```
C Program Name : HARBOR.FOR
C
C ***** THE OSCILLATION OF CONSTANT DEPTH & ARBITRARY SHAPE HARBOUR    *****
C ***** BY BOUNDARY ELEMENT METHOD WITH VARY REFLECTING FACTOR
*****
C ***** ------------------------ PROGRAM MODIFIED ON 1989,9            *****
C******    2008/01/13  重新整理    周宗仁

          PARAMETER(n11=10 ,n12=20,n13=10,n1=n11+n12+n13,n1x=n1+1)
        PARAMETER(n21=n12,n22=80          ,n2=n21+n22       ,n2x=n2+1)
        PARAMETER(M=N1+N22)

          REAL X1(N1),Y1(N1),XN1(N1),YN1(N1),S1(N1),XX1(N1X),YY1(N1X)
        REAL X2(N2),Y2(N2),XN2(N2),YN2(N2),S2(N2),XX2(N2X),YY2(N2X)
        REAL GB(M,M),G(M,M)
        REAL KR1(N1),AFA1(N1),KR2(N2),AFA2(N2),KH

          COMPLEX HB(M,M),H(M,M),C(M)
          COMPLEX F0(N1),F0B(N1),F1(N1),F1B(N1),F2(N2),F2B(N2)
          COMPLEX FA(M),FB(M)
        COMPLEX HT,IM,R
C ------------------------------      *****       OPEN SEQUENCIAL FILE       *****
C
          OPEN(2,FILE='OUT.DAT',FORM='FORMATTED',STATUS='OLD')
          OPEN(3,FILE='OU2.DAT',FORM='FORMATTED',STATUS='OLD')
          OPEN(4,FILE='04.APT',FORM='UNFORMATTED',STATUS='UNKNOWN')
          OPEN(5,FILE='05.APT',FORM='UNFORMATTED',STATUS='UNKNOWN')
          OPEN(6,FILE='KH.DAT',FORM='FORMATTED',STATUS='OLD')
          OPEN(8,FILE='08.APT',FORM='UNFORMATTED',STATUS='UNKNOWN')
          OPEN(10,FILE='10.APT',FORM='UNFORMATTED',STATUS='UNKNOWN')
          OPEN(11,FILE='11.APT',FORM='UNFORMATTED',STATUS='UNKNOWN')
C ---------------------------------------
          IM=(0.,1.)
          PAI=3.1415927
        g=9.81
C ----------------      *****       設定元素       *****
      WRITE(*,*) '執行幾個週期=?'
      READ(6,*) NCASE
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```
      READ(6,*) DEPTH
      READ(6,989) (XX1(I),YY1(I),I=1,N1X)                    !兩端點  外海逆時針
      READ(6,989) (XX2(I),YY2(I),I=1,N2X)                    !兩端點  內港領順時針
989   FORMAT(2F10.4)

      READ(6,987) (kr1(i),I=1,N1)    !在港口反射率爲 0
      READ(6,987) (kr2(i),I=1,N2)
987   FORMAT(F10.4)

        CALL COOR_HANKEL(N1,X1,Y1,S1,XN1,YN1,XX1,YY1,N1,N1X)
        CALL COOR_HANKEL(N2,X2,Y2,S2,XN2,YN2,XX2,YY2,N2,N2X)

          DO 1001 IJK=1,NCASE
        READ(6,*) IOI
          OI=IOI*PAI/180.
      READ(6,*) T

      shg=4*pai*pai/t**2/g*depth
      CALL shg_kh(shg,kh)

C-----------------------------------輸入反射率  計算消能係數-------------------
        do i=1,n1
      AFA1(I)=im*kh*sqrt(1-kr1(i)**2)
      end do
        do i=1,n2
      AFA2(I)=im*kh*sqrt(1-kr2(i)**2)
      end do
c---------------------------------

        CALL INCIDENT(F0,F0B,X1,Y1,XN1,YN1,N1,OI,KH)

        CALL G2_HANKEL(GB,G,M,N1,X1,Y1,S1,XN1,YN1,KH,H,HB) !外海

          REWIND 10
          WRITE(10) ((H(I,J),J=1,N1),I=1,N1)
          ENDFILE (UNIT=10)
```

```
      CALL G2_HANKEL(GB,G,M,N2,X2,Y2,S2,XN2,YN1,KH,H,HB) !內港

        REWIND 11
        WRITE(11) ((H(I,J),J=1,N2),I=1,N2)
        ENDFILE (UNIT=11)

!       連立方程式

        DO I=1,M          !歸零
      DO J=1,M
      HB(I,J)=0
      END DO
      END DO

        REWIND 10
        READ(10) ((H(I,J),J=1,N1),I=1,N1)

        DO I=1,N1

        DO J=1,N11
        HB(I,J)=H(I,J)*AFA1(J)
        IF(I.EQ.J) HB(I,J)=HB(I,J)-1
        END DO

        DO J=1,N12
        JJ=J+N11
        HB(I,JJ)=H(I,JJ)
        END DO

        DO J=1,N13
        JJ=J+N11+N12
        HB(I,JJ)=H(I,JJ)*AFA1(JJ)
        IF(I.EQ.JJ) HB(I,JJ)=HB(I,JJ)-1
        END DO
        END DO

      DO I=1,N1
      RS=0
```

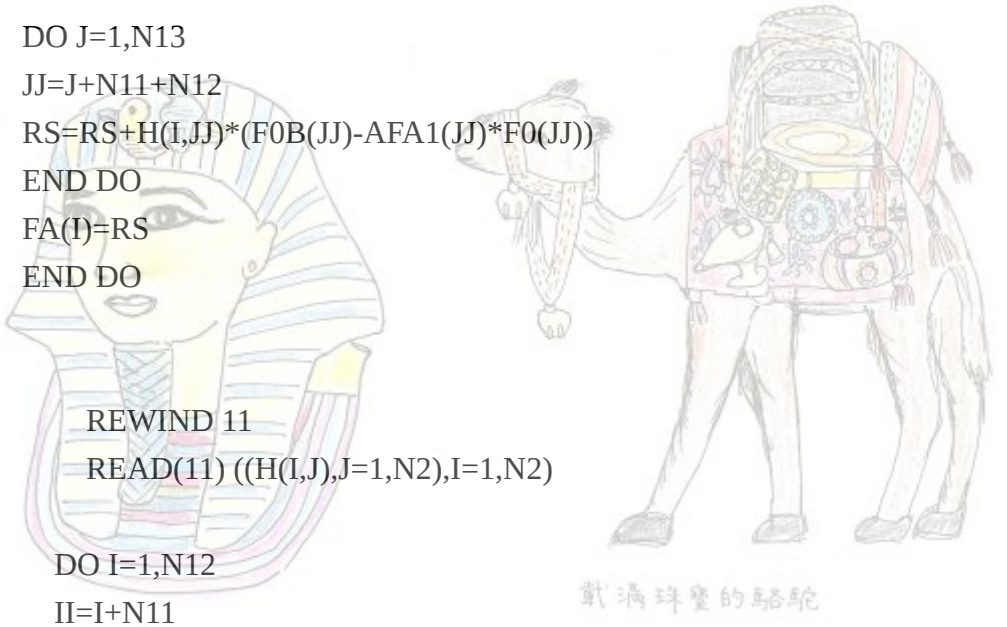
```
DO J=1,N11
RS=RS+H(I,J)*(F0B(J)-AFA1(J)*F0(J))              !S1~S3
END DO
DO J=1,N13
JJ=J+N11+N12
RS=RS+H(I,JJ)*(F0B(JJ)-AFA1(JJ)*F0(JJ))
END DO
FA(I)=RS
END DO

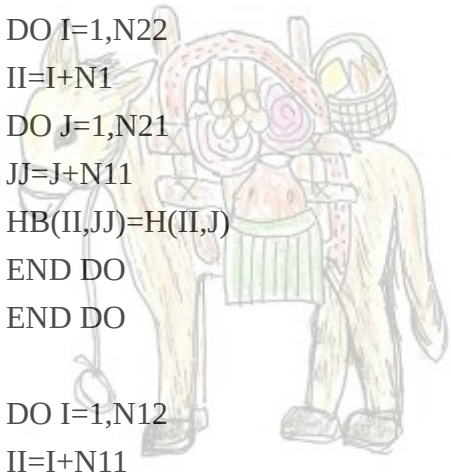
   REWIND 11
   READ(11) ((H(I,J),J=1,N2),I=1,N2)

  DO I=1,N12
  II=I+N11
  DO J=1,N12
  JJ=J+N11
  HB(II,JJ)=HB(II,JJ)-H(I,J)
  END DO
  END DO

  DO I=1,N22
  II=I+N1
  DO J=1,N21
  JJ=J+N11
  HB(II,JJ)=H(II,J)
  END DO
  END DO

  DO I=1,N12
  II=I+N11
  DO J=1,N22
  JJ=J+N1
  JJJ=J+N21
  HB(II,JJ)=-AFA2(JJJ)*H(I,JJJ)
  END DO
  END DO
```





```
DO I=1,N22
II=I+N1
III=I+N21
DO J=1,N22
JJ=I+N1
JJJ=J+N21
HB(II,JJ)=-AFA2(N21+J)*H(III,JJJ)
IF(I.EQ.J) HB(II,JJ)=HB(II,JJ)-1
END DO
END DO

DO I=1,N12                                    !S 2=S2+O11F0B-F0
II=I+N11
RS=0
DO J=1,N21
JJ=J+N11
RS=RS+H(I,J)*F0B(JJ)
END DO
FA(II)=FA(II)+RS-F0(II)
END DO

DO I=1,N22
II=I+N1
III=I+N21
RS=0
DO J=1,N21
JJ=J+N11
RS=RS-H(III,J)*F0B(JJ)                        !S4
END DO
FA(II)=RS
END DO
  REWIND 5
  WRITE(5) ((REAL (HB(I,J)),J=1,M),I=1,M)
  WRITE(5) ((AIMAG(HB(I,J)),J=1,M),I=1,M)

  CALL CMINVS(G,GB,M,M)
```

```
   DO    I = 1,M
   DO    J = 1,M
   HB(I,J) = G(I,J) + IM*GB(I,J)
   END DO
END DO

DO I=1,M
RS=0
DO J=1,M
RS=RS+HB(I,J)*FA(J)
END DO
FB(I)=RS        ! 結果
END DO

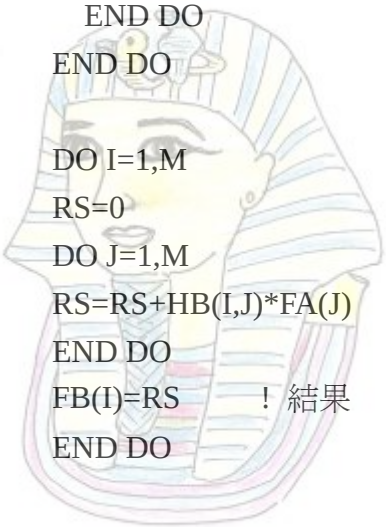
DO I=1,N11
F1(I)=FB(I)
F1B(I)=AFA1(I)*F1(I)
END DO

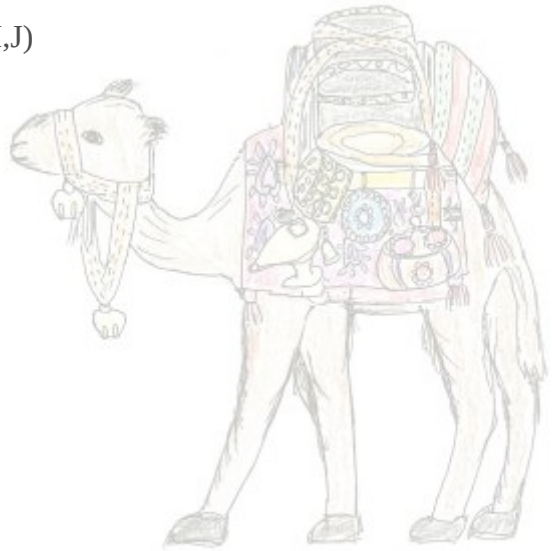
DO I=N11+1,N11+N12
F1B(I)=FB(I)
F2B(I-N11)=F1B(I)+F0B(I)
END DO

DO I=N11+N12+1,N1
F1(I)=FB(I)
F1B(I)=AFA1(I)*F1(I)
END DO

DO I=1,N22
II=I+N21
F2(II)=FB(N1+I)
F2B(II)=AFA2(II)*F2(II)
END DO

   REWIND 11
   READ(11) ((H(I,J),J=1,N2),I=1,N2)
```





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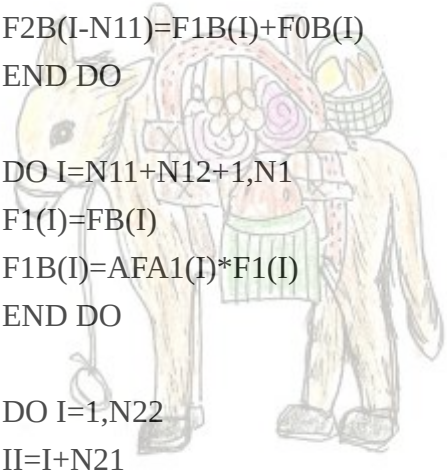

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```
DO I=1,N21
RS=0
DO J=1,N21
RS=RS+H(I,J)*F2B(J)
END DO
DO J=1,N22
JJ=J+N21
RS=RS+H(I,JJ)*F2B(JJ)
END DO
F2(I+N21)=RS
END DO

DO I=1,N12
II=I+N12
F1(II)=F2(I)-F0(II)
END DO

DO IX=1,50
X=0.5*IX
DO IY=1,50
Y=0.5*IY
CALL WHT(X,Y,KH,X1,Y1,S1,XN1,YN1,M,N1,HT,F1,F1B) !外海任意點波高
G(IX,IY)=CABS(HT)
END DO
END DO

DO IX=1,50
X=0.5*IX
DO IY=1,50
Y=-0.5*IY
CALL WHT(X,Y,KH,X2,Y2,S2,XN2,YN2,M,N2,HT,F2,F2B) !港內任意點波高
   GB(IX,IY)=CABS(HT)
END DO
END DO

CLOSE(4)
CLOSE(5)
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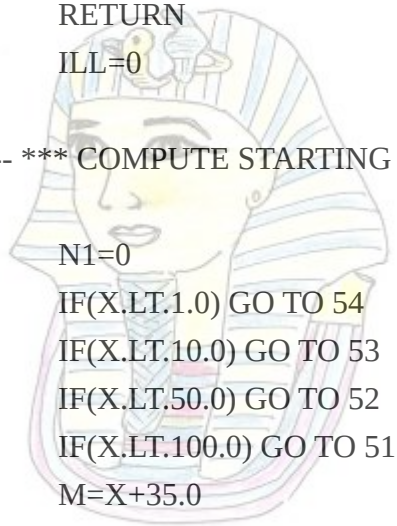
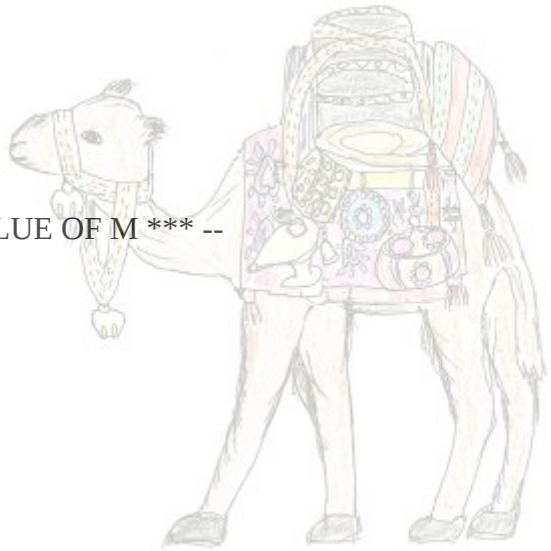
```
      CLOSE(10)
      CLOSE(11)

1001  CONTINUE
      STOP
      END

      SUBROUTINE COOR_HANKEL(N,X,Y,S,XN,YN,XX,YY,M,M1)
C
C     M1=M+1
C     INPUT  DATA  XX,YY  元素端點座標
C     元素個數:N
C
      REAL X(M),Y(M),S(M),XN(M),YN(M),XX(M1),YY(M1)
      DO  I=1,N
      I1=I+1
      X(I)=0.5*(XX(I)+XX(I1))
      Y(I)=0.5*(YY(I)+YY(I1))
      S(I)=SQRT((XX(I1)-XX(I))**2+(YY(I1)-YY(I))**2)
      YN(I)=(XX(I1)-XX(I))/S(I)
      XN(I)=-(YY(I1)-YY(I))/S(I)
      END DO
      RETURN
      END

      SUBROUTINE INCIDENT(F0,F0B,X,Y,XN,YN,N,OI,KH)
C
C     F0   :入射波速度勢
C     F0B :入射波速度勢導函數
C     OI   :入射波方向(與 X 軸)
C     KH :  入射波波數
C     N   :  等水深領域元素個數
C     X,Y:  元素中點座標
C     XN,YN : X,Y 法線分向
C
      COMPLEX IM,F0(N),F0B(N)
      REAL X(N),Y(N),XN(N),YN(N)
      IM=(0,1)
```

```
      DO    I=1,N
      F0(I)=-IM*CEXP(-IM*KH*(X(I)*COS(OI)+Y(I)*SIN(OI)))
      F0B(I)=-CEXP(-IM*KH*(X(I)*COS(OI)+Y(I)*SIN(OI)))*
     &   (COS(OI)*XN(I)+SIN(OI)*YN(I))*KH
      END DO
C ***********************************************************************
      SUBROUTINE G2_HANKEL(GB,G,M,N,XM,YM,SM,XN,YN,KH,H,HB)

      REAL GB(M,M),G(M,M),XM(M),YM(M),SM(M),XN(M),YN(M),KH
      COMPLEX IM,H(M,M),HB(M,M), RS,RT

      OPEN(UNIT=5,FILE='5.TMP',FORM='UNFORMATTED',status='UNKNOWN')
      OPEN(UNIT=4,FILE='4.TMP',FORM='UNFORMATTED',status='UNKNOWN')

      PAI=3.1415927
      IM=(0.,1.)
      DO 100 I=1,N
      DO 100 J=1,N
      IF(I.NE.J) THEN
        R=SQRT((XM(I)-XM(J))**2+(YM(I)-YM(J))**2)
        RK=KH*R
        CALL BESJNS(RK,0,BJO,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- J0'
1       FORMAT(1H0,'ILL=',I7,A5)
        CALL BESJNS(RK,1,BJ1,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- J1'
        CALL BESYNS(RK,0,BYO,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- Y0'
        CALL BESYNS(RK,1,BY1,ILL)
        IF(ILL.NE.0) WRITE(3,1) ILL,'-- Y1'
        RN=((XM(J)-XM(I))*XN(J)+(YM(J)-YM(I))*YN(J))/R
        RS=0.5*IM*KH*(BJ1+IM*BY1)*SM(J)*RN
        RT=-0.5*IM*(BJO+IM*BYO)*SM(J)
      ELSE
       RS=(1.,0.)
        RT=(ALOG(KH*SM(J)/4.)-0.42278-IM*PAI/2.)/PAI*SM(J)
      END IF
```

```
101     GB(I,J)=REAL(RS)
        G(I,J)=AIMAG(RS)
100     HB(I,J)=RT
        REWIND 5
        WRITE(5) ((GB(I,J),J=1,N),I=1,N)
        WRITE(5) ((G(I,J),J=1,N),I=1,N)
        ENDFILE (UNIT=5)
        CALL CMINVS(GB,G,M,N)
        DO   I=1,N
        DO   J=1,N
        RS=(0.,0.)
        DO   K=1,N
        RS=RS+(GB(I,K)+IM*G(I,K))*HB(K,J)
        END DO
        H(I,J)=RS
        END DO
        END DO
        CLOSE(4)
        CLOSE(5)
        RETURN
        END

C*************************************
        SUBROUTINE BESJNS(X,N,BJN,ILL)
C
        BJN=0.0
        IF(N) 10,20,20
10      ILL=1
        RETURN
20      IF(X) 30,21,31
21      IF(N.GT.1) GO TO 30
        ILL=0
        IF(N.EQ.0) BJN=1.0
        RETURN
30      ILL=2
        RETURN
31      IF(X-15.0) 32,32,34
32      NTEST=20.0+10.0*X-X*X/3.0
```

```
      GO TO 36
34    NTEST=110.0+X/2.0
36    IF(N-NTEST) 40,38,38
38    ILL=3
      RETURN
40    ILL=0
C
C -- *** COMPUTE STARTING VALUE OF M *** --
C
      N1=0
      IF(X.LT.1.0) GO TO 54
      IF(X.LT.10.0) GO TO 53
      IF(X.LT.50.0) GO TO 52
      IF(X.LT.100.0) GO TO 51
      M=X+35.0
      GO TO 55
51    M=1.1*X+25.0
      GO TO 55
52    M=1.3*X+15.0
      N1=N+10
      GO TO 55
53    M=2.0*X+8.0
      N1=N+7
      GO TO 55
54    M=4.0*X+6.0
55    M=MAX0(M,N1)
C
C --- ** SET F(M),F(M-1) ** ---
C
      FM1=1.0E-30
      FM=0.0
      ALPHA=0.0
      IF(M-(M/2)*2) 120,110,120
110   JT=-1
      GO TO 130
120   JT=1
130   M2=M-2
      DO 160 K=1,M2
```





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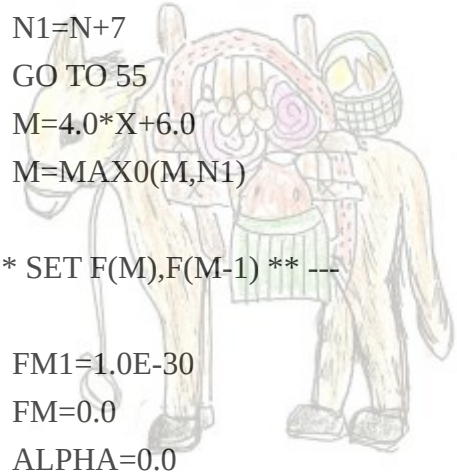

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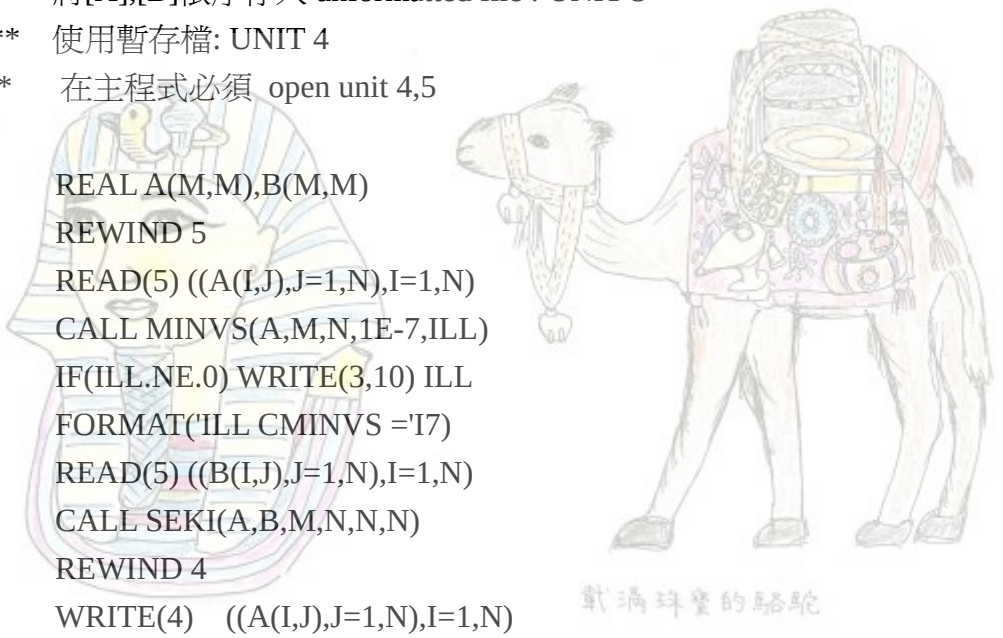
```
      MK=M-K
      FMK=FLOAT(MK)
      BMK=2.0*FMK*FM1/X-FM
      FM=FM1
      FM1=BMK
      IF(MK-N-1) 150,140,150
140   BJN=BMK
150   JT=-JT
      S=1+JT
160   ALPHA=ALPHA+BMK*S
      BMK=2.0*FM1/X-FM
      IF(N) 180,170,180
170   BJN=BMK
180   ALPHA=ALPHA+BMK
      BJN=BJN/ALPHA
      RETURN
      END

C*************************************
      SUBROUTINE BESYNS(X,N,BYN,ILL)
C
      BYN=-1.0E30
      IF(N) 180,10,10
10    ILL=0
      IF(X) 190,11,20
11    IF(N.GT.1) GO TO 190
      RETURN
20    PI=3.141592653
      IF(X-4.0) 40,40,30
30    T=4.0/X
      T=T*T
      P0=((((-0.0000037043*T+0.0000173565)*T-0.0000487613)*T
     &+0.0001734300)*T-0.0017530620)*T+0.3989422793
      Q0=((((0.0000032312*T-0.0000142078)*T+0.0000342468)*T
     &-0.0000869791)*T+0.0004564324)*T-0.0124669441
      P1=((((0.0000042414*T-0.0000200920)*T+0.0000580759)*T
     &-0.0002232030)*T+0.0029218256)*T+0.3989422819
      Q1=((((-0.0000036594*T+0.0000162200)*T-0.0000398708)*T
```

```
     &+0.0001064741)*T-0.0006390400)*T+0.0374008364
       A=SQRT(2.0*PI)
       B=4.0*A
       P0=A*P0
       Q0=B*Q0/X
       P1=A*P1
       Q1=B*Q1/X
       A=X-PI/4.0
       B=SQRT(2.0/(PI*X))
       Y0=B*(P0*SIN(A)+Q0*COS(A))
       Y1=B*(-P1*COS(A)+Q1*SIN(A))
       GO TO 90
C
C --- ** COMPUTE Y0,Y1 FOR X <= 4 ** ---
C
40     XX=X/2.0
       X2=XX*XX
       T=ALOG(XX)+0.5772156649
       SUM=0.0
       TERM=T
       Y0=T
       DO 70 L=1,15
       IF(L-1) 50,60,50
50     SUM=SUM+1.0/FLOAT(L-1)
60     FLL=L
       TS=T-SUM
       TERM=(TERM*(-X2)/(FLL*FLL))*(1.0-1.0/(FLL*TS))
70     Y0=Y0+TERM
       TERM=XX*(T-0.5)
       SUM=0.0
       Y1=TERM
       DO 80 L=2,16
       SUM=SUM+1.0/FLOAT(L-1)
       FLL=L
       FL1=FLL-1.0
       TS=T-SUM
       TERM=(TERM*(-X2)/(FL1*FLL))*((TS-0.5/FLL)/(TS+0.5/FL1))
80     Y1=Y1+TERM
```

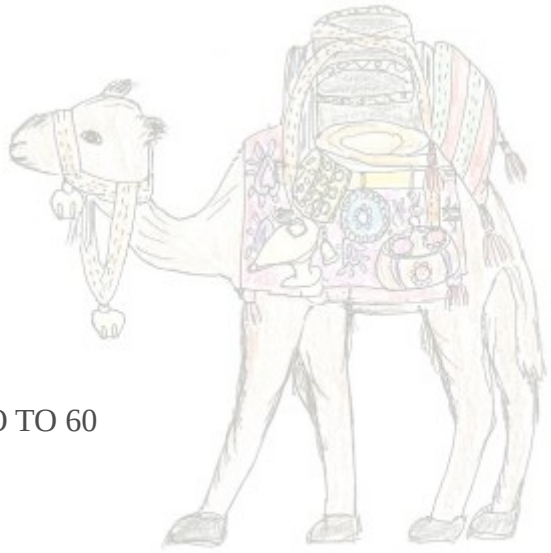
```
      PI2=2.0/PI
      Y0=PI2*Y0
      Y1=-PI2/X+PI2*Y1
C
C --- ** CHECK IF ONLY Y0 OR Y1 IS DESIRED ** ---
C ** -------------------------------------- **
90    IF(N-1) 100,100,130
C ** -------------------------------------- **
C --- ** RETURN EITHER Y0 OR Y1 AS REQUIRED ** ---
C ** -------------------------------------- **
100   IF(N) 110,120,110
110   BYN=Y1
      RETURN
120   BYN=Y0
      RETURN
C ---------------------------------------
C --- ** PERFORM RECURRENCE OPERATIONS TO FIND YN(X) ** ----
C ---------------------------------------------------------
130   YA=Y0
      YB=Y1
      K=1
140   T=FLOAT(2*K)/X
      YC=T*YB-YA
      K=K+1
      IF(K-N) 150,160,150
150   YA=YB
      YB=YC
      GO TO 140
160   BYN=YC
      RETURN
180   ILL=1
      RETURN
190   ILL=2
      RETURN
      END

C*************************************************************************
      SUBROUTINE CMINVS(A,B,M,N)
```

```
C **   [A+iB]的逆距陣
C **   將[A],[B]依序存入 unformatted file : UNIT 5
C **   使用暫存檔: UNIT 4
C**    在主程式必須  open unit 4,5
C
       REAL A(M,M),B(M,M)
       REWIND 5
       READ(5) ((A(I,J),J=1,N),I=1,N)
       CALL MINVS(A,M,N,1E-7,ILL)
       IF(ILL.NE.0) WRITE(3,10) ILL
10     FORMAT('ILL CMINVS ='I7)
       READ(5) ((B(I,J),J=1,N),I=1,N)
       CALL SEKI(A,B,M,N,N,N)
       REWIND 4
       WRITE(4)   ((A(I,J),J=1,N),I=1,N)
       CALL SEKI(B,A,M,N,N,N)
       REWIND 5
       READ(5) ((A(I,J),J=1,N),I=1,N)
       DO 100 I=1,N
       DO 100 J=1,N
100    A(I,J)=A(I,J)+B(I,J)
       CALL MINVS(A,M,N,1E-7,ILL)
       IF(ILL.NE.0) WRITE(3,11) ILL
11     FORMAT(1H0,'ILL CS.2 =',I7)
       REWIND 4
       READ(4) ((B(I,J),J=1,N),I=1,N)
       CALL SEKI(B,A,M,N,N,N)
       DO I=1,N
       DO J=1,N
       B(I,J)=- B(I,J)
       END DO
       END DO
       RETURN
       END

C**************************************
            SUBROUTINE SA(A,B,NA,N,NS)
```



```
C
C   [A],[B]宣告(na, na)
C   [B]=[A]-[B]
C   [B]資料被取代
C
      REAL A(NA,NA),B(NA,NA)
      DO 100 I=1,N
      DO 100 J=1,NS
      B(I,J)=A(I,J)-B(I,J)
100   CONTINUE
      RETURN
      END

C**********************************
      SUBROUTINE MINVS(A,KO,N,EPS,ILL)
C
C 宣告 A(KO,KO)，使用 A(N,N)，矩陣必須從 1 開始
C   KO<3000
C   ill=3000 輸入資料有誤，未計算
C   ill≠0    計算錯誤
C
      REAL A(KO,KO)
      INTEGER X(3000)
      LOGICAL B
      ILL=0
      IF((KO.GE.N).AND.(N.GE.2).AND.(N.LE.3000).AND.(EPS.GT.0.0))GO TO 1
      ILL=30000
      RETURN
1     DO 10 I=1,N
      X(I)=I
10    CONTINUE
      DO 110 K=1,N
      M=K
      W=0.0
      DO 20 I=K,N
      ABSA=ABS(A(I,K))
      IF(ABSA.LE.W) GO TO 20
      W=ABSA
```

```
      M=I
20    CONTINUE
      IF(M.EQ.K) GO TO 50
      L=X(M)
      X(M)=X(K)
      X(K)=L
      DO 40 J=1,N
      W=A(K,J)
      A(K,J)=A(M,J)
      A(M,J)=W
40    CONTINUE
50    IF(ABS(A(K,K)).GE.EPS) GO TO 60
      ILL=K
      RETURN
60    P=1.0/A(K,K)
      DO 70 J=1,N
      A(K,J)=A(K,J)*P
70    CONTINUE
      DO 100 I=1,N
      T=-A(I,K)
      B=(I.NE.K).AND.(T.NE.0.0)
      IF(.NOT.B) GO TO 100
      DO 90 J=1,N
      A(I,J)=A(I,J)+A(K,J)*T
90    CONTINUE
100   A(I,K)=P*T
      A(K,K)=P
110   CONTINUE
      DO 140 I=1,N
120   IF(X(I).EQ.I) GO TO 140
      K=X(I)
      DO 130 J=1,N
      W=A(J,I)
      A(J,I)=A(J,K)
      A(J,K)=W
130   CONTINUE
      L=X(I)
      X(I)=X(K)
```



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```
      X(K)=L
      GO TO 120
140   CONTINUE
      RETURN
      END
C************************************
      SUBROUTINE SEKI(A,B,M,NA,NK,NB)
C
C   [A],[B]宣告(m, m)
C   [A]=[A][B]
C   (na,nb)=(na,nk)x(nk,nb)
C   [A]資料被取代
C
      REAL A(M,M),B(M,M),C(300)
      DO 100 I=1,NA
      DO 101 K=1,NK
      C(K)=A(I,K)
101   CONTINUE
      DO 100 J=1,NB
      R=0.
      DO 102 K=1,NK
      R=R+C(K)*B(K,J)
102   CONTINUE
      A(I,J)=R
100   CONTINUE
      RETURN
      END
C************************************
      SUBROUTINE WA(A,B,NA,N,NS)
C
C   [A],[B]宣告(na, na)
C   [B]=[A]+[B]
C   B 資料被取代
C
      REAL A(NA,NA),B(NA,NA)
      DO 100 I=1,N
      DO 100 J=1,NS
```

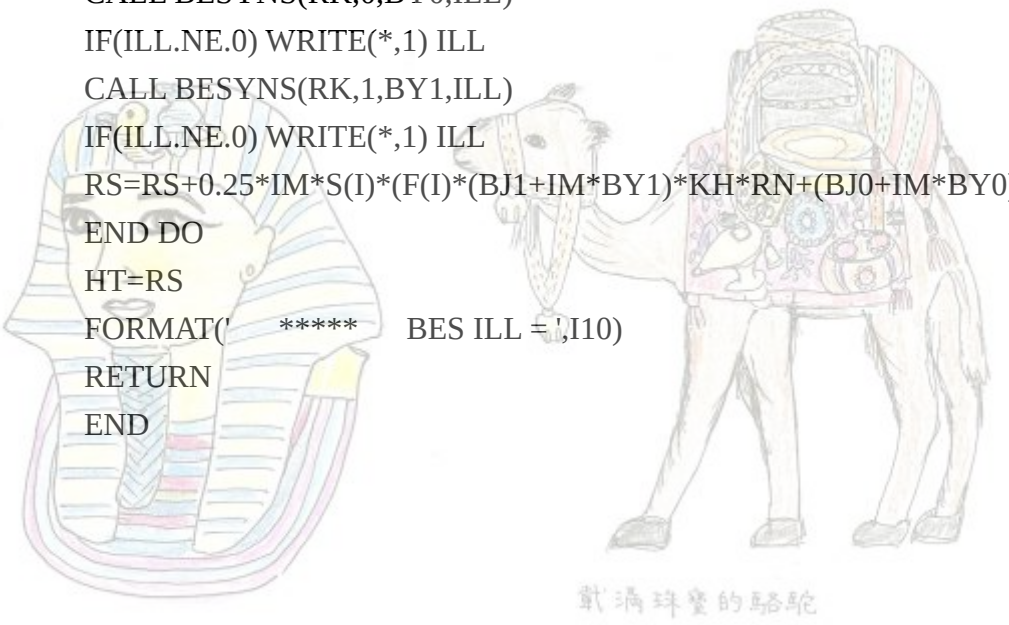
```
            B(I,J)=A(I,J)+B(I,J)
100         CONTINUE
            RETURN
            END
C**********************************
      subroutine shg_kh(shg,hk)

! **利用牛頓近似法，已知     從分散關係式求 kh**

      IF(SHG-10.) 2,2,1
1     XY=SHG
      GO TO 6
2     IF(SHG-1.0) 3,4,4
3     X=SQRT(SHG)
      GO TO 5
4     X=SHG
5     COTHX=1./TANH(X)
      XY=X-(X-SHG*COTHX)/(1.+SHG*(COTHX**2-1.))
      E=1.-XY/X
      X=XY
      IF(ABS(E)-0.0005)6,5,5
6     hk=XY
        RETURN
      END
C*************************************************

            SUBROUTINE WHT(XX,YY,KH,X,Y,S,XN,YN,M,N,HT,F,FB)
            REAL KH,X(M),Y(M),S(M),XN(M),YN(M)
            COMPLEX RS,RT,IM,HT,F(M),FB(M)
            IM=(0.,1.)
            RT=0
            RS=0
            DO  I=1,N
            R=SQRT((XX-X(I))**2+(YY-Y(I))**2)
            RN=((X(I)-XX)*YN(I)-(Y(I)-YY)*XN(I))/R
            RK=KH*R
            CALL BESJNS(RK,0,BJ0,ILL)
            IF(ILL.NE.0) WRITE(*,1) ILL
```

```
      CALL BESJNS(RK,1,BJ1,ILL)
      IF(ILL.NE.0) WRITE(*,1) ILL
      CALL BESYNS(RK,0,BY0,ILL)
      IF(ILL.NE.0) WRITE(*,1) ILL
      CALL BESYNS(RK,1,BY1,ILL)
      IF(ILL.NE.0) WRITE(*,1) ILL
      RS=RS+0.25*IM*S(I)*(F(I)*(BJ1+IM*BY1)*KH*RN+(BJ0+IM*BY0)*FB(I))
      END DO
      HT=RS
1     FORMAT('     *****     BES ILL = ',I10)
      RETURN
      END
```



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