR) THEN
            DO 60 J=K,N
              WR=AR(LR,J)
              WI=AI(LR,J)
              AR(LR,J)=AR(K,J)
              AI(LR,J)=AI(K,J)
              AR(K,J)=WR
              AI(K,J)=WI
60          CONTINUE
          ENDIF
          WR= AR(K,K)/PIVOT
          WI=-AI(K,K)/PIVOT
          K1=K+1
          DO 80 I=K1,N
            W=AR(K,I)*WR-AI(K,I)*WI
            AI(K,I)=AR(K,I)*WI+AI(K,I)*WR
            AR(K,I)=W
80        CONTINUE
          DO 100 I=1,M
```

```
            IF (I.NE.K) THEN
              WR=AR(I,K)
              WI=AI(I,K)
              DO 90 J=K1,N
                W1=AR(K,J)*WR-AI(K,J)*WI
                W2=AR(K,J)*WI+AI(K,J)*WR
                W=AR(I,J)-W1
                AI(I,J)=AI(I,J)-W2
                AR(I,J)=W
   90         CONTINUE
            ENDIF
  100     CONTINUE
  110   CONTINUE
        M1=M-1
        DO 140 I=1,M1
  120     K=WORK(I)
          IF (K.NE.I) THEN
            IW=WORK(K)
            WORK(K)=WORK(I)
            WORK(I)=IW
            M2=M+1
            DO 130 J=M2,N
              WR=AR(K,J)
              WI=AI(K,J)
              AR(K,J)=AR(I,J)
              AI(K,J)=AI(I,J)
              AR(I,J)=WR
              AI(I,J)=WI
  130       CONTINUE
            GOTO 120
          ENDIF
  140   CONTINUE
        ERR=0
      ENDIF
      RETURN
      END
C
C     応力  σx,σy,τxy を求める
C
      SUBROUTINE OXY(SIT,SR,SS,TRS,SX,SY,TXY)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      REAL*8 SIT,PI,S
      COMPLEX*16 SR,SS,TRS,SX,SY,TXY
      PI =3.1415926D0
      S  =SIT*PI/180.D0
      SN =DSIN(S)
      CS =DCOS(S)
      SX =SR*CS**2+SS*SN**2-2.D0*CS*SN*TRS
      SY =SR*SN**2+SS*CS**2+2.D0*CS*SN*TRS
      TXY=(SR-SS)*CS*SN+(CN**2-SN**2)*TRS
      RETURN
      END
C
C     変位  Ux,Uyを求める
C
      SUBROUTINE HXY(SIT,UR,US,UX,UY)
```

```
IMPLICIT DOUBLE PRECISION (A-H,O-Z)
REAL*8 SIT,PI,S
COMPLEX*16 UR,US,UX,UY
PI =3.1415926D0
S  =SIT*PI/180.0D0
SN =DSIN(S)
CS =DCOS(S)
UX =UR*CS-US*SN
UY =UR*SN+US*CS
RETURN
END
```