INTERACTION NOTES

Note 227

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INTEGRAL EQUATION APPROACH TO WIDEBAND INVERSE SCATTERING

Volume II

Computer Program Descriptions and Listings

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SECTION 1

PROGRAM ASSET

This section describes the program ASSET, which solves the asymmetric scattering problem for conducting surfaces as discussed in Sec. 2.3 of Vol. I. Section 1.2 contains a listing of the program code.

1.1 ASSET PROGRAM DESCRIPTION

The flow chart of the ASSET program, shown in Fig. 1, describes pictorially the operation of ASSET and the calling sequence of the subroutines that constitute ASSET.

The first step is to set up the required geometry parameters which model the target being considered. This is done in subroutine SPHER3 in this case, which models a sphere of arbitrary radius and number of patches.

Subroutine PRNTG prints the geometry parameters of the scattering body under consideration.

Subroutine PULSE generates the Gaussian-shaped pulse given in Eq. (4) of Vol. I for the incident magnetic field. The parameters used to describe the incident field are discussed in Sec. 2.3.1 of Vol. I.

Subroutine STEP3 carries out the iteration in time that is dictated by Eq. (10) of Vol. I and computes the surface current at all sample points in space-time.

Subroutine PRNTC prints the values stored in the surface current array at all sample points in space-time.

Subroutine FAR3 computes and prints the far scattered magnetic field given in Eq. (9) of Vol. I and uses the geometry parameters displayed in Vol. I, Fig. 4.

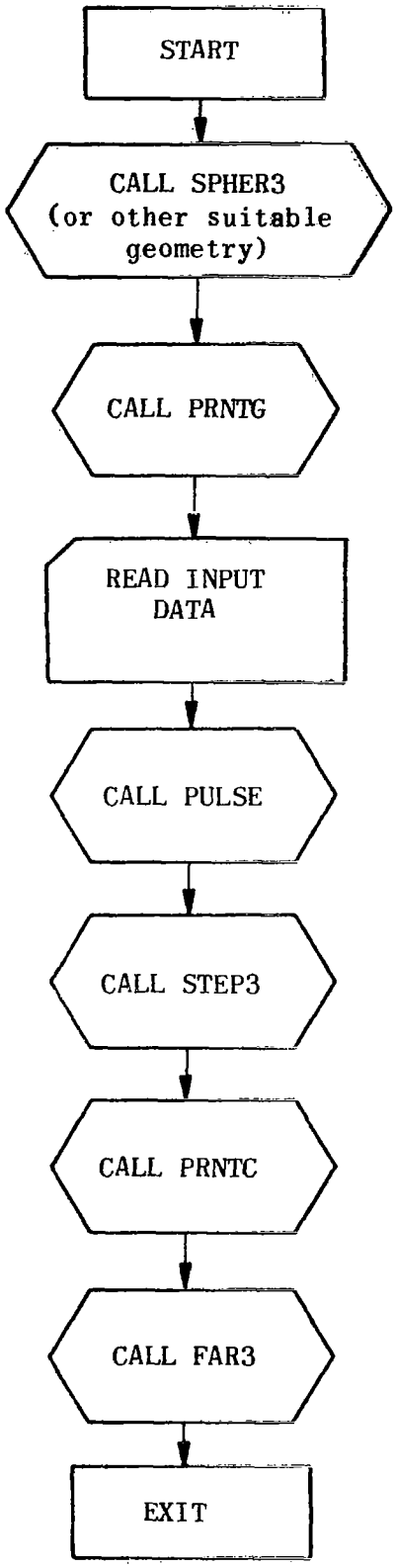

FIG. 1 Flow chart of ASSET program.

1.2 ASSET PROGRAM LISTINGS

```
0001     C ASSET DRIVER
0002           DIMENSION X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100),
0003          *T( 40),F(100, 40,3),JSTART(100),
0004          *TF(050),HPXP(050,09),HPXT(050,09),HYZT(050,09),HYZX(050,09)
0005          *,PSIPX(09),PSIYZ(09)
0006           ISMAX=100
0007           JSMAX= 40
0008           JFMAX=050
0009           IFMAX=09
0010           CALL SPHER3(X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0011           CALL PRNTS (X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0012           READ(5,10) T(1),DT,TNOSUR
0013           READ(5,10) AN
0014           READ(5,10) ALPHA,BETA
0015        10 FORMAT(3F10.4)
0016           WRITE(6,20) T(1),DT,TNOSUR,AN,ALPHA,BETA
0017        20 FORMAT(1H1,10X,16HINPUT PARAMETERS//
0018          *5X,7HTSTART=,F10.5/5X,7H     DT=,F10.5/5X,7HTNOSUR=,F10.5/
0019          *5X,7H     AN=,F10.5/5X,7H ALPHA=,F10.5/5X,7H  BETA=,F10.5)
0020           JNO=(TNOSUR-T(1))/DT+1.01
0021           IF(JNO.GT.JSMAX) GO TO 600
0022           DO 100 J=2,JNO
0023       100 T(J)=T(J-1)+DT
0024           CALL PULSE (AN,ALPHA,BETA,T,DT,JNO,X,Y,Z,XN,NTOTAL,F,JSTART,
0025          *ISMAX,JSMAX)
0026           WRITE(6,1)
0027         1 FORMAT(1H1)
0028           WRITE(6,2)(I,JSTART(I),I=1,NTOTAL)
0029         2 FORMAT(5X,2I10)
0030           CALL STEP3(T,DT,JNO,X,Y,Z,XN,MOST,DS,NTOTAL,F,JSTART,
0031          *ISMAX,JSMAX)
0032           CALL PRNTC (T,JNO,F,NTOTAL,ISMAX,JSMAX)
0033           CALL PAR3(T,DT,JNO,X,Y,Z,DS,NTOTAL,F,JSTART,ISMAX,JSMAX,
0034          *TF,NTF,HPXP,HPXT,HYZT,HYZX,PSIPX,PSIYZ,NPX,NYZ,IFMAX,JFMAX
0035          *,ALPHA,BETA)
0036           STOP
0037       600 CONTINUE
0038           WRITE(6,30)
0039        30 FORMAT(1H1,5X,31HTERMINATE RUN, TNOSUR TOO LARGE)
0040           STOP 100
0041           END
```

```
0001          SUBROUTINE SPHER3 (X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0002          DIMENSION X(ISMAX),Y(ISMAX),Z(ISMAX),XN(ISMAX,3),MOST(ISMAX),
0003         *DS(ISMAX)
0004          DIMENSION ML(25),THETA(25),PHI(25)
0005          DATA PI/3.14159265/
0006          MLMAX=25
0007          READ (5,10) RO,MTOTAL
0008       10 FORMAT (F10.5,I5)
0009          IF(MTOTAL.GT.(MLMAX-1)) GO TO 200
0010          READ (5,11)(ML(I),I=1,MTOTAL)
0011       11 FORMAT (16I5)
0012          RSQ=RO*RO
0013          AM=MTOTAL
0014          DTHETA=PI/AM
0015          THETA(1)=0.
0016          DO 100 I=1,MTOTAL
0017      100 THETA(I+1)=THETA(I)+DTHETA
0018          N=0
0019          DO 150 I=1,MTOTAL
0020          MI=ML(I)
0021          IF(MI.GT.MLMAX) GO TO 200
0022          AM=MI
0023          AREA=PI*RSQ*(COS(THETA(I))-COS(THETA(I+1)))/AM*2.
0024          DPHI=2.*PI/AM
0025          PHI(1)=DPHI/2.
0026          DO 110 II=2,MI
0027      110 PHI(II)=PHI(II-1)+DPHI
0028          THET=THETA(I)+DTHETA/2.
0029          RSINT=SIN(THET)*RO
0030          RCOST=COS(THET)*RO
0031          DO 120 II=1,MI
0032          N=N+1
0033          X(N)=RSINT*COS(PHI(II))
0034          Y(N)=RSINT*SIN(PHI(II))
0035          Z(N)=RCOST
0036          XN(N,1)=X(N)/RO
0037          XN(N,2)=Y(N)/RO
0038          XN(N,3)=Z(N)/RO
0039          DS(N)=AREA
0040      120 CONTINUE
0041      150 CONTINUE
0042          NTOTAL=N
0043          IF(NTOTAL.GT.ISMAX) GO TO 200
0044          DO 170 I=1,NTOTAL
0045          MOSTI=1
0046          DO 160 K=2,3
0047          IF(ABS(XN(I,K)).GT.ABS(XN(I,MOSTI))) MOSTI=K
0048      160 CONTINUE
0049          MOST(I)=MOSTI
0050      170 CONTINUE
0051          RETURN
0052      200 CONTINUE
0053          WRITE (6,20)
0054       20 FORMAT (1H1,54HTERMINATE RUN, GEOMETRY INPUT PARAMETERS ARE TOO LA
0055         *RGE)
0056          STOP 1
0057          END
```

```
0001            SUBROUTINE PRNTS (X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0002            DIMENSION X(ISMAX),Y(ISMAX),Z(ISMAX),XN(ISMAX,3),DS(ISMAX),
0003           *MOST(ISMAX)
0004            DIMENSION RHO(500)
0005            DO 100 I=1,NTOTAL
0006          100 RHO(I)=SQRT(X(I)**2+Y(I)**2)
0007            WRITE (6,10)
0008           10 FORMAT (1H1,3X,1HI,2X,4HMOST,6X,1HX,14X,1HY,14X,1HZ,14X,2HXN,
0009           *13X,2HYN,13X,2HZN,10X,2HDS,8X,3HRHO//)
0010            WRITE (6,20)(I,MOST(I),X(I),Y(I),Z(I),(XN(I,K),K=1,3),DS(I)
0011           *,RHO(I),I=1,NTOTAL)
0012           20 FORMAT (2I5,6F15.8,2F10.6)
0013            RETURN
0014            END


0001            SUBROUTINE PULSE (AN,ALPHA,BETA,T,DT,JNO,X,Y,Z,XN,NTOTAL,F,JSTART,
0002           *ISMAX,JSMAX)
0003            DIMENSION T(JSMAX),X(ISMAX),Y(ISMAX),Z(ISMAX),XN(ISMAX,3),
0004           *F(ISMAX,JSMAX,3),JSTART(ISMAX)
0005            DO 100 I=1,ISMAX
0006            JSTART(I)=JSMAX
0007            DO 100 J=1,JSMAX
0008            DO 100 K=1,3
0009          100 F(I,J,K)=0.
0010            TRUNK=3.0
0011            T1=T(1)
0012            FACT=2.*AN/SQRT(3.141593)
0013            SINA=SIN(ALPHA)
0014            COSA=COS(ALPHA)
0015            SINB=SIN(BETA)
0016            COSB=COS(BETA)
0017            HX=FACT*SINB
0018            HY=-FACT*COSB*COSA
0019            HZ=FACT*COSB*SINA
0020            DO 120 I=1,NTOTAL
0021            RHO=Y(I)*SINA+Z(I)*COSA
0022            TMIN=-TRUNK/AN-RHO
0023            TMAX=TRUNK/AN-RHO
0024            JST=(TMIN-T1)/DT+0.5
0025            IF(JST.LT.1) GO TO 130
0026            JJN=(TMAX-T1)/DT+1.5
0027            JJN=MIN0(JJN,JNO)
0028            JSTART(I)=JST
0029            JST=JST+1
0030            DO 110 J=JST,JJN
0031            ZSQ=(AN*(T(J)+RHO))**2
0032            EX=EXP(-ZSQ)
0033            FX=XN(I,2)*HZ-XN(I,3)*HY
0034            FY=XN(I,3)*HX-XN(I,1)*HZ
0035            FZ=XN(I,1)*HY-XN(I,2)*HX
0036            F(I,J,1)=FX*EX
0037            F(I,J,2)=FY*EX
0038            F(I,J,3)=FZ*EX
0039          110 CONTINUE
0040          120 CONTINUE
0041            RETURN
0042          130 CONTINUE
0043            WRITE(6,10)
0044           10 FORMAT(1H1,31HTERMINATE RUN, TSTART TOO LARGE)
0045            STOP 2
0046            END
```

```
0001          SUBROUTINE PRNTC (T,JND,F,NTOTAL,ISMAX,JSMAX)
0002          DIMENSION T(40),F(100,40,3)
0003          NRITE =(NTOTAL-1)/5+1
0004          IST=1
0005          IND=5
0006          IND=MIND(IND,NTOTAL)
0007          DO 200 N=1,NRITE
0008          WRITE (6,10)
0009       10 FORMAT (1H1,5X,29HCOMPONENTS OF CURRENT DENSITY//)
0010          MAX=IST+4
0011          WRITE (6,11)(I,I,I,I=IST,MAX)
0012       11 FORMAT (3X,6HTIME  ,5(4H FX(,I3,1H),4H FY(,I3,1H),4H FZ(,I3,1H)))
0013          DO 100 J=1,JND
0014      100 WRITE (6,20)T(J),((F(I,J,K),K=1,3),I=IST,IND)
0015       20 FORMAT (1X,16F8.4)
0016          IST=IND+1
0017          IND=IST+4
0018          IND=MIND(IND,NTOTAL)
0019      200 CONTINUE
0020          RETURN
0021          END
```

```
0001            SUBROUTINE STEP3(T,DT,JND,X,Y,Z,XN,MOST,DS,NTOTAL,F,JSTART,
0002           *ISMAX,JSMAX)
0003            DIMENSION T(JSMAX),X(ISMAX),Y(ISMAX),Z(ISMAX),XN(ISMAX,3),
0004           *MOST(ISMAX),DS(ISMAX),F(ISMAX,JSMAX,3),JSTART(ISMAX)
0005            DIMENSION XNL(3),XR(3),FEQ(3),AI(3),XNR(3),XNI(3)
0006            CINT=0.5/3.1415927
0007            DT1=DT
0008            DT2=2.*DT*DT1
0009            DT3=3.*DT*DT2
0010            DT4=4.*DT*DT3
0011            DO 500 J=1,JND
0012            DO 490 I=1,NTOTAL
0013            XI=X(I)
0014            YI=Y(I)
0015            ZI=Z(I)
0016            MOSTI=MOST(I)
0017            KOT1=MOSTI
0018            KOT2=MOSTI+1
0019            IF(KOT2.GT.3) KOT2=KOT2-3
0020            KOT3=KOT2+1
0021            IF(KOT3.GT.3) KOT3=KOT3-3
0022            DO 250 K=1,3
0023            XNI(K)=XN(I,K)
0024       250  AI(K)=0.
0025            DO 480 L=1,NTOTAL
0026            IF(I.EQ.L) GO TO 480
0027            DY=XI-X(L)
0028            DY=YI-Y(L)
0029            DZ=ZI-Z(L)
0030            RSQ=DX**2+DY**2+DZ**2
0031            R=SQRT(RSQ)
0032            XNL(1)=XN(L,1)
0033            XNL(2)=XN(L,2)
0034            XNL(3)=XN(L,3)
0035            JSTL=JSTART(L)
0036            TAU=T(J)-R
0037            JTAU=(TAU-T(1))/DT+1.5
0038            IF(JTAU.LE.JSTL) GO TO 490
0039            IF(JTAU.GE.J) GO TO 600
0040            NORDER=J-JSTL-1
0041            IF(NORDER.LT.1) GO TO 480
0042            NORDER=MIND(NORDER,4)
0043            JDIF=(NORDER+1)/2
0044            JZ=JTAU-JDIF
0045            JZ=MAXO(JSTL,JZ)
0046            JCOMP=J-(NORDER+1)
0047            JZ=MIND(JCOMP,JZ)
0048            XR(1)=DX/RSQ
0049            XR(2)=DY/RSQ
0050            XR(3)=DZ/RSQ
0051            KIN1=MOST(L)
0052            KIN2=KIN1+1
0053            IF(KIN2.GT.3)KIN2=KIN2-3
0054            KIN3=KIN2+1
0055            IF(KIN3.GT.3)KIN3=KIN3-3
0056            K=KIN2
```

```
0057            DTAU1=TAU-T(JZ)
0058            GO TO (305,315,325,335),NORDER
0059       305  CONTINUE
0060            DO 310 KDUM=1,2
0061            DFZ=F(L,JZ,K)
0062            DF1=F(L,JZ+1,K)-DFZ
0063            FAC1=DF1/DT1
0064            FTAU=DFZ+DTAU1*FAC1
0065            DFTAU=FAC1
0066            FEQ(K)=(FTAU/R+DFTAU)
0067            K=KIN3
0068       310  CONTINUE
0069            GO TO 350
0070       315  CONTINUE
0071            DTAU2=DTAU1-DT
0072            DO 320 KDUM=1,2
0073            DFZ=F(L,JZ,K)
0074            DF1=F(L,JZ+1,K)
0075            DF2=F(L,JZ+2,K)-DF1
0076            DF1=DF1-DFZ
0077            DF2=DF2-DF1
0078            FAC2=DF2/DT2
0079            FAC1=DF1/DT1+DTAU2*FAC2
0080            FTAU=DFZ+DTAU1*FAC1
0081            DFTAU=FAC1+DTAU1*FAC2
0082            FEQ(K)=(FTAU/R+DFTAU)
0083            K=KIN3
0084       320  CONTINUE
0085            GO TO 350
0086       325  CONTINUE
0087            DTAU2=DTAU1-DT
0088            DTAU3=DTAU2-DT
0089            DO 330 KDUM=1,2
0090            DFZ=F(L,JZ,K)
0091            DF1=F(L,JZ+1,K)
0092            DF2=F(L,JZ+2,K)
0093            DF3=F(L,JZ+3,K)-DF2
0094            DF2=DF2-DF1
0095            DF1=DF1-DFZ
0096            DF3=DF3-DF2
0097            DF2=DF2-DF1
0098            DF3=DF3-DF2
0099            FAC3=DF3/DT3
0100            FAC2=DF2/DT2+DTAU3*FAC3
0101            FAC1=DF1/DT1+DTAU2*FAC2
0102            FTAU=DFZ+DTAU1*FAC1
0103            DFTAU=FAC1+DTAU1*(FAC2+DTAU2*FAC3)
0104            FEQ(K)=(FTAU/R+DFTAU)
0105            K=KIN3
0106       330  CONTINUE
0107            GO TO 350
0108       335  CONTINUE
0109            DTAU2=DTAU1-DT
0110            DTAU3=DTAU2-DT
0111            DTAU4=DTAU3-DT
0112            DO 340 KDUM=1,2
0113            DFZ=F(L,JZ,K)
```

```
0114            DF1=F(L,JZ+1,K)
0115            DF2=F(L,JZ+2,K)
0116            DF3=F(L,JZ+3,K)
0117            DF4=F(L,JZ+4,K)-DF3
0118            DF3=DF3-DF2
0119            DF2=DF2-DF1
0120            DF1=DF1-DF2
0121            DF4=DF4-DF3
0122            DF3=DF3-DF2
0123            DF2=DF2-DF1
0124            DF4=DF4-DF3
0125            DF3=DF3-DF2
0126            DF4=DF4-DF3
0127            FAC4=DF4/DT4
0128            FAC3=DF3/DT3+DTAU4*FAC4
0129            FAC2=DF2/DT2+DTAU3*FAC3
0130            FAC1=DF1/DT1+DTAU2*FAC2
0131            FTAU=DF2+DTAU1*FAC1
0132            DFTAU=FAC1+DTAU1*(FAC2+DTAU2*(FAC3+DTAU3*FAC4))
0133            FEQ(K)=(FTAU/R+DFTAU)
0134            K=KIN3
0135       340  CONTINUE
0136       350  CONTINUE
0137            FEQ(KIN1)=-(XNL(KIN2)*FEQ(KIN2)+XNL(KIN3)*FEQ(KIN3))/XNL(KIN1)
0138            DO 355 K=1,3
0139       355  XNR(K)=XNI(K)*XR(K)
0140            K1=MOST1
0141            K2=KOT2
0142            K3=KOT3
0143            DO 370 KDUM=1,2
0144            AI(K2)=AI(K2)+(FEQ(K2)*(XNR(K3)+XNR(K1))
0145           *                -(FEQ(K3)*XNI(K3)+FEQ(K1)*XNI(K1))*XR(K2))*DS(L)
0146            K3=MOST1
0147            K1=KOT2
0148            K2=KOT3
0149       370  CONTINUE
0150       480  CONTINUE
0151            K=KOT2
0152            DO 485 KDUM=1,2
0153            F(I,J,K)=F(I,J,K)+CINT*AI(K)
0154       485  K=KOT3
0155            F(I,J,KOT1)=-(F(I,J,KOT2)*XNI (KOT2)+F(I,J,KOT3)*XNI (KOT3))
0156           */XNI (KOT1)
0157       490  CONTINUE
0158       500  CONTINUE
0159            RETURN
0160       600  CONTINUE
0161            WRITE(6,10)
0162        10  FORMAT(1H1,5X,18HJTAU.GE.J IN STEP2)
0163            STOP 3
0164            END
```

```
0001          SUBROUTINE FAR3(T,DT,JNO,X,Y,Z,DS,NTOTAL,F,JSTART,ISMAX,JSMAX,
0002         *TF,NTF,HPXP,HPXT,HYZT,HYZX,PSIPX,PSIYZ,NPX,NYZ,IFMAX,JFMAX
0003         *,ALPHA,BETA)
0004          DIMENSION T(JSMAX),X(ISMAX),Y(ISMAX),Z(ISMAX),DS(ISMAX),
0005         *F(ISMAX,JSMAX,3),TF(JFMAX),HPXP(JFMAX,IFMAX),HPXT(JFMAX,IFMAX),
0006         *HYZT(JFMAX,IFMAX),HYZX(JFMAX,IFMAX),PSIPX(IFMAX),PSIYZ(IFMAX)
0007         *,JSTART(ISMAX)
0008          DIMENSION AI(100,3)
0009          IF(JFMAX.GT.100) GO TO 610
0010          AFMAX=JFMAX
0011          PI=3.1415927
0012          CONST=.25/PI
0013          DTORAD=PI/180.
0014          DXSQ=DT*DT
0015          DXQC=DXSQ*DXSQ
0016          NPX=0
0017          NYZ=0
0018          DO 95 I=1,IFMAX
0019          PSIPX(I)=0.
0020          PSIYZ(I)=0.
0021          DO 95 J=1,JFMAX
0022          HPXT(J,I)=0.
0023          HPXP(J,I)=0.
0024          HYZT(J,I)=0.
0025          HYZX(J,I)=0.
0026       95 CONTINUE
0027          READ(5,10) TFST,TFNC
0028       10 FORMAT(2F10.5 )
0029          NTF=(TFNC-TFST)/DT+1.01
0030          NTF=MIND(NTF,JFMAX)
0031          TF(1)=TFST
0032          JDIF=IFIX((T(1)-TF(1))/DT+0.01)
0033          DO 100 JF=2,NTF
0034      100 TF(JF)=TF(JF-1)+DT
0035          READ(5,20) NYZ
0036       20 FORMAT(I5)
0037          IF(NYZ.LT.1) GO TO 300
0038          READ(5,25) (PSIYZ(I),I=1,NYZ)
0039       25 FORMAT(F10.5)
0040          DO 195 JF=1,NTF
0041          DO 195 I=1,NYZ
0042          HYZT(JF,I)=0.
0043      195 HYZX(JF,I)=0.
0044          JFMIN=NTF
0045          JFSTP=1
0046          DO 290 I=1,NYZ
0047          PSI=PSIYZ(I)*DTORAD
0048          SINAP=SIN(ALPHA+PSI)
0049          COSAP=COS(ALPHA+PSI)
0050          DO 200 J=1,NTF
0051          DO 200 K=1,3
0052      200 AI(J,K)=0.
0053          DO 250 L=1,NTOTAL
0054          DR=Y(L)*SINAP+Z(L)*COSAP
0055          DSL=DS(L)
0056          KST=JSTART(L)
```

```
      JDEL=IFIX(AFMAX+DR/DT+0.5)-JFMAX-1
      ADEL=JDEL
      KND=MIND((JND-2),(NTF+JDEL-JDIF))
      IF(KND.LT.KST) GO TO 260
      X0=DR-ADEL*DT
      X1=X0-DT
      X2=X1-DT
      A0=(X1*X2)/(2.*DXSQ)
      A1=-(X0*X2)/DXSQ
      A2=(X0*X1)/(2.*DXSQ)
      K=KST
      JFST=KST-JDEL+JDIF
      JFND=KND-JDEL+JDIF
      JF=JFST
      DO 235 KOD=1,3
  235 AI(JF,KOD)=(A0*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
     **AI(JF,KOD)
      JF=JF+1
      IF(KND.EQ.(KST+1)) GO TO 254
      KND=KND-2
      X0=X0+DT
      X1=X0-DT
      X2=X1-DT
      X3=X2-DT
      X4=X3-DT
      B0=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXQD)
      B1=-(X0*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXQD)
      B2=(X1*(X3*(X3+X4)+X3*X4)+X0*X3*X4)/(4.*DXQD)
      B3=-(X1*(X2*(X0+X4)+X0*X4)+X2*X0*X4)/(6.*DXQD)
      B4=(X1*(X2*(X3+X0)+X3*X0)+X2*X3*X0)/(24.*DXQD)
      DO 250 K=KST,KND
      DO 240 KOD=1,3
      AI(JF,KOD)=(B0*F(L,K,KOD)+B1*F(L,K+1,KOD)+B2*F(L,K+2,KOD)
     **+B3*F(L,K+3,KOD)+B4*F(L,K+4,KOD))*DSL+AI(JF,KOD)
  240 CONTINUE
      JF=JF+1
  250 CONTINUE
      K=KND+1
  254 K=K+1
      DO 255 KOD=1,3
  255 AI(JF,KOD)=(A0*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
     **AI(JF,KOD)
      JFMIN=MIND(JFST,JFMIN)
      JFSTP=MAXO(JFND,JFSTP)
  260 CONTINUE
      DO 280 JF=JFMIN,JFSTP
      HYZT(JF,I)=CONST*AI(JF,1)
      HYZX(JF,I)=CONST*(AI(JF,2)*COSAP-AI(JF,3)*SINAP)
  280 CONTINUE
  290 CONTINUE
  300 CONTINUE
      READ(5,20) NPX
      IF(NPX.LT.1) GO TO 500
      READ(5,25) (PSIPX(I),I=1,NPX)
      SINA=SIN(ALPHA)
      COSA=COS(ALPHA)
      DO 395 JF=1,NTF
```

```
C114            DO 395 I=1,NPX
C115            PPXP(JF,I)=0.
C116        395 PPXT(JF,I)=0.
C117            JFMIN=NTF
C118            JFSTP=1
C119            DO 490 I=1,NPX
C120            PSI=PSIPX(I)*DTORAD
C121            SINP=SIN(PSI)
C122            COSP=COS(PSI)
C123            DO 400 J=1,NTF
C124            DO 400 K=1,3
C125        400 AI(J,K)=0.
C126            DO 460 L=1,NTOTAL
C127            DSL=DS(L)
C128            KST=JSTART(L)
C129            DR=X(L)*SINP+(Y(L)*SINA+Z(L)*COSA)*COSP
C130            JDEL=IFIX(AFMAX*DR/DT+0.5)-JFMAX-1
C131            ADEL=JDEL
C132            KND=MIND((JND-2),(NTF+JDEL-JDIF))
C133            IF(KND.LT.KST) GO TO 458
C134            XC=DR-ADEL*DT
C135            X1=XC-DT
C136            X2=X1-DT
C137            A0=(X1*X2)/(2.*DXSQ)
C138            A1=-(XC*X2)/DXSQ
C139            A2=(XC*X1)/(2.*DXSQ)
C140            K=KST
C141            JFST=KST-JDEL+JDIF
C142            JFND=KND-JDEL+JDIF
C143            JF=JFST
C144            DO 435 KOD=1,3
C145        435 AI(JF,KOD)=(A0*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
C146           *+AI(JF,KOD)
C147            JF=JF+1
C148            IF(KND.EQ.(KST+1)) GO TO 454
C149            KND=KND-2
C150            XC=XC+DT
C151            X1=XC-DT
C152            X2=X1-DT
C153            X3=X2-DT
C154            X4=X3-DT
C155            B0=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXQC)
C156            B1=-(XC*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXQC)
C157            B2=(X1*(XC*(X3+X4)+X3*X4)+XC*X3*X4)/(4.*DXQC)
C158            B3=-(X1*(X2*(XC+X4)+XC*X4)+X2*XC*X4)/(6.*DXQC)
C159            B4=(X1*(X2*(X3+XC)+X3*XC)+X2*X3*XC)/(24.*DXQC)
C160            DO 450 K=KST,KND
C161            DO 440 KOD=1,3
C162            AI(JF,KOD)=(B0*F(L,K,KOD)+B1*F(L,K+1,KOD)+B2*F(L,K+2,KOD)
C163           *+B3*F(L,K+3,KOD)+B4*F(L,K+4,KOD))*DSL                    *AI(JF,KOD)
C164        440 CONTINUE
C165            JF=JF+1
C166        450 CONTINUE
C167            K=KND+1
C168        454 K=K+1
C169            DO 455 KOD=1,3
C170        455 AI(JF,KOD)=(A0*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
```

```
0171            **AI(JF,KOD)
0172              JFMIN=MIND(JFST,JFMIN)
0173              JFSTP=MAXO(JFND,JFSTP)
0174          450 GR=-X(L)*SINP+(Y(L)*SINA+Z(L)*COSA)*COSP
0175          460 CONTINUE
0176              DO 480 JF=JFMIN,JFSTP
0177              HPXP(JF,I)=CONST*(COSP*AI(JF,1)-SINP*(SINA*AI(JF,2)+
0178             *COSA*AI(JF,3)))
0179              HPXT(JF,I)=CONST*(COSA*AI(JF,2)-SINA*AI(JF,3))
0180          480 CONTINUE
0181          490 CONTINUE
0182          500 CONTINUE
0183              WRITE(6,35)
0184           35 FORMAT(1H1,5X,35HCOMPONENTS OF FAR FIELD IN YZ PLANE)
0185              WRITE(6,37)
0186           37 FORMAT(5X,25HSMOOTHED IMPULSE RESPONSE//)
0187              CALL PRNTF (TF,NTF,HYZX,HYZT,PSIYZ,NYZ,IFMAX,JFMAX)
0188              WRITE(6,36)
0189           36 FORMAT(1H1,5X,35HCOMPONENTS OF FAR FIELD IN PX PLANE)
0190              WRITE(6,37)
0191              CALL PRNTF (TF,NTF,HPXP,HPXT,PSIPX,NPX,IFMAX,JFMAX)
0192              RETURN
0193          610 CONTINUE
0194              STOP 5
0195              END
```

```
0001              SUBROUTINE PRNTF (TF,NTF,PER,TANG,ANG,NANG,IFMAX,JFMAX)
0002              DIMENSION TF(JFMAX),PER(JFMAX,IFMAX),TANG(JFMAX,IFMAX),ANG(IFMAX),
0003             *KANG(15)
0004              DO 50 N=1,NANG
0005           50 KANG(N)=ANG(N)
0006              NRITE=(NANG-1)/7+1
0007              IST=1
0008              IND=7
0009              IND=MIND(IND,NANG)
0010              DO 200 NPASS=1,NRITE
0011              WRITE (6,11)
0012           11 FORMAT (5X,4HTIME,4X,7(3HPER,5X,3HTAN,5X))
0013              WRITE(6,12)(KANG(I),KANG(I),I=IST,IND)
0014           12 FORMAT (12X,14(I4,4X))
0015              DO 100 J=1,NTF
0016          100 WRITE (6,20)TF(J),(PER(J,N),TANG(J,N),N=IST,IND)
0017           20 FORMAT (3X,F8.2,14F8.4)
0018              IST=IND+1
0019              IND=IST+6
0020              IND=MIND(IND,NANG)
0021          200 CONTINUE
0022              RETURN
0023              END
```

SECTION 2

PROGRAM PLNSY

The computer program PLNSY, which solves the plane symmetric scattering problem for conducting surfaces as discussed in Sec. 2.3 of Vol. I, is described in this section. Section 2.2 contains a listing of the program code.

2.1 PLNSY PROGRAM DESCRIPTION

The flow chart of the PLNSY program shown in Fig. 2 describes pictorially the operation of PLNSY and the calling sequence of the subroutines that constitute PLNSY.

Subroutines PRNTG, PULSE and PRNTC are the same as those described in Sec. 1.

Subroutine SPHER2 generates the geometry parameters in the x greater than 0 half-space, as required for plane symmetric targets. In particular, SPHER2 models a sphere of arbitrary radius and number of patches. Other target geometries are treated similarly.

Subroutine STEP2 carries out the iteration in time that is dictated by Eq. (10) of Vol. I and computes the surface current at all sample points in space-time. This routine differs from STEP3 in the incorporation of the symmetry conditions on surface current for the plane symmetric scattering problems given in Vol. I, Table I.

Subroutine FAR2 computes and prints the far scattered magnetic field given in Eq. (9) of Vol. I and uses the geometry parameters displayed in Fig. 4 of Vol. I. FAR2 differs from FAR3 in the same fashion as STEP2 differs from STEP3.

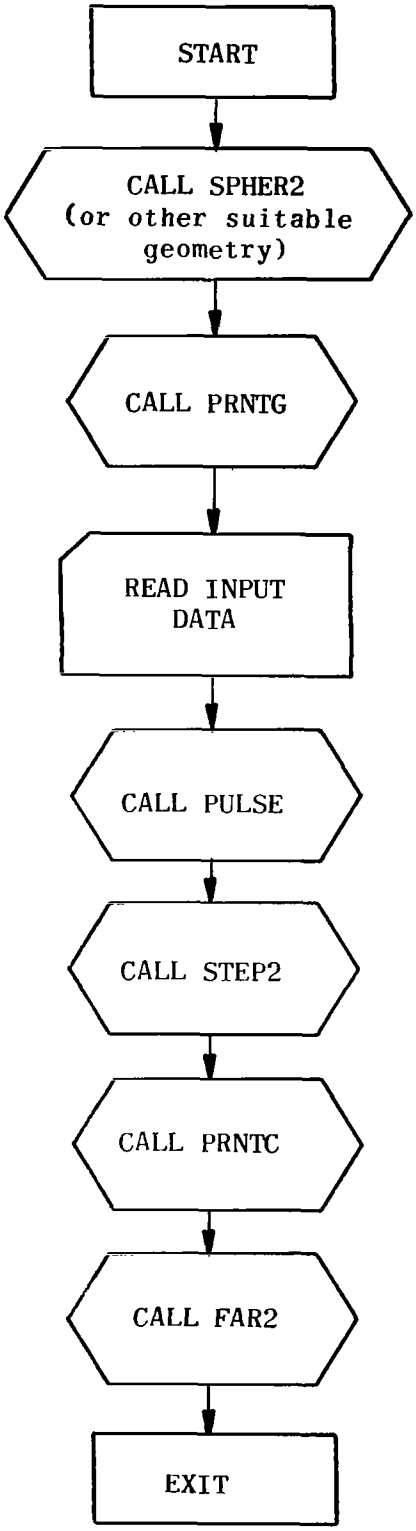

FIG. 2 Flow chart of PLNSY program.

2.2 PLNSY PROGRAM LISTINGS

```
0001     C PLNSY DRIVER
0002           DIMENSION X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100),
0003          *T( 40),F(100, 40,3),JSTART(100),
0004          *  GN(3,2)
0005           ISMAX=100
0006           JSMAX= 40
0007           JFMAX=050
0008           IFMAX=09
0009           CALL SPHER2(X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0010           CALL PRNTG (X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0011           READ(5,10) T(1),DT,TNDSUR
0012           READ(5,10) AN
0013           READ(5,10) ALPHA,BETA
0014        10 FORMAT(3F10.4)
0015           WRITE(6,20) T(1),DT,TNDSUR,AN,ALPHA,BETA
0016        20 FORMAT(1H1,10X,16HINPUT PARAMETERS//
0017          *5X,7HTSTART=,F10.5/5X,7H     DT=,F10.5/5X,7HTNDSUR=,F10.5/
0018          *5X,7H     AN=,F10.5/5X,7H ALPHA=,F10.5/5X,7H   BETA=,F10.5)
0019           CALL MIRROR(ALPHA,BETA,  GN)
0020           JND=(TNDSUR-T(1))/DT+1.01
0021           IF(JND.GT.JSMAX) GO TO 600
0022           DO 100 J=2,JND
0023       100 T(J)=T(J-1)+DT
0024           CALL PULSE (AN,ALPHA,BETA,T,DT,JND,X,Y,Z,XN,NTOTAL,F,JSTART,
0025          *ISMAX,JSMAX)
0026           CALL STEP2(T,DT,JND,X,Y,Z,XN,MOST,DS,NTOTAL,F,JSTART,  GN,
0027          *ISMAX,JSMAX)
0028           CALL PRNTC (T,JND,F,NTOTAL,JSTART,ISMAX,JSMAX)
0029           CALL FAR2(T,DT,JND,X,Y,Z,DS,NTOTAL,F,JSTART,ISMAX,JSMAX,
0030          *IFMAX,JFMAX,ALPHA,BETA)
0031           STOP
0032       600 CONTINUE
0033           WRITE(6,30)
0034        30 FORMAT(1H1,5X,31HTERMINATE RUN, TNDSUR TOO LARGE)
0035           STOP 100
0036           END
```

```
0001          SUBROUTINE FAR2(T,DT,JND,X,Y,Z,DS,NTOTAL,F,JSTART,ISMAX,JSMAX,
0002         *IFMAX,JFMAX,ALPHA,BETA)
0003          DIMENSION T(1),X(1),Y(1),Z(1),DS(1),
0004         *F(100,40,3),TF(50),HPXP(50,9),HPXT(50,9),
0005         *HYZT(50,9),HYZX(50,9),PSIPX(9),PSIYZ(9)
0006         *,JSTART(1)
0007          DIMENSION AI(100,3)
0008          DIMENSION   GN(3,2)
0009          IF(JFMAX.GT.100) GO TO 610
0010          AFMAX=JFMAX
0011          PI=3.1415927
0012          DTORAD=PI/180.
0013          DXSQ=DT*DT
0014          DXQD=DXSQ*DXSQ
0015          NPX=0
0016          NYZ=0
0017          DO 95 I=1,IFMAX
0018          PSIPX(I)=0.
0019          PSIYZ(I)=0.
0020          DO 95 J=1,JFMAX
0021          HPXT(J,I)=0.
0022          HPXP(J,I)=0.
0023          HYZT(J,I)=0.
0024          HYZX(J,I)=0.
0025       95 CONTINUE
0026          KASE=0
0027          IF(ABS(BETA).LT..001) KASE=1
0028          IF(ABS(BETA-PI/2.).LT..001) KASE=2
0029          IF(KASE.EQ.0) GO TO 600
0030          READ(5,10) TFST,TFND
0031       10 FORMAT(2F10.5 )
0032          NTF=(TFND-TFST)/DT+1.01
0033          NTF=MIND(NTF,JFMAX)
0034          TF(1)=TFST
0035          JDTF=IFIX((T(1)-TF(1))/DT+0.01)
0036          DO 100 JF=2,NTF
0037      100 TF(JF)=TF(JF-1)+DT
0038          READ(5,20) NYZ
0039       20 FORMAT(I5)
0040          IF(NYZ.LT.1) GO TO 300
0041          READ(5,25) (PSIYZ(I),I=1,NYZ)
0042       25 FORMAT(F10.5)
0043          CONST=0.5/PI
0044          DO 195 JF=1,NTF
0045          DO 195 I=1,NYZ
0046          HYZT(JF,I)=0.
0047      195 HYZX(JF,I)=0.
0048          JFMIN=NTF
0049          JFSTP=1
0050          DO 230 I=1,NYZ
0051          PSI=PSIYZ(I)*DTORAD
0052          SINAP=SIN(ALPHA+PSI)
0053          COSAP=COS(ALPHA+PSI)
0054          DO 200 J=1,NTF
0055          DO 200 K=1,3
0056      200 AI(J,K)=0.
```

```
0057            DO 260 L=1,NTOTAL
0058            DR=V(L)*SINAP+Z(L)*COSAP
0059            DSL=DS(L)
0060            KST=JSTART(L)
0061            JDEL=IFIX(AFMAX*DR/DT+0.5)-JFMAX-1
0062            ADEL=JDEL
0063            KND=MIND((JNC-2),(NTF+JDEL-JDIF))
0064            IF(KND.LT.KST) GO TO 260
0065            XO=DR-ADEL*DT
0066            X1=XO-DT
0067            X2=X1-DT
0068            AO=(X1*X2)/(2.*DXSQ)
0069            A1=-(XO*X2)/DXSQ
0070            A2=(XO*X1)/(2.*DXSQ)
0071            GO TO (220,225),KASE
0072       220  KOD1=1
0073            KOD2=1
0074            GO TO 230
0075       225  KOD1=2
0076            KOD2=3
0077       230  CONTINUE
0078            K=KST
0079            JFST=KST-JDEL+JDIF
0080            IF(JFST.LT.1) GO TO 290
0081            JFND=KND-JDEL+JDIF
0082            JF=JFST
0083            DO 235 KOD=KOD1,KOD2
0084       235  AI(JF,KOD)=(AO*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
0085           **AI(JF,KOD)
0086            JF=JF+1
0087            IF(KND.EQ.(KST+1)) GO TO 254
0088            KND=KND-2
0089            XO=XO+DT
0090            X1=XO-DT
0091            X2=X1-DT
0092            X3=X2-DT
0093            X4=X3-DT
0094            BO=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXQD)
0095            B1=-(XO*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXQD)
0096            B2=(X1*(XO*(X3+X4)+X3*X4)+XO*X3*X4)/(4.*DXQD)
0097            B3=-(X1*(X2*(XO+X4)+XO*X4)+X2*XO*X4)/(6.*DXQD)
0098            B4=(X1*(X2*(X3+XO)+X3*XO)+X2*X3*XO)/(24.*DXQD)
0099            DO 250 K=KST,KND
0100            DO 240 KOD=KOD1,KOD2
0101            AI(JF,KOD)=(BO*F(L,K,KOD)+B1*F(L,K+1,KOD)+B2*F(L,K+2,KOD)
0102           **B3*F(L,K+3,KOD)+B4*F(L,K+4,KOD))*DSL+AI(JF,KOD)
0103       240  CONTINUE
0104            JF=JF+1
0105       250  CONTINUE
0106            K=KND+1
0107       254  K=K+1
0108            DO 255 KOD=KOD1,KOD2
0109       255  AI(JF,KOD)=(AO*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
0110           **AI(JF,KOD)
0111            JFMIN=MIND(JFST,JFMIN)
0112            JFSTP=MAXO(JFND,JFSTP)
0113       260  CONTINUE
```

```
0114            DO 230 JF=JFMIN,JFSTP
0115            GO TO (265,270),KASE
0116        265 HYZT(JF,I)=CONST*AI(JF,1)
0117            GO TO 280
0118        270 HYZX(JF,I)=CONST*(AI(JF,2)*COSAP-AI(JF,3)*SINAP)
0119        280 CONTINUE
0120        290 CONTINUE
0121        300 CONTINUE
0122            READ(5,20) NPX
0123            IF(NPX.LT.1) GO TO 500
0124            READ(5,25) (PSIPX(I),I=1,NPX)
0125            CALL MIRROR(ALPHA,BETA,  GN)
0126            CONST=.25/PI
0127            SINA=SIN(ALPHA)
0128            COSA=COS(ALPHA)
0129            DO 395 JF=1,NTF
0130            DO 395 I=1,NPX
0131            HPXP(JF,I)=0.
0132        395 HPXT(JF,I)=0.
0133            JFMIN=NTF
0134            JFSTP=1
0135            DO 490 I=1,NPX
0136            PSI=PSIPX(I)*DTORAD
0137            SINP=SIN(PSI)
0138            COSP=COS(PSI)
0139            DO 400 J=1,NTF
0140            DO 400 K=1,3
0141        400 AI(J,K)=0.
0142            DO 450 L=1,NTOTAL
0143            DSL=DS(L)
0144            KST=JSTART(L)
0145            DR=X(L)*SINP+(Y(L)*SINA+Z(L)*COSA)*COSP
0146            DO 458 MP=1,2
0147            JDEL=IFIX(AFMAX*DR/DT+0.5)-JFMAX-1
0148            ADEL=JDEL
0149            KND=MIND((JND-2),(NTF+JDEL-JDIF))
0150            IF(KND.LT.KST) GO TO 458
0151            XC=DR-ADEL*DT
0152            X1=XC-DT
0153            X2=X1-DT
0154            A0=(X1*X2)/(2.*DXSQ)
0155            A1=-(XC*X2)/DXSQ
0156            A2=(XC*X1)/(2.*DXSQ)
0157            K=KST
0158            JFST=KST-JDEL+JDIF
0159            IF(JFST.LT.1) GO TO 490
0160            JFND=KND-JDEL+JDIF
0161            JF=JFST
0162            DO 435 KOD=1,3
0163        435 AI(JF,KOD)=(A0*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL*
0164           *  GN(KOD,MP)+AI(JF,KOD)
0165            JF=JF+1
0166            IF(KND.EQ.(KST+1)) GO TO 454
0167            KND=KND-2
0168            XC=XC+DT
0169            X1=XC-DT
0170            X2=X1-DT
```

```
0171            X3=X2-DT
0172            X4=X3-DT
0173            B0=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXGD)
0174            B1=-(XD*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXGD)
0175            B2=(X1*(XD*(X3+X4)+X3*X4)+XD*X3*X4)/(4.*DXGD)
0176            B3=-(X1*(X2*(XD+X4)+XD*X4)+X2*XD*X4)/(6.*DXGD)
0177            B4=(X1*(X2*(X3+XD)+X3*XD)+X2*X3*XD)/(24.*DXGD)
0178            DO 45D K=KST,KND
0179            DO 44D KOD=1,3
0180            AI(JF,KOD)=(B0*F(L,K,KOD)+B1*F(L,K+1,KOD)+B2*F(L,K+2,KOD)
0181           *+B3*F(L,K+3,KOD)+B4*F(L,K+4,KOD))*DSL*  GN(KOD,MP)+AI(JF,KOD)
0182        44D CONTINUE
0183            JF=JF+1
0184        45D CONTINUE
0185            K=KND+1
0186        454 K=K+1
0187            DO 455 KOD=1,3
0188        455 AI(JF,KOD)=(A0*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL*
0189           *  GN(KOD,MP)+AI(JF,KOD)
0190            JFMIN=MIND(JFST,JFMIN)
0191            JFSTP=MAXD(JFND,JFSTP)
0192        458 DR=-X(L)*SINP+(Y(L)*SINA+Z(L)*COSA)*COSP
0193        46D CONTINUE
0194            DO 48D JF=JFMIN,JFSTP
0195            HPXP(JF,I)=CONST*(COSP*AI(JF,1)-SINP*(SINA*AI(JF,2)+
0196           *COSA*AI(JF,3)))
0197            HPXT(JF,I)=CONST*(COSA*AI(JF,2)-SINA*AI(JF,3))
0198        48D CONTINUE
0199        49D CONTINUE
0200        5DD CONTINUE
0201            WRITE(6,35)
0202         35 FORMAT(1H1,5X,35HCOMPONENTS OF FAR FIELD IN YZ PLANE)
0203            WRITE(6,37)
0204         37 FORMAT(5X,25HSMOOTHED IMPULSE RESPONSE//)
0205            CALL PRNTF2(TF,NTF,HYZX,HYZT,PSIYZ,NYZ,IFMAX,JFMAX)
0206            WRITE(6,36)
0207         36 FORMAT(1H1,5X,35HCOMPONENTS OF FAR FIELD IN PX PLANE)
0208            WRITE(6,37)
0209            CALL PRNTF2(TF,NTF,HPXP,HPXT,PSIPX,NPX,IFMAX,JFMAX)
0210            RETURN
0211        6DD CONTINUE
0212            WRITE(6,5)
0213          5 FORMAT(1H1,5X,21HINVALID VALUE OF BETA)
0214            STOP 4
0215        61D CONTINUE
0216            STOP 5
0217            END
```

```
0001          SUBROUTINE MIRROR(ALPHA,BETA,  GN)
0002          DIMENSION   GN(3,2)
0003          DATA PI/3.141592654/
0004          DO 90 K=1,3
0005          DO 90 M=1,2
0006       90   GN(K,M)=1.
0007          IF(ABS(BETA).LT..0001) GO TO 100
0008          IF(ABS(BETA-PI/2.).LT..0001) GO TO 110
0009          WRITE (6,9)
0010        9 FORMAT(1H1,5X,21HINVALID VALUE OF BETA)
0011          STOP 10
0012      100 CONTINUE
0013            GN(2,2)=-1.
0014            GN(3,2)=-1.
0015          GO TO 120
0016      110 CONTINUE
0017            GN(1,2)=-1.
0018      120 CONTINUE
0019          RETURN
0020          END
```

```
0001          SUBROUTINE PRNTC (T,JND,F,NTOTAL,JSTART,ISMAX,JSMAX)
0002          DIMENSION T(40),F(100,40,3),JSTART(100)
0003          NRITE =(NTOTAL-1)/5+1
0004          IST=1
0005          IND=5
0006          IND=MIND(IND,NTOTAL)
0007          DO 200 N=1,NRITE
0008          WRITE (6,10)
0009       10 FORMAT (1H1,5X,29HCOMPONENTS OF CURRENT DENSITY//)
0010          MAX=IST+4
0011          WRITE (6,11)(I,I,I,I=IST,MAX)
0012       11 FORMAT (3X,6HTIME  ,5(4H FX(,I3,1H),4H FY(,I3,1H),4H FZ(,I3,1H)))
0013          DO 100 J=1,JND
0014      100 WRITE (6,20)T(J),((F(I,J,K),K=1,3),I=IST,IND)
0015       20 FORMAT (1X,16F8.4)
0016          WRITE(6,60) (JSTART(I),I=IST,IND)
0017       60 FORMAT(/7H JSTART,13X,5(I2,22X))
0018          IST=IND+1
0019          IND=IST+4
0020          IND=MIND(IND,NTOTAL)
0021      200 CONTINUE
0022          RETURN
0023          END
```

```
0001          SUBROUTINE PRNTF (TF,NTF,PER,TANG,ANG,NANG,IFMAX,JFMAX)
0002          DIMENSION TF(50),PER(50,9),TANG(50,9),ANG(9),
0003         *KANG(15)
0004          DO 50 N=1,NANG
0005       50 KANG(N)=ANG(N)
0006          NRITE=(NANG-1)/7+1
0007          IST=1
0008          IND=7
0009          IND=MIND(IND,NANG)
0010          DO 200 NPASS=1,NRITE
0011          WRITE (6,11)
0012       11 FORMAT (5X,4HTIME,4X,7(3HPER,5X,3HTAN,5X))
0013          WRITE(6,12)(KANG(I),KANG(I),I=IST,IND)
0014       12 FORMAT (12X,14(I4,4X))
0015          DO 100 J=1,NTF
0016      100 WRITE (6,20)TF(J),(PER(J,N),TANG(J,N),N=IST,IND)
0017       20 FORMAT (3X,F8.2,14F8.4)
0018          IST=IND+1
0019          IND=IST+6
0020          IND=MIND(IND,NANG)
0021      200 CONTINUE
0022          RETURN
0023          END
```

```
0001          SUBROUTINE PRNTS (X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0002          DIMENSION X(1),Y(1),Z(1),XN(100,3),MOST(1),DS(1)
0003          DIMENSION RHO(500)
0004          DO 100 I=1,NTOTAL
0005      100 RHO(I)=SQRT(X(I)**2+Y(I)**2)
0006          WRITE (6,10)
0007       10 FORMAT (1H1,3X,1HI,2X,4HMOST,6X,1HX,14X,1HY,14X,1HZ,14X,2HXN,
0008         *13X,2HYN,13X,2HZN,10X,2HDS,8X,3HRHO//)
0009          WRITE (6,20)(I,MOST(I),X(I),Y(I),Z(I),(XN(I,K),K=1,3),DS(I)
0010         *,RHO(I),I=1,NTOTAL)
0011       20 FORMAT (2I5,6F15.8,2F10.6)
0012          RETURN
0013          END
```

```
0001            SUBROUTINE PULSE (AN,ALPHA,BETA,T,DT,JND,X,Y,Z,XN,NTOTAL,F,JSTART,
0002           *ISMAX,JSMAX)
0003            DIMENSION T(1),X(1),Y(1),Z(1),XN(100,3),F(100,40,3),JSTART(1)
0004            DO 100 I=1,ISMAX
0005            JSTART(I)=JSMAX
0006            DO 100 J=1,JSMAX
0007            DO 100 K=1,3
0008          100 F(I,J,K)=0.
0009            TRUNK=3.0
0010            T1=T(1)
0011            FACT=2.*AN/SQRT(3.141593)
0012            SINA=SIN(ALPHA)
0013            COSA=COS(ALPHA)
0014            SINB=SIN(BETA)
0015            COSB=COS(BETA)
0016            HX=FACT*SINB
0017            HY=-FACT*COSB*COSA
0018            HZ=FACT*COSB*SINA
0019            DO 120 I=1,NTOTAL
0020            RHO=Y(I)*SINA+Z(I)*COSA
0021            TMIN=-TRUNK/AN-RHO
0022            TMAX=TRUNK/AN-RHO
0023            JST=(TMIN-T1)/DT+0.5
0024            IF(JST.LT.1) GO TO 130
0025            JJN=(TMAX-T1)/DT+1.5
0026            JJN=MIND(JJN,JND)
0027            JSTART(I)=JST
0028            JST=JST+1
0029            DO 110 J=JST,JJN
0030            ZSQ=(AN*(T(J)+RHO))**2
0031            EX=EXP(-ZSQ)
0032            FX=XN(I,2)*HZ-XN(I,3)*HY
0033            FY=XN(I,3)*HX-XN(I,1)*HZ
0034            FZ=XN(I,1)*HY-XN(I,2)*HX
0035            F(I,J,1)=FX*EX
0036            F(I,J,2)=FY*EX
0037            F(I,J,3)=FZ*EX
0038          110 CONTINUE
0039          120 CONTINUE
0040            RETURN
0041          130 CONTINUE
0042            WRITE(6,10)
0043           10 FORMAT(1H1,31HTERMINATE RUN, TSTART TOO LARGE)
0044            STOP 2
0045            END
```

```
0001          SUBROUTINE SPHER2 (X,Y,Z,XN,MOST,DS,NTOTAL,ISMAX)
0002          DIMENSION X(1),Y(1),Z(1),XN(100,3),MOST(1),DS(1)
0003          DIMENSION ML(25),THETA(25),PHI(25)
0004          DATA PI/3.14159265/
0005          MLMAX=25
0006          READ (5,10) RO,MTOTAL
0007       10 FORMAT (F10.5,I5)
0008          IF(MTOTAL.GT.(MLMAX-1)) GO TO 200
0009          READ (5,11)(ML(I),I=1,MTOTAL)
0010       11 FORMAT (16I5)
0011          RSQ=RO*RO
0012          AM=MTOTAL
0013          DTHETA=PI/AM
0014          THETA(1)=0.
0015          DO 100 I=1,MTOTAL
0016      100 THETA(I+1)=THETA(I)+DTHETA
0017          N=0
0018          DO 150 I=1,MTOTAL
0019          MI=ML(I)
0020          IF(MI.GT.MLMAX) GO TO 200
0021          AM=MI
0022          AREA=PI*RSQ*(COS(THETA(I))-COS(THETA(I+1)))/AM
0023          DPHI=PI/AM
0024          PHI(1)=(-PI+DPHI)/2.
0025          DO 110 II=2,MI
0026      110 PHI(II)=PHI(II-1)+DPHI
0027          THET=THETA(I)+DTHETA/2.
0028          RSINT=SIN(THET)*RO
0029          RCOST=COS(THET)*RO
0030          DO 120 II=1,MI
0031          N=N+1
0032          X(N)=RSINT*COS(PHI(II))
0033          Y(N)=RSINT*SIN(PHI(II))
0034          Z(N)=RCOST
0035          XN(N,1)=X(N)/RO
0036          XN(N,2)=Y(N)/RO
0037          XN(N,3)=Z(N)/RO
0038          DS(N)=AREA
0039      120 CONTINUE
0040      150 CONTINUE
0041          NTOTAL=N
0042          IF(NTOTAL.GT.ISMAX) GO TO 200
0043          DO 170 I=1,NTOTAL
0044          MOSTI=1
0045          DO 160 K=2,3
0046          IF(ABS(XN(I,K)).GT.ABS(XN(I,MOSTI))) MOSTI=K
0047      160 CONTINUE
0048          MOST(I)=MOSTI
0049      170 CONTINUE
0050          RETURN
0051      200 CONTINUE
0052          WRITE (6,20)
0053       20 FORMAT (1H1,54HTERMINATE RUN, GEOMETRY INPUT PARAMETERS ARE TOO LA
0054         *RGE)
0055          STOP 1
0056          END
```

```
0001           SUBROUTINE STEP2(T,DT,JND,X,Y,Z,XN,MOST,DS,NTOTAL,F,JSTART,  GN,
0002          *ISMAX,JSMAX)
0003           DIMENSION X(1),Y(1),Z(1),XN(100,3),MOST(1),DS(1)
0004          *,T(1),F(100,40,3),JSTART(1),  GN(3,2)
0005           DIMENSION XNL(3),XR(3),FFQ(3),AI(3),XNR(3),XNI(3)
0006           CINT=0.5/3.1415927
0007           DT1=DT
0008           DT2=2.*DT*DT1
0009           DT3=3.*DT*DT2
0010           DT4=4.*DT*DT3
0011     C COMPUTE CURRENT FOR ALL TIMES J
0012           DO 500 J=1,JND
0013           DO 490 I=1,NTOTAL
0014           XI=X(I)
0015           YI=Y(I)
0016           ZI=Z(I)
0017           MOSTI=MOST(I)
0018           KOT1=MOSTI
0019           KOT2=MOSTI+1
0020           IF(KOT2.GT.3) KOT2=KOT2-3
0021           KOT3=KOT2+1
0022           IF(KOT3.GT.3) KOT3=KOT3-3
0023           DO 250 K=1,3
0024           XNI(K)=XN(I,K)
0025       250 AI(K)=0.
0026           DO 480 L=1,NTOTAL
0027           DX=XI-X(L)
0028           DY=YI-Y(L)
0029           DZ=ZI-Z(L)
0030           DYSQ=DY**2
0031           DZSQ=DZ**2
0032           XNL(1)=XN(L,1)
0033           XNL(2)=XN(L,2)
0034           XNL(3)=XN(L,3)
0035           JSTL=JSTART(L)
0036           DO 450 MP=1,2
0037           IF((I.EQ.L).AND.(MP.EQ.1)) GO TO 445
0038           RSQ=DX**2+DYSQ+DZSQ
0039           R=SQRT(RSQ)
0040           TAU=T(J)-R
0041           JTAU=(TAU-T(1))/DT+1.5
0042           IF(JTAU.LE.JSTL) GO TO 445
0043           IF(JTAU.GE.J) GO TO 600
0044           NORDER=J-JSTL-1
0045           IF(NORDER.LT.1) GO TO 445
0046           NORDER=MIND(NORDER,4)
0047           JDIF=(NORDER+1)/2
0048           JZ=JTAU-JDIF
0049           JZ=MAXO(JSTL,JZ)
0050           JCOMP=J-(NORDER+1)
0051           JZ=MIND(JCOMP,JZ)
0052           XR(1)=DX/RSQ
0053           XR(2)=DY/RSQ
0054           XR(3)=DZ/RSQ
0055           KIN1=MOST(L)
0056           KIN2=KIN1+1
```

```
0057            IF(KIN2.GT.3)KIN2=KIN2-3
0058            KIN3=KIN2+1
0059            IF(KIN3.GT.3)KIN3=KIN3-3
0060            K=KIN2
0061            DTAU1=TAU-T(JZ)
0062            GO TO (305,315,325,335),NORDER
0063        305 CONTINUE
0064            DO 310 KDUM=1,2
0065            DF2=F(L,JZ,K)
0066            DF1=F(L,JZ+1,K)-DF2
0067            FAC1=DF1/DT1
0068            FTAU=DF2+DTAU1*FAC1
0069            DFTAU=FAC1
0070            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0071            K=KIN3
0072        310 CONTINUE
0073            GO TO 350
0074        315 CONTINUE
0075            DTAU2=DTAU1-DT
0076            DO 320 KDUM=1,2
0077            DF2=F(L,JZ,K)
0078            DF1=F(L,JZ+1,K)
0079            DF2=F(L,JZ+2,K)-DF1
0080            DF1=DF1-DF2
0081            DF2=DF2-DF1
0082            FAC2=DF2/DT2
0083            FAC1=DF1/DT1+DTAU2*FAC2
0084            FTAU=DF2+DTAU1*FAC1
0085            DFTAU=FAC1+DTAU1*FAC2
0086            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0087            K=KIN3
0088        320 CONTINUE
0089            GO TO 350
0090        325 CONTINUE
0091            DTAU2=DTAU1-DT
0092            DTAU3=DTAU2-DT
0093            DO 330 KDUM=1,2
0094            DF2=F(L,JZ,K)
0095            DF1=F(L,JZ+1,K)
0096            DF2=F(L,JZ+2,K)
0097            DF3=F(L,JZ+3,K)-DF2
0098            DF2=DF2-DF1
0099            DF1=DF1-DF2
0100            DF3=DF3-DF2
0101            DF2=DF2-DF1
0102            DF3=DF3-DF2
0103            FAC3=DF3/DT3
0104            FAC2=DF2/DT2+DTAU3*FAC3
0105            FAC1=DF1/DT1+DTAU2*FAC2
0106            FTAU=DF2+DTAU1*FAC1
0107            DFTAU=FAC1+DTAU1*(FAC2+DTAU2*FAC3)
0108            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0109            K=KIN3
0110        330 CONTINUE
0111            GO TO 350
0112        335 CONTINUE
0113            DTAU2=DTAU1-DT
```

```
0114            DTAU3=DTAU2-DT
0115            DTAU4=DTAU3-DT
0116            DO 340 KDUM=1,2
0117            DFZ=F(L,JZ,K)
0118            DF1=F(L,JZ+1,K)
0119            DF2=F(L,JZ+2,K)
0120            DF3=F(L,JZ+3,K)
0121            DF4=F(L,JZ+4,K)-DF3
0122            DF3=DF3-DF2
0123            DF2=DF2-DF1
0124            DF1=DF1-DFZ
0125            DF4=DF4-DF3
0126            DF3=DF3-DF2
0127            DF2=DF2-DF1
0128            DF4=DF4-DF3
0129            DF3=DF3-DF2
0130            DF4=DF4-DF3
0131            FAC4=DF4/DT4
0132            FAC3=DF3/DT3+DTAU4*FAC4
0133            FAC2=DF2/DT2+DTAU3*FAC3
0134            FAC1=DF1/DT1+DTAU2*FAC2
0135            FTAU=DFZ+DTAU1*FAC1
0136            DFTAU=FAC1+DTAU1*(FAC2+DTAU2*(FAC3+DTAU3*FAC4))
0137            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0138            K=KIN3
0139        340 CONTINUE
0140        350 CONTINUE
0141            FEQ(KIN1)=-(XNL(KIN2)*FEQ(KIN2)+XNL(KIN3)*FEQ(KIN3))/XNL(KIN1)
0142            DO 355 K=1,3
0143        355 XNR(K)=XNI(K)*XR(K)
0144            K1=MOSTI
0145            K2=KOT2
0146            K3=KOT3
0147            DO 370 KDUM=1,2
0148            AI(K2)=AI(K2)+(FEQ(K2)*(XNR(K3)+XNR(K1))
0149           *                -(FEQ(K3)*XNI(K3)+FEQ(K1)*XNI(K1)))*XR(K2))*DS(L)
0150            K3=MOSTI
0151            K1=KOT2
0152            K2=KOT3
0153        370 CONTINUE
0154        445 CONTINUE
0155            DX=XI+X(L)
0156            XNL(1)=-XNL(1)
0157        450 CONTINUE
0158        480 CONTINUE
0159            K=KOT2
0160            DO 485 KDUM=1,2
0161            F(I,J,K)=F(I,J,K)+CINT*AI(K)
0162        485 K=KOT3
0163            F(I,J,KOT1)=-(F(I,J,KOT2)*XNI (KOT2)+F(I,J,KOT3)*XNI (KOT3))
0164           */XNI (KOT1)
0165        490 CONTINUE
0166        500 CONTINUE
0167            RETURN
0168        600 CONTINUE
0169            WRITE(6,10)
0170         10 FORMAT(1H1,5X,18HJTAU.GE.J IN STEP2)
0171            STOP 3
0172            END
```

SECTION 3

PROGRAM ROTSY

Section 3.1 describes the program ROTSY, which solves the rotationally symmetric scattering problem for conducting surfaces as discussed in Sec. 2.4 of Vol. I.

3.1 ROTSY PROGRAM DESCRIPTION

The flow chart in Fig. 3 describes pictorially the operation and the calling sequence of the subroutines that constitute ROTSY.

Subroutine GEOM3 generates the geometry parameters which model the target being considered. In particular, GEOM3 treats composite bodies of right circular cyclinders with a common axis. The three satellite bodies ADC, UES and GGTS-2 are special cases of this general class.

Subroutine IMP1 generates the Gaussian-shaped pulse given in Eq. (4) of Vol. I for the incident magnetic field in the same manner as PULSE does in the ASSET and PLNSY programs.

Subroutine COEF2 generates the influence coefficients a_{ijn}, b_{ijn}, c_{ijn} and d_{ijn} used in Eq. (19) and described in Sec. 2.4.1 of Vol. I.

Subroutine CURSUM carries out the iteration in time that is dictated by Eq. (10), Vol. I, and computes the surface current at all sample points in space-time.

Subroutine FRFLD2 computes the far scattered magnetic field given in Eq. (20) using the geometry parameters displayed in Fig. 9 of Vol. I.

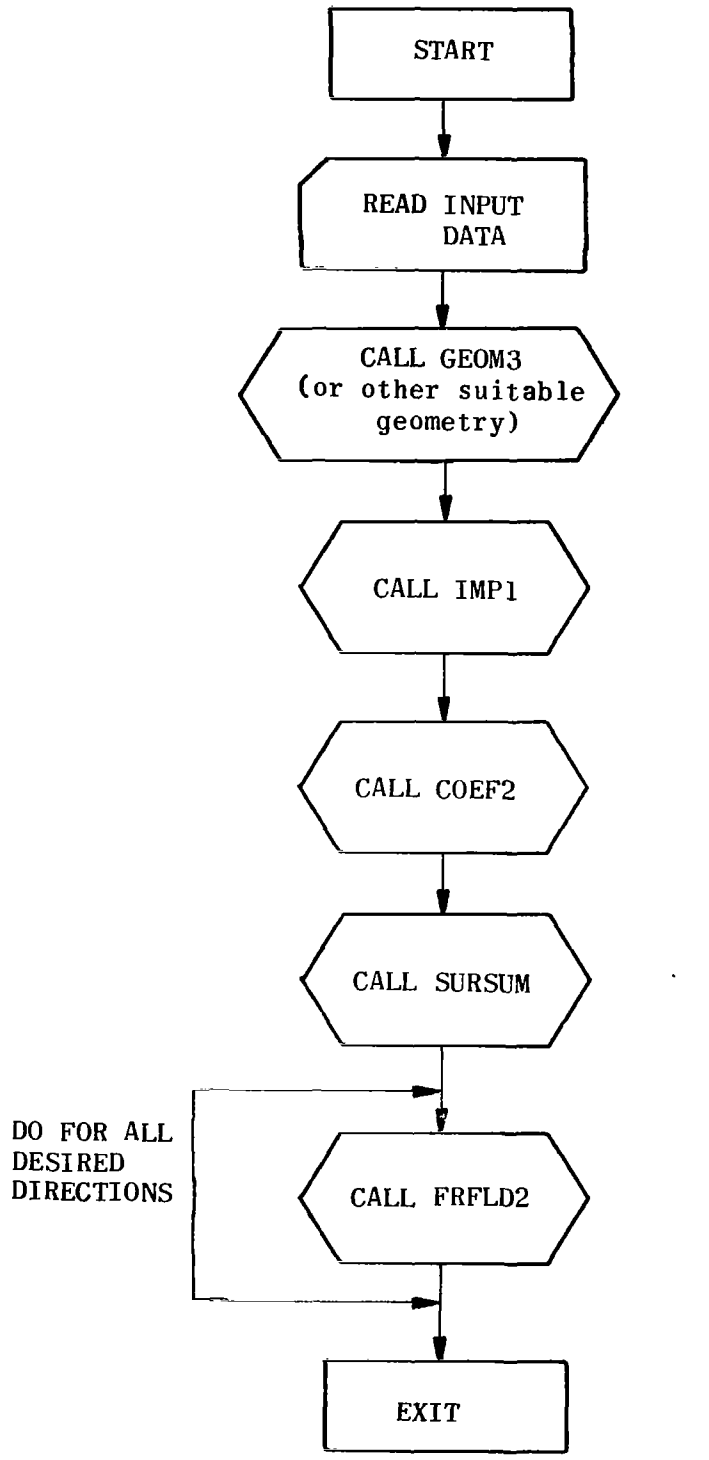

FIG. 3 Flow chart of ROTSY program.

3.2 ROTSY PROGRAM LISTINGS

```
0001     C DRIVER FOR ROTSY
0002           DIMENSION A(29,25,25),B(29,25,25),C(29,25,25),D(29,25,25)
0003          *,KREF(25,25),MK(25,25),Z(25),JSTART(25),NPINC(100,25)
0004          *,F2(100,25),F3(100,25),XF(5),HEAD(20),RHO(25),DS(25)
0005          *,HE(100),HH(100),TN(100),ME(100),TEN(100)
0006          *,HH(100),MM(25),G(25),SPHI(100,25),CPHI(100,25),GP(25)
0007          *,NBE(4),NBC(4),RAD(4),NPE(4,8),NPC(4,8)
0008          *,IKEY(12),JKEY(12)
0009          *,SP(100),CP(100)
0010           DATA XF/24.,-6.,4.,-6.,24./
0011          *,PI/3.14159265/
0012           NDMT=25
0013           NDMT4=29
0014           NDMT2=100
0015           NCTI=100
0016           NEMAX=4
0017       101 READ (5,200) HEAD
0018           WRITE (6,200) HEAD
0019           READ (5,10)    DT,AN,T1,TE,TFI,TFE,THE
0020           WRITE (6,100) DT,AN,T1,TE,TFI,TFE,THE
0021           READ (5,130) NEND,NCYL,(NBE(J),J=1,NEND),((NPC(I),I=1,NCYL)
0022           WRITE(6,110) NEND,NCYL,(NBE(J),J=1,NEND),((NPC(I),I=1,NCYL)
0023           READ (5,10)(RAD(I),I=1,NCYL)
0024           WRITE(6,30)(RAD(I),I=1,NCYL)
0025           DO 301 J=1,NEND
0026           NBEJ=NBE(J)
0027           READ (5,130)(NPE(J,M),M=1,NBEJ)
0028           WRITE (6,90)J,(NPE(J,M),M=1,NBEJ)
0029       301 CONTINUE
0030           DO 302 I=1,NCYL
0031           NBCI=NBC(I)
0032           READ (5,130)(NPC(I,N),N=1,NBCI)
0033           WRITE (6,210)I,(NPC(I,N),N=1,NBCI)
0034       302 CONTINUE
0035           READ (5,130) IGEOM,IINC,ICOEF,ITAP,IMPOUB
0036          *,IPNCHS,IPNCHF
0037           WRITE (6,170) IGEOM,IINC,ICOEF,ITAP,IMPOUB
0038          *,IPNCHS,IPNCHF
0039           DO 501 I=1,12
0040           IKEY(I)=0
0041       501 JKEY(I)=0
0042           NE=(TE-T1)/DT+1
0043           T=T1
0044           DO 39 J=1,NE
0045           TN(J)=T
0046        39 T=T+DT
0047           CALL GEOM3(NEND,NCYL,NBE,NBC,NPE,NPC,NEMAX,MTOTAL,MM,RHO
0048          *,Z,G,GP,DS,RAD,IKEY,JKEY)
0049           MTL=MIND(12,MTOTAL)
0050        37 IF(IGEOM.LE.0) GO TO 32
0051           WRITE (6,200) HEAD
0052           WRITE (6,40)
0053           WRITE (6,220)IKEY,JKEY
0054           DO 33 I=1,MTOTAL
0055        33 WRITE (6,190) I,MM(I),RHO(I),Z(I),G(I),GP(I),DS(I)
0056        32 IF(IMPOUB.NE.0) GO TO 3322
```

```
0057          CALL IMP1(AN,Z,MTOTAL,T1,DT,JSTART,M2INC     ,NDTI)
0058          GO TO 3333
0059     3322 CALL DUB1(AN,Z,MTOTAL,T1,DT,JSTART,M2INC     ,NDTI)
0060     3333 CONTINUE
0061          IF(IINC.LE.0) GO TO 51
0062          I1=1
0063          I2=MTL
0064       38 WRITE (6,200) HEAD
0065          WRITE (6,150)(I,I= I1,I2)
0066          WRITE(6,160)(JSTART(I),I=I1,I2)
0067          DO 4 J=1,NE
0068        4 WRITE (6,140) TN(J),(M2INC(J,I),I=I1,I2)
0069          IF(I2.EQ.MTOTAL) GO TO 31
0070          I1=MTL+1
0071          I2=MTOTAL
0072          GO TO 38
0073       31 CONTINUE
0074       51 DO 5 I=1,MTOTAL
0075          IF(JSTART(I).LE.0) GO TO 9
0076        5 CONTINUE
0077          DO 102 J=1,MTOTAL
0078          MJ=MM(J)
0079          MJ2=MJ*MJ
0080          DP=PI/MJ
0081          PHI=DP/2
0082          CALL SCFUN(PHI,DP,SP,CP,MJ2)
0083          DO 102 JB=1,MJ2
0084          SPHI(JB,J)=SP(JB)
0085          CPHI(JB,J)=CP(JB)
0086      102 CONTINUE
0087          CALL COEF2(DT,A,B,C,D,KREF,MK,MTOTAL,Z,G,GP,RHO,DS,MM,SPHI,CPHI
0088         *,XF,IKEY,JKEY,NDMT4,NDMT,NDMT2)
0089          IF(ICOEF.LE.0) GO TO 34
0090          WRITE (6,200) HEAD
0091          WRITE (6,50)
0092          DO 7 IGO=1,4
0093          WRITE (6,60) IGO
0094          DO 7 I=1,MTOTAL
0095          WRITE (6,70) I
0096          DO 7 J=1,MTOTAL
0097          N=KREF(J,I)
0098          M=MK(J,I)
0099          GO TO (11,12,13,14),IGO
0100       11 WRITE (6,80) J,N,(A(K,J,I),K=1,M)
0101          GO TO 7
0102       12 WRITE (6,80) J,N,(B(K,J,I),K=1,M)
0103          GO TO 7
0104       13 WRITE (6,80) J,N,(C(K,J,I),K=1,M)
0105          GO TO 7
0106       14 WRITE (6,80) J,N,(D(K,J,I),K=1,M)
0107        7 CONTINUE
0108       34 CONTINUE
0109          WRITE (6,200) HEAD
0110          WRITE (6,300)
0111       29 CALL CURSUM(   NE,MTOTAL,JSTART,GP,        KREF,MK,F2,F3,A,B,C,D,
0112         *M2INC,DT,NDMT4,NDMT,NDTI)
0113          DO 16 IDO=2,3
0114          I1=1
0115          I2=MTL
0116       18 WRITE (6,310) IDO,(I,I=I1,I2)
0117          DO 15 N=1,NE
0118          GO TO (17,17,19),IDO
0119       17 WRITE (6,140) TN(N),(F2(N,I),I=I1,I2)
0120          GO TO 15
0121       19 WRITE (6,140) TN(N),(F3(N,I),I=I1,I2)
```

```
0122        15 CONTINUE
0123           WRITE (6,20)
0124           IF(I2.EQ.MTOTAL) GO TO 16
0125           I1=MTL+1
0126           I2=MTOTAL
0127           GO TO 18
0128        16 CONTINUE
0129           NTF=(TFE-TF1)/DT+1.
0130           TF=TF1
0131           DO 6 NF=1,NTF
0132           TFN(NF)=TF
0133         6 TF=TF+DT
0134           IF(IPNCHS.LE.0) GO TO 21
0135           PUNCH 10,DT,T1,TF1
0136           PUNCH 130,MTOTAL,NE,NTF,NDTI,NDMT2
0137           PUNCH 230,(MM(I),Z(I),RHO(I),G(I),GP(I),DS(I),JSTART(I),
0138          * I=1,MTOTAL)
0139       230 FORMAT (I5,5F10.5,I5)
0140           DO 601 I=1,MTOTAL
0141           NUM=2*MM(I)
0142           PUNCH180,(SPHI(N,I),N=1,NUM)
0143           PUNCH180,(CPHI(N,I),N=1,NUM)
0144       601 CONTINUE
0145           DO 602 I=1,MTOTAL
0146           PUNCH180,(F2(N,I),N=1,NE)
0147           PUNCH180,(F3(N,I),N=1,NE)
0148       602 CONTINUE
0149        21 CALL FRFL02( F2, F3,DT,Z,TF1,NTF,HE,HH,T1,MTOTAL,RHO,G,GP,JSTART
0150          *,DS,MM,THE,SPHI,CPHI,XF,HEI,HHI,NE,NDTI,NDMT2)
0151           WRITE (6,200) HEAD
0152           WRITE (6,120) THE
0153           DO 603 NF=1,NTF
0154           WRITE (6,140) TFN(NF),HEI(NF),HHI(NF),HE(NF),HH(NF)
0155           IF(IPNCHF.GT.0) PUNCH 10,HEI(NF),HHI(NF),HE(NF),HH(NF)
0156       603 CONTINUE
0157         2 READ (5,130)ISTOP
0158           IF(ISTOP-1)25,22,101
0159        22 READ (5,10) THE
0160           GO TO 21
0161         9 WRITE (6,400) JSTART(I)
0162        25 CONTINUE
0163           STOP
0164        10 FORMAT (8F10.5)
0165        20 FORMAT ('1')
0166        30 FORMAT (' RAD='4F10.5)
0167        40 FORMAT (' FLAT END CYLINDERS'
0168          */'  I   M(I)'3X,'RHO(I)'8X,'Z(I)'8X,'G(I)'7X,'GP(I)'7X,'DS(I)')
0169        50 FORMAT ('1COEFFICIENT DATA')
0170        60 FORMAT (' COEFFICIENTS - INTEGRAL' I2)
```

```
C171        70 FORMAT (' I=' I2/' J KREF(J,I)')
0172        80 FORMAT (I3,I6,3X,10F10.5/(12X,10F10.5))
0173        90 FORMAT (' J='I2,', NPE(J,M),M=1,NBEJ' 10I5)
0174       100 FORMAT (' MAIN INPUT DATA'/,
0175          *                          ' DT='F10.5,', AN='F10.5,', TI='
0176          *F10.5,', TE='F10.5,', TF1='F10.5,', TFE='F10.5,', THE='F10.5
0177          *)
0178       110 FORMAT (     ' GEOMETRY INPUT DATA'/
0179          *' NEND='I2,', NCYL='I2/' NBE(J),J=1,NEND, NBC(I),I=1,NCYL'25I3)
0180       120 FORMAT (' FARFIELD            THETA='F10.5,' DEGREES'/
0181          * 13X,'PRE DIFFERENTIATION'5X,'POST DIFFERENTIATION'/
0182          *14X,'HEI'10X,'HHI'11X,'HE'11X,'HH')
0183       130 FORMAT (16I5)
0184       140 FORMAT (F10.3,12F10.5)
0185       150 FORMAT(' INCIDENT WAVE DATA '       ,/50X,'2*J(TIME,Z(I))'/
0186          * '    TIME',(12I10 ))
0187       160 FORMAT (' JSTART' 1X,12(6X,'('I2,')'))
0188       170 FORMAT (' IGEOM='I2,', IINC='I2,', ICOEF='I2,', ITAP='I2,
0189          * ', IMPDUB='I2,', IPNCHS='I2,', IPNCHF='I2)
0190       180 FORMAT (8F10.7)
0191       190 FORMAT (2I3,5F12.5)
0192       200 FORMAT (20A4)
0193       210 FORMAT (' I='I2,', NPC(I,N),N=1,NBCI' 10I5)
0194       220 FORMAT (' IKEY='12I3/' JKEY='12I3)
0195       300 FORMAT (' CURRENT--NUMERICAL RESULTS')
0196       310 FORMAT (50X,'J'I1,'(N,Z(I))'/3X,'T(N)'3X,12(I5,5X))
0197       400 FORMAT (' UNRECOVERABLE ERROR, JSTART='I5)
0198           END
```

```
0001          SUBROUTINE GEOM2(NEND,NCYL,NBE,NBC,NPE,NPC,NEMAX,MTOTAL,MM,RHO
0002         *,Z,G,GP,DS,RAD,IKEY,JKEY)
0003          DIMENSION NBE(1),NBC(1),RAD(1),NPE(NEMAX,1),NPC(NEMAX,1)
0004         *,MM(1),RHO(1),Z(1),DS(1),G(1),GP(1)
0005         *,IKEY(1),JKEY(1)
0006          DR=.25
0007          DZ=.25
0008          DZ2=.125
0009          DR2=.125
0010          Z1=0
0011          PDR=DR*3.14159265
0012          PDZ=PDR
0013          R1=DZ/2.
0014          NELEM=NCYL*NEND
0015          MT=0
0016          IEDG=0
0017          I=1
0018          J=1
0019          FAC=1
0020          RAD(NCYL+1)=0
0021          DO 23 K=1,NELEM,2
0022          NBEJ=NBE(J)
0023          DO 21 M=1,NBEJ
0024          MT=MT+1
0025          XM=NPE(J,M)
0026          MM(MT)=XM
0027          RHO(MT)=R1
0028          Z(MT)=Z1
0029          DS(MT)=PDR*R1/XM
0030          G(MT)=0
0031          GP(MT)=-FAC
0032
0033          R1=R1+FAC*DR
0034       21 CONTINUE
0035          Z1=Z1-DZ2
0036          IF(K+1.GT.NELEM) GO TO 23
0037          J=J+1
0038          RO=RAD(I)
0039          IF(RO.GT.RAD(I+1)) FAC=-1.
0040          IEDG=IEDG+1
0041          IKEY(IEDG)=MT
0042          JKEY(IEDG)=MT+1
0043          IEDG=IEDG+1
0044          IKEY(IEDG)=MT+1
0045          JKEY(IEDG)=MT
0046          NBCI=NBC(I)
0047          DO 22 N=1,NBCI
0048          MT=MT+1
0049          MM(MT)=NPC(I,N)
0050          XM=MM(MT)
0051          RHO(MT)=RO
0052          Z(MT)=Z1
0053          DS(MT)=PDZ*RO/XM
0054          G(MT)=1
0055          GP(MT)=0
0056          Z1=Z1-DZ
```

```
0057        22 CONTINUE
0058           IEDG=IEDG+1
0059           IKEY(IEDG)=MT
0060           JKEY(IEDG)=MT+1
0061           IEDG=IEDG+1
0062           IKEY(IEDG)=MT+1
0063           JKEY(IEDG)=MT
0064           I=I+1
0065           R1=R0+DR2*FAC
0066           Z1=Z1+DZ2
0067        23 CONTINUE
0068           MTOTAL=MT
0069           RETURN
0070           END
```

```
0001          SUBROUTINE CURSUM(NE,MTOTAL,JSTART,GP,KREF,MK,F2,F3,A,B,C,D,
0002         *H2INC,DT,N4,N1,NT)
0003          DIMENSION JSTART(1),GP(1),KREF(N1,1)
0004         *,MK(N1,1),F2(NT,1),F3(NT,1),H2INC(NT,1),A(N4,N1,1),B(N4,N1,1)
0005         *,C(N4,N1,1),D(N4,N1,1)
0006          DATA PI/3.141592657
0007        7 DO 5 I=1,MTOTAL
0008          DO 5 L=1,NT
0009          F2(L,I)=0
0010          F3(L,I)=0
0011        5 CONTINUE
0012        8 DO6 N=1,NE
0013          DO 4 I=1,MTOTAL
0014          SUM22=0
0015          SUM23=0
0016          SUM32=0
0017          SUM33=0
0018          JSI=JSTART(I)
0019          OR=GP(I)
0020          IF(N.LT.JSI) GO TO 3
0021          DO 2 J=1,MTOTAL
0022          KSF=N-KREF(J,I)+3
0023          KSJ=KSF-JSTART(J)
0024          IF(KSJ.LE.0) GO TO 3
0025          NIJ=MK(J,I)
0026          IF(KSJ.LT.NIJ) NIJ=KSJ
0027          DO 1 NS=1,NIJ
0028          NTS=KSF-NS
0029        9 F2N=F2(NTS,J)
0030          F3N=F3(NTS,J)
0031       11 SUM22=SUM22+A(NS,J,I)*F2N
0032          SUM23=SUM23+B(NS,J,I)*F3N
0033          SUM32=SUM32+C(NS,J,I)*F2N
0034
0035        1 SUM33=SUM33+D(NS,J,I)*F3N
0036        2 CONTINUE
0037        3 H2I=H2INC(N,I)
0038          F2(N,I)=H2I-(SUM22+SUM23)/PI
0039          F3(N,I)= H2I*OR+(SUM32+SUM33)/PI
0040        4 CONTINUE
0041        6 CONTINUE
0042          RETURN
0043          END
```

```
0001          SUBROUTINE DETS(H,Y,Z,NDIM,IER)
0002          DIMENSION Y(1),Z(1)
0003          IF(NDIM-5)4,1,1
0004        1 IF(H)2,5,2
0005        2 HH=.08333333/H
0006          YY=Y(NDIM-4)
0007          B=HH*(-25.*Y(1)+48.*Y(2)-36.*Y(3)+16.*Y(4)-3.*Y(5))
0008          C=HH*(-3.*Y(1)-10.*Y(2)+18.*Y(3)-6.*Y(4)+Y(5))
0009          DO 3 I=5,NDIM
0010          A=B
0011          B=C
0012          C=HH*(Y(I-4)-Y(I)+8.*(Y(I-1)-Y(I-3)))
0013        3 Z(I-4)=A
0014          IER=0
0015          A=HH*(-YY+6.*Y(NDIM-3)-18.*Y(NDIM-2)+10.*Y(NDIM-1)+3.*Y(NDIM))
0016          Z(NDIM)=HH*(3.*YY-16.*Y(NDIM-3)+36.*Y(NDIM-2)-48.*Y(NDIM-1)
```

```
0017          * +25.*Y(NDIM))
0018            Z(NDIM-1)=A
0019            Z(NDIM-2)=C
0020            Z(NDIM-3)=B
0021            RETURN
0022          4 IER=-1
0023            RETURN
0024          5 IER=1
0025            RETURN
0026            END


0001            SUBROUTINE FRFLD2(F2,F3,DT,Z,TF1,NTF,HE,HH,T1,MTOTAL,RHO,
0002           *G,GP,JSTART,DS,M,THE,SPHI,CPHI,XL,HEI,HHI,NE,MT,M2)
0003            DIMENSION F2(MT,1),F3(MT,1),HH(1),HHI(1),HEI(1),HE(1)
0004           *,RHO(1),G(1),GP(1),M(1),DS(1),SPHI(M2,1),CPHI(M2,1),Z(1),JSTART(1)
0005            DIMENSION XL(5),AE(5),AH(5),DUM(5)
0006            DATA PI/3.14159265/,FAKT/.01745329/
0007            THS=THE*FAKT
0008            CT=COS(THS)
0009            ST=SIN(THS)
0010            PI4=4.*PI
0011             D2=DT*DT
0012            DO 2 NT=1,NTF
0013            HHI(NT)=0
0014          2 HEI(NT)=0
0015            DO 8 J=1,MTOTAL
0016            GJ=G(J)
0017            GPJ=GP(J)
0018            JSJ=JSTART(J)
0019            MJ=M(J)
0020            MJ2=MJ+MJ
0021            DSJ=DS(J)/PI4
0022            C1=DSJ
0023            C3=C1*GPJ
0024            ZJCT=Z(J)*CT
0025            RJST=RHO(J)*ST
0026            DO 7 L=1,MJ2
0027            SPH=SPHI(L,J)
0028            CPH=CPHI(L,J)
0029            TAUE=TF1*RJST*CPH*ZJCT
0030            TAUH=TF1*RJST*SPH*ZJCT
0031            KE=(TAUE-T1)/DT+1.5
0032            KH=(TAUH-T1)/DT+1.5
0033            TKE=T1+(KE-1)*DT
0034            TKH=T1+(KH-1)*DT
0035            XE=TAUE-TKE
0036            XH=TAUH-TKH
0037            XXE=XE-D2
0038            XXH=XH-D2
0039            CALL LGFUN(XXE,DT,XL,AE,DUM)
0040            CALL LGFUN(XXH,DT,XL,AH,DUM)
0041            S2=SPH*SPH
0042            UL1=CPH*(GPJ*CPH*CT-ST*GJ)*(-C1)
0043            UL2=S2*CT*(-C1)
0044            UL3=CPH*CPH*(-C3)
0045            UL4=S2* (-C1)
0046            DO 5 NT=1,NTF
0047            IF(KE.LT.JSJ) GO TO 3
0048            XI1=SOMFUN(UL1,AE,F2,KE,J,NE,MT)
0049            XI2=SOMFUN(UL2,AE,F3,KE,J,NE,MT)
0050            HEI(NT)=HEI(NT)+    XI1+    XI2
0051          3 IF (KH.LT.JSJ) GO TO 4
0052            XI3=SOMFUN(UL3,AH,F2,KH,J,NE,MT)
0053            XI4=SOMFUN(UL4,AH,F3,KH,J,NE,MT)
0054            HHI(NT)=HHI(NT)+    XI3+    XI4
0055          4 KE=KE+1
0056            KH=KH+1
```

```
0057          5 CONTINUE
0058          7 CONTINUE
0059          8 CONTINUE
0060            CALL DETS(DT,HEI,HE,NTF,IER)
0061            IF(IER.NE.0) WRITE (6,10) IER
0062            CALL DETS(DT,HHI,HH,NTF,IER)
0063            IF(IER.NE.0) WRITE (6,10)IER
0064         10 FORMAT (' ERROR IN DETS, IER=',I3)
0065            RETURN
0066            END



0001            FUNCTION SOMFUN(U,A,F,K,J,N,NT)
0002            DIMENSION A(1),F(NT,1)
0003            KA=MIND(N-K,2)
0004            KS=K+KA+1
0005            SUM=0
0006            DO 1 I=1,5
0007            KU=KS-I
0008          1 SUM=SUM+A(I)*F(KU,J)
0009            SOMFUN=SUM*U
0010            RETURN
0011            END



0001            SUBROUTINE DUBI(AN,Z,MTOTAL,T1,DT,JSTART,H2INC,NDTI)
0002            DIMENSION Z(1),JSTART(1),H2INC(NDTI,1)
0003            DATA SQRPI/1.772454/
0004            DO 3 I=1,NDTI
0005            DO 3 J=1,MTOTAL
0006          3 H2INC(I,J)=0
0007            TAUO=3./AN
0008            FAC=2.*AN/SQRPI
0009            AN2=-AN*AN
0010            DO 1 I=1,MTOTAL
0011            ZI=Z(I)
0012            TSL=-TAUO-ZI
0013            TSG=TAUO-ZI
0014            JSTART(I)=(TSL-T1)/DT +1.
0015            JE      =(TSG-T1)/DT+1
0016            JS=JSTART(I)
0017            T=T1+FLOAT(JS-1)*DT
0018            DO 5 J=JS,JE
0019          2 H2INC(J,I)=FAC*EXP(AN2*(T+ZI)**2)*2.*AN2*(T+ZI)
0020            T=T+DT
0021          5 CONTINUE
0022          1 CONTINUE
0023            WRITE(6,86)
0024         86 FORMAT(1H1,4DX,32HINC IS SMOOTHED DOUBLET@)
0025            RETURN
0026            END
```

```
0001          SUBROUTINE IMP1(AN,Z,MTOTAL,T1,DT,JSTART,H2INC,NDTI)
0002          DIMENSION Z(1),JSTART(1),H2INC(NDTI,1)
0003          DATA SQRPI/1.772454/
0004          DO 3 I=1,NDTI
0005          DO 3 J=1,MTOTAL
0006        3 H2INC(I,J)=0
0007          TAU0=3./AN
0008          FAC=2.*AN/SQRPI
0009          AN2=-AN*AN
0010          DO 1 I=1,MTOTAL
0011          ZI=Z(I)
0012          TSL=-TAU0-ZI
0013          TSG=TAU0-ZI
0014          JSTART(I)=(TSL-T1)/DT +1.
0015          JE      =(TSG-T1)/DT+1
0016          JS=JSTART(I)
0017          T=T1+FLOAT(JS-1)*DT
0018          DO 5 J=JS,JE
0019        2 H2INC(J,I)=FAC*EXP(AN2*(T+ZI)**2)
0020          T=T+DT
0021        5 CONTINUE
0022        1 CONTINUE
0023          WRITE(6,86)
0024       86 FORMAT(1H1,40X,@2HINC IS SMOOTHED IMPLUSE@)
0025          RETURN
0026          END
```

```
0001          SUBROUTINE LGFUN(XX,DT,XF,XL,XLP)
0002          DIMENSION XF(5),XL(5),XLP(5),TX(5)
0003          X=XX
0004          DO 1 I=1,5
0005          TX(I)=X
0006        1 X=X+DT
0007          DT4=DT**4
0008          DO 2 L=1,5
0009          SUM=0
0010          XFL=XF(L)*DT4
0011          DO 3 K=1,5
0012          IF(K.EQ.L) GO TO 3
0013          P1=TX(K)
0014          P2=1.
0015          DO 4 J=1,5
0016          IF(J.EQ.K) GO TO 4
0017          IF(J.EQ.L) GO TO 4
0018          P2=P2*TX(J)
0019        4 CONTINUE
0020          SUM=SUM+P2
0021        3 CONTINUE
0022          XL(L)=P1*P2/XFL
0023          XLP(L)=SUM/XFL
0024        2 CONTINUE
0025          RETURN
0026          END
```

```
0001          SUBROUTINE SCFUN(X,DX,S,C,NVAL)
0002          DIMENSION S(1),C(1)
0003          SX=SIN(X)
0004          CX=COS(X)
0005          SDX=SIN(DX)
0006          CDX=COS(DX)
0007          DO 1 I=1,NVAL
0008          S(I)=SX
0009          C(I)=CX
0010          SXX=SX*CDX+CX*SDX
0011          CX=CX*CDX-SX*SDX
0012        1 SX=SXX
0013          RETURN
0014          END
```

```
0001          SUBROUTINE EDGE(RHO,Z,I,J,MJ,GI,GIP,GJ,GJP,A,B)
0002          DIMENSION RHO(1),Z(1),A(1),B(1)
0003         *,CPH(25),SPH(25)
0004         *,SIMA(4,11),SIMB(4,11),     SIMPA(11),SIMPB(11)
0005         *,SIMJA(4,11),SIMJB(4,11),SL(4)
0006          DATA PI/3.14159265/
0007         *,NINT/10/,DZ/.25/,DR/.25/,DZ2/.125/,DR2/.125/
0008         *,DZ10/.025/,DR10/.025/
0009          XN=NINT
0010          NP=NINT+1
0011          ZI=Z(I)
0012          RI=RHO(I)
0013          RI2=RI*RI
0014          XMJ=MJ*NINT
0015          DPH=PI/XMJ
0016          CALL SCFUN(0.,DPH,SPH,CPH,NP)
0017          ZJ=Z(J)-GJ*DZ2
0018          RJ=RHO(J)-GI*DR2
0019          DZP=GJ*DZ10
0020          DRP=GI*DR10
0021          DLZ=AMAX1(DZP,DRP)
0022          GIRI=GI*RI
0023          DO 15 JP=1,NP
0024          ZIJ=ZI-ZJ
0025          RPT=RJ*RJ+RI2+ZIJ*ZIJ
0026          RIJ=RI*RJ
0027          DRP=RJ*DPH
0028          GJRJ=GJ*RJ
0029          T1=GJRJ+GJP*ZIJ
0030          T2=GIRI-GIP*ZIJ
0031          GIRJ=GI*RJ
0032          GJRI=GJ*RI
0033          T3=GJP*T2-GIP*GJRJ
0034          DO 12 L=1,NP
0035          CP=CPH(L)
0036          SP=SPH(L)
0037          S2=SP*SP
0038          RSQ=RPT-2.*CP*RIJ
0039          R=SQRT(RSQ)
0040          RCUB=R*RSQ
0041          SL(1)=CP*(CP*T1-GJRI)
0042          SL(2)=ZIJ*S2
0043          SL(3)=S2*T3
0044          SL(4)=CP*(CP*T2-GIRJ)
0045          DO 11 IS=1,4
```

```
0046            SLI=SL(IS)
0047            SIMA(IS,L)=SLI/RCUB
0048         11 SIMB(IS,L)=SLI/RSQ
0049         12 CONTINUE
0050            DO 14 LS=1,4
0051            DO 13 L=1,NP
0052            SIMPA(L)=SIMA(LS,L)
0053         13 SIMPB(L)=SIMB(LS,L)
0054            CALL SIMPON(SIMPA,DPH,NINT,ANS)
0055            SIMJA(LS,JP)=ANS*RJ
0056            CALL SIMPON(SIMPB,DPH,NINT,ANS)
0057            SIMJB(LS,JP)=ANS*RJ
0058         14 CONTINUE
0059            ZJ=ZJ+DZP
0060            RJ=RJ+DRP
0061         15 CONTINUE
0062            DO 17 JS=1,4
0063            DO 16 JP=1,NP
0064            SIMPA(JP)=SIMJA(JS,JP)
0065         16 SIMPB(JP)=SIMJB(JS,JP)
0066            CALL SIMPON(SIMPA,DLZ,NINT,A(JS))
0067            CALL SIMPON(SIMPB,DL7,NINT,B(JS))
0068         17 CONTINUE
0069            RETURN
0070            END



0001            SUBROUTINE SIMPON(F,DELX,N,AX)
0002            DIMENSION F(200)
0003            IF(N-1) 40,45,50
0004         40 AX=0.
0005            GO TO 100
0006         45 AX=(F(2)+F(1))*DELX/2.
0007            GO TO 100
0008         50 K=N/2
0009            SUM4=0.
0010            SUM2=0.
0011            AX=0
0012            I=0
0013            IF(2*K-N)41,55,41
0014         41 CONTINUE
0015            AX=(.41666667*F(1)+.6666667*F(2)-.08333333*F(3))*DELX
0016            I=1
0017         55 DO 60 J=1,K
0018            L=2*J+I
0019         60 SUM4=SUM4+F(L)
0020            IF(N-2)42,90,42
0021         42 IF(N-3) 43,90,43
0022         43 CONTINUE
0023            DO 65 J=2,K
0024            L=2*J+I-1
0025         65 SUM2=SUM2+F(L)
0026         90 AX=AX+(1.3333333*SUM4+.6666667*SUM2+.3333333*(F(I+1)+F(N+1)))*DELX
0027        100 RETURN
0028            END
```

```
0001          SUBROUTINE COEF2(DT,A,B,C,D,KREF,MK,MTOTAL,Z,G,GP,RHO,DS,M,SPHI,
0002         * CPHI,XF,IKEY,JKEY,N4,N1,N2)
0003          DIMENSION A(N4,N1,1),B(N4,N1,1),C(N4,N1,1),D(N4,N1,1)
0004         *,KREF(N1,1),MK(N1,1),M(1),RHO(1),Z(1),G(1),GP(1),DS(1)
0005         *,SPHI(N2,1),CPHI(N2,1),XF(5),XL(5),XLP(5)
0006         *,AL(4),BL(4),IKEY(1),JKEY(1)
0007          DO 101 I=1,MTOTAL
0008          DO 101 K=1,N4
0009          DO 101 J=1,MTOTAL
0010          A(K,J,I)=0
0011          B(K,J,I)=0
0012          C(K,J,I)=0
0013          D(K,J,I)=0
0014      101 CONTINUE
0015          IPATCH=1
0016          DO 5 I=1,MTOTAL
0017          RI=RHO(I)
0018          ZI=Z(I)
0019          GI=G(I)
0020          GPI=GP(I)
0021          RIGI=RI*GI
0022          DO 4 J=1,MTOTAL
0023          IEDGE=0
0024          IJ=0
0025          IF(I.EQ.IKEY(IPATCH).AND.J.EQ.JKEY(IPATCH)) IEDGE=1
0026          IF(I.EQ.J) IJ=1
0027          ZJ=Z(J)
0028          GJ=G(J)
0029          DSJ=DS(J)
0030          GPJ=GP(J)
0031          RJ=RHO(J)
0032          RJGJ=RJ*GJ
0033          ZIJ=ZI-ZJ
0034          RPT=RI*RI+RJ*RJ+ZIJ*ZIJ
0035          TEM1=GPJ*ZIJ
0036          TEM2=RIGI-GPI*ZIJ
0037          TEM3=GPJ*TEM2-GPI*RJGJ
0038          RIGJ=RI*GJ
0039          RJGI=RJ*GI
0040          V1J=DSJ
0041          V2J=DSJ*ZIJ
0042          V3J=V1J
0043          V4J=DSJ
0044          MJ=M(J)
0045          NIJ=5
0046          DO 3 L=1,MJ
0047          IE=0
0048          CPH=CPHI(L,J)
0049          RSQ=RPT-2.*CPH*RI*RJ
0050          R=SQRT(RSQ)
0051          RCUB=RSQ*R
0052          KDUM=1+IFIX(R/DT-1.5)
0053          KDUM=MAXO(3,KDUM)
0054          IF(L.EQ.1) KREF(I,J)=KDUM
0055          IF(L.NE.1) NIJ=NIJ+(KDUM-KD)
0056          IF((IJ-L).EQ.0) GO TO 21
```

```
0057            X=KOUM*DT-R
0058            XX=X-2.*DT
0059            CALL LGFUN(XX,DT,XF,XL,XLP)
0060            IF(L.NE.IEDGE) GO TO 31
0061            CALL EDGE(RHO,Z,I,J,MJ,GI,GPI,GJ,GPJ,AL,BL)
0062            IE=1
0063            IPATCH=IPATCH+1
0064            GO TO 32
0065         31 CONTINUE
0066            SPH=SPHI(L,J)
0067            S2=SPH*SPH
0068            AFAC=CPH*(CPH*(RJGJ*TEM1)-RIGJ1*V1J
0069            BFAC=S2*V2J
0070            CFAC=S2*TEM3*V3J
0071            DFAC=CPH*(CPH*TEM2-RJGI)*V4J
0072         32 CONTINUE
0073            DO 2 K=1,5
0074            KS=NIJ-5+K
0075            XLK=XL(K)
0076            XLPK=XLP(K)
0077            IF(IE)34,34,33
0078         33 ALKA=XLK*AL(1)+XLPK*BL(1)
0079            ALKB=XLK*AL(2)+XLPK*BL(2)
0080            ALKC=XLK*AL(3)+XLPK*BL(3)
0081            ALKD=XLK*AL(4)+XLPK*BL(4)
0082            GO TO 35
0083         34 TERM=XLK/RCUB+XLPK/RSQ
0084            ALKA=AFAC*TERM
0085            ALKB=BFAC*TERM
0086            ALKC=CFAC*TERM
0087            ALKD=DFAC*TERM
0088         35 CONTINUE
0089            A(KS,J,I)=ALKA+A(KS,J,I)
0090            B(KS,J,I)=ALKB+B(KS,J,I)
0091            C(KS,J,I)=ALKC+C(KS,J,I)
0092            D(KS,J,I)=ALKD+D(KS,J,I)
0093          2 CONTINUE
0094         21 CONTINUE
0095            KO=KOUM
0096          3 CONTINUE
0097            MK(J,I)=NIJ
0098            IJ=0
0099          4 CONTINUE
0100          5 CONTINUE
0101            RETURN
0102            END
```

SECTION 4

PROGRAM WSCAT

Program WSCAT, which solves the problem of scattering from finite wires as discussed in Sec. 3 of Vol. I, is described in Sec. 4.1. Section 4.2 contains a listing of the program code.

4.1 WSCAT PROGRAM DESCRIPTION

The flow chart in Fig. 4 describes pictorially the operation and the calling sequence of the subroutines that constitute WSCAT.

Subroutine XCIT generates the Gaussian-shaped pulse given in Vol. I, Eq. (4) for the incident magnetic field, and converts it to the source term $\sqrt{\epsilon/\mu}\ (\partial E_x^i/\partial t)$ appearing in F_{ij} of Eq. (9) of Vol. I.

Subroutine WDTW5 carries out the iteration in time that is dictated by Eq. (30) of Vol. I and computes the wire current at all sample points in space-time.

Subroutine PRNTW prints the values stored in the wire current array at all sample points in space-time.

Subroutine FARW5 computes and prints the far scattered magnetic field given in Eq. (28) of Vol. I.

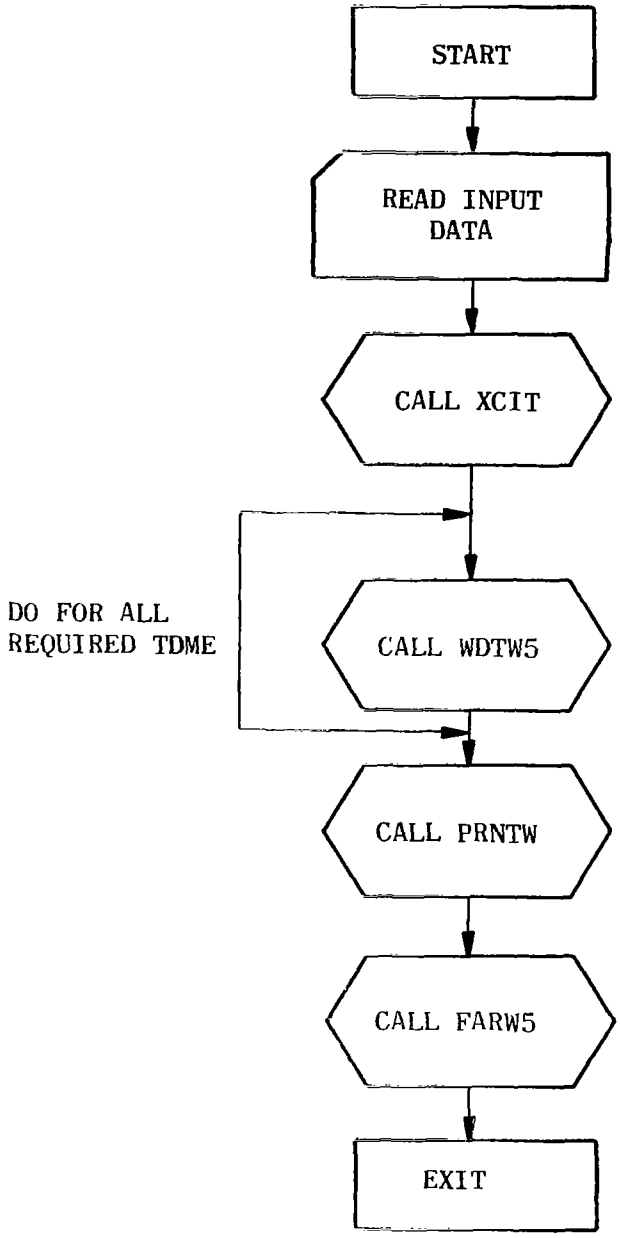

FIG. 4 Flow chart of WSCAT program.

4.2 WSCAT PROGRAM LISTINGS

```
0001      C DRIVER FOR WSCAT
0002            COMMON TW(150),DTW,XW(41),DXW,NXW,C(41,150),JSTW(41),WRAD
0003           **,EFLD(41,150),FP4(41,150),TF(150)
0004            DIMENSION PSI(9)
0005           **,HEAD(20),PS(150,9),P(150)
0006            IWMAX=41
0007            JWMAX=150
0008            IFMAX=9
0009            JFMAX=150
0010            READ(5,10) TW1,DTW,TWND,XW1,DXW,XWND,TFST,TFND,WRAD,AN,TETIN
0011            WRITE (6,20)TW1,DTW,TWND,XW1,DXW,XWND,TFST,TFND,WRAD,AN,TETIN
0012         10 FORMAT (8F10.5)
0013         20 FORMAT (' TW1,DTW,TWND,XW1,DXW,XWND,TFST,TFND,WRAD,AN,TETIN'/
0014           *(8F10.5))
0015            READ (5,30) NP
0016         30 FORMAT (16I5)
0017            WRITE (6,40) NP
0018         40 FORMAT (' NP'I3)
0019            READ (5,10)(PSI(I),I=1,NP)
0020            WRITE (6,50)(PSI(I),I=1,NP)
0021         50 FORMAT (' PSI'(8F10.5))
0022            NXW=(XWND-XW1)/DXW+1.01
0023            IF(NXW.GT.IWMAX) GO TO 1000
0024            XWW=XW1
0025            DO 1 IW=1,NXW
0026            XW(IW)=XWW
0027          1 XWW=XWW+DXW
0028            NTW=(TWND-TW1)/DTW+1.01
0029            IF(NTW.GT.JWMAX) GO TO 1010
0030            TWW=TW1
0031            DO 2 JW=1,NTW
0032            TW(JW)=TWW
0033          2 TWW=TWW+DTW
0034            NTF=(TFND-TFST)/DTW+1.01
0035            IF(NTF.GT.JFMAX) GO TO 1020
0036            TFF=TFST
0037            DO 3 JF=1,NTF
0038            TF(JF)=TFF
0039          3 TFF=TFF+DTW
0040            CALL XCIT (AN,TETIN,NTW)
0041            KAT=1
0042            EPS=0.5*DXW
0043            DO 4 JW=1,NTW
0044            CALL WOTWS(JW,KAT,EPS)
0045          4 KAT=2
0046            CALL PRNTW(NTW,2)
0047            CALL FARWS(NTW,NTF,NP,PSI,PS)
0048       2000 STOP
0049       1000 WRITE (6,210) NXW
0050        210 FORMAT (' DATA ERROR--TOO MANY XW--NXW='I5)
0051            GO TO 2000
0052       1010 WRITE (6,220) NTW
0053        220 FORMAT (' DATA ERROR--TOO MANY TW--NTW='I5)
0054            GO TO 2000
0055       1020 WRITE (6,230) NTF
0056        230 FORMAT (' DATA ERROR**TOO MANY TF--NTF='I5)
0057            GO TO 2000
0058            END
```

```
0001            SUBROUTINE FARWS(NT,NTF,NP,PSI,HS)
0002            COMMON T(150),DT,Z(41),DZ,NZ,C(41,150),JSTART(411),WRAD
0003           *,EFLD(41,150),FP4(41,150),TF(150)
0004            DIMENSION HS(50,9),PSI(9),AI(50)
0005            INTEGER IWMAX/41/,JFMAX/50/
0006            PI=3.14159265
0007            AFMAX=JFMAX
0008            DTORAD=PI/180.
0009            DXSQ=DT*DT
0010            DXQD=DXSQ*DXSQ
0011            JDIF=(T(1)-TF(1))/DT+0.01
0012            CONST=0.25/PI
0013            DO 195 JF=1,NTF
0014            DO 195 IF=1,NP
0015       195  HS(JF,IF)=0.
0016            JFMIN=NTF
0017            JFSTP=1
0018            DO 290 I=1,NP
0019            PSIR=PSI(I)*DTORAD
0020            SINP=SIN(PSIR)
0021            COSP=COS(PSIR)
0022            DO 200 J=1,NTF
0023       200  AI(J)=0.
0024            DO 260 L=1,NZ
0025            WAIT=1.
0026            IF(L.EQ.1) WAIT=0.5
0027            IF(L.EQ.NZ) WAIT=0.5
0028            DR=Z(L)*SINP
0029            KST=JSTART(L)
0030            JDEL=IFIX(AFMAX+DR/DT+0.5)-JFMAX-1
0031            ADEL=JDEL
0032            KND=MIND((NT-2),(NTF+JDEL-JDIF))
0033            IF(KND.LT.KST) GO TO 260
0034            XC=DR-ADEL*DT
0035            X1=XC-DT
0036            X2=X1-DT
0037            A0=(X1*X2)/(2.*DXSQ)
0038            A1=-(XC*X2)/DXSQ
0039            A2=(XC*X1)/(2.*DXSQ)
0040            K=KST
0041            JFST=KST-JDEL*JDIF
0042            IF(JFST.LT.1) GO TO 290
0043            JFND=KND-JDEL*JDIF
0044            JF=JFST
0045            AI(JF)=(A0*C(L,K)+A1*C(L,K+1)+A2*C(L,K+2))*DZ*WAIT*AI(JF)
0046            JF=JF+1
0047            IF(KND.EQ.(KST+1)) GO TO 254
0048            KND=KND-2
0049            XC=XC+DT
0050            X1=XC-DT
0051            X2=X1-DT
0052            X3=X2-DT
0053            X4=X3-DT
0054            B0=(X1*(X2*(X3*X4)+X3*X4)+X2*X3*X4)/(24.*DXQD)
0055            B1=-(XC*(X2*(X3*X4)+X3*X4)+X2*X3*X4)/(6.*DXQD)
0056            B2=(X1*(XC*(X3*X4)+X3*X4)+XC*X3*X4)/(4.*DXQD)
0057            B3=-(X1*(X2*(XC*X4)+XC*X4)+X2*XC*X4)/(6.*DXQD)
0058            B4=(X1*(X2*(X3*XC)+X3*XC)+X2*X3*XC)/(24.*DXQD)
0059            DO 250 K=KST,KND
0060            AI(JF)=(B0*C(L,K)+B1*C(L,K+1)+B2*C(L,K+2)
0061           *+B3*C(L,K+3)+B4*C(L,K+4))*DZ*WAIT+AI(JF)
0062       250  JF=JF+1
0063            K=KND+1
0064       254  K=K+1
0065            AI(JF)=(A0*C(L,K)+A1*C(L,K+1)+A2*C(L,K+2))*DZ*WAIT+AI(JF)
0066            JFMIN=MIND(JFST,JFMIN)
```

```
0067          JFSTP=MAXO(JFND,JFSTP)
0068      260 CONTINUE
0069          DO 280 JF=JFMIN,JFSTP
0070      280 PS(JF,I)=CONST*COSP*AI(JF)
0071      290 CONTINUE
0072          WRITE (6,50)(PSI(I),I=1,NP)
0073       50 FORMAT (1H1,4X,4HTIME,4X,10(F5.1,5X)  )
0074          WRITE (6,52)
0075       52 FORMAT(1H )
0076          DO 55 J=1,NTF
0077          WRITE (6,51)TF(J),(PS(J,I),I=1,NP)
0078       51 FORMAT (1X,11F10.4)
0079       55 CONTINUE
0080          RETURN
0081          END



0001          SUBROUTINE PRNTW(NTW,IGO)
0002          COMMON TW(150),DTW,XW(41),DXW,NXW,C(41,150),JSTW(41),WRAD
0003         *,EFLD(41,150),FP4(41,150)           ,TF(150)
0004          NRITE=(NXW-1)/16+1
0005          IST=1
0006          IND=16
0007          IND=MINO(IND,NXW)
0008          DO 10 N=1,NRITE
0009          WRITE(6,4)(XW(I),I=IST,IND)
0010       4  FORMAT(1H1,2X,4HTIME,2X,16(F5.2,2X))
0011          GO TO (11,12,13),IGO
0012       11 CONTINUE
0013          WRITE (6,30)
0014       30 FORMAT (' EFLD(I,J)')
0015          GO TO 14
0016       12 CONTINUE
0017          WRITE (6,20)
0018       20 FORMAT (' C(I,J)')
0019          GO TO 14
0020       13 CONTINUE
0021          WRITE (6,40)
0022       40 FORMAT (' FP4(I,J)')
0023       14 CONTINUE
0024          WRITE(6,5)
0025        5 FORMAT(1H )
0026          DO 7 J=1,NTW
0027          GO TO (2,1,3),IGO
0028        1 CONTINUE
0029          WRITE(6,6) TW(J),(C(I,J),I=IST,IND)
0030          GO TO 7
0031        2 CONTINUE
0032          WRITE (6,6) TW(J),(EFLD(I,J),I=IST,IND)
0033          GO TO 7
0034        3 CONTINUE
0035          WRITE (6,6) TW(J),(FP4(I,J),I=IST,IND)
0036        6 FORMAT(1X,17F7.3)
0037        7 CONTINUE
0038          WRITE(6,5)
0039          WRITE(6,8)(JSTW(I),I=IST,IND)
0040        8 FORMAT(3X,4HJSTW,16I7)
0041          IST=IND+1
0042          IND=IST+15
0043          IND=MINO(IND,NXW)
0044       10 CONTINUE
0045          RETURN
0046          END
```

```
0001          SUBROUTINE WOTW5(JW,KAT,EPS)
0002          COMMON TW(150),DTW,XW(41),DXW,NXW,C(41,150),JSTW(41),WRAD
0003         *,EFLD(41,150),FP4(41,150),TF(150)
0004          DIMENSION FC(41), AROW(41), BROW(41), CROW(41)
0005          POINT2(A,B,C)=A+(B-A)*C
0006          POINT3(A,B,C,D)=B+(C-A)*D/2.+(C+A-2.*B)*D*D/2.
0007          IF(KAT.GT.1) GO TO 2
0008          DTDX=DTW/DXW
0009          IF(DTDX.GT.1.) GO TO 199
0010          DO 1 IW=1,NXW
0011          AROW(IW)=0.0
0012          BROW(IW)=0.0
0013          CROW(IW)=0.0
0014          DO 1 JC=1,40
0015          FP4(IW,JC)=0
0016        1 CONTINUE
0017          TW1=TW(1)
0018          NXWM=NXW-1
0019          A2=WRAD*WRAD
0020          DXS=DXW*DXW
0021          RCON=.5*A2
0022          P2=2.*3.14159265
0023          TERM=EPS+SQRT(EPS*EPS+A2)
0024          ALPHA=ALOG(TERM/WRAD)/P2
0025          ALPHA1=ALOG((DXW+SQRT(DXS+A2))/TERM)
0026          P4=P2+P2
0027          DTS=DTW*DTW
0028          DTDXS=DTDX*DTDX
0029        2 CONTINUE
0030          JWM=JW-1
0031          JWMM=JW-2
0032          TWJW=TW(JW)
0033          DO 3 IW=1,NXW
0034          AROW(IW)=BROW(IW)
0035          BROW(IW)=CROW(IW)
0036        3 CONTINUE
0037          DO 27IW=1,NXW
0038          JST=JSTW(IW)
0039          XIW=XW(IW)
0040          CCL=0.
0041          CL=0.
0042          IF(JW.LE.JST) GO TO 28
0043          TJST=TW(JST)
0044          IF(IW.LE.2) GO TO 17
0045          IWM=IW-1
0046          IM=0
0047          DO 13 K=1,IWM
0048          KR=IW-K
0049          DELX=XIW-XW(KR)
0050          TAU=TWJW-DELX
0051          JZ=(TAU-TW1)/DTW+1.51
0052          IF(JZ.LE.JST) GO TO 15
0053          R=DELX+RCON/DELX
0054        5 CONTINUE
0055          IF(JW-JST-2) 199,6,9
0056        6 CONTINUE
0057          TTJS=(TAU-TJST)/DTW
0058          FC(K)=POINT2(C(KR,JST),C(KR,JST+1),TTJS)/R
0059          GO TO 12
0060        8 CONTINUE
0061          JZ=MAXO(JZ,JST+1)
0062          JZ=MINO(JZ,JW-2)
0063          TTJZ=(TAU-TW(JZ))/DTW
0064          FC(K)=POINT3(C(KR,JZ-1),C(KR,JZ),C(KR,JZ+1),TTJZ)/R
0065       12 IM=K
```

```
0066        13 CONTINUE
0067        15 CONTINUE
0068           CALL ATRAP(FC,IM,DXW,CL)
0069        17 CONTINUE
0070           IF(IW.GT.1) CL=CL+ALPHA1*C(IW-1,JW-1)
0071           IF(IW.GE.NXWM) GO TO 26
0072           IWM=NXW-IW
0073           IM=0
0074           DO 24 K=1,IWM
0075           KR=IW+K
0076           DELX=XW(KR)-XIW
0077           TAU=TWJW-DELX
0078           JZ=(TAU-TW1)/DTW+1.51
0079           IF(JZ.LE.JST) GO TO 25
0080           R=DELX*RCON/DELX
0081           IF(JW-JST-2) 199,19,21
0082        19 CONTINUE
0083           TTJS=(TAU-TJST)/DTW
0084           FC(K)=POINT2(C(KR,JST),C(KR,JST+1),TTJS)/R
0085           GO TO 22
0086        21 CONTINUE
0087           JZ=MAXO(JZ,JST+1)
0088           JZ=MINO(JZ,JW-2)
0089           TTJZ=(TAU-TW(JZ))/DTW
0090           FC(K)=POINT3(C(KR,JZ-1),C(KR,JZ),C(KR,JZ+1),TTJZ)/R
0091        22 IM=K
0092        24 CONTINUE
0093        25 CONTINUE
0094           CALL ATRAP(FC,IM,DXW,CCL)
0095        26 CONTINUE
0096           IF(IW.LT.NXW) CCL=CCL+ALPHA1*C(IW+1,JW-1)
0097           CROW(IW)=CL+CCL
0098           IF(IW.EQ.1) GO TO 27
0099           IF(IW.EQ.NXW) GO TO 27
0100           FPART=(BROW(IW-1)-2.*BROW(IW)+BROW(IW+1))/DXS
0101          *-(AROW(IW)-2.*BROW(IW)+CROW(IW))/DTS
0102           FP4(IW,JWM)=FPART/P4
0103           C2IJM=2.*C(IW,JWM)
0104           C(IW,JW)=DTDXS*(C(IW-1,JWM)-C2IJM+C(IW+1,JWM))-(C(IW,JWMM)-C2IJM)+
0105          *DTS*(FP4(IW,JWM)+EFLD(IW,JWM))/ALPHA
0106        27 CONTINUE
0107        28 CONTINUE
0108           C(1,JW)=0.
0109           C(NXW,JW)=0.
0110           RETURN
0111       199 WRITE(6,10) IW,JW,TAU,TWJW
0112        10 FORMAT(' WDTWS--RUN ABORTED*/* IW,JW,TAU,TWJW*2I3,2F10.5)
0113           STOP
0114           END
```

```
0001          SUBROUTINE XCIT (AN,TETIN,NTW)
0002          COMMON TW(150),DTW,XW(41),DXW,NXW,C(41,150),JSTW(41),WRAD
0003         *,EFLD(41,150),FP4(41,150),TF(150)
0004          C1=AN/1.77245
0005          RATO=3./AN
0006          TETR=TETIN*3.14159265/180.
0007          SN=SIN(TETR)
0008          C1=C1*COS(TETR)
0009          C3=-2.*AN*C1
0010          TW1=TW(1)
0011          DO 2 IW=1,NXW
0012          XS=XW(IW)*SN
0013          TMIN=-RATO-XS
0014          TMAX=RATO-XS
0015          DO 1 JW=1,40
0016          C(IW,JW)=0.
0017        1 EFLD(IW,JW)=0.
0018          JSTW(IW)=(TMIN-TW1)/DTW+.5
0019          IF(JSTW(IW).LE.2) GO TO 3
0020          JST=JSTW(IW)+1
0021          NARG=(TMAX-TW1)/DTW+1.5
0022          JND=MIND(NTW,NARG)
0023          DO 2 JW=JST,JND
0024          ARG=AN*(TW(JW)+XS)
0025        2 EFLD(IW,JW)=C3*ARG*EXP(-ARG*ARG)
0026          RETURN
0027        3 WRITE (6,10) IW,JSTW(IW)
0028       10 FORMAT(' XCITS--RUN ABORT 0'/' I,JSTW(I)'2I5)
0029          STOP
0030          END
```

```
0001          SUBROUTINE ATRAP(F,N,DX,ANS)
0002          DIMENSION F(1)
0003          SUM=0
0004          IF(N-2) 21,22,23
0005       21 ANS=0.
0006          GO TO 24
0007       23 CONTINUE
0008          NN=N-1
0009          DO 1 I=2,NN
0010        1 SUM=SUM+F(I)
0011       22 CONTINUE
0012          ANS=DX*(.5*(F(1)+F(N))+SUM)
0013       24 CONTINUE
0014          RETURN
0015          END
```

SECTION 5

PROGRAM CSCAT

Section 5.1 describes the program CSCAT, which solves the problem of scattering from three-dimensional surfaces with wires attached, as described in Sec. 4.2 of Vol. I. Section 5.2 contains a listing of the program code.

5.1 CSCAT PROGRAM DESCRIPTION

The flow chart in Fig. 5 describes pictorially the operation and the calling sequence of the subroutines that constitute CSCAT.

Subroutine SCUBE generates the geometry parameters for the scatterer under consideration (SSS satellite model).

Subroutines PRNTG, PRNTC and PULSE are the same as those used in the ASSET program.

Subroutines XCIT and PRNTW are the same as those used in WSCAT.

Subroutine WDTS4 computes the influence of the surface currents on the wire current according to Eqs. (33) and (36) of Vol. I.

Subroutine WDTW4 computes the influence of wire currents on other wire currents in the same manner as WDTW4 does in WSCAT. This routine differs from WDTW5 in the incorporation of symmetry conditions for plane symmetric scattering problems.

Subroutine SDTS4 is essentially the same as subroutine STEP2 which appears in PLNSY, and computes the influence of surface currents on other surface currents for plane symmetric scattering problems.

Subroutine SDTW4 computes the influence of wire currents on the surface current according to Eqs. (31) and (32) of Vol. I.

Subroutine FAR4 computes and prints the far scattered magnetic field due to both the surface and wire currents. This routine is essentially a combination of FAR2 (far field due to surface currents) and FARW5 (far field due to wire currents).

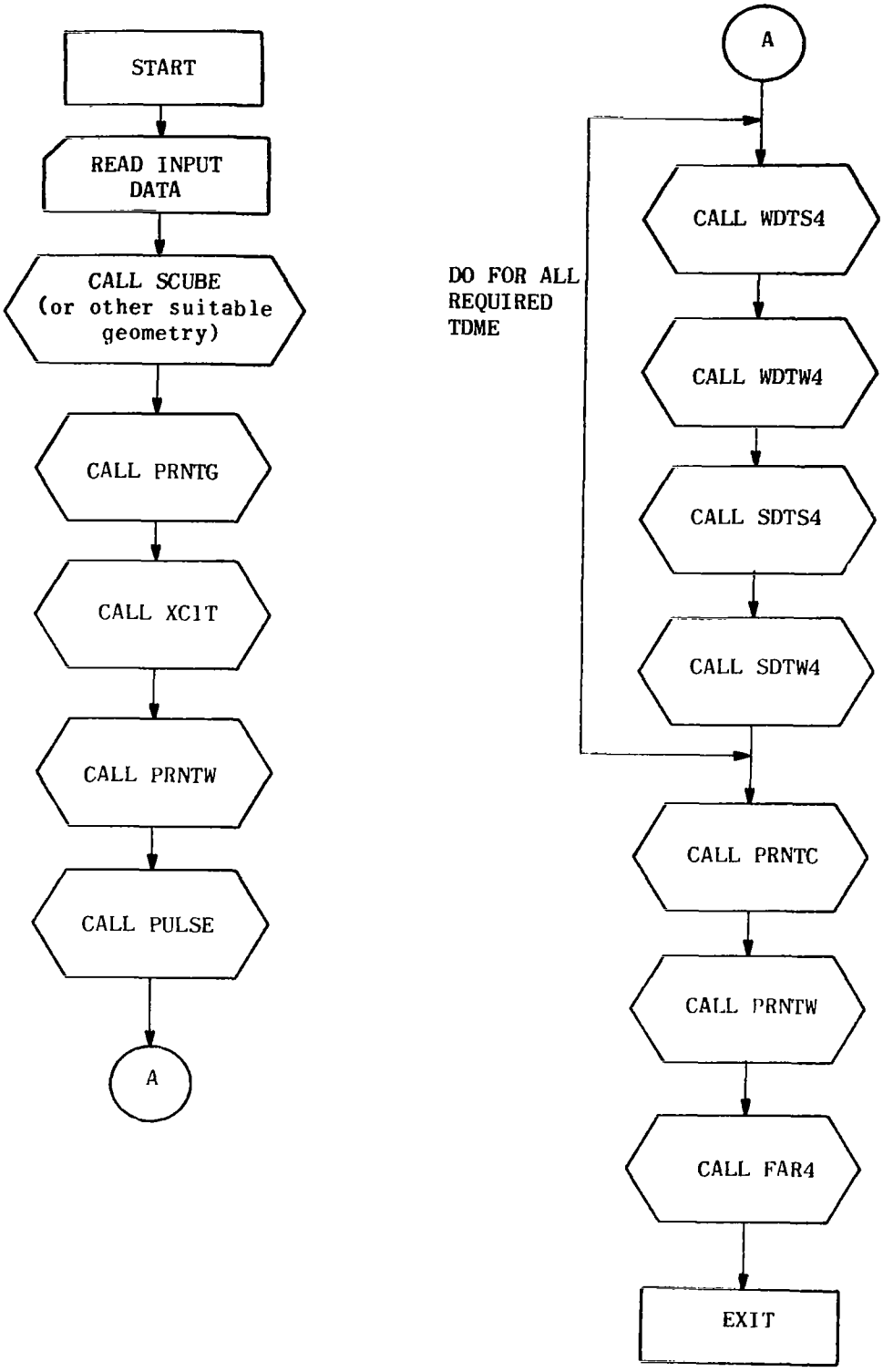

FIG. 5 Flow chart of CSCAT program.

5.2 CSCAT PROGRAM LISTINGS

```
0001      C CSCAT DRIVER
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLD(41,080),FP4(41,080),TF(080)
0005           *,PPXP(80,9),PPXT(80,9),PYZT(80,9),PYZX(80,9),PSIPX(9),PSIYZ(9)
0006            READ (5,10) TS1,DT,TNDS,AN,ALPHA,TFST,TFND
0007           *,TW1,DTW,TWND,TETIN,WRAD
0008            WRITE(6,20) TS1,DT,TNDS,AN,ALPHA,TFST,TFND
0009           *,TW1,DTW,TWND,TETIN,WRAD
0010         20 FORMAT('1FS1,DT,TNDS,AN,ALPHA,TFST,TFND,TW1,DTW,TWND,TETIN,WRAD'
0011           */(8F10.5))
0012            DIMENSION RHO(100)
0013         10 FORMAT (8F10.5)
0014         30 FORMAT (16I5)
0015            READ (5,30) NYZ,NPX
0016            WRITE (6,40) NYZ,NPX
0017         40 FORMAT (' NYZ,NPX'/(16I5))
0018            READ (5,10)(PSIYZ(I),I=1,NYZ)
0019            WRITE (6,50)(PSIYZ(I),I=1,NYZ)
0020         50 FORMAT (' PSIYZ'/(8F10.5))
0021            READ (5,10) (PSIPX(I),I=1,NPX)
0022            WRITE (6,60)(PSIPX(I),I=1,NPX)
0023         60 FORMAT (' PSIPX'/(8F10.5))
0024            READ (5,30) IPNCH
0025            WRITE (6,70) IPNCH
0026         70 FORMAT (' IPNCH='I3)
0027            CALL SCUBE
0028            CALL PRNTS
0029            NTS=(TNDS-TS1)/DT+1.01
0030            TJ=TS1
0031            DO 11 J=1,NTS
0032            T(J)=TJ
0033         11 TJ=TJ+DT
0034            NTW=(TWND-TW1)/DTW+1.01
0035            TWW=TW1
0036            DO 13 JW=1,NTW
0037            TW(JW)=TWW
0038         13 TWW=TWW+DTW
0039            CALL XCIT (AN,TETIN,NTW)
0040            CALL PRNTW(NTW,1)
0041             CALL PULSE (ALPHA,NTS,AN)
0042            KAT=1
0043            DO 1 J=1,NTS
0044            TJ=T(J)
0045            JW=(TJ-TW1)/DTW+1.01
0046            CALL WDTS4(KAT,JW,TJ)
0047            CALL WDTW4(JW,KAT)
0048            CALL SDTS4(J,KAT,NTS)
0049            IF(JW.GT.0) CALL SDTW4(J,TW(JW),DTW)
0050            KAT=2
0051          1 CONTINUE
0052            CALL PRNTC(NTS)
0053            CALL PRNTW(NTW,1)
0054            CALL PRNTW(NTW,2)
0055            CALL PRNTW(NTW,3)
0056            NTF=(TFND-TFST)/DT+1.01
```

```
0019            AM=MTOTAL
0020            DTHETA=PI/AM
0021            ISMAX=100
0022            THETA(1)=0.
0023            DO 100 I=1,MTOTAL
0024       100  THETA(I+1)=THETA(I)+DTHETA
0025            DO 150 I=1,MTOTAL
0026            MI=ML(I)
0027            AM=MI
0028            AREA=PI*RSQ*(COS(THETA(I))-COS(THETA(I+1)))/AM
0029            DPHI=PI/AM
0030            PHI=(-PI+DPHI)/2.
0031            THET=THETA(I)+DTHETA/2.
0032            RSINT=SIN(THET)*RO
0033            RCOST=COS(THET)*RO
0034            ABZ=ABS(RCOST)
0035            DO 120 II=1,MI
0036            N=N+1
0037            X(N)=RSINT*COS(PHI     )
0038            Y(N)=RSINT*SIN(PHI     )
0039            Z(N)=RCOST
0040            XN(N,1)=X(N)/RO
0041            XN(N,2)=Y(N)/RO
0042            XN(N,3)=Z(N)/RO
0043            DS(N)=AREA
0044            IF(ABZ+ABS(Y(N)).LE.1.E-7) N=N-1
0045            PHI=PHI+DPHI
0046       120  CONTINUE
0047       150  CONTINUE
0048            NTOTAL=N
0049            IF(NTOTAL.GT.ISMAX) GO TO 200
0050            DO 170 I=1,NTOTAL
0051            MOSTI=1
0052            DO 160 K=2,3
0053            IF(ABS(XN(I,K)).GT.ABS(XN(I,MOSTI))) MOSTI=K
0054       160  CONTINUE
0055            MOST(I)=MOSTI
0056       170  CONTINUE
0057            RETURN
0058       200  CONTINUE
0059            WRITE(6,20)
0060        20  FORMAT(' SCUBE--TERMINATION--GEOMETRY INPUT PARAMETERS TOO LARGE')
0061            STOP
0062            END
0063            SUBROUTINE XCIT (AN,TETIN,NTW)
0064            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0065           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0066           *,C(41,080),JSTW(41),WRAC,EFLD(41,040),FP4(41,080),TF(080)
0067           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0068            C1=AN/1.77245
0069            RATO=3./AN
0070            TETR=TETIN*3.14159265/180.
0071            SN=SIN(TETR)
0072            C1=C1*COS(TETR)
0073            C3=-2.*AN*C1
0074            TW1=TW(1)
0075            DO 2 IW=1,NXW
0076            XS=X(IW)*SN
0077            TMIN=-RATO-XS
0078            TMAX=RATO-XS
0079            DO 1 JW=1,40
0080            C(IW,JW)=0.
0081         1  EFLD(IW,JW)=0.
0092            JSTW(IW)=(TMIN-TW1)/DTW+.5
0083            IF(JSTW(IW).LE.2) GO TO 3
0084            JST=JSTW(IW)+1
```

```
0057            TFJ=TFST
0058            DO 12 J=1,NTF
0059            TF(J)=TFJ
0060         12 TFJ=TFJ+DT
0061            CALL FAR4(NTS,NTF,NTW,ALPHA,NYZ,NPX)
0062            IF(IPNCH.LE.0) GO TO 216
0063            DO 201 I=1,NTOTAL
0064        201 RHO(I)=SQRT(X(I)**2+Y(I)**2)
0065            M=1
0066            DO 205 I=2,NTOTAL
0067            IF(ABS(RHO(M)-RHO(I)).GT.0.001) GO TO 204
0068            IF(ABS(Z(M)-Z(I)).GT.0.001) GO TO 204
0069            GO TO 205
0070        204 CONTINUE
0071            M=M+1
0072            RHO(M)=RHO(I)
0073            Z(M)=Z(I)
0074        205 CONTINUE
0075            MTOTAL=M
0076            MTW=M+M
0077            DO 207 M=1,MTOTAL
0078            MREV=MTW+1-M
0079            RHO(MREV)=-RHO(M)
0080            Z(MREV)=Z(M)
0081        207 CONTINUE
0082            PUNCH 10,DT,TS1,TFST
0083            PUNCH 30,MTOTAL,NTS,NTF
0084            DO 209 I=1,MTOTAL
0085            PUNCH 80,I,Z(I),RHO(I)
0086         80 FORMAT (I5,2F10.5)
0087        209 CONTINUE
0088            I=0
0089            PUNCH 30,NYZ,I,I
0090            DTH=PSIYZ(2)-PSIYZ(1)
0091            PUNCH 10,PSIYZ(1),DTH
0092            DO 215 I=1,NYZ
0093            DO 212 J=1,NTF
0094            PUNCH 90,HPXP(J,I),HYZT(J,I)
0095         90 FORMAT (20X,2F10.5)
0096        212 CONTINUE
0097        215 CONTINUE
0098        216 CONTINUE
0099            STOP
0100            END
```

```
0001            SUBROUTINE SCUBE
0002      C     COMPUTE GEOMETRY FOR SSS
0003            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0004           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0005           *,C(41,080),JSTW(41),WRAD,EFLO(41,080),FP4(41,080),TF(080)
0006           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0007            INTEGER MTOTAL/6/ML(6)/2,4,6,6,4,2/
0008            REAL PI/3.14159265/,RO/0.5/
0009            DIMENSION THETA(25)
0010            XLONG=1.
0011            XW1=RO
0012            DXW=0.2
0013            NXW=XLONG/DXW+1.01
0014            XWW=XW1
0015            DO 1 IW=1,NXW
0016            XW(IW)=XWW
0017          1 XWW=XWW+DXW
0018            RSQ=RO*RO
```

```
0085            NARG=(TMAX-TW1)/DTW+1.5
0086            JNC=MINO(NTW,NARG)
0087            DO 2 JW=JST,JND
0088            ARG=AN*(TW(JW)+XS)
0089          2 EFLD(IW,JW)=C3*ARG*EXP(-ARG*ARG)
0090            RETURN
0091          3 WRITE (6,10) IW,JSTW(IW)
0092         10 FORMAT(' XCIT --RUN ABORTED'/' I,JSTW(I)'2I5)
0093            STOP
0094            END



0001            SUBROUTINE PULSE (ALPHA,JND,AN)
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLD(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            REAL TRUNK/3.0/
0007            INTEGER ISMAX/100/,JSMAX/080/
0008            T1=T(1)
0009            PI=3.14159265
0010            FACT=AN/SQRT(PI)
0011            FACT=FACT*FACT
0012            SINA=SIN(ALPHA)
0013            COSA=COS(ALPHA)
0014            HX=0.
0015            HY=-FACT*COSA
0016            HZ= FACT*SINA
0017            DO 100 I=1,ISMAX
0018            JSTART(I)=JSMAX
0019            DO 100 J=1,JSMAX
0020            DO 100 K=1,3
0021            F(I,J,K)=0.
0022          100 CONTINUE
0023            DO 120 I=1,NTOTAL
0024            RHO=Y(I)*SINA+Z(I)*COSA
0025            TMIN=-TRUNK/AN-RHO
0026            TMAX=TRUNK/AN-RHO
0027            JST=(TMIN-T1)/DT+0.5
0028            IF(JST.LT.1) GO TO 130
0029            JJN=(TMAX-T1)/DT+1.5
0030            JJN=MING(JJN,JND)
0031            JSTART(I)=JST
0032            JST=JST+1
0033            DO 110 J=JST,JJN
0034            ZSQ=(AN*(T(J)+RHO))**2
0035            EX=EXP(-ZSQ)
0036            FX=XN(I,2)*HZ-XN(I,3)*HY
0037            FY=XN(I,3)*HX-XN(I,1)*HZ
0038            FZ=XN(I,1)*HY-XN(I,2)*HX
0039            F(I,J,1)=FX*EX
0040            F(I,J,2)=FY*EX
0041            F(I,J,3)=FZ*EX
0042          110 CONTINUE
0043          120 CONTINUE
0044            RETURN
0045          130 CONTINUE
0046            WRITE(6,10)
0047           10 FORMAT('PULSE --TERMINATION--TSTART TOO LARGE')
0048            STOP
0049            END
```

```
0001          SUBROUTINE SDTW4(JS,TWJW)
0002          COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003         *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004         *,C(41,080),JSTW(41),MRAC,EFLD(41,080),FP4(41,080),TF(080)
0005         *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006          DIMENSION ARRAY(100)
0007          DATA CON/12.566370617/
0008          TW1=TW(1)
0009          TJ=T(JS)
0010          JW=(TWJW-TW1)/DTW+1.01
0011          DO 2 IS=1,NTOTAL
0012          XX=X(IS)
0013          YY=Y(IS)
0014          ZZ=Z(IS)
0015          TERMA=YY*YY+ZZ*ZZ
0016          DO 1 I=1,NXW
0017          XP=XW(I)
0018          ARRAY(I)=0.
0019          JSTWI=JSTW(I)
0020          DO 14 MP=1,2
0021          DX=XX-XP
0022          R2=DX*DX+TERMA
0023          R=SQRT(R2)
0024          R3=R*R2
0025          TAU=TJ-R
0026          JZ=(TAU-TW1)/DTW+1.5
0027          IF(JZ.LE.JSTWI) GO TO 1
0028          IF(TAU+DTW.LE.TWJW  ) GO TO 11
0029        9 WRITE (6,10) I,JS,JW,TAU,TWJW  ,XW(I)
0030       10 FORMAT (' SDTW4--RUN ABORTED*/* I,JS,JW,TAU,TWJW,XW(I)*3I3,3F10.5)
0031          STOP
0032       11 CONTINUE
0033          IF(JW-JSTWI-2) 9,111,12
0034      111 DCXPT=C(I,JSTWI+1)/DTW
0035          TWJS=TW(JSTWI+1)-DTW
0036          CXPT=DCXPT*(TAU-TWJS)
0037          GO TO 13
0038       12 CONTINUE
0039          JZ=MAXO(JZ,JSTWI+1)
0040          JZ=MINO(JZ,JW-2)
0041          F1=C(I,JZ-1)
0042          F2=C(I,JZ)
0043          F3=C(I,JZ+1)
0044          A=F2
0045          B=(F3-F1)/(2.*DTW)
0046          CC=(F3-2.*F2+F1)/(DTW*DTW)
0047          DEL=TAU-TW(JZ)
0048          CXPT=A+B*DEL+CC*DEL*DEL/2.
0049          DCXPT=B+CC*DEL
0050       13 CONTINUE
0051          ARRAY(I)=CXPT/R3+DCXPT/R2
0052         *+ARRAY(I)
0053          XP=-XP
0054       14 CONTINUE
0055        1 CONTINUE
0056          CALL ATRAP(ARRAY,NXW,DXW,VAL)
0057          VALCON=VAL/CON
0058          F(IS,JS,1)=F(IS,JS,1)
0059         *+(YY*XN(IS,2)+ZZ*XN(IS,3))*VALCON
0060          F(IS,JS,2)=F(IS,JS,2)
0061         *-YY*XN(IS,1)*VALCON
0062          F(IS,JS,3)=F(IS,JS,3)
0063         *-ZZ*XN(IS,1)*VALCON
0064        2 CONTINUE
0065        3 CONTINUE
0066          RETURN
0067          END
```

```
0001            SUBROUTINE SDTS4(J,KAT,JNO)
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLC(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            DIMENSION XNL(3),XR(3),FEQ(3),AI(3),XNR(3),XNI(3)
0007            DIMENSION   GN(3,2)
0008            IF(KAT.NE.1) GO TO 100
0009            CINT=0.5/3.1415927
0010            DT1=DT
0011            DT2=2.*DT*DT1
0012            DT3=3.*DT*DT2
0013            DT4=4.*DT*DT3
0014            DO 90 K=1,3
0015            DO 90 M=1,2
0016         90   GN(K,M)=1.
0017              GN(2,2)=-1.
0018              GN(3,2)=-1.
0019        100 CONTINUE
0020            DO 490 I=1,NTOTAL
0021            XI=X(I)
0022            YI=Y(I)
0023            ZI=Z(I)
0024            MOSTI=MOST(I)
0025            KOT1=MOSTI
0026            KOT2=MOSTI+1
0027            IF(KOT2.GT.3) KOT2=KOT2-3
0028            KOT3=KOT2+1
0029            IF(KOT3.GT.3) KOT3=KOT3-3
0030            DO 250 K=1,3
0031            XNI(K)=XN(I,K)
0032        250 AI(K)=0.
0033            DO 490 L=1,NTOTAL
0034            DX=XI-X(L)
0035            DY=YI-Y(L)
0036            DZ=ZI-Z(L)
0037            DYSQ=DY**2
0038            DZSQ=DZ**2
0039            XNL(1)=XN(L,1)
0040            XNL(2)=XN(L,2)
0041            XNL(3)=XN(L,3)
0042            JSTL=JSTART(L)
0043            DO 450 MP=1,2
0044            IF((I.EQ.L).AND.(MP.EQ.1)) GO TO 445
0045            RSQ=DX**2+DYSQ+DZSQ
0046            R=SQRT(RSQ)
0047            IF(R.LT.DT) GO TO 445
0048            TAU=T(J)-R
0049            JTAU=(TAU-T(1))/DT+1.5
0050            IF(JTAU.LE.JSTL) GO TO 445
0051            IF(JTAU.GE.J) GO TO 600
0052            NORDER=J-JSTL-1
0053            IF(NORDER.LT.1) GO TO 445
0054            NORDER=MIN0(NORDER,4)
0055            JDIF=(NORDER+1)/2
0056            JZ=JTAU-JDIF
0057            JZ=MAX0(JSTL,JZ)
0058            JCOMP=J-(NORDER+1)
0059            JZ=MIN0(JCOMP,JZ)
0060            XR(1)=DX/RSQ
0061            XR(2)=DY/RSQ
0062            XR(3)=DZ/RSQ
0063            KIN1=MOST(L)
0064            KIN2=KIN1+1
0065            IF(KIN2.GT.3)KIN2=KIN2-3
0066            KIN3=KIN2+1
0067            IF(KIN3.GT.3)KIN3=KIN3-3
```

```
0068            K=KIN2
0069            DTAU1=TAU-T(JZ)
0070            GO TO (305,315,325,335),NORDER
0071       305  CONTINUE
0072            DO 310 KDUM=1,2
0073            DFZ=F(L,JZ,K)
0074            DF1=F(L,JZ+1,K)-DFZ
0075            FAC1=DF1/DT1
0076            FTAU=DFZ+DTAU1*FAC1
0077            DFTAU=FAC1
0078            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0079            K=KIN3
0080       310  CONTINUE
0081            GO TO 350
0082       315  CONTINUE
0083            DTAU2=DTAU1-DT
0084            DO 320 KDUM=1,2
0085            DFZ=F(L,JZ,K)
0086            DF1=F(L,JZ+1,K)
0087            DF2=F(L,JZ+2,K)-DF1
0088            DF1=DF1-DFZ
0089            DF2=DF2-DF1
0090            FAC2=DF2/DT2
0091            FAC1=DF1/DT1+DTAU2*FAC2
0092            FTAU=DFZ+DTAU1*FAC1
0093            DFTAU=FAC1+DTAU1*FAC2
0094            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0095            K=KIN3
0096       320  CONTINUE
0097            GO TO 350
0098       325  CONTINUE
0099            DTAU2=DTAU1-DT
0100            DTAU3=DTAU2-DT
0101            DO 330 KDUM=1,2
0102            DFZ=F(L,JZ,K)
0103            DF1=F(L,JZ+1,K)
0104            DF2=F(L,JZ+2,K)
0105            DF3=F(L,JZ+3,K)-DF2
0106            DF2=DF2-DF1
0107            DF1=DF1-DFZ
0108            DF3=DF3-DF2
0109            DF2=DF2-DF1
0110            DF3=DF3-DF2
0111            FAC3=DF3/DT3
0112            FAC2=DF2/DT2+DTAU3*FAC3
0113            FAC1=DF1/DT1+DTAU2*FAC2
0114            FTAU=DFZ+DTAU1*FAC1
0115            DFTAU=FAC1+DTAU1*(FAC2+DTAU2*FAC3)
0116            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0117            K=KIN3
0118       330  CONTINUE
0119            GO TO 350
0120       335  CONTINUE
0121            DTAU2=DTAU1-DT
0122            DTAU3=DTAU2-DT
0123            DTAU4=DTAU3-DT
0124            DO 340 KDUM=1,2
0125            DFZ=F(L,JZ,K)
0126            DF1=F(L,JZ+1,K)
0127            DF2=F(L,JZ+2,K)
0128            DF3=F(L,JZ+3,K)
0129            DF4=F(L,JZ+4,K)-DF3
0130            DF3=DF3-DF2
0131            DF2=DF2-DF1
0132            DF1=DF1-DFZ
0133            DF4=DF4-DF3
```

```
0134            DF3=DF3-DF2
0135            DF2=DF2-DF1
0136            DF4=DF4-DF3
0137            DF3=DF3-DF2
0138            DF4=DF4-DF3
0139            FAC4=DF4/DT4
0140            FAC3=DF3/DT3+DTAU4*FAC4
0141            FAC2=DF2/DT2+DTAU3*FAC3
0142            FAC1=DF1/DT1+DTAU2*FAC2
0143            FTAU=DF2+DTAU1*FAC1
0144            DFTAU=FAC1+DTAU1*(FAC2+DTAU2*(FAC3+DTAU3*FAC4))
0145            FEQ(K)=(FTAU/R+DFTAU)*  GN(K,MP)
0146            K=KIN3
0147         340 CONTINUE
0148         350 CONTINUE
0149            FEQ(KIN1)=-(XNL(KIN2)*FEQ(KIN2)+XNL(KIN3)*FEQ(KIN3))/XNL(KIN1)
0150            DO 355 K=1,3
0151         355 XNR(K)=XNI(K)*XR(K)
0152            K1=MOSTI
0153            K2=KOT2
0154            K3=KOT3
0155            DO 370 KDUM=1,2
0156            AI(K2)=AI(K2)+(FEQ(K2)*(XNR(K3)+XNR(K1))
0157           *                -(FEQ(K3)*XNI(K3)+FEQ(K1)*XNI(K1)))*XR(K2))*DS(L)
0158            K3=MOSTI
0159            K1=KOT2
0160            K2=KOT3
0161         370 CONTINUE
0162         445 CONTINUE
0163            CX=XI+X(L)
0164            XNL(1)=-XNL(1)
0165         450 CONTINUE
0166         480 CONTINUE
0167            K=KOT2
0168            DO 485 KDUM=1,2
0169            F(I,J,K)=F(I,J,K)+CINT*AI(K)
0170         485 K=KOT3
0171            F(I,J,KOT1)=-(F(I,J,KOT2)*XNI (KOT2)+F(I,J,KOT3)*XNI (KOT3))
0172           */XNI (KOT1)
0173         490 CONTINUE
0174         500 CONTINUE
0175            RETURN
0176         600 CONTINUE
0177            WRITE(6,10)
0178          10 FORMAT(' SOTS4--TERMINATION--JTAU.GE.J IN STEP2')
0179            STOP
0180            END
```

```
0001            SUBROUTINE WOTS4(IDUM,JW,TJS)
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLO(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            DIMENSION TERM(4)
0007            DATA                        CON/12.566370614/
0008            IF(IDUM.GT.1) GO TO 4
0009            NXWM=NXW-1
0010            DT2=DT/2.
0011            T1=T(1)
0012          4 CONTINUE
0013            IF(JW.LE.0) GO TO 5
0014            TWJW=TW(JW)
```

```
0015          JS=(TJS-T1)/DT+1.01
0016          DO 3 IW=2,NXWM
0017          XIW=XW(IW)
0018          SUM=0
0019          DO 2 IS=1,NTOTAL
0020          XS=X(IS)
0021          YS=Y(IS)
0022          ZS=Z(IS)
0023          JST=JSTART(IS)
0024          TERMC=YS*YS+ZS*ZS
0025          DO 26 MP=1,2
0026          DELX=XIW-XS
0027          R2=DELX*DELX+TERMC
0028          R=SQRT(R2)
0029          R3=R*R2
0030          C1=3./R2
0031          C2=3./R
0032          TAU=TWJW-R
0033          JZ=(TAU-T1)/DT+1.5
0034          IF(JZ.LE.JST) GO TO 2
0035          IF(TAU+DT.LE.TJS) GO TO 21
0036        9 WRITE(6,10)IS,IW,JW,TAU,TJS,XS,YS,ZS
0037       10 FORMAT (' WDTS4--RUN ABORTED--TAU OUT OF RANGE'/' IS,IW,JW,TAU,TJS
0038         *,XS,YS,ZS'3I3,5F10.5)
0039          STOP
0040       21 CONTINUE
0041          IF(JS-JST-2)9,111,112
0042      112 IF(JZ.NE.JST+1) GO TO 23
0043      111 DO 22 K=1,3
0044          DJRTAU=F(IS,JST+1,K)/DT
0045          TSJST=T(JST+1)-DT
0046          VJRTAU=DJRTAU*(TAU-TSJST)
0047          TERM(K)=C1*VJRTAU+C2*DJRTAU
0048          IF(K.EQ.1)TERM(4)=VJRTAU+R*DJRTAU
0049       22 CONTINUE
0050          DDJRT=0
0051          GO TO 24
0052       23 CONTINUE
0053          JZ=MIND(JZ,JS-2)
0054          DEL=TAU-T(JZ)
0055          DO 1 K=1,3
0056          F1=F(IS,JZ-1,K)
0057          F2=F(IS,JZ,K)
0058          F3=F(IS,JZ+1,K)
0059          A=F2
0060          B=(F3-F1)/(2*DT)
0061          CC=(F3-2.*F2+F1)/(DT*DT)
0062          VJRTAU=A+B*DEL+CC*DEL*DEL/2.
0063          DJRTAU=B+CC*DEL
0064          DDJRT=CC
0065          TERM(K)=C1*VJRTAU+C2*DJRTAU+DDJRT
0066          IF(K.EQ.1)TERM(4)=VJRTAU+R*DJRTAU+R2*DDJRT
0067        1 CONTINUE
0068       24 CONTINUE
0069          IF(MP.EQ.1) GO TO 25
0070          TERM(2)=-TERM(2)
0071          TERM(3)=-TERM(3)
0072       25 CONTINUE
0073          ARRAY=(DELX*(DELX*TERM(1)-YS*TERM(2)-ZS*TERM(3))-TERM(4))/R3
0074          SUM=SUM+ARRAY*DS(IS)
0075       26 XS=-XS
0076        2 CONTINUE
0077          EFLD(IW,JW)=EFLD(IW,JW)+SUM/CON
0078        3 CONTINUE
0079        5 CONTINUE
0080          RETURN
0081          END
```

```
0001          SUBROUTINE WCTW4(JW,KAT)
0002          COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003         *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004         *,C(41,080),JSTW(41),WRAD,EFLD(41,080),FP4(41,080),TF(080)
0005         *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006          DIMENSION FC(41), AROW(41), BROW(41), CROW(41)
0007         *,ARO(4),BRO(4),CRO(4)
0008          POINT2(A,B,C)=A+(B-A)*C
0009          POINT3(A,B,C,D)=B+(C-A)*D/2.+(C+A-2.*B)*D*D/2.
0010          IF(KAT.GT.1) GO TO 2
0011          DTDX=DTW/DXW
0012          IF(DTDX.GT.1) GO TO 198
0013          DO 1 IW=1,NXW
0014          AROW(IW)=0.0
0015          BROW(IW)=0.0
0016          CROW(IW)=0.0
0017          DO 1 JC=1,40
0018          FP4(IW,JC)=0
0019        1 CONTINUE
0020          TW1=TW(1)
0021          NXWM=NXW-1
0022          A2=WRAD*WRAD
0023          DXS=DXW*DXW
0024          RCON=.5*A2
0025          P2=2.*3.14159265
0026          DXP=DXW/2.
0027          DXPS=DXP*DXP
0028          TERM=SQRT(1.+A2/DXPS)+1.
0029          ALPHA=ALOG(DXP*TERM/WRAD)/P2
0030          ALPHA1=ALOG(2.*(1.+SQRT(1.+A2/DXS))/TERM)
0031          P4=P2+P2
0032          DTS=DTW*DTW
0033          DTDXS=DTDX*DTDX
0034          KM=1
0035          X1=XW(1)
0036        2 CONTINUE
0037          IF(JW.LE.0) GO TO 29
0038          JWM=JW-1
0039          JWMM=JW-2
0040          TWJW=TW(JW)
0041    C   SHIFT G(I,J) INTO G(I,J-1) , G(I,J+1) INTO G(I,J)
0042          DO 3 IW=1,NXW
0043          AROW(IW)=BROW(IW)
0044          BROW(IW)=CROW(IW)
0045        3 CONTINUE
0046          DO 27IW=1,NXW
0047          JST=JSTW(IW)
0048          XIW=XW(IW)
0049          CCL=0.
0050          CL=0.
0051          CCM=0.
0052          IF(JW.LE.JST) GO TO 28
0053          TJST=TW(JST)
0054          IM=0
0055          IX=1
0056          DO 6 K=KM,NXW
0057          DELX=XIW-XW(K)
0058          TAU=TWJW-DELX
0059          JZ=(TAU-TW1)/DTW+1.51
0060          IF(JZ.LE.JST) GO TO 7
0061          IM=IM+1
0062          R=DELX*RCON/DELX
0063          IF(JW-JST-2) 199,4,5
0064        4 CONTINUE
0065          TTJS=(TAU-TJST)/DTW
0066          FC(IM)=POINT2(C( K,JST),C( K,JST+1),TTJS)/R
```

```
0067            GO TO 6
0068          5 CONTINUE
0069            JZ=MAXO(JZ,JST+1)
0070            JZ=MINO(JZ,JW-2)
0071            TTJZ=(TAU-TW(JZ))/DTW
0072            FC(IM)=POINT3(C( K,JZ-1),C( K,JZ),C( K,JZ+1),TTJZ)/R
0073          6 CONTINUE
0074          7 CONTINUE
0075            CALL ATRAP(FC,IM,DXW,CCM)
0076            IF(IW.LE.2) GO TO 17
0077            IWM=IW-1
0078            IM=0
0079            IX=2
0080            DO 13 K=1,IWM
0081            KR=IW-K
0082            DELX=XIW-XW(KR)
0083            TAU=TWJW-DELX
0084            JZ=(TAU-TW1)/DTW+1.51
0085            IF(JZ.LE.JST) GO TO 15
0086            R=DELX+RCON/DELX
0087            IF(JW-JST-2) 199,8,9
0088          8 CONTINUE
0089            TTJS=(TAU-TJST)/DTW
0090            FC(K)=POINT2(C(KR,JST),C(KR,JST+1),TTJS)/R
0091            GO TO 12
0092          9 CONTINUE
0093            JZ=MAXO(JZ,JST+1)
0094            JZ=MINO(JZ,JW-2)
0095            TTJZ=(TAU-TW(JZ))/DTW
0096            FC(K)=POINT3(C(KR,JZ-1),C(KR,JZ),C(KR,JZ+1),TTJZ)/R
0097         12 IM=K
0098         13 CONTINUE
0099         15 CONTINUE
0100            CALL ATRAP(FC,IM,DXW,CL)
0101         17 CONTINUE
0102            IF(IW.GT.1) CL=CL+ALPHA1*C(IW-1,JW-1)
0103            IF(IW.GE.NXWM) GO TO 26
0104            IWM=NXW-IW
0105            IM=0
0106            IX=3
0107            DO 24 K=1,IWM
0108            KR=IW+K
0109            DELX=XW(KR)-XIW
0110            TAU=TWJW-DELX
0111            JZ=(TAU-TW1)/DTW+1.51
0112            IF(JZ.LE.JST) GO TO 25
0113            R=DELX+RCON/DELX
0114            IF(JW-JST-2) 199,19,21
0115         19 CONTINUE
0116            TTJS=(TAU-TJST)/DTW
0117            FC(K)=POINT2(C(KR,JST),C(KR,JST+1),TTJS)/R
0118            GO TO 22
0119         21 CONTINUE
0120            JZ=MAXO(JZ,JST+1)
0121            JZ=MINO(JZ,JW-2)
0122            TTJZ=(TAU-TW(JZ))/DTW
0123            FC(K)=POINT3(C(KR,JZ-1),C(KR,JZ),C(KR,JZ+1),TTJZ)/R
0124         22 IM=K
0125         24 CONTINUE
0126         25 CONTINUE
0127            CALL ATRAP(FC,IM,DXW,CCL)
0128         26 CONTINUE
0129            IF(IW.LT.NXW) CCL=CCL+ALPHA1*C(IW+1,JW-1)
0130            CROW(IW)=CL+CCL+CCM
0131            IF(IW.EQ.1) GO TO 27
0132            IF(IW.EQ.NXW) GO TO 27
```

```
0133            FPART=(BROW(IW-1)-2.*BROW(IW)+BROW(IW+1))/DXS
0134           *-(AROW(IW)-2.*BROW(IW)+CROW(IW)))/DTS
0135            FP4(IW,JWM)=FPART/P4
0136            C2IJM=2.*C(IW,JWM)
0137            C(IW,JW)=DTDXS*(C(IW-1,JWM)-C2IJM+C(IW+1,JWM))-(C(IW,JWMM)-C2IJM)+
0138           *DTS*(FP4(IW,JWM)+EFLC(IW,JWM))/ALPHA
0139         27 CONTINUE
0140            C(1,JW)=C(2,JW)
0141            C(NXW,JW)=0.
0142         28 CONTINUE
0143         29 CONTINUE
0144            RETURN
0145        198 WRITE (6,20) DXW,DTW
0146         20 FORMAT (' WDTW4--TERMINATION--DXW,DTW'/2F10.5)
0147            GO TO 197
0148        199 WRITE (6,10) IW,JW,IX,K,KR,TAU,TWJW
0149         10 FORMAT (' WDTW4--TERMINATION?/' IW,JW,IX,K,KR,TAU,TWJW'5I3,2F10.5)
0150        197 CONTINUE
0151            STOP
0152            END



0001            SUBROUTINE FAR4(JND,NTF,NTW,ALPHA,NYZ,NPX)
0002            COMMON T(80),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(4I),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLC(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            DIMENSION AI(100,3)
0007            DIMENSION   GN(3,2)
0008            DIMENSION HS(80,9)
0009            INTEGER ISMAX/100/,JSMAX/80/,JFMAX/80/,IFMAX/9/
0010            IF(JFMAX.GT.100) GO TO 610
0011            AFMAX=JFMAX
0012            PI=3.1415927
0013            DTORAD=PI/180.
0014            DXSQ=DT*DT
0015            DX00=DXSQ*DXSQ
0016            DO 95 I=1,IFMAX
0017            DO 95 J=1,JFMAX
0018            HPXT(J,I)=0.
0019            HPXP(J,I)=0.
0020            HYZT(J,I)=0.
0021            HYZX(J,I)=0.
0022         95 CONTINUE
0023            JOIF=IFIX((T(1)-TF(1))/DT+0.01)
0024            IF(NYZ.LT.1) GO TO 300
0025            CONST=0.5/PI
0026            DO 195 JF=1,NTF
0027            DO 195 I=1,NYZ
0028            HYZT(JF,I)=0.
0029        195 HYZX(JF,I)=0.
0030            JFMIN=NTF
0031            JFSTP=1
0032            DO 290 I=1,NYZ
0033            PSI=PSIYZ(I)*DTORAD
0034            SINAP=SIN(ALPHA*PSI)
0035            COSAP=COS(ALPHA*PSI)
0036            DO 200 J=1,NTF
0037            DO 200 K=1,3
0038        200 AI(J,K)=0.
0039            DO 260 L=1,NTOTAL
0040            DR=Y(L)*SINAP+Z(L)*COSAP
0041            DSL=DS(L)
0042            KST=JSTART(L)
```

```
      JDEL=IFIX(AFMAX*DR/DT+0.5)-JFMAX-1
      ADEL=JDEL
      KND=MIND((JND-2)*(NTF*JDEL-JDIF))
      IF(KND.LT.KST) GO TO 260
      XO=DR-ADEL*DT
      X1=XO-DT
      X2=X1-DT
      AC=(X1+X2)/(2.*DXSQ)
      A1=-(XC+X2)/DXSQ
      A2=(XO+X1)/(2.*DXSQ)
C     VERTICAL POLARIZATION
  220 KOD1=1
      KOD2=1
      K=KST
      JFST=KST-JDEL*JDIF
      IF(JFST.LT.1) GO TO 290
      JFND=KND-JDEL*JDIF
      JF=JFST
      DO 235 KOD=KOD1,KOD2
  235 AI(JF,KOD)=(AO*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
     **AI(JF,KOD)
      JF=JF+1
      IF(KND.EQ.(KST+1)) GO TO 254
      KND=KND-2
      XO=XO+DT
      X1=XO-DT
      X2=X1-DT
      X3=X2-DT
      X4=X3-DT
      BO=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXQD)
      B1=-(XO*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXQD)
      B2=(X1*(XO*(X3+X4)+X3*X4)+XO*X3*X4)/(4.*DXQD)
      B3=-(X1*(X2*(XO+X4)+XO*X4)+X2*XO*X4)/(6.*DXQD)
      B4=(X1*(X2*(X3+XO)+X3*XO)+X2*X3*XO)/(24.*DXQD)
      DO 250 K=KST,KND
      DO 240 KOD=KOD1,KOD2
      AI(JF,KOD)=(BO*F(L,K,KOD)+B1*F(L,K+1,KOD)+B2*F(L,K+2,KOD)
     **B3*F(L,K+3,KOD)+B4*F(L,K+4,KOD))*DSL+AI(JF,KOD)
  240 CONTINUE
      JF=JF+1
  250 CONTINUE
      K=KND+1
  254 K=K+1
      DO 255 KOD=KOD1,KOD2
  255 AI(JF,KOD)=(AO*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL
     **AI(JF,KOD)
      JFMIN=MIND(JFST,JFMIN)
      JFSTP=MAXO(JFND,JFSTP)
  260 CONTINUE
      DO 280 JF=JFMIN,JFSTP
  265 HYZT(JF,I)=CONST*AI(JF,1)
  280 CONTINUE
  290 CONTINUE
  300 CONTINUE
      IF(NPX.LT.1) GO TO 500
      DO 80 K=1,3
      DO 90 M=1,2
   90   GN(K,M)=1.
        GN(3,2)=-1.
        GN(2,2)=-1.
      CONST=.25/PI
      SINA=SIN(ALPHA)
      COSA=COS(ALPHA)
      DO 395 JF=1,NTF
      DO 395 I=1,NPX
      HYZT(JF,I)=0.
```

```
0109      395 HPXT(JF,I)=0.
0110          JFMIN=NTF
0111          JFSTP=1
0112          DO 490 I=1,NPX
0113          PSI=PSIPX(I)*DTORAD
0114          SINP=SIN(PSI)
0115          COSP=COS(PSI)
0116          DO 400 J=1,NTF
0117          DO 400 K=1,3
0118      400 AI(J,K)=0.
0119          DO 460 L=1,NTOTAL
0120          DSL=DS(L)
0121          KST=JSTART(L)
0122          DR=X(L)*SINP+(Y(L)*SINA+Z(L)*COSA)*COSP
0123          DO 458 MP=1,2
0124          JDEL=IFIX(AFMAX*DR/DT+0.5)-JFMAX-1
0125          ADEL=JDEL
0126          KND=MIND((JND-2),(NTF+JDEL-JDIF))
0127          IF(KND.LT.KST) GO TO 458
0128          XO=DR-ADEL*DT
0129          X1=XO-DT
0130          X2=X1-DT
0131          AO=(X1*X2)/(2.*DXSQ)
0132          A1=-(XO*X2)/DXSQ
0133          A2=(XO*X1)/(2.*DXSQ)
0134          K=KST
0135          JFST=KST-JDEL+JDIF
0136          IF(JFST.LT.1) GO TO 490
0137          JFND=KND-JDEL+JDIF
0138          JF=JFST
0139          DO 435 KOD=1,3
0140      435 AI(JF,KOD)=(AO*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL*
0141         *  GN(KOD,MP)+AI(JF,KOD)
0142          JF=JF+1
0143          IF((KND.EQ.(KST+1))) GO TO 454
0144          KND=KND-2
0145          XO=XO+DT
0146          X1=XO-DT
0147          X2=X1-DT
0148          X3=X2-DT
0149          X4=X3-DT
0150          BO=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXQD)
0151          B1=-(XO*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXQD)
0152          B2=(X1*(XO*(X3+X4)+X3*X4)+XO*X3*X4)/(4.*DXQD)
0153          B3=-(X1*(X2*(XO+X4)+XO*X4)+X2*XO*X4)/(6.*DXQD)
0154          B4=(X1*(X2*(X3+XO)+X3*XO)+X2*X3*XO)/(24.*DXQD)
0155          DO 450 K=KST,KND
0156          DO 440 KOD=1,3
0157          AI(JF,KOD)=(BO*F(L,K,KOD)+B1*F(L,K+1,KOD)+B2*F(L,K+2,KOD)
0158         *+B3*F(L,K+3,KOD)+B4*F(L,K+4,KOD))*DSL*  GN(KOD,MP)+AI(JF,KOD)
0159      440 CONTINUE
0160          JF=JF+1
0161      450 CONTINUE
0162          K=KND+1
0163      454 K=K+1
0164          DO 455 KOD=1,3
0165      455 AI(JF,KOD)=(AO*F(L,K,KOD)+A1*F(L,K+1,KOD)+A2*F(L,K+2,KOD))*DSL*
0166         *  GN(KOD,MP)+AI(JF,KOD)
0167          JFMIN=MIND(JFST,JFMIN)
0168          JFSTP=MAXO(JFND,JFSTP)
0169      458 DR=-X(L)*SINP+(Y(L)*SINA+Z(L)*COSA)*COSP
0170      460 CONTINUE
```

```
0171            DO 480 JF=JFMIN,JFSTP
0172            HPXP(JF,I)=CONST*(COSP*AI(JF,1)-SINP*(SINA*AI(JF,2)+
0173           *COSA*AI(JF,3)))
0174            HPXT(JF,I)=CONST*(COSA*AI(JF,2)-SINA*AI(JF,3))
0175        480 CONTINUE
0176        490 CONTINUE
0177        500 CONTINUE
0178            CALL FARW4(NTW,NTF,NPX,PSIPX,HS)
0179      C ADD CONTRIBUTION OF WIRE CURRENTS TO FARFIELD
0180            DO 710 I=1,NYZ
0181            DO 710 JF=1,NTF
0182        710 HYZT(JF,I)=HYZT(JF,I)+HS(JF,1)
0183            DO 720 I=1,NPX
0184            DO 720 JF=1,NTF
0185        720 HPXP(JF,I)=HPXP(JF,I)+HS(JF,I)
0186            WRITE(6,35)
0187         35 FORMAT(1H1,5X,35HCOMPONENTS OF FAR FIELD IN YZ PLANE)
0188            WRITE(6,37)
0189         37 FORMAT(5X,25HSMOOTHED IMPULSE RESPONSE//)
0190            CALL PRNTF2(TF,NTF,HYZX,HYZT,PSIYZ,NYZ)
0191            WRITE(6,36)
0192         36 FORMAT(1H1,5X,35HCOMPONENTS OF FAR FIELD IN PX PLANE)
0193            WRITE(6,37)
0194            CALL PRNTF (TF,NTF,HPXP,HPXT,PSIPX,NPX)
0195        102 CONTINUE
0196            RETURN
0197        610 CONTINUE
0198            STOP 5
0199            END


0001            SUBROUTINE FARW4(NT,NTF,NP,PSI,HS)
0002            COMMON TS(080),DTS,XS(100),YS(100),ZS(100),XNS(100,3),MOST(100)
0003           *,VS(100),NTOTAL,F(100,080,3),JSTS(100),T(080),DT,Z(41),DZ,NZ
0004           *,C(41,080),JSTART(41),WRAD,EFLD(41,080),EP4(41,080),TF(080)
0005           *,PXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            DIMENSION HS(80,9),PSI(9),AI(80)
0007            INTEGER IWMAX/41/,JFMAX/80/
0008            PI=3.14159265
0009            JFMAX=JFMAX
0010            DTORAD=PI/180.
0011            DXSQ=DT*DT
0012            DXQD=DXSQ*DXSQ
0013            JDIF=(T(1)-TF(1))/DT+0.01
0014            CONST=0.25/PI
0015            DO 195 JF=1,NTF
0016            DO 195 IF=1,NP
0017        195 HS(JF,IF)=0.
0018            JFMIN=NTF
0019            JFSTP=1
0020            DO 490 I=1,NP
0021            PSIR=PSI(I)*DTORAD
0022            SINP=SIN(PSIR)
0023            COSP=COS(PSIR)
0024            DO 200 J=1,NTF
0025        200 AI(J)=0.
0026            DO 260 L=1,NZ
0027            WAIT=1.
0028            IF(L.EQ.1) WAIT=0.5
0029            IF(L.EQ.NZ) WAIT=0.5
0030            KST=JSTART(L)
0031            ZL=Z(L)
0032            DO 255 MP=1,2
0033            YP=ZL*SINP
```

```
0034          JDEL=IFIX(AFMAX*DR/DT+0.5)-JFMAX-1
0035          ADEL=JDEL
0036          KND=MIND((NT-2),(NTF*JDEL-JDIF))
0037          IF(KND.LT.KST) GO TO 260
0038          XC=DR-ADEL*DT
0039          X1=XC-DT
0040          X2=X1-DT
0041          AC=(X1*X2)/(2.*DXSQ)
0042          A1=-(XC*X2)/DXSQ
0043          A2=(XC*X1)/(2.*DXSQ)
0044          K=KST
0045          JFST=KST-JDEL*JDIF
0046          IF(JFST.LT.1) GO TO 290
0047          JFND=KND-JDEL*JDIF
0048          JF=JFST
0049          AI(JF)=(AC*C(L,K)+A1*C(L,K+1)+A2*C(L,K+2))*DZ*WAIT+AI(JF)
0050          JF=JF+1
0051          IF(KND.EQ.(KST+1)) GO TO 254
0052          KND=KND-2
0053          XC=XC+DT
0054          X1=XC-DT
0055          X2=X1-DT
0056          X3=X2-DT
0057          X4=X3-DT
0058          B0=(X1*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(24.*DXQD)
0059          B1=-(XC*(X2*(X3+X4)+X3*X4)+X2*X3*X4)/(6.*DXQD)
0060          B2=(X1*(XC*(X3+X4)+X3*X4)+XC*X3*X4)/(4.*DXQD)
0061          B3=-(X1*(X2*(XC+X4)+XC*X4)+X2*XC*X4)/(6.*DXQD)
0062          B4=(X1*(X2*(X3+XC)+X3*XC)+X2*X3*XC)/(24.*DXQC)
0063          DO 250 K=KST,KND
0064          AI(JF)=(B0*C(L,K)+B1*C(L,K+1)+B2*C(L,K+2)
0065         **+B3*C(L,K+3)+B4*C(L,K+4))*DZ*WAIT+AI(JF)
0066      250 JF=JF+1
0067          K=KND+1
0068      254 K=K+1
0069          AI(JF)=(AC*C(L,K)+A1*C(L,K+1)+A2*C(L,K+2))*DZ*WAIT+AI(JF)
0070          JFMIN=MIND(JFST,JFMIN)
0071          JFSTP=MAXO(JFND,JFSTP)
0072      255 ZL=-ZL
0073      260 CONTINUE
0074          DO 280 JF=JFMIN,JFSTP
0075      280 PS(JF,I)=CONST*COSP*AI(JF)
0076      290 CONTINUE
0077          WRITE (6,50)(PSI(I),I=1,NP)
0078       50 FORMAT (1H1,4X,4HTIME,4X,10(F5.1,5X)  )
0079          WRITE (6,52)
0080       52 FORMAT(1H )
0081          DO 55 J=1,NTF
0082          WRITE (6,51)TF(J),(PS(J,I),I=1,NP)
0083       51 FORMAT (1X,11F10.4)
0084       55 CONTINUE
0085          RETURN
0086          END



0001          SUBROUTINE ATRAP(F,N,DX,ANS)
0002          DIMENSION F(1)
0003          SUM=0
0004          IF(N-2) 21,22,23
0005       21 ANS=0.
0006          GO TO 24
0007       23 CONTINUE
0008          NN=N-1
0009          DO 1 I=2,NN
```

```
0010          1 SUM=SUM+F(I)
0011         22 CONTINUE
0012            ANS=DX*(.5*(F(I)+F(N))+SUM)
0013         24 CONTINUE
0014            RETURN
0015            END



0001            SUBROUTINE PRNTW(NTW,IGO)
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,DPC,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLD(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            NPITE=(NXW-1)/16+1
0007            IST=1
0008            IND=15
0009            IND=MIND(IND,NXW)
0010            DO 10 N=1,NPITE
0011            WRITE(6,4)(XW(I),I=IST,IND)
0012             4 FORMAT(1H1,2X,4HTIME,2X,16(F5.2,3X))
0013            GO TO (11,12,13),IGO
0014           11 CONTINUE
0015            WRITE (6,30)
0016           30 FORMAT (' EFLD(I,J)')
0017            GO TO 14
0018           12 CONTINUE
0019            WRITE (6,20)
0020           20 FORMAT (' C(I,J)')
0021            GO TO 14
0022           13 CONTINUE
0023            WRITE (6,40)
0024           40 FORMAT (' FP4(I,J)')
0025           14 CONTINUE
0026            WRITE(6,5)
0027            FORMAT(1H )
0028            DO 7 J=1,NTW
0029            GO TO (2,1,3),IGO
0030            1 CONTINUE
0031            WRITE(6,6) TW(J),(C(I,J),I=IST,IND)
0032            GO TO 7
0033            2 CONTINUE
0034            WRITE (6,6) TW(J),(EFLD(I,J),I=IST,IND)
0035            GO TO 7
0036            3 CONTINUE
0037            WRITE (6,6) TW(J),(FP4(I,J),I=IST,IND)
0038            6 FORMAT(1X,16F8.4)
0039            7 CONTINUE
0040            WRITE(6,9)
0041            WRITE(6,8)(JSTW(I),I=IST,IND)
0042            8 FORMAT(3X,4HJSTW,16I7)
0043            IST=IND+1
0044            IND=IST+15
0045            IND=MIND(IND,NXW)
0046           10 CONTINUE
0047            RETURN
0048            END
```

```
0001            SUBROUTINE PRNTG
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLD(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            DIMENSION RHO(500)
0007            DO 100 I=1,NTOTAL
0008          100 RHO(I)=SQRT(X(I)**2+Y(I)**2)
0009            WRITE (6,10)
0010           10 FORMAT (1H1,3X,1HI,2X,4HMOST,6X,1HX,14X,1HY,14X,1HZ,14X,2HXN,
0011           *13X,2HYN,13X,2HZN,10X,2HDS,8X,3HRHO//)
0012            WRITE (6,20)(I,MOST(I),X(I),Y(I),Z(I),(XN(I,K),K=1,3),DS(I)
0013           *,RHO(I),I=1,NTOTAL)
0014           20 FORMAT (2I5,6F15.8,2F10.6)
0015            RETURN
0016            END
```

```
0001            SUBROUTINE PRNTC(NTS)
0002            COMMON T(080),DT,X(100),Y(100),Z(100),XN(100,3),MOST(100),DS(100)
0003           *,NTOTAL,F(100,080,3),JSTART(100),TW(080),DTW,XW(41),DXW,NXW
0004           *,C(41,080),JSTW(41),WRAD,EFLD(41,080),FP4(41,080),TF(080)
0005           *,HPXP(80,9),HPXT(80,9),HYZT(80,9),HYZX(80,9),PSIPX(9),PSIYZ(9)
0006            NRITE=(NTOTAL-1)/5+1
0007            IST=1
0008            INC=5
0009            INC=MINO(INC,NTOTAL)
0010            DO 4 N=1,NRITE
0011            WRITE(6,30)
0012           30 FORMAT(1H1,5X,29HCOMPONENTS OF CURRENT DENSITY///)
0013            MAX=IST+4
0014            WRITE(6,40)(I,I,I,I=IST,MAX)
0015           40 FORMAT(3X,6HTIME  ,5(4H FX(,I3,1H),4H FY(,I3,1H),4H FZ(,I3,1H)))
0016            DO 3 J=1,NTS
0017            3 WRITE(6,50)T(J),((F(I,J,K),K=1,3),I=IST,INC)
0018           50 FORMAT(1X,16F8.4)
0019            WRITE(6,60) (JSTART(I),I=IST,INC)
0020           60 FORMAT (/' JSTART' 13X,4(I2,22X),I2)
0021            IST=INC+1
0022            INC=IST+4
0023            INC=MINO(INC,NTOTAL)
0024            4 CONTINUE
0025            RETURN
0026            END
```

```
0001            SUBROUTINE PRNTF (TF,NTF,PER,TANG,ANG,NANG)
0002            DIMENSION TF(80),PER(80,9),TANG(80,9),ANG(9),
0003           *KANG(15)
0004            DO 50 N=1,NANG
0005         50 KANG(N)=ANG(N)
0006            NRITE=(NANG-1)/7+1
0007            IST=1
0008            IND=7
0009            IND=MIND(IND,NANG)
0010            DO 200 NPASS=1,NRITE
0011            WRITE (6,11)
0012         11 FORMAT (5X,4HTIME,4X,7(3HPER,5X,3HTAN,5X))
0013            WRITE(6,12)(KANG(I),KANG(I),I=IST,IND)
0014         12 FORMAT (12X,14(I4,4X))
0015            DO 100 J=1,NTF
0016        100 WRITE (6,20)TF(J),(PER(J,N),TANG(J,N),N=IST,IND)
0017         20 FORMAT (3X,F8.2,14F8.4)
0018            IST=IND+1
0019            IND=IST+6
0020            IND=MIND(IND,NANG)
0021        200 CONTINUE
0022            RETURN
0023            END
```