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AVEC.FORTRAN

05/27/77 1641.8RE 07/02/76 1424.4

```
AVEC RETURNS THE SUM OF TWO VECTORS
SUBROUTINE AVEC(U,V,W)
DIMENSION U(3),V(3),W(3)
W(1)=U(1)+V(1)
W(2)=U(2)+V(2)
W(3)=U(3)+V(3)
RETURN
END
```

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GEOMAG.FORTRAN

06/03/76 1406.3RE 03/31/76 1739.6

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SUBROUTINE GEOMAG(TM,FLAT,FLONG,ALT,RA,B,BMAG)
DIMENSION B(3)
DEGRAD=3.14159265/180.
MODEL=7
RKM=ALT+6378.17
TM=TM
COLAT=(90.-FLAT)*DEGRAD
ST=SIN(COLAT)
CT=COS(COLAT)
SPH=SIN(FLONG*DEGRAD)
CPH=COS(FLONG*DEGRAD)
CALL ALLMAG(MODEL,TM,RKM,ST,CT,SPH,CPH,BR,BT,BP,BMAG)
B(1)=-BT
B(2)=BP
B(3)=-BR
CALL C$ROTATE(2,FLAT+90.,B)
CALL C$ROTATE(3,-RA,B)
RETURN
END
```

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MVEC.FORTRAN

12/15/78 1311.4RE 04/12/78 0931.4

C MVEC RETURNS THE PRODUCT OF A SCALAR AND VECTOR
SUBROUTINE MVEC(A,V,AV)
DIMENSION V(3),AV(3)
AV(1)=A*V(1)
AV(2)=A*V(2)
AV(3)=A*V(3)
RETURN
END

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SASORB.FORTRAN

01/30/79 1742.6RE 01/10/79 1548.5

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SUBROUTINE SASORB(Y,T,DEC,RA,RAD,V,FLAT,FLONG,ALT)
DIMENSION Y(15),V(3),X(15)
C      Y(1)=EPOCH IN JULIAN DAY-2442500.
C      Y(3)=MEAN ANOMALY AT EPOCH IN DEGREES FROM PERIGEE
C      Y(4)=INERTIAL PERIOD AT EPOCH IN SECONDS
C      Y(5)=CHANGE OF INERTIAL PERIOD IN(SEC/ORBIT)/ORBIT
C      Y(6)=ECCENTRICITY AT EPOCH
C      Y(7)=CHANGE OF ECCENTRICITY PER DAY
C      Y(8)=ARGUMENT OF PERIGEE AT EPOCH IN DEGREES
C      Y(9)=CHANGE OF ARGUMENT OF PERIGEE IN DEGREES PER DAY
C      Y(11)=RIGHT ASCENSION OF THE ASCENDING NODE IN DEGREES
C      Y(12)=CHANGE OF THE ASCENDING NODE IN DEGREES PER DAY
C      Y(14)=INCLINATION IN DEGREES
C      Y(15)=SEMI-MAJOR AXIS IN KILOMETERS
X(1)=Y(1)
X(3)=Y(3)/360.
X(4)=86400./Y(4)-Y(9)/360.-Y(12)/360.
X(5)=-Y(5)*86400.**2/Y(4)**3
X(6)=0.000555-(T-39.5)*3.333E-08+0.000045*SIN(6.283*(T-38.64)/23.488)
DO 1 I=7,15
C      X(I)=Y(I)
CALL ORB(X,T,DEC,RA,RAD,V)
FLAT=DEC
FLONG=AMOD(RA-(T-39.5)*360.9856-44.217.360.)-180.
ALT=RAD-6387.7
RETURN
END
```

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VECTOR.FORTRAN

12/15/78 1311.4RE 04/12/78 0928.6

C VECTOR RETURNS THE COMPONENTS OF A VECTOR WITH GIVEN EL,AZ IN DEGREES
SUBROUTINE VECTOR(EL,AZ,V)
DIMENSION V(3)
DR=3.14159265/180.
V(1)=COS(EL*DR)*COS(AZ*DR)
V(2)=COS(EL*DR)*SIN(AZ*DR)
V(3)=SIN(EL*DR)
RETURN
END

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NEWMAGNAV.FORTRAN

12/15/78 1311.4REW 07/24/78 1502.3

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DIMENSION Y(15),B(3),W(3),DW(3),V(3),WV(3),WXB(3)
DOUBLE PRECISION T0
CHARACTER STRING*25
PRINT,"      TSTART(MM/DD/YY HH:MM:SS)?"
READ 101,STRING
101 FORMAT(A25)
CALL CONVERT<DATE<T0<JULIAN<(STRING,T0,IERR)
T1=T0
PRINT,"      WHEEL RATE IN RPM(ENTER WITH + OR - ACCORDING TO SIGN OF DIPOLE)"
READ,RPM
1 PRINT,"      ZRA,ZDEC?(IF NO CHANGE TYPE TWO RETURNS)"
READ,ZRA1,ZDEC1
IF(ZRA1.EQ.0..AND.ZDEC1.EQ.0.) GO TO 4
ZRA=ZRA1
ZDEC=ZDEC1
4 PRINT,"      DURATION OF TORQUE(SECONDS)?"
READ,TT
DT=.1/1440.
T2=T1+TT/86400.
TORQUE=43482.*DT/RPM
Y(1)=0.
Y(2)=0.
CALL VECTOR(ZDEC,ZRA,W)
CALL MVEC(0.,WV,W)
CALL AVEC(W,W,DW)
T=T1-DT
2 T=T+DT
IF(T.GT.T2) GO TO 3
IF(T.LT.Y(1).OR.T.GT.Y(2)) CALL ORBEL(T,Y)
CALL SASORB(Y,T,DEC,RA,RAD,V,FLAT,FLONG,ALT)
TM=1975.24+T/365.25
CALL GEOMAG(TM,FLAT,FLONG,ALT,RA,B,BMAG)
CALL C$CROSS(2,W,B,WXB)
CALL MVEC(TORQUE,WXB,DW)
CALL AVEC(W,DW,W)
GO TO 2
3 CALL ELAZ(W,DEC,RA)
DRA=RA-ZRA
DDEC=DEC-ZDEC
PRINT 100,T1,T,ZRA,ZDEC,RA,DEC,DRA,DDEC
100 FORMAT(" START=",F12.5/" STOP =",F12.5/" ZRA1 =",F7.2/" ZDEC1=",F7.2/" ZRA2 =",F7.2/"
" ZDEC2=",F7.2/" DRA =",F7.2/" DDEC =",F7.2//)
IF(T.GT.T2) GO TO 1
GO TO 2
END

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MAGTORQUE.FORTRAN

05/27/77 1641.8RE 06/23/76 1402.2

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CROSS.FORTRAN

10/18/75 2025.3RE 10/17/75 0539.0

```
C      CROSS RETURNS THE COMPONENTS OF THE CROSS PRODUCT OF TWO
C      GIVEN VECTORS, EITHER UNNORMALIZED(N=1) OR NORMALIZED(N=2)
      SUBROUTINE CROSS(N,U,V,UXV)
      DIMENSION U(3),V(3),UXV(3)
      DO 1 I=1,3
        J=MOD(I,3)+1
        K=MOD(I+1,3)+1
1      UXV(I)=U(J)*V(K)-U(K)*V(J)
      IF(N.EQ.1) RETURN
      S=0.
      DO 2 I=1,3
2      S=S+UXV(I)**2
      S=SQRT(S)
      DO 3 I=1,3
3      UXV(I)=UXV(I)/S
      RETURN
      END
```

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ROTATE.FORTRAN

10/18/75 2025.3RE 09/21/75 2358.7

```
C      ROTATE RETURNS THE COMPONENTS OF A GIVEN VECTOR
C      AFTER A RIGHT HANDED SCREW ROTATION OF THE COORDINATE SYSTEM
C      AROUND THE NTH AXIS BY THE ANGLE A
      SUBROUTINE ROTATE(N,A,V)
      DIMENSION V(3)
      AA=A*3.14159265/180.
      SINA=SIN(AA)
      COSA=COS(AA)
      U1=V(1)
      U2=V(2)
      U3=V(3)
      NN=N
      GO TO (1,2,3),NN
1      V(2)=U2*COSA+U3*SINA
      V(3)=U3*COSA-U2*SINA
      GO TO 4
2      V(3)=U3*COSA+U1*SINA
      V(1)=U1*COSA-U3*SINA
      GO TO 4
3      V(1)=U1*COSA+U2*SINA
      V(2)=U2*COSA-U1*SINA
4      IF(ABS(V(1))-1.0)5,6,6
5      IF(ABS(V(2))-1.0)7,8,8
7      IF(ABS(V(3))-1.0)9,10,10
6      V(1)=SIGN(.9999999,V(1))
      V(2)=0.
      V(3)=0.
      RETURN
8      V(1)=0.
      V(2)=SIGN(.9999999,V(2))
      V(3)=0.
      RETURN
10     V(1)=0.
      V(2)=0.
      V(3)=SIGN(.9999999,V(3))
9      RETURN
      END
```