```
C            單一 PC   3 維造波水槽   2003/0504
c            執行本程式前必須先 "依序" 執行 ELEMENT 目錄下列 8 個程式
c            注意:各 *.in 的內容要正確一致，執行後
c            並將 node_element.dat 及 xyz.dat 檔複製至 3dwavemaker 目錄下
c
C              1. SURFACE.F
C              2. PADDLE .F
C              3. RIGHT   .F
C              4. LEFT    .F
C              5. BEACH   .F
C              6. BOTTOM .F(OR TERRIAN.F)
C              7. NODE    .F
c              8. xyz     .f

      parameter(ni1=41,nj1=21,ni2=2,nj2=21,ni3=2 ,nj3=21,
     /          ni4=2 ,nj4=21,ni5=2,nj5=21,ni6=21,nj6=11,b6=1)

      parameter(ni11=ni1-1,nj11=nj1-1,ni21=ni2-1,nj21=nj2-1,ni31=ni3-1,
     /          nj31=nj3-1,ni41=ni4-1,nj41=nj4-1,ni51=ni5-1,nj51=nj5-1,
     /          ni61=ni6-1,nj61=nj6-1)

      parameter(nt1=ni1*nj1,nt2=ni2*nj2,nt3=ni3*nj3,
     /          nt4=ni4*nj4,nt5=ni5*nj5,nt6=ni6*nj6)

      parameter(nt=nt1+nt2+nt3+nt4+nt5+nt6,nt26=nt-nt1)

c     select large one between nt1 and nt26

      parameter(nt0=nt1)

c      parameter(nt0=nt26)

      PARAMETER(NSPEC=2048)

      real x(nt),y(nt),z(nt)

      real hh(nt0,nt0),gg(nt0,nt0)
```

```
      real f1(nt1),f1b(nt1),f2b(nt2),xp(3,3),xpkj(3,3,nj1)

      real u(nj2),xx(4),yy(4),zz(4),tmp(nt1)

        real rnum(nspec),s0(nspec),HKK(NSPEC),RE(NSPEC),SS(NSPEC),
     #          E25(25),F25(25),THETA(NSPec)

c=================
        OPEN(UNIT=3,FILE='3dwave.old',FORM='UNFORMATTED',status='UNKNOWN')
        OPEN(UNIT=7,FILE='7.apt',FORM='UNFORMATTED',status='UNKNOWN')
        OPEN(UNIT=8,FILE='8.apt',FORM='UNFORMATTED',status='UNKNOWN')
        OPEN(UNIT=9,FILE='9.apt',FORM='UNFORMATTED',status='UNKNOWN')
        OPEN(UNIT=40,FILE='40.apt',FORM='UNFORMATTED',STATUS='UNKNOWN')
        OPEN(UNIT=41,FILE='41.apt',FORM='UNFORMATTED',status='UNKNOWN')
        OPEN(UNIT=42,FILE='42.apt',FORM='UNFORMATTED',status='UNKNOWN')
        OPEN(UNIT=23,FILE='hw.dat')
        OPEN(UNIT=22,FILE='surface.dat')
c=================================================
        OPEN(UNIT=12,FILE='3dwave.in')
      read(12,*) icase
      read(12,*) start
      read(12,*) eend
        read(12,*) wave
      close(12)

        PA2I=1.570796327
      PAI =3.141592654
      PAI2=6.283185308

c     ipa=nj21/nj11

        gro=9.81
        ho=1
      nch=nj2
      ITYPE=1
        umu=0
      gr=gro*ho
c=================================================================
```

```
    if(wave.eq.1) then
    open(unit=12,file='regular.dat')
read(12,*) shg
read(12,*) h31
read(12,*) teta0
read(12,*) depth
read(12,*) ntt
close(12)

h31=h31*ho
depth=depth*ho
t31=sqrt(4*pai**2*depth/shg/gr)
    HK=2*PAI/WAVEL(T31,DEPTH/ho)
dt=t31/ntt
    RTETA0=TETA0*PAI/180.0
    DF=2*PAI/T31
    write(*,*) 't31=',t31,'    kh=',hk,'    L/h=',pai2/hk
    E=-DF*H31*(sinh(hK)*cosh(hK)+hK)/2./sinh(hK)**2
end if

    if(wave.eq.2) then
    open(unit=12,file='cross.dat')
read(12,*) shg1
read(12,*) h31
read(12,*) teta01
read(12,*) shg2
read(12,*) h32
read(12,*) teta02
read(12,*) depth
read(12,*) ntt
close(12)

depth=depth*ho

h31=h31*ho
t31=sqrt(4*pai**2*depth/shg1/gr)
    HK1=2*PAI/WAVEL(T31,DEPTH/ho)
dt=t31/ntt
```

```
    RTETA01=TETA01*PAI/180.0
    DF1=2*PAI/T31

    write(*,*) 't31=',t31

h32=h32*ho
t32=sqrt(4*pai**2*depth/shg2/gr)
    HK2=2*PAI/WAVEL(T32,DEPTH/ho)
    RTETA02=TETA02*PAI/180.0
    DF2=2*PAI/T32

    E1=-DF1*H31*(sinh(hK1)*cosh(hK1)+hK1)/2./sinh(hK1)**2
    E2=-DF2*H32*(sinh(hK2)*cosh(hK2)+hK2)/2./sinh(hK2)**2
    end if

    if(wave.eq.3) then
    open(unit=12,file='soliton.dat')
read(12,*) h
read(12,*) teta0
read(12,*) depth
read(12,*) ntt
close(12)

    dt=ntt
h=h*ho
depth=depth*ho
gr1=gr*DEPTH
H=H/DEPTH
    RTETA0=TETA0*PAI/180.0
ce=sqrt(gr1*(1+H))
xo=sqrt(4.*H/3./(1+H))
omega=sqrt(gr1)*sqrt(.75*H*(1+H))
tc=pai/omega
xleff=9.5766/sqrt(H)
teff=xleff/ce
ddt=tc/dT
    end if
```

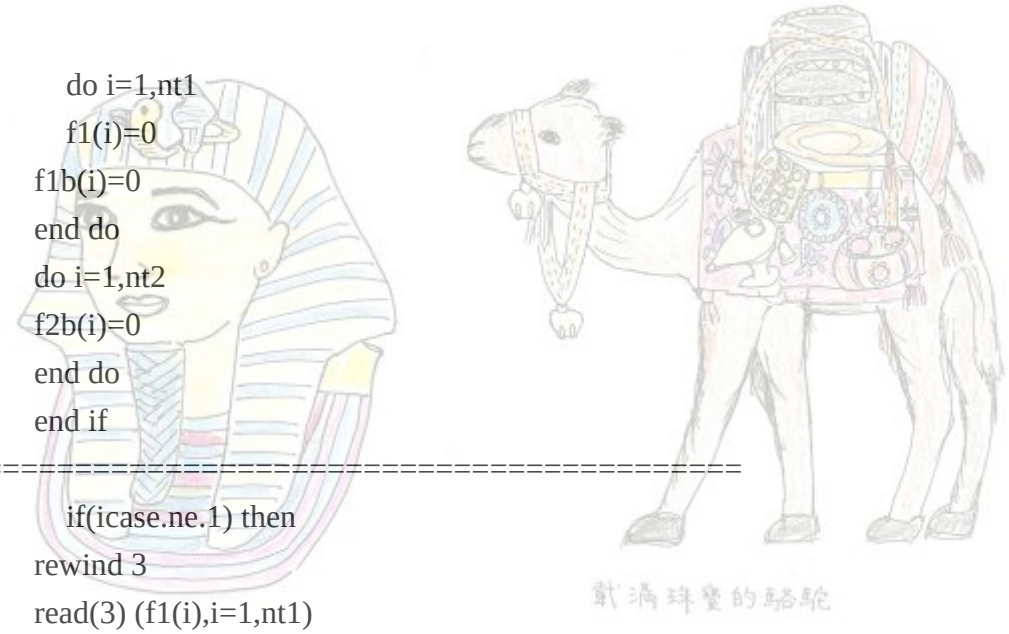
```
      if(wave.eq.4) then
      open(unit=12,file='FREQ.dat')
     read(12,*) itpspc
     read(12,*) shg31
     read(12,*) h31
     read(12,*) teta0
     read(12,*) deptho
     read(12,*) ntt
     IF(ITPSPC.eq.4) then
     READ(12,*) FPEAK
     READ(12,*) SPEAK
     READ(12,*) (E25(I),i=2,25)
      end if
     close(12)

      dtt=ntt
     h31=h31*ho
     depth=deptho*ho
     t31=sqrt(4*pai**2*depth/shg31/gr)
      write(*,*) 't31=',t31
c=============================================
      TMIN=0.5
     TMAX=2.5

      RTETA0=TETA0*PAI/180.0

     IXY=7
      fmax=1./tmin
     fmin=1./tmax
     df=(fmax-fmin)/nspec
     dt=1./(2.*nspec*df)
     ddt=tmin/dtt

      IF(ITPSPC.EQ.1) CALL BM0(S0,nspec,nspec,H31,T31,DT)
      IF(ITPSPC.EQ.2) CALL BMS(S0,nspec,nspec,H31,T31,DT)
      IF(ITPSPC.EQ.3) CALL JONSWAP(S0,nspec,nspec,H31,T31,DT)
      IF(ITPSPC.EQ.4) CALL SPECIN(S0,nspec,nspec,DT,E25,F25,FPEAK,SPEAK)
```

```
      DO I=1,NSPEC
      S0(I)=S0(I)*ho**2
      END DO

         CALL wvmod(RE,nspec,NSPec,DEPTHo,DT,TMAX,TMIN,ITYPE,HKK)

            DO J=1,nspec
              CALL RANDU(IXY,IY,FL)
              IXY=IY
              RNUM(J)=PAI2*FL+HKK(J)*I*BLOD*(COS(RTETA0))
            END DO
c=======================================
         end if

         if(wave.eq.5) then
         open(unit=12,file='MUTI.dat')
      read(12,*) itpspc
      read(12,*) shg31
      read(12,*) h31
      read(12,*) teta0
      read(12,*) deptho
      read(12,*) smax
      read(12,*) ntt
      IF(ITPSPC.eq.4) then
      READ(12,*) FPEAK
      READ(12,*) SPEAK
      READ(12,*) (E25(I),i=2,25)
         end if
      close(12)

         dtt=ntt
      h31=h31*ho
      depth=deptho*ho
      t31=sqrt(4*pai**2*depth/shg31/gr)
         write(*,*) 't31=',t31
c=========================================================
         TMIN=0.5
         TMAX=2.5
```

```
      RTETA0=TETA0*PAI/180.0

    IXY=7
      fmax=1./tmin
    fmin=1./tmax
    df=(fmax-fmin)/nspec
    dt=1./(2.*nspec*df)
    ddt=tmin/dtt

      IF(ITPSPC.EQ.1) CALL BM0(S0,nspec,nspec,H31,T31,DT)
      IF(ITPSPC.EQ.2) CALL BMS(S0,nspec,nspec,H31,T31,DT)
      IF(ITPSPC.EQ.3) CALL JONSWAP(S0,nspec,nspec,H31,T31,DT)
      IF(ITPSPC.EQ.4) CALL SPECIN(S0,nspec,nspec,DT,E25,F25,FPEAK,SPEAK)
    DO I=1,NSPEC
    S0(I)=S0(I)*ho**2
    END DO
      CALL wvmod(RE,nspec,nspec,DEPTHo,DT,TMAX,TMIN,ITYPE,HKK)
C=====================2011 DIRECTION ======================
          L=(INT(0.11*SMAX+0.55))
          L2=2*L
          KG=1
          KK=1
          LL2=L2
100       KG=KG*LL2
          KK=KK*(LL2-1)
          LL2=LL2-2
          IF (LL2.GT.0) GO TO 100
          EXPR=PAI*FLOAT(KK)/FLOAT(KG)
          IRX=IXY
          DO   J=1,NSPEC
210           CALL RANDU(IRX,IRY,FL)
              IRX=IRY
              RCON=FL*EXPR
          THETAL=0.0
          THETAR=PAI
200       THETAM=(THETAL+THETAR)/2.0
          THETAD=(THETAR-THETAL)
```

```
          GI=THETAM
          ALFA=THETAM-PA2I
         DO N=1,L
         GI=((SIN(ALFA)*(COS(ALFA))**(2*N-1))+(2*N-1)*GI)/(2*N)
         END DO
           DEF=GI-RCON
             IF(DEF .EQ. 0.0) GO TO 300
             IF(DEF .GT. 0.0) THETAR=THETAM
             IF(DEF .LT. 0.0) THETAL=THETAM
             IF(THETAD .GE.    0.0017) GO TO 200
300          IF (TETA0 .LT. 90.0) THEN
                THETAM=THETAM-(PA2I-THETA0)
                IF (THETAM.LE.0.0 .OR. THETAM.GE.PA2I+THETA0) GOTO 210
             ELSE IF (TETA0 .GT. 90.0) THEN
                THETAM=THETAM-(PA2I-THETA0)
                IF (THETAM.LE.THETA0-PA2I .OR. THETAM.GE.PAI) GOTO 210
             END IF
          THETA(J)=THETAM
       END DO
           DO J=1,nspec
             CALL RANDU(IXY,IY,FL)
             IXY=IY
             RNUM(J)=PAI2*FL+HKK(J)*I*BLOD*(COS(THETA(J)))
           END DO

       end if
c=================================================
      iwrite=ntt
c=================================================
       if(icase.eq.1) then

       OPENUNIT=4,FILE='xyz.dat')

     read(4,4) (x(i),y(i),z(i),i=1,nt)

       close(4)
     do i=1,nt
     x(i)=x(i)*ho
```

```
      y(i)=y(i)*ho
      z(i)=z(i)*ho
      end do

         do i=1,nt1
         f1(i)=0
      f1b(i)=0
      end do
      do i=1,nt2
      f2b(i)=0
      end do
      end if
c=============================================
         if(icase.ne.1) then
      rewind 3
      read(3) (f1(i),i=1,nt1)
      read(3) (z(i),x(i),y(i),i=1,nt)
      close(3)
      end if
c-------------------------------------------------------------

         blod=x(nj2+nt1)/nj21

C ******    BEGIN TO REPEAT    ************************************
            istart=start*100
         iend=eend*100
            istart1=istart+1
         iend1=iend
      if(icase.ne.1) istart1=istart-istart+1
      if(icase.ne.1) iend1=iend-istart

            DO Itt=istart1,iend1
         it1=1+float(ntt)/100*(itt-1)
         it2=float(ntt)/100*itt

         do it=it1,it2
         ttx=start+it/float(ntt)
            write( *,*) 'it=',ttx
```



```
      if(wave.eq.1) call REGULAR(IT,U,e,df,dt,hk,rteta0,nch,blod)

      if(wave.eq.2) call
     /    cross(IT,U,e1,e2,dt,hk1,hk2,rteta01,rteta02,df1,df2,nch,blod)

      if(wave.eq.3) call SOLITON(IT,U,xo,omega,tc,rteta0,ddt,nch,blod)

      if(wave.eq.4) call FREQ_WAVE(IT,U,s0,df,nspec,re,ddt,rnum,nch)

      if(wave.eq.5) call muti_WAVE(IT,U,s0,df,nspec,re,ddt,rnum,nch)

c=================================================
      DO kI=1,ni2
    do kj=1,nj2
    i=kj+nj2*(ki-1)
    F2B(I)=U(kj)
    end do
    end do
c=========================================================

      CALL hg(hh,gg,x,y,z,ni11,nj11,ni21,nj21,ni31,nj31,ni41,nj41
     /                              ,ni51,nj51,ni61,nj61,nt,nt0)

        call MIR2(hh,gg,nt0,nt1,nt26,7,9)

        call MTR2(hh,gg,nt0,nt1,nt26,9,8,7)

c==================
    do ki=1,ni1
    do kj=1,nj1

      nstart=0
    i=kj+nj1*(ki-1)

      if(ki.ne.ni1.or.kj.ne.nj1) then
      call xx_x_1(xx,yy,zz,x,y,z,nt,nj11,ki,kj,nstart)
      CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
```

xt1=xx(1)
xt2=xx(2)
xt3=xx(3)
xt4=xx(4)

yt1=yy(1)
yt2=yy(2)
yt3=yy(3)
yt4=yy(4)

zt1=zz(1)
zt2=zz(2)
zt3=zz(3)
zt4=zz(4)

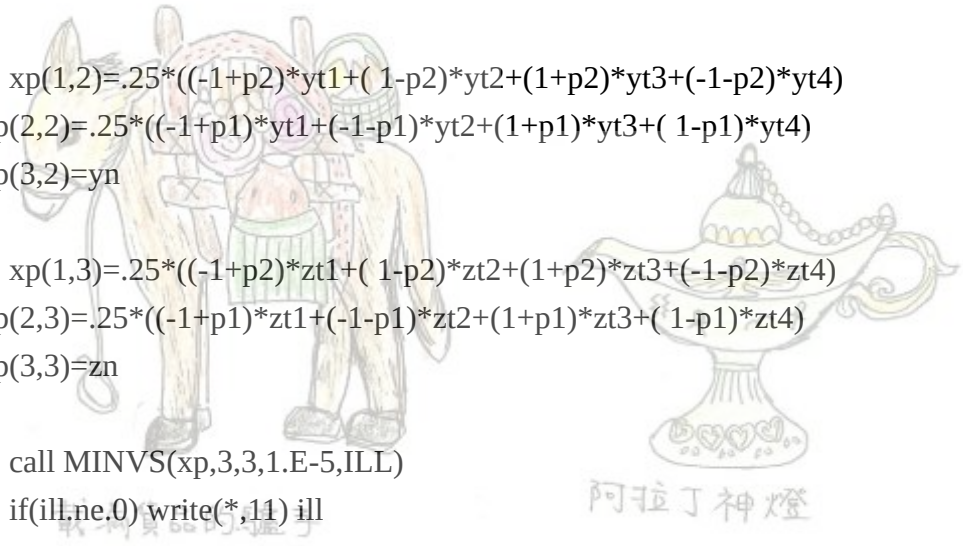
p1=-1
p2=-1

xp(1,1)=.25*((-1+p2)*xt1+(1-p2)*xt2+(1+p2)*xt3+(-1-p2)*xt4)
xp(2,1)=.25*((-1+p1)*xt1+(-1-p1)*xt2+(1+p1)*xt3+(1-p1)*xt4)
xp(3,1)=xn

xp(1,2)=.25*((-1+p2)*yt1+(1-p2)*yt2+(1+p2)*yt3+(-1-p2)*yt4)
xp(2,2)=.25*((-1+p1)*yt1+(-1-p1)*yt2+(1+p1)*yt3+(1-p1)*yt4)
xp(3,2)=yn

xp(1,3)=.25*((-1+p2)*zt1+(1-p2)*zt2+(1+p2)*zt3+(-1-p2)*zt4)
xp(2,3)=.25*((-1+p1)*zt1+(-1-p1)*zt2+(1+p1)*zt3+(1-p1)*zt4)
xp(3,3)=zn

call MINVS(xp,3,3,1.E-5,ILL)
if(ill.ne.0) write(*,11) ill

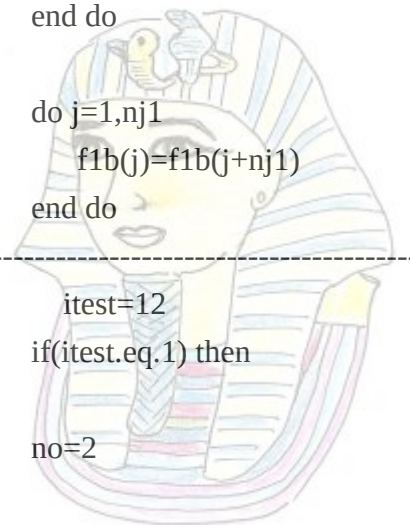


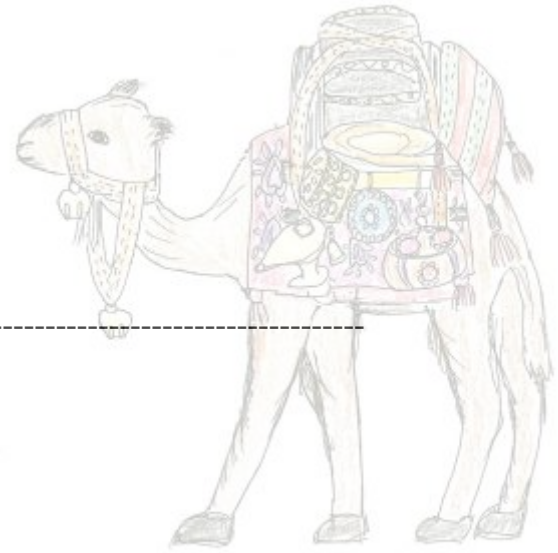
if(ki.eq.ni11) then
do ii=1,3
do jj=1,3
xpkj(ii,jj,kj)=xp(ii,jj)

```
   end do
end do
end if

end if

   if(kj.ne.nj1) fp1=(f1(i+1)-f1(i))/2.
   if(kj.eq.nj1) fp1=(f1(i)-f1(i-1))/2.

   if(ki.ne.ni1) fp2=(f1(i+nj1)-f1(i))/2.
   if(ki.eq.ni1) fp2=(f1(i)-f1(i-nj1))/2.

   fp3=f1b(i)

if(ki.eq.ni1) then

do ii=1,3
do jj=1,3
xp(ii,jj)=xpkj(ii,jj,kj)
   end do
end do

end if


fx=xp(1,1)*fp1 +xp(1,2)*fp2 +xp(1,3)*fp3
fy=xp(2,1)*fp1 +xp(2,2)*fp2 +xp(2,3)*fp3
fz=xp(3,1)*fp1 +xp(3,2)*fp2 +xp(3,3)*fp3

c    kk=ipa*(kj-1)+1
c       if(ki.eq.1) fx=u(kj)*cos(rteta0)
     if(ki.eq.1) fx=0
c       if(ki.eq.1) fy=u(kj)*sin(rteta0)

if(ki.eq.ni1)                fy=0
   if(kj.eq.1.or.kj.eq.nj1) fx=0

x(i)=x(i)+fx*dt
```

```
      y(i)=y(i)+fy*dt
      z(i)=z(i)+fz*dt

      if(kj.eq.nj1)       z(i)=z(i-1)

        if(ki.eq.ni1)       z(i)=z(i-nj1)

      f1(i)=f1(i)+dt*(.5*(fx**2+fy**2+fz**2)-gr*z(i))
      if(ki.ge.ni1-11)
c     if(ki.ge.ni1-11.or.kj.le.5.or.kj.ge.nj1-5)
     /    f1(i)=f1(i)-umu*f1(i)*dt

      if(kj.eq.nj1) f1(i)=f1(i-1)

        end do
      end do
      do ki=1,ni1
      z((ki-1)*nj1+1) = z((ki-1)*nj1+2)
      f1((ki-1)*nj1+1)=f1((ki-1)*nj1+2)
      end do

c ==============================================
        rewind 7
          READ(7) ((hh(I,J),J=1,Nt1 ),I=1,Nt1)
          READ(7) ((gg(I,J),J=1,nt26),I=1,nt1)

        call MINVS(hh,nt0,nt1,1.E-7,ILL)
        if(ill.ne.0) write(*,10) ill

      do i=1,nt1
      rs=0
      do j=1,nt2
      rs=rs+gg(i,j)*f2b(j)
      end do
      tmp(i)=f1(i)-rs
      end do

      do i=1,nt1
```

```
      f1b(i)=0
      do j=1,nt1
         f1b(i)=f1b(i)+hh(i,j)*tmp(j)
      end do
      end do

c     do j=1,nj1
c        f1b(j)=f1b(j+nj1)
c     end do
c-----------------------------------------------------------------------
         itest=12
      if(itest.eq.1) then

      no=2

         dx=float(nj21)/float(nj11)
      nstart=nt1
      if(dx.eq.1) then
      call dx_1(y,z,nt,ni2,nj2,nstart)
      end if

      if(dx.eq.1.5) then
      call dx_15(y,z,nt,ni2,nj2,nstart)

      do i=1,ni2
      do jj=1,nj2/2
      j=2*jj+nt1+nj2*(i-1)
      j3=2*jj-1+nt1+nj2*(i-1)
      j1=2*(jj-1)+1+nt1+nj2*(i-1)
      y(j)=y(j1)+(y(j3)-y(j1))/2
      end do
      if(i.eq.1) then
      do jj=1,nj2/2
      j=2*jj+nt1+nj2*(i-1)
      j3=2*jj-1+nt1+nj2*(i-1)
      j1=2*(jj-1)+1+nt1+nj2*(i-1)
      z(j)=z(j1)+(z(j3)-z(j1))/2
      end do
```





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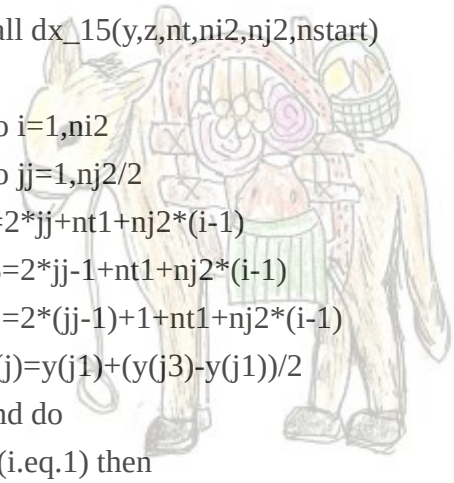
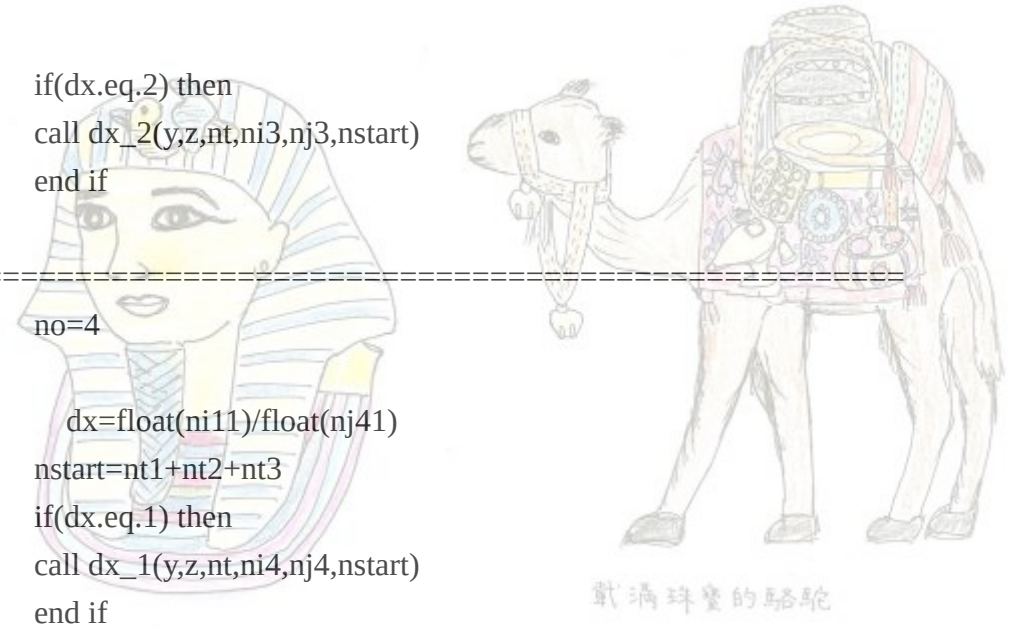


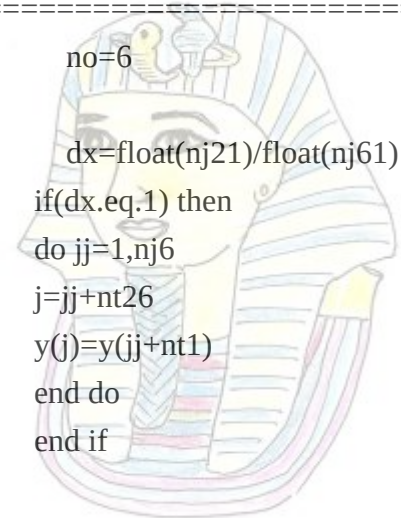
阿拉丁神燈

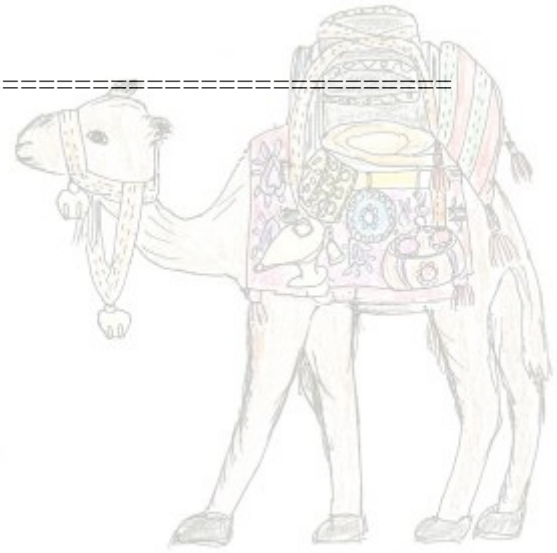
```
end if
end do
   end if

if(dx.eq.2) then
call dx_2(y,z,nt,ni2,nj2,nstart)

do i=1,ni2
do j=1,3
do jj=1,nj2/4
jjj=4*jj+j+nt1+nj2*(i-1)
j3 =4*jj-1+nt1+nj2*(i-1)
j1 =4*(jj-1)+1+nt1+nj2*(i-1)
y(jjj)=y(jjj-1)+(y(j3)-y(j1))/4
end do
end do
if(i.eq.1) then
do j=1,3
do jj=1,nj2/4
jjj=4*jj+j+nt1+nj2*(i-1)
j3 =4*jj-1+nt1+nj2*(i-1)
j1 =4*(jj-1)+1+nt1+nj2*(i-1)
z(jjj)=z(jjj-1)+(z(j3)-z(j1))/4
end do
end do
end if
end do
end if

c=============================================
      no=3

   dx=float(ni11)/float(nj31)
nstart=nt1+nt2
if(dx.eq.1) then
call dx_1(y,z,nt,ni3,nj3,nstart)
end if
```

```
      if(dx.eq.1.5) then
      call dx_15(y,z,nt,ni3,nj3,nstart)
         end if

      if(dx.eq.2) then
      call dx_2(y,z,nt,ni3,nj3,nstart)
      end if
c=====================================================
      no=4

         dx=float(ni11)/float(nj41)
      nstart=nt1+nt2+nt3
      if(dx.eq.1) then
      call dx_1(y,z,nt,ni4,nj4,nstart)
      end if

      if(dx.eq.1.5) then
      call dx_15(y,z,nt,ni4,nj4,nstart)
         end if

      if(dx.eq.2) then
      call dx_2(y,z,nt,ni4,nj4,nstart)
      end if
c=============================================
      no=5

         dx=float(nj11)/float(nj51)
      nstart=nt1+nt2+nt3+nt4
      if(dx.eq.1) then
      call dx_1(x,z,nt,ni5,nj5,nstart)
      end if

      if(dx.eq.1.5) then
      call dx_15(x,z,nt,ni5,nj5,nstart)
         end if
```



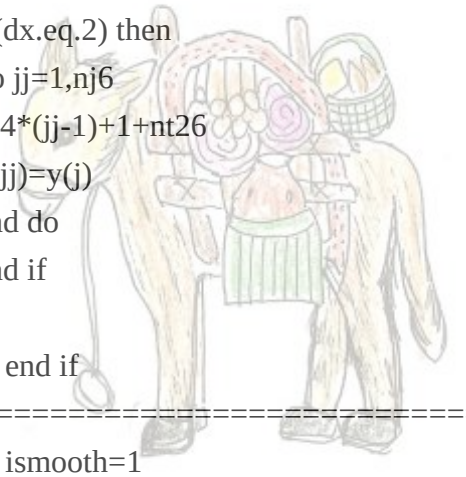
```
      if(dx.eq.2) then
      call dx_2(x,z,nt,ni5,nj5,nstart)
      end if

c=====================================================
          no=6

          dx=float(nj21)/float(nj61)
      if(dx.eq.1) then
      do jj=1,nj6
      j=jj+nt26
      y(j)=y(jj+nt1)
      end do
      end if

      if(dx.eq.1.5) then
      do jj=1,nj6
      j=2*(jj-1)+1+nt26
      y(jj)=y(j)
      end do
         end if

      if(dx.eq.2) then
      do jj=1,nj6
      j=4*(jj-1)+1+nt26
      y(jj)=y(j)
      end do
      end if

         end if
c=====================================================
         ismooth=1
      idex=.01*ntt
      if(ismooth.eq.1) then
         itemp = MODULO(it,idex)
         IF (itemp.EQ.0) then

      do    i=1,ni1
```





載滿珠寶的駱駝

2011 埃及尼羅河之旅



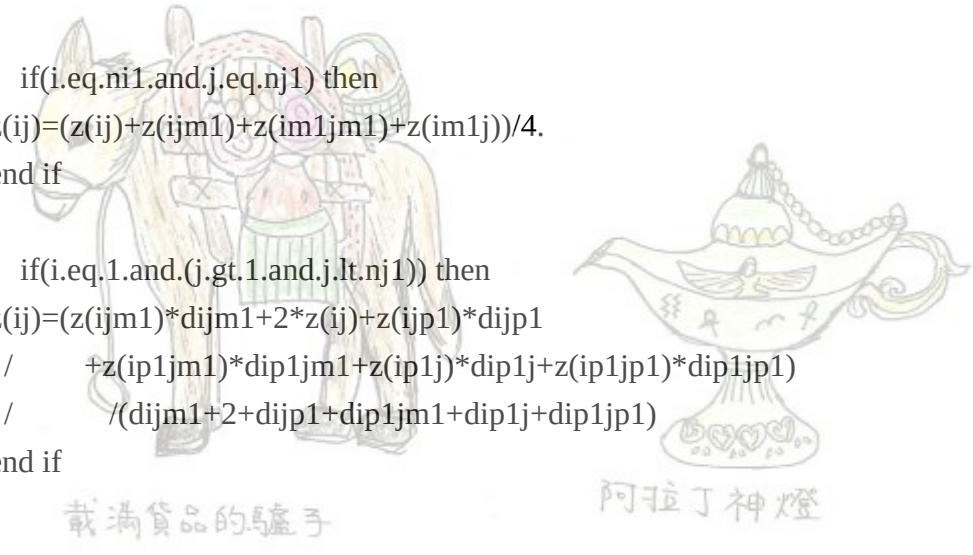
載滿寶品的騙子

阿拉丁神燈

```
do    j=1,nj1

ij=j+nj1*(i-1)
ijp1=ij+1
ip1j=ij+nj1
ip1jp1=ip1j+1
ijm1=ij-1
im1j=ij-nj1
ip1jm1=ip1j-1
im1jm1=im1j-1
im1jp1=im1j+1

   if(j.ne.1) then
dijm1=(x(ijm1)-x(ij))**2+(y(ijm1)-y(ij))**2
dijm1=1/dijm1
   if(i.ne.ni1) then
dip1jm1=(x(ip1jm1)-x(ij))**2+(y(ip1jm1)-y(ij))**2
dip1jm1=1/dip1jm1
   end if
if(i.ne.1) then
dim1jm1=(x(im1jm1)-x(ij))**2+(y(im1jm1)-y(ij))**2
   dim1jm1=1/dim1jm1
end if
end if

   if(j.ne.nj1) then
dijp1=(x(ijp1)-x(ij))**2+(y(ijp1)-y(ij))**2
   dijp1=1/dijp1
if(i.ne.ni1) then
dip1jp1=(x(ip1jp1)-x(ij))**2+(y(ip1jp1)-y(ij))**2
   dip1jp1=1/dip1jp1
end if
if(i.ne.1) then
dim1jp1=(x(im1jp1)-x(ij))**2+(y(im1jp1)-y(ij))**2
   dim1jp1=1/dim1jp1
end if
end if
```

```
if(i.ne.ni1) then
dip1j=(x(ip1j)-x(ij))**2+(y(ip1j)-y(ij))**2
   dip1j=1/dip1j
   end if

   if(i.ne.1) then
dim1j=(x(im1j)-x(ij))**2+(y(im1j)-y(ij))**2
   dim1j=1/dim1j
end if

   if(i.eq.1.and.j.eq.1) then
z(ij)=(z(ij)+z(ijp1)+z(ip1j)+z(ip1jp1))/4.
end if
```


```
   if(i.eq.ni1.and.j.eq.1) then
z(ij)=(z(ij)+z(im1j)+z(ijp1)+z(im1jp1))/4.
end if

   if(i.eq.ni1.and.j.eq.nj1) then
z(ij)=(z(ij)+z(ijm1)+z(im1jm1)+z(im1j))/4.
end if

   if(i.eq.1.and.(j.gt.1.and.j.lt.nj1)) then
z(ij)=(z(ijm1)*dijm1+2*z(ij)+z(ijp1)*dijp1
 /        +z(ip1jm1)*dip1jm1+z(ip1j)*dip1j+z(ip1jp1)*dip1jp1)
 /          /(dijm1+2+dijp1+dip1jm1+dip1j+dip1jp1)
end if
```



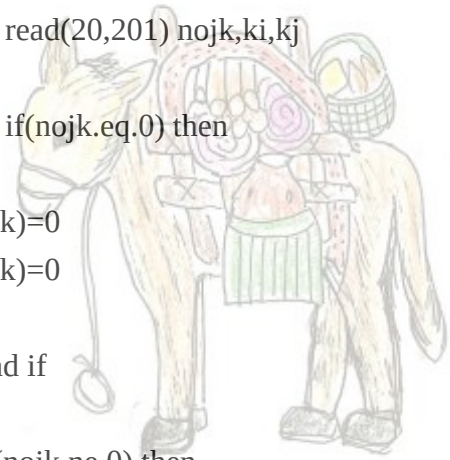

```
   if(j.eq.1.and.(i.gt.1.and.i.lt.ni1)) then
z(ij)=(z(im1j)*dim1j+2*z(ij)+z(ip1j)*dip1j
 /        +z(im1jp1)*dim1jp1+z(ijp1)*dijp1+z(ip1jp1)*dip1jp1)
 /          /(dim1j+2+dip1j+dim1jp1+dijp1+dip1jp1)
```

```
      end if

        if((i.ge.2.and.i.lt.ni1).and.(j.ge.2.and.j.lt.nj1)) then
      z(ij)=(z(im1jm1)*dim1jm1+z(im1j)*dim1j+z(im1jp1)*dim1jp1
       /          +z(ijm1)*dijm1+2*z(ij)+z(ijp1)*dijp1
       /          +z(ip1jm1)*dip1jm1+z(ip1j)*dip1j+z(ip1jp1)*dip1jp1)
       /          /(dim1jm1+dim1j+dim1jp1+dijm1+2+dijp1+dip1jm1+dip1j+dip1jp1)
      end if

        if(j.eq.nj1.and.(i.gt.1.and.i.lt.ni1)) then
      z(ij)=(z(im1j)*dim1j+2*z(ij)+z(ip1j)*dip1j
       /        +z(im1jm1)*dim1jm1+z(ijm1)*dijm1+z(ip1jm1)*dip1jm1)
       /          /(dim1j+2+dip1j+dim1jm1+dijm1+dip1jm1)
      end if

        if(i.eq.ni1.and.(j.gt.1.and.j.lt.nj1)) then
      z(ij)=(z(ijm1)*dijm1+2*z(ij)+z(ijp1)*dijp1
       /        +z(im1jm1)*dim1jm1+ z(im1j)*dim1j+ z(im1jp1)*dim1jp1)
       /          /(dijm1+2+dijp1+dim1jm1+dim1j+dim1jp1)
      end if

        end do
      end do

      end if
      end if

c=====================================================
        do ki=ni1,1,-1
      i1=nj1*(ki-1)+1
      i2=nj1*ki

        if(wave.ne.3)       write(*,88) (z(i)/h31,i=i1,i2)
        if(wave.eq.3)       write(*,88) (z(i)/h    ,i=i1,i2)

        end do
c=====================================================
        idex=ntt/iwrite
```

```
      wd=float(it)/float(idex)-it/idex
      if(wd.eq.0) then
      write(22,*) 'ttx=',ttx
      do ki=ni1,1,-1
     i1=nj1*(ki-1)+1
     i2=nj1*ki

      if(wave.ne.3)       write(22,88) (z(i)/h31,i=i1,i2)
      if(wave.eq.3)       write(22,88) (z(i)/h    ,i=i1,i2)

      end do
      write(23,*) 'ttx=',ttx
     write(23,7) (z(i),x(i),y(i),i=1,nt1)
      end if

     end do
     end do
     close(21)
     if(itt.eq.iend1.and.it.eq.it2) then
     rewind 3
     write(3) (f1(i),i=1,nt1)
     write(3) (z(i),x(i),y(i),i=1,nt)
     close(3)
      end if
c=====================================================
7       format( 3f7.3)
6       format(21f5.2)
5       format(8f16.8)
4       FORMAT(3F10.4)
3       FORMAT(3F10.4)
2       FORMAT(4F10.4)
10      FORMAT('   ILL = ',I7)
11      FORMAT('   ILL11 = ',I7)
88    format(41f5.2)

      stop
     end
```

```
c================================================
      subroutine hg(hh,gg,x,y,z,ni11,nj11,ni21,nj21,ni31,nj31,ni41,nj41
     /                                ,ni51,nj51,ni61,nj61,nt,nt0)

      real x(nt),y(nt),z(nt),XX(4),YY(4),ZZ(4)

      real hh(nt0,nt0),gg(nt0,nt0)

      real xg(4),yg(4),zg(4),p(2),e(2),h(4),g(4)

        ni1=ni11+1
      nj1=nj11+1
      ni2=ni21+1
      nj2=nj21+1
      ni3=ni31+1
      nj3=nj31+1
      ni4=ni41+1
      nj4=nj41+1
      ni5=ni51+1
      nj5=nj51+1
      ni6=ni61+1
      nj6=nj61+1

      nt1=ni1*nj1
      nt2=ni2*nj2
      nt3=ni3*nj3
      nt4=ni4*nj4
      nt5=ni5*nj5
      nt6=ni6*nj6

      nt26=nt-nt1

c================================================
      pai=3.1415927

        rewind 7
      rewind 8
```

```
    do ii=1,2
if(ii.eq.1) is=1
if(ii.eq.1) ie=nt1
if(ii.eq.2) is=nt1+1
if(ii.eq.2) ie=nt

    do jj=1,2
if(jj.eq.1) js=1
if(jj.eq.1) je=nt1
if(jj.eq.2) js=nt1+1
if(jj.eq.2) je=nt

    do i=is,ie
ix=i-nt1*(ii-1)

    open(unit=20,file='node_element.dat')

do j=js,je
    jx=j-nt1*(jj-1)

do k=1,4

    read(20,201) nojk,ki,kj

    if(nojk.eq.0) then

h(k)=0
g(k)=0

end if

if(nojk.ne.0) then

if(i.eq.j) then

h(k)=0

if(nojk.eq.1) then
```



```
nstart=0
   call xx_x_1(xx,yy,zz,x,y,z,nt,nj11,ki,kj,nstart)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call rsxyz(k,xx,yy,zz,gs)
end if

if(nojk.eq.2) then
nstart=nt1
   call xx_x_23(xx,yy,zz,x,y,z,nt,nj21,ki,kj,nstart)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call rsxyz(k,xx,yy,zz,gs)
end if

if(nojk.eq.3) then
nstart=nt1+nt2
   call xx_x_23(xx,yy,zz,x,y,z,nt,nj31,ki,kj,nstart)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call rsxyz(k,xx,yy,zz,gs)
end if

if(nojk.eq.4) then
nstart=nt1+nt2+nt3
   call xx_x_45(xx,yy,zz,x,y,z,nt,nj41,ki,kj,nstart)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call rsxyz(k,xx,yy,zz,gs)
end if

if(nojk.eq.5) then
nstart=nt1+nt2+nt3+nt4
   call xx_x_45(xx,yy,zz,x,y,z,nt,nj51,ki,kj,nstart)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call rsxyz(k,xx,yy,zz,gs)
end if

if(nojk.eq.6) then
nstart=nt1+nt2+nt3+nt4+nt5
   call xx_x_6(xx,yy,zz,x,y,z,nt,nj61,ki,kj,nstart)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
```

```
call rsxyz(k,xx,yy,zz,gs)
end if

call ggg(g,x,y,z,xg,yg,zg,gs,nt,i,k)

end if

if(i.ne.j) then

   if(nojk.eq.1) then
nstart=0
   call xx_x_1(xx,yy,zz,x,y,z,nt,nj11,ki,kj,nstart)
   CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)
end if

   if(nojk.eq.2) then
nstart=nt1
   call xx_x_23(xx,yy,zz,x,y,z,nt,nj21,ki,kj,nstart)
   CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)
end if

   if(nojk.eq.3) then
nstart=nt1+nt2
   call xx_x_23(xx,yy,zz,x,y,z,nt,nj31,ki,kj,nstart)
   CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
call h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)
end if

   if(nojk.eq.4) then
nstart=nt1+nt2+nt3
   call xx_x_45(xx,yy,zz,x,y,z,nt,nj41,ki,kj,nstart)
   CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
   call xyz_gauss(xg,yg,zg,xx,yy,zz)
```

call h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)
end if

if(nojk.eq.5) then
nstart=nt1+nt2+nt3+nt4
call xx_x_45(xx,yy,zz,x,y,z,nt,nj51,ki,kj,nstart)
call xyz_gauss(xg,yg,zg,xx,yy,zz)
CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
call h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)
end if

if(nojk.eq.6) then
nstart=nt1+nt2+nt3+nt4+nt5
call xx_x_6(xx,yy,zz,x,y,z,nt,nj61,ki,kj,nstart)
call xyz_gauss(xg,yg,zg,xx,yy,zz)
CALL normal(XX,YY,ZZ,XN,YN,ZN,A)
call h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)
end if

end if

end if

end do

hh(ix,jx)=h(1)+h(2)+h(3)+h(4)
if(i.eq.j) hh(ix,jx)=hh(ix,jx)+1
gg(ix,jx)=g(1)+g(2)+g(3)+g(4)

end do

close(20)

end do

if(ii.eq.1) ix=nt1
if(jj.eq.1) jx=nt1
if(ii.eq.2) ix=nt26

```
      if(jj.eq.2) jx=nt26

          WRITE(7) ((hh(I,J),J=1,jx),I=1,ix)
        write(8) ((gg(i,j),j=1,jx),i=1,ix)

      end do
      end do
4       FORMAT(3F10.4)
2       FORMAT(4F10.4)
201     format(3i5)
      return
      end

c=============================================================
      subroutine xyz_gauss(xg,yg,zg,xx,yy,zz)

        real xg(4),yg(4),zg(4),xx(4),yy(4),zz(4),p(2,2),e(2,2)

        qr=1./sqrt(3.)

      p(1,1)=-qr
      e(1,1)=-qr
      p(1,2)= qr
      e(1,2)=-qr

      p(2,1)= qr
      e(2,1)= qr
      p(2,2)=-qr
      e(2,2)= qr

        n=2

      do l=1,n
      do m=1,n

        f1=(1-p(l,m)-e(l,m)+p(l,m)*e(l,m))/4.
        f2=(1+p(l,m)-e(l,m)-p(l,m)*e(l,m))/4
        f3=(1+p(l,m)+e(l,m)+p(l,m)*e(l,m))/4.
```

```
      f4=(1-p(l,m)+e(l,m)-p(l,m)*e(l,m))/4.

      lm=m+n*(l-1)

      xg(lm)=f1*xx(1)+f2*xx(2)+f3*xx(3)+f4*xx(4)
      yg(lm)=f1*yy(1)+f2*yy(2)+f3*yy(3)+f4*yy(4)
      zg(lm)=f1*zz(1)+f2*zz(2)+f3*zz(3)+f4*zz(4)

      end do
      end do

        return
      end
c=============================================
      subroutine rsxyz(k,xx,yy,zz,gs)

      real xx(4),yy(4),zz(4)

      if(k.eq.1) pc=-1
      if(k.eq.2) pc=1
      if(k.eq.3) pc=1
      if(k.eq.4) pc=-1

      rx=.25*((-1+pc)*xx(1)-(1+pc)*xx(2)+(1+pc)*xx(3)+(1-pc)*xx(4))
      ry=.25*((-1+pc)*yy(1)-(1+pc)*yy(2)+(1+pc)*yy(3)+(1-pc)*yy(4))
      rz=.25*((-1+pc)*zz(1)-(1+pc)*zz(2)+(1+pc)*zz(3)+(1-pc)*zz(4))

        if(k.eq.1.or.k.eq.2) then
        rsx=.5*(xx(3)-xx(4))
      rsy=.5*(yy(3)-yy(4))
      rsz=.5*(zz(3)-zz(4))
      end if

        if(k.eq.3.or.k.eq.4) then
      rsx=.5*(xx(2)-xx(1))
      rsy=.5*(yy(2)-yy(1))
```

```
rsz=.5*(zz(2)-zz(1))
end if

gs1=rsy*rz-rsz*ry
gs2=rsz*rx-rsx*rz
gs3=rsx*ry-rsy*rx

gs=sqrt(gs1**2+gs2**2+gs3**2)

return
end
c=======================================================
subroutine h_g(h,g,xg,yg,zg,x,y,z,xn,yn,zn,a,nt,i,k)

real x(nt),y(nt),z(nt)

real h(4),g(4),xg(4),yg(4),zg(4),p(2,2),e(2,2)

   n=2
wl=1
wm=1
   qr=1./sqrt(3.)

p(1,1)=-qr
e(1,1)=-qr
p(1,2)= qr
e(1,2)=-qr

p(2,1)= qr
e(2,1)= qr
p(2,2)=-qr
e(2,2)= qr

pai=3.1415927

h(k)=0
   g(k)=0
```

```
do l=1,n
do m=1,n
lm=m+n*(l-1)

rilm=(x(i)-xg(lm))**2+(y(i)-yg(lm))**2+(z(i)-zg(lm))**2
rilm2=sqrt(rilm)

rn=(xg(lm)-x(i))*xn+(yg(lm)-y(i))*yn+(zg(lm)-z(i))*zn
rn=rn/rilm2

if(k.eq.1) then
   h(k)=h(k)+wl*wm*(1-p(l,m)-e(l,m)+p(l,m)*e(l,m))/rilm*rn*a
g(k)=g(k)+wl*wm*(1-p(l,m)-e(l,m)+p(l,m)*e(l,m))/rilm2*a
end if

if(k.eq.2) then
   h(k)=h(k)+wl*wm*(1+p(l,m)-e(l,m)-p(l,m)*e(l,m))/rilm*rn*a
g(k)=g(k)+wl*wm*(1+p(l,m)-e(l,m)-p(l,m)*e(l,m))/rilm2*a
end if

if(k.eq.3) then
   h(k)=h(k)+wl*wm*(1+p(l,m)+e(l,m)+p(l,m)*e(l,m))/rilm*rn*a
g(k)=g(k)+wl*wm*(1+p(l,m)+e(l,m)+p(l,m)*e(l,m))/rilm2*a
end if

if(k.eq.4) then
   h(k)=h(k)+wl*wm*(1-p(l,m)+e(l,m)-p(l,m)*e(l,m))/rilm*rn*a
g(k)=g(k)+wl*wm*(1-p(l,m)+e(l,m)-p(l,m)*e(l,m))/rilm2*a
end if

   end do
end do

h(k)=-1./8/pai*h(k)
g(k)= 1./8/pai*g(k)

return
end
```

```
c=============================================
      subroutine ggg(g,x,y,z,xg,yg,zg,gs,nt,i,k)

      real x(nt),y(nt),z(nt)

      real g(4),xg(4),yg(4),zg(4),p(2,2),e(2,2)

        n=2
      wl=1
      wm=1
         qr=1./sqrt(3.)

      p(1,1)=-qr
      e(1,1)=-qr
      p(1,2)= qr
      e(1,2)=-qr

      p(2,1)= qr
      e(2,1)= qr
      p(2,2)=-qr
      e(2,2)= qr

      pai=3.1415927

      g(k)=0
      do l=1,n
      do m=1,n
      lm=m+n*(l-1)
      rilm=(x(i)-xg(lm))**2+(y(i)-yg(lm))**2+(z(i)-zg(lm))**2

      rilm2=sqrt(rilm)
      if(k.eq.1) then
      g(k)=g(k)+wl*wm*(1-p(l,m)-e(l,m)+p(l,m)*e(l,m))/rilm2*gs
      end if

      if(k.eq.2) then
```

```
g(k)=g(k)+wl*wm*(1+p(l,m)-e(l,m)-p(l,m)*e(l,m))/rilm2*gs
end if

if(k.eq.3) then
g(k)=g(k)+wl*wm*(1+p(l,m)+e(l,m)+p(l,m)*e(l,m))/rilm2*gs
end if

if(k.eq.4) then
g(k)=g(k)+wl*wm*(1-p(l,m)+e(l,m)-p(l,m)*e(l,m))/rilm2*gs
end if

end do
end do

g(k)=1./8/pai*g(k)

return
end
```



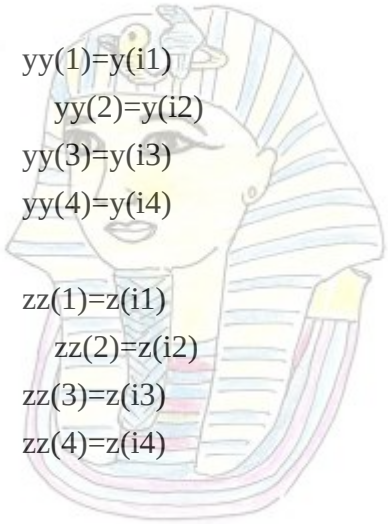
```
C*****************************************************************
      SUBROUTINE normal(XX,YY,ZZ,XN,YN,ZN,A)

      REAL XX(4),YY(4),ZZ(4)

      R1=XX(3)-XX(1)
      R2=YY(3)-YY(1)
      R3=ZZ(3)-ZZ(1)
      R4=XX(4)-XX(2)
      R5=YY(4)-YY(2)
      R6=ZZ(4)-ZZ(2)

      R=SQRT((R5*R3-R6*R2)**2+(R6*R1-R4*R3)**2+(R4*R2-R5*R1)**2)
      XN=(R5*R3-R6*R2)/R
      YN=(R6*R1-R4*R3)/R
      ZN=(R4*R2-R5*R1)/R

      T1=XX(2)-XX(1)
```

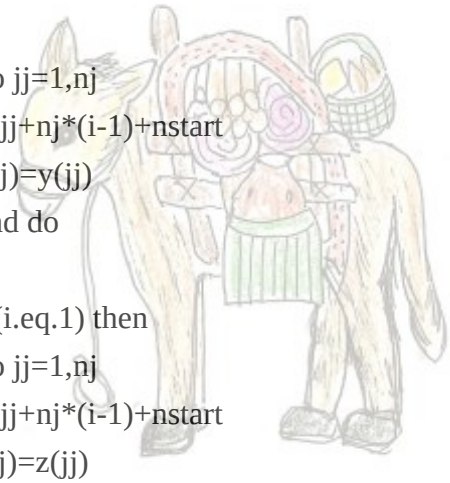
```
      T2=YY(2)-YY(1)
      T3=ZZ(2)-ZZ(1)
      T4=XX(4)-XX(1)
      T5=YY(4)-YY(1)
      T6=ZZ(4)-ZZ(1)

      R=.5*SQRT((T2*R3-T3*R2)**2+(T3*R1-T1*R3)**2+(T1*R2-T2*R1)**2)
      T=.5*SQRT((R2*T6-R3*T5)**2+(R3*T4-R1*T6)**2+(R1*T5-R2*T4)**2)

      A=R+T

      RETURN
      END
c=============================================================
      subroutine xx_x_1(xx,yy,zz,x,y,z,nt,nj_1,ki,kj,nstart)

      real x(nt),y(nt),z(nt)

      real xx(4),yy(4),zz(4)

      i1=kj+1+(nj_1+1)*(ki-1)+nstart
     i2=kj    +(nj_1+1)*(ki-1)+nstart
     i3=kj    +(nj_1+1)*ki+nstart
     i4=kj+1+(nj_1+1)*ki+nstart

c    i1=kj    +(nj_1+1)*ki+nstart
c    i2=kj+1+(nj_1+1)*ki+nstart
c    i3=kj+1+(nj_1+1)*(ki-1)+nstart
c    i4=kj    +(nj_1+1)*(ki-1)+nstart


     xx(1)=x(i1)
      xx(2)=x(i2)
     xx(3)=x(i3)
     xx(4)=x(i4)

     yy(1)=y(i1)
      yy(2)=y(i2)
```

```
      yy(3)=y(i3)
      yy(4)=y(i4)

      zz(1)=z(i1)
        zz(2)=z(i2)
      zz(3)=z(i3)
      zz(4)=z(i4)

      return
      end
c=====================================================================
        subroutine xx_x_23(xx,yy,zz,x,y,z,nt,nj_1,ki,kj,nstart)

        real x(nt),y(nt),z(nt),xx(4),yy(4),zz(4)

      i1=kj+1+(nj_1+1)*ki+nstart
      i2=kj    +(nj_1+1)*ki+nstart
      i3=kj    +(nj_1+1)*(ki-1)+nstart
      i4=kj+1+(nj_1+1)*(ki-1)+nstart

      xx(1)=x(i1)
        xx(2)=x(i2)
      xx(3)=x(i3)
      xx(4)=x(i4)

      yy(1)=y(i1)
        yy(2)=y(i2)
      yy(3)=y(i3)
      yy(4)=y(i4)

      zz(1)=z(i1)
        zz(2)=z(i2)
      zz(3)=z(i3)
      zz(4)=z(i4)

      return
      end
c=====================================================================
```

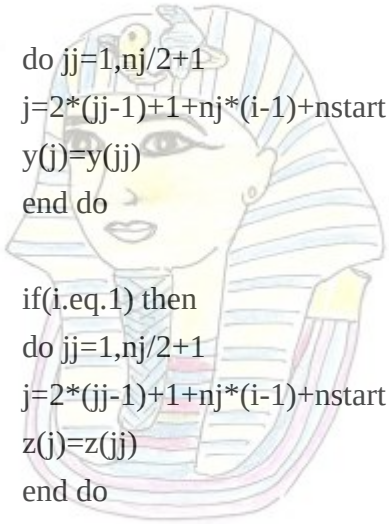
```
      subroutine xx_x_45(xx,yy,zz,x,y,z,nt,nj_1,ki,kj,nstart)

      real x(nt),y(nt),z(nt),xx(4),yy(4),zz(4)

      i1=kj    +(nj_1+1)*ki+nstart
      i2=kj+1+(nj_1+1)*ki+nstart
      i3=kj+1+(nj_1+1)*(ki-1)+nstart
      i4=kj    +(nj_1+1)*(ki-1)+nstart

      xx(1)=x(i1)
        xx(2)=x(i2)
      xx(3)=x(i3)
      xx(4)=x(i4)

      yy(1)=y(i1)
        yy(2)=y(i2)
      yy(3)=y(i3)
      yy(4)=y(i4)

      zz(1)=z(i1)
        zz(2)=z(i2)
      zz(3)=z(i3)
      zz(4)=z(i4)

      return
      end
c=======================================================================
      subroutine xx_x_6(xx,yy,zz,x,y,z,nt,nj_1,ki,kj,nstart)

      real x(nt),y(nt),z(nt)

      real xx(4),yy(4),zz(4)

      i1=kj    +(nj_1+1)*(ki-1)+nstart
      i2=kj+1+(nj_1+1)*(ki-1)+nstart
      i3=kj+1+(nj_1+1)*ki+nstart
      i4=kj    +(nj_1+1)*ki+nstart
```

```
      xx(1)=x(i1)
        xx(2)=x(i2)
      xx(3)=x(i3)
      xx(4)=x(i4)

      yy(1)=y(i1)
        yy(2)=y(i2)
      yy(3)=y(i3)
      yy(4)=y(i4)

      zz(1)=z(i1)
        zz(2)=z(i2)
      zz(3)=z(i3)
      zz(4)=z(i4)

      return
      end
c=============================================
      subroutine dx_1(y,z,nt,ni,nj,nstart)
      real y(nt),z(nt)

      do i =1,ni

      do jj=1,nj
      j=jj+nj*(i-1)+nstart
      y(j)=y(jj)
      end do

      if(i.eq.1) then
      do jj=1,nj
      j=jj+nj*(i-1)+nstart
      z(j)=z(jj)
      end do
      end if
      end do

      return
      end
```





```
c==========================================
      subroutine dx_15(y,z,nt,ni,nj,nstart)
      real y(nt),z(nt)
      do i=1,ni

      do jj=1,nj/2+1
      j=2*(jj-1)+1+nj*(i-1)+nstart
      y(j)=y(jj)
      end do

      if(i.eq.1) then
      do jj=1,nj/2+1
      j=2*(jj-1)+1+nj*(i-1)+nstart
      z(j)=z(jj)
      end do
      end if
      end do

      return
      end
c==========================================
      subroutine dx_2(y,z,nt,ni,nj,nstart)
      real y(nt),z(nt)

      do i=1,ni
      do jj=1,nj/4+1
      j=4*(jj-1)+1+nj*(i-1)+nstart
      y(j)=y(jj)
      end do

      if(i.eq.1) then
      do jj=1,nj/4+1
      j=4*(jj-1)+1+nj*(i-1)+nstart
      z(j)=z(jj)
      end do
      end if
      end do
```



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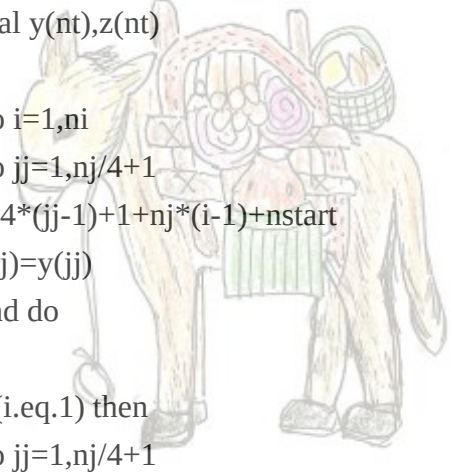

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```
      return
      end

C*****************************************************************
C           REGULAR WAVE CONTROL PROGRAM
C*****************************************************************
        SUBROUTINE REGULAR(IT,U,e,df,dt,hk,rteta0,nch,blod)
      REAL U(NCH)
          DO    I=1,NCH
        U(I)=E*SIN(DF*DT*(IT-1)-HK*(I-1)*BLOD*COS(RTETA0))
        end do
          RETURN
          END
C*****************************************************************
C           SHORT CREST WAVE CONTROL PROGRAM
C*****************************************************************
        SUBROUTINE CROSS(IT,U,e1,e2,dt,hk1,hk2,rteta01,rteta02,
       /                      df1,df2,nch,blod)
      REAL U(NCH)
          DO 10 I=1,NCH
        U(I)=E1*SIN(DF1*DT*(IT-1)-HK1*(I-1)*BLOD*COS(RTETA01))
       &       +E2*SIN(DF2*DT*(IT-1)+HK2*(I-1)*BLOD*COS(RTETA02))
    10    CONTINUE
          RETURN
          END
C*****************************************************************
C           SOLITARY WAVE CONTROL PROGRAM
C*****************************************************************
        SUBROUTINE SOLITON(IT,U,xo,omega,tc,rteta0,ddt,nch,blod)
      REAL U(NCH)
          DO 10 I=1,NCH
        U(I)=-xo*omega/cosh(omega*(DDT*IT-TC)-(I-1)*BLOD*COS(RTETA0))**2
    10    CONTINUE
          RETURN
          END
C*****************************************************************
C               ONE DIRECTIONAL IREGULAR WAVE SIMULATION PROGRAM
C*****************************************************************
```

```
      SUBROUTINE FREQ_WAVE(IT,U,s0,df,nspec,re,ddt,rnum,nch)
      real rnum(nspec),u(nch),s0(nspec),re(nspec)
      PAI2=6.283185308
      DO I=1,NCH
    temp=0
      DO J=1,nspec
      SIGMAT=PAI2*DF*(J-1)
      aa=re(j)*sqrt(2.*df*s0(j))
    temp=temp+aa*SIGMAT*cos(SIGMAT*(IT-1)*DDT-RNUM(J))
      END DO
      u(i)=temp
    END DO
      RETURN
      END
C*************************************************************
C
C            MUTIPLE DIRECTIONAL WAVE SIMULATION (3-D WAVE) PROGRAM
C
C*************************************************************
      SUBROUTINE muti_WAVE(IT,U,s0,df,nspec,re,ddt,rnum,nch)
      real rnum(nspec),u(nch),s0(nspec),re(nspec)
      PAI2=6.283185308
      DO I=1,NCH
    temp=0
      DO J=1,nspec
      SIGMAT=PAI2*DF*(J-1)
      aa=re(j)*sqrt(2.*df*s0(j))
    temp=temp+aa*SIGMAT*cos(SIGMAT*(IT-1)*DDT-RNUM(J))
      END DO
    u(i)=temp
    END DO
      RETURN
      END
C-------------------------------------------------------------
      SUBROUTINE wvmod(X,N,M,D,DT,TMAX,TMIN,ITYPE,HKK)
C-------------------------------------------------------------
C       CALCULATION OF CHARACTERISTIC FUNCTION OF WAVE GENERATOR
C-------------------------------------------------------------
```

```
C        X       : CHARACTERISTIC FUNCTION ---- 1.0/F(F,H)
C        N       : DATA NUMBER
C        D       : WATER DEPTH (M)
C        DT      : TIME INTERVAL (SEC)
C        TMAX : MAXIMUM PERIOD FOR WAVE GENERATOR (SEC)
C        TMIN : MINIMUM PERIOD FOR WAVE GENERATOR (SEC)
C        ITYP : TYPE OF WAVE GENERATOR     1--->PISTON ; 2--->FLAP

         DIMENSION X(M),HKK(M)
      real kh
         PAI=3.14159265
         DF=1.0/(2*N*DT)
         X(1)=0.0
      HKK(1)=0
         DO 1 I=2,N
         T=1.0/(DF*(I-1))
         IF(T .GT. TMAX) GO TO 5
         IF(T .LT. TMIN) GO TO 5
      KH=2.*PAI*D/WAVEL(T,D)
      KH=HKK(I)
         IF (KH.GT.40.0) THEN
           X(I)=X(I-1)
           GO TO 1
         ENDIF
         AA=SINH(KH)
         BB=COSH(KH)
         IF(ITYPE.EQ.2) GO TO 50
         X(I)=(AA*BB+KH)/AA**2
         GO TO 1
   50 X(I)=KH*(AA*BB+KH)/(AA*(1.0-BB+KH*AA))
         GO TO 1
    5 X(I)=0.0
1     CONTINUE
         RETURN
         END
C-----------------------------------------------------------------------
         SUBROUTINE SPECIN(X,N,M,DT,E,F,FPEAK,SPEAK)
         DIMENSION    X(M),E(25),F(25)
```

```
C
c          caution :coefficent should be changed case by case
c
      F(1)=0
      E(1)=0
      DO 55 I=2,25
55    F(I)=0.25*(I-1)
      X(1)=0.0
      DO 20 I=2,N
       DF=1.0/(2*N*DT)
       DFT=DF*(I-1)
       IF (DFT.GE.5.0)   GOTO 11
       IF (DFT.GE.F(1) .AND. DFT.LT.F(2))   THEN
        XF= ABS((DFT-F(1))/(F(2)-F(1)))
        X(I)=(1.0-XF)*E(1)+XF*E(2)
        GOTO 20
       ELSEIF (DFT.GE.F(23) .AND. DFT.LT.F(24))   THEN
         XF=ABS((DFT-F(23))/(F(24)-F(23)))
        X(I)=(1.0-XF)*E(23)+XF*E(24)
        GOTO 20
       ELSEIF (DFT.GE.F(24) .AND. DFT.LT.F(25))   THEN
        XF=(DFT-F(24))/(F(25)-F(24))
        X(I)=(1.0-XF)*E(24)+XF*E(25)
        GOTO 20
       ENDIF
      DO 10 J=2,22
       IF (DFT.GE.F(J) .AND. DFT.LT.F(J+1))   THEN
        XF=(DFT-F(J))/(F(J+1)-F(J))
        X(I)=(1.0-XF)*E(J)+XF*E(J+1)
        GOTO 20
       ENDIF
10     CONTINUE
11     X(I)=0.0
20       CONTINUE
       DO 220 IP=2,N
        DF=1.0/(2*N*DT)
        DFT=DF*(IP-1)
        IF (DFT.GE.FPEAK) GOTO 221
```

```
220     CONTINUE
221     IPEAK=IP
        DELTAF=SPEAK-X(IPEAK)
        NHS=IPEAK-20
        NHE=IPEAK+20
        IF (NHS.LE.1)   NHS=2
        IF (NHE.GE.N)   NHE=N
        DO 230 IH=NHS,NHE
         DF=1.0/(2*N*DT)
         DFT=DF*(IH-1)
         XDELTA=(-((DFT-FPEAK)/0.25)**2+1.0)*DELTAF
         X(IH)=X(IH)+XDELTA
230     CONTINUE
      RETURN
      END
C-----------------------------------------------------------------
      SUBROUTINE JONSWAP(X,N,M,H3,T3,DT)
      DIMENSION X(M)
      DF=1.0/(2*N*DT)
      GANMA=3.3
      ALPHA=0.0624/(0.23+0.0336*GANMA-0.185*(1.9+GANMA)**(-1))
      BETA=ALPHA*(1.094-0.01915*LOG(GANMA))
      TPEAK=T3/(1-0.132*(GANMA+0.2)**(-0.559))
      FPEAK=1/(TPEAK)
      C1J=BETA*H3**2*TPEAK**(-4)
      C2J=-1.25*TPEAK**(-4)
      X(1)=0.0
      DO 2 I=2,N
       F=DF*(I-1)
       IF (F.LT.FPEAK) SIGMA=0.07
       IF (F.GE.FPEAK) SIGMA=0.09
       F1=C2J*F**(-4)
       F2=-(TPEAK*F-1.00)**2/(2.00*SIGMA**2)
       IF (F2.LT.-25.0) THEN
          F0=1.0
       ELSE
          F0=GANMA**EXP(F2)
       END IF
```

```
          IF (F1.LT.-25.0) THEN
            X(I)=0.0
          ELSE
            X(I)=C1J*F**(-5)*EXP(F1)*F0
          END IF
    2     CONTINUE
          RETURN
          END
C-----------------------------------------------------------------------
          SUBROUTINE BM0(X,N,M,H3,T3,DT)
C-----------------------------------------------------------------------
C         COMPUTATION OF BRETSCHNEIDER-MITSUYASU TYPE SPECTRUM
C-----------------------------------------------------------------------
C         X    : BRETSCHNEIDER MITSUYASU TYPE FREQUENCY SPECTRUM
C         N    : DATA NUMBER OF SPECTRUM
C         H3 : SIGNIFICANT WAVE HEIGHT
C         T3 : SIGNIFICANT WAVE PERIOD
C         DT : TIME INTERVAL
          DIMENSION X(M)
          DF=1.0/(2*N*DT)
          A=0.257*H3**2
          B=T3**(-4)
          C=-1.03*B
          AB=A*B
          X(1)=0.0
          DO 1 I=2,N
          F0=DF*(I-1)
          CFB=F0**(-4)
          CF=C*CFB
          IF(CF .LT. -25.0)    GO TO 2
          X(I)=AB*CFB/F0*EXP(CF)
          GO TO 1
        2 X(I)=0.
        1 CONTINUE
          RETURN
          END
C-----------------------------------------------------------------------
```

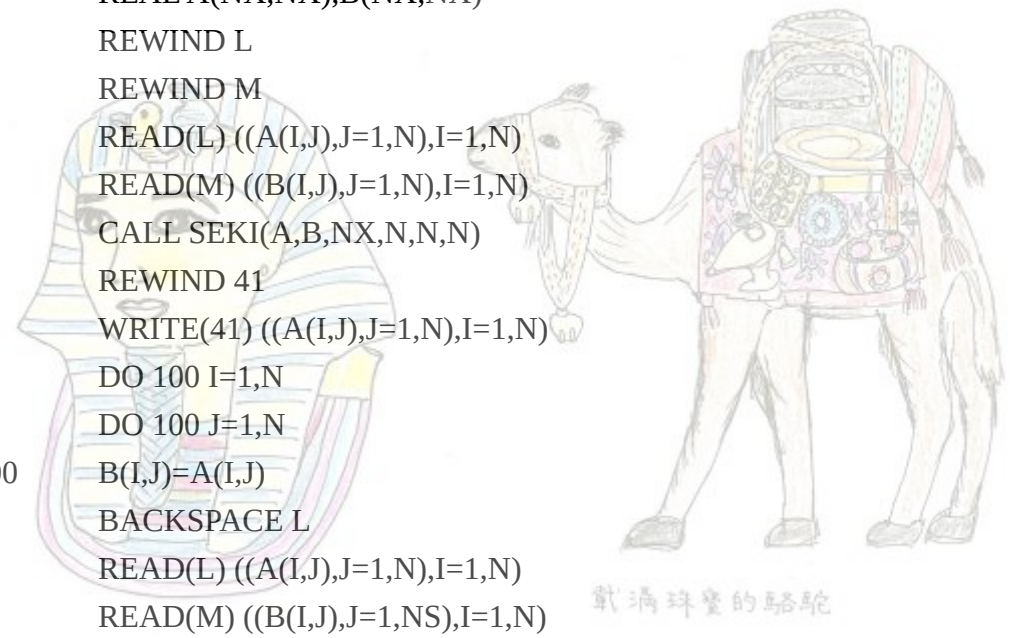
```
      SUBROUTINE BMS(X,N,M,H3,T3,DT)
C-----------------------------------------------------------------------
C       COMPUTATION OF SHUUSEI BRETSCHNEIDER-MITSUYASU TYPE SPECTRUM
C-----------------------------------------------------------------------
C       X   : SHUUSEI BRETSCHNEIDER MITSUYASU TYPE FREQUENCY SPECTRUM
C       N   : DATA NUMBER OF SPECTRUM
C       H3 : SIGNIFICANT WAVE HEIGHT
C       T3 : SIGNIFICANT WAVE PERIOD
C       DT : TIME INTERVAL

      DIMENSION X(M)
      DF=1.0/(2*N*DT)
      A=0.205*H3**2
      B=T3**(-4)
      C=-0.75*B
      AB=A*B
      X(1)=0.0
      DO 1 I=2,N
      F0=DF*(I-1)
      CFB=F0**(-4)
      CF=C*CFB
      IF(CF .LT. -25.0)   GO TO 2
      X(I)=AB*CFB/F0*EXP(CF)
      GO TO 1
    2 X(I)=0.
    1 CONTINUE
      RETURN
      END
c=======================================================================
      FUNCTION WAVEL(T,D)
C-----------------------------------------------------------------
C       CALCULATION OF WAVE LENGTH   (M)
C-----------------------------------------------------------------
C       T : WAVE PERIOD (SEC)
C       D : WATER DEPTH (M)

      PAI2=6.283185
      DD=PAI2*D/(9.8*T**2/PAI2)
```

```
      X=DD
      IF(DD .LT. 1.0) X=SQRT(DD)
    4 COTH=1.0/TANH(X)
      XX=X-(X-DD*COTH)/(1.0+DD*(COTH**2-1.0))
      EMIN=1.0-XX/X
      X=XX
      IF(ABS(EMIN) .GE. 0.0005) GO TO 4
      WAVEL=PAI2/X
      RETURN
      END
C*******************************************************
      SUBROUTINE SEKI(A,B,M,NA,NK,NB)
      REAL A(M,M),B(M,M),C(10000)
      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 MINVS(A,KO,N,EPS,ILL)
      REAL A(KO,KO)
      INTEGER X(10000)
      LOGICAL B
      ILL=0
      IF((KO.GE.N).AND.(N.GE.2).AND.(N.LE.10000).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)
      X(K)=L
      GO TO 120
140   CONTINUE
      RETURN
      END
c=======================================================
      SUBROUTINE WA(A,B,NA,N,NS)
C*******************************************************
C       [A]n,ns + [B]n,ns =====> [B]n,ns
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 SA(A,B,NA,N,NS)
C*******************************************************
C       [A]n,ns - [B]n,ns =====> [B]n,ns
c       required file number 40 41 42
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 MTR2 (A,B,Nx,N,NS,L,M,K)
      REAL A(NX,NX),B(NX,NX)
      REWIND L
      REWIND M
      READ(L) ((A(I,J),J=1,N),I=1,N)
      READ(M) ((B(I,J),J=1,N),I=1,N)
      CALL SEKI(A,B,NX,N,N,N)
      REWIND 41
      WRITE(41) ((A(I,J),J=1,N),I=1,N)
      DO 100 I=1,N
      DO 100 J=1,N
100   B(I,J)=A(I,J)
      BACKSPACE L
      READ(L) ((A(I,J),J=1,N),I=1,N)
      READ(M) ((B(I,J),J=1,NS),I=1,N)
      CALL SEKI (A,B,NX,N,N,NS)
      WRITE(41) ((A(I,J),J=1,NS),I=1,N)
      READ(L) ((A(I,J),J=1,NS),I=1,N)
      READ(M) ((B(I,J),J=1,N ),I=1,NS)
      CALL SEKI (A,B,NX,N,NS,N)
      REWIND 41
      READ(41) ((B(I,J),J=1,N),I=1,N)
      CALL WA (A,B,NX,N,N)
      REWIND K
      WRITE(K) ((B(I,J),J=1,N),I=1,N)
      READ(L) ((A(I,J),J=1,N ),I=1,NS)
      READ(L) ((A(I,J),J=1,NS),I=1,NS)
      REWIND L
      READ(L) ((A(I,J),J=1,N ),I=1,N)
      READ(L) ((A(I,J),J=1,NS),I=1,N)
      READ(M) ((B(I,J),J=1,NS),I=1,NS)
      CALL SEKI (A,B,NX,N,NS,NS)
      READ(41) ((B(I,J),J=1,NS),I=1,N)
      CALL WA (A,B,NX,N,NS)
      WRITE(K) ((B(I,J),J=1,NS),I=1,N)
      REWIND M
      READ(M) ((B(I,J),J=1,N),I=1,N)
```



```
      READ(L) ((A(I,J),J=1,N),I=1,NS)
      CALL SEKI (A,B,NX,NS,N,N)
      REWIND 41
      WRITE(41) ((A(I,J),J=1,N),I=1,NS)
      READ(L) ((B(I,J),J=1,NS),I=1,NS)
      BACKSPACE L
      BACKSPACE L
      READ(L) ((A(I,J),J=1,N),I=1,NS)
      READ(M) ((B(I,J),J=1,NS),I=1,N)
      CALL SEKI (A,B,NX,NS,N,NS)
      WRITE(41) ((A(I,J),J=1,NS),I=1,NS)
      READ(L) ((A(I,J),J=1,NS),I=1,NS)
      READ(M) ((B(I,J),J=1,N ),I=1,NS)
      CALL SEKI (A,B,NX,NS,NS,N)
      REWIND 41
      READ(41) ((B(I,J),J=1,N ),I=1,NS)
      CALL WA (A,B,NX,NS,N)
      WRITE(K) ((B(I,J),J=1,N ),I=1,NS)
      BACKSPACE L
      READ(L) ((A(I,J),J=1,NS),I=1,NS)
      READ(M) ((B(I,J),J=1,NS),I=1,NS)
      CALL SEKI (A,B,NX,NS,NS,NS)
      READ(41) ((B(I,J),J=1,NS),I=1,NS)
      CALL WA (B,A,NX,NS,NS)
      WRITE(K) ((A(I,J),J=1,NS),I=1,NS)

    RETURN
      END
C*******************************************************
      SUBROUTINE WAR2(A,B,Nx,N,NS,L,M,K)
      REAL A(NX,NX),B(NX,NX)
      REWIND L
      REWIND M
      REWIND K
      READ(L) ((A(I,J),J=1,N),I=1,N)
      READ(M) ((B(I,J),J=1,N),I=1,N)
      CALL WA(B,A,NX,N,N)
      WRITE(K) ((A(I,J),J=1,N),I=1,N)
```

```
      READ(L) ((A(I,J),J=1,NS),I=1,N)
      READ(M) ((B(I,J),J=1,NS),I=1,N)
      CALL WA(B,A,NX,N,NS)
      WRITE(K) ((A(I,J),J=1,NS),I=1,N)
      READ(L) ((A(I,J),J=1,N),I=1,NS)
      READ(M) ((B(I,J),J=1,N),I=1,NS)
      CALL WA(B,A,NX,NS,N)
      WRITE(K) ((A(I,J),J=1,N),I=1,NS)
      READ(L) ((A(I,J),J=1,NS),I=1,NS)
      READ(M) ((B(I,J),J=1,NS),I=1,NS)
      CALL WA(B,A,NX,NS,NS)
      WRITE(K) ((A(I,J),J=1,NS),I=1,NS)
      RETURN
      END
C=======================================================
      SUBROUTINE MIR2(A,B,Nx,N,NS,L,M)
C*******************************************************
C     Calculate large matrix A(n+ns,n+ns)'s inverse    [A1]n,n  [A2]n,ns
C  read A from unit L file, after calculating,          [A3]ns,n [A4]ns,ns
C  write to unit M file with :
C                  [M1] = [ [A1] - [A2] [A4]^ [A3] ]^ ,   ^ means inverse
C                  [M3] = - [A4]^ [A3] [M1]
C                  [M4] = [ [A4] - [A3] [A1]^ [A2] ]^
C                  [M2] = - [A1]^ [A2] [M4]
C*******************************************************
      REAL A(NX,NX),B(NX,NX)

      REWIND L
      READ(L) ((A(I,J),J=1,N ),I=1,N)
      READ(L) ((A(I,J),J=1,NS),I=1,N)
      READ(L) ((A(I,J),J=1,N ),I=1,NS)
      READ(L) ((B(I,J),J=1,NS),I=1,NS)
      CALL MINVS(B,NX,NS,1E-7,ILL)
      ILLD=1
      IF(ILL.NE.0) WRITE (*,10) ILLD,ILL
      CALL SEKI(B,A,NX,NS,NS,N)
      REWIND 40
      WRITE(40) ((B(I,J),J=1,N),I=1,NS)
```

```
      BACKSPACE L
      BACKSPACE L
      BACKSPACE L
      READ(L) ((A(I,J),J=1,NS),I=1,N)
      CALL SEKI (A,B,NX,N,NS,N)
      READ(L) ((B(I,J),J=1,N ),I=1,NS)
      READ(L) ((B(I,J),J=1,NS),I=1,NS)
      REWIND L
      READ(L) ((B(I,J),J=1,N ),I=1,N )
      CALL SA (B,A,NX,N,N)
    CALL MINVS (A,NX,N,1E-7,ILL)
    ILLD=2
      IF(ILL.NE.0) WRITE (6,10) ILLD,ILL
      READ(L) ((B(I,J),J=1,NS),I=1,N)
      READ(L) ((B(I,J),J=1,N ),I=1,NS)
      READ(L) ((B(I,J),J=1,NS),I=1,NS)
      REWIND M
      WRITE(M) ((A(I,J),J=1,N ),I=1,N)
      REWIND 40
      READ(40) ((B(I,J),J=1,N ),I=1,NS)
      CALL SEKI (B,A,NX,NS,N,N)
      DO 100 I=1,NS
      DO 100 J=1,N
      B(I,J)=-B(I,J)
100   CONTINUE
      REWIND 42
      WRITE(42) ((B(I,J),J=1,N ),I=1,NS)
      REWIND L
      READ(L) ((A(I,J),J=1,N ),I=1,N)
      CALL MINVS (A,NX,N,1E-7,ILL)
      ILLD=3
      IF(ILL.NE.0) WRITE(*,10) ILLD,ILL
      READ(L) ((B(I,J),J=1,NS),I=1,N )
      CALL SEKI (A,B,NX,N,N,NS)
      REWIND 40
      WRITE(40) ((A(I,J),J=1,NS),I=1,N)
      READ(L) ((B(I,J),J=1,N ),I=1,NS)
      CALL SEKI (B,A,NX,NS,N,NS)
```

```
      READ(L) ((A(I,J),J=1,NS),I=1,NS)
      CALL SA (A,B,NX,NS,NS)
      CALL MINVS (B,NX,NS,1E-7,ILL)
      ILLD=4
      IF(ILL.NE.0) WRITE(*,10) ILLD,ILL
      WRITE(42) ((B(I,J),J=1,NS),I=1,NS)
      REWIND 40
      READ(40) ((A(I,J),J=1,NS),I=1,N)
      CALL SEKI (A,B,NX,N,NS,NS)
      DO 101 I=1,N
      DO 101 J=1,NS
      A(I,J)=-A(I,J)
101   CONTINUE
      WRITE(M) ((A(I,J),J=1,NS),I=1,N)
      REWIND 42
      READ(42) ((A(I,J),J=1,N ),I=1,NS)
      WRITE(M) ((A(I,J),J=1,N),I=1,NS)
      READ(42) ((A(I,J),J=1,NS),I=1,NS)
      WRITE(M) ((A(I,J),J=1,NS),I=1,NS)
10    FORMAT(1X,'ILL(',I1,')=',I7)
      RETURN
      END
```