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THE EDIT-COMGEOM CODE

Gary G. Kuehl

September 1975

USA BALLISTIC RESEARCH LABORATORIES
ABERDEEN PROVING GROUND, MARYLAND

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Target Signature Analysis

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report assumes a familiarity with the GIFT and MAGIC computer codes. The EDIT-COMGEOM code is a FORTRAN computer code. The EDIT-COMGEOM code converts the target description data which was used in the MAGIC computer code to the target description data which can be used in the GIFT computer code. Changes are also made to the target description data to decrease computer run time and computer memory.

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I. INTRODUCTION

1.1 Background

The original EDIT-COMGEOM code was written by Mr. Larry Bain of Army Materiel Systems Analysis Agency: the version of the EDIT-COMGEOM code presented in this report is an improvement of the original code.

This report assumes a familiarity with the MAGIC[1] and the GIFT[2] codes. The EDIT-COMGEOM code converts target description data used as input to the MAGIC code into target description data which can be used as input to the GIFT code.

The air space (01) enclosing the target used by the MAGIC code can be deleted in the GIFT code. The EDIT-COMGEOM code deletes those regions defined as "01" air spaces and when possible the solids associated with those regions are also deleted. The GIFT code has a new solid type called RPP which requires less computer storage and computer run time than either the BOX or the ARB solid. The EDIT-COMGEOM code converts the BOX and the ARB solids which are equivalent to RPP's into RPP solids.

After the above changes are made, a renumbering and reordering of the target description data for the MAGIC code is required before the data can be used as input for the GIFT code. The EDIT-COMGEOM code does the renumbering and reordering.

1.2 Contents of this Report

This report contains three sections and three appendices. The first section discusses the requirements and limitations of the EDIT-COMGEOM code. The second section describes the input requirements for the code. The third section describes the output of the code. Appendix A is a listing (print-out) of the code. Appendix B is a listing of a sample input. Appendix C is a listing of the output from the sample input.

---

[1] NWC Technical Note 4565-3-71; Volumes I & II; "MAGIC Computer Simulation, Volume I, User Manual; Volume II, Analyst Manual," by Armament Systems, Inc., and Propulsion Development Department, May 1971. (Available from Department of the Navy, Naval Weapons Center, China Lake, California 93555).

[2] Lawrence W. Bain & Mathew J. Reisinger, "The GIFT Code User Manual; Volume I Introduction and Input Requirements," BRL Report No. 1802, April 1975.

II. GENERAL DISCUSSION

2.1 Required Tapes

The EDIT-COMGEOM code requires three temporary binary tapes on FORTRAN units 10, 11, and 12. Disc or drum may be substituted for these tapes. The tape on FORTRAN unit 10 contains the region table created by EDIT-COMGEOM Code. The tape on FORTRAN unit 11 contains the MAGIC Solid Table, and the tape on FORTRAN unit 12 contains the original MAGIC Region Table.

An array called "IDENT" is used to store the Region Identification Table. It is dimensioned for 1000 regions. An array called "ISOLID" flags those solids to be kept in the target description data. It is dimensioned for 2500 solids. The Solid Table, Region Table and Region Identification Table will be discussed in more detail in later sections of this report.

2.2 Converting the Code for use by Different Computers

The EDIT-COMGEOM code, listed in Appendix A, runs on either the CDC or Univac computers. The code can be made to run on BRLESC (or IBM) computer by changing the comment cards labeled in card columns 73-80 with "BRLESC" (or "IBM") to executable statements. Cards labeled in columns 73-80 with other computers must be removed or changed to comment cards.

For example, the arrowed lines in the listing of the code in Appendix A are as follows:

```
C 104 CALL SETCWD (4)                                              BRLESC
C     DECODE (80,32,SOL(1)) IREG, (IOP(I),ISOL(I),I=1,9)           BRLESC
```

In order to use the EDIT-COMGEOM code on the BRLESC computer, "C" would be removed. The four lines following the above lines:

```
104 WRITE (10,31) SOL                                              UNIVAC
    REWIND 10                                                       IBM
    READ  (10,40) IREG, (IOP(I),ISOL(I),I=1,9)                      AND
    REWIND 10                                                       CDC
```

would be removed or changed to comment cards.

III. INPUT

3.1 Control Card

The control card is the first data card. It specifies the FORTRAN input and output unit numbers. The format of the card is shown in Figure 1.

3.2 MAGIC Target Description Data

The MAGIC target description data follows the control card. The form of the data is reported in reference 1, "MAGIC Computer Simulation."

The data consists of:

(a) A Title Card.

(b) A Target Input Constraints Card.

(c) A set of solid descriptions called a Solid Table.

(d) A set of regions described in terms of combinations of solids called a Region Table.

(e) A set of alphanumeric descriptions of a region called a Region Identification Table.

3.3 Target Input Constraints Card

The input data for the EDIT-COMGEOM code uses the same input format as stated in technical note "MAGIC Computer Simulation," except for the Target Input Constraints card. The format of the Target Input Constraints card is shown in Figure 2.

3.4 Order of Input

A summary of the order of the data for EDIT-COMGEOM code is shown in Figure 3. A listing of a sample input for the EDIT-COMGEOM code is located in Appendix B.

1-5	6-10	11-15
(BLANK)	IN	IOUT

FORMAT: (5X, 2I5)

Name	Columns	Remarks
IN	6-10	The FORTRAN unit number for the input. (If "IN" equals 0, it is set to 5 by the code.)
IOUT	11-15	The FORTRAN unit number for the output. (If "IOUT" equals zero, it is set to 6 by the code.)

Figure 1. Control Card

1-10	11-20	21-30
NRPP	NSOL	NREGON

FORMAT: (3I10)

Name	Columns	Remarks
NRPP	1-10	The number of rectangular parallelepipeds (RPPs) used to describe the target's environment.
NSOL	11-20	The number of solids other than the above RPPs used to describe the target.
NREGON	21-30	The number of regions used to describe the target.

Figure 2. The Target Input Constraints Card

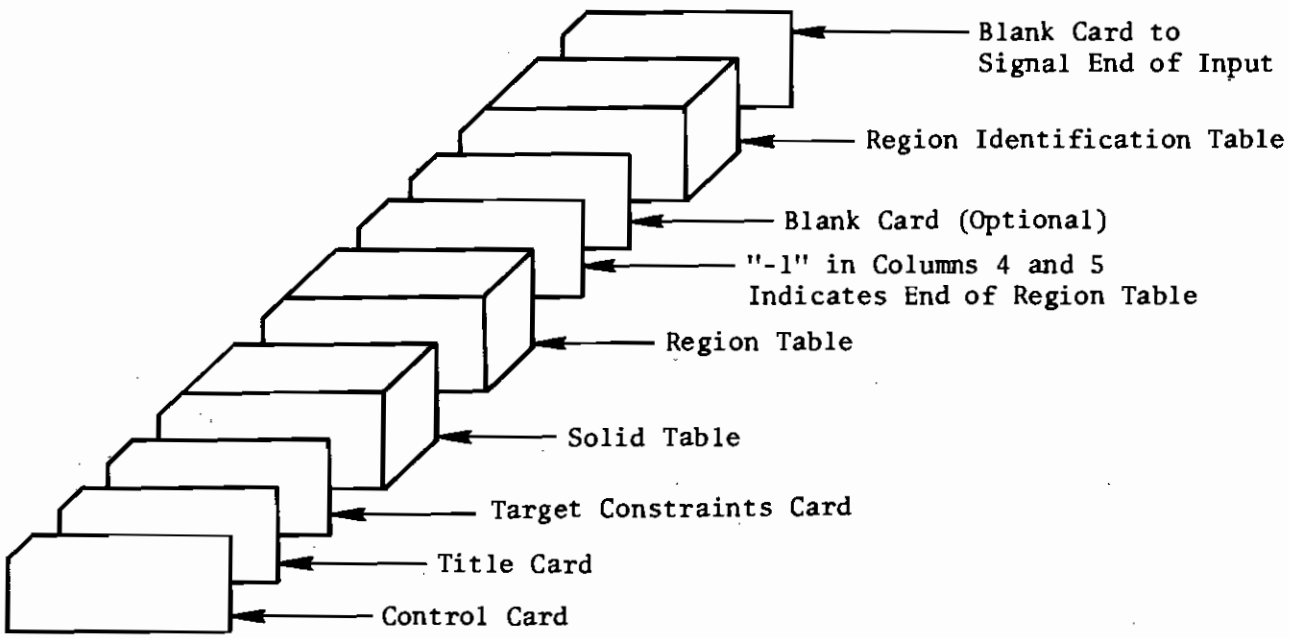

Figure 3. Card Order for Input

IV. OUTPUT

A listing of the output of the EDIT-COMGEOM using the Sample Input of Appendix B is located in Appendix C.

4.1 Solid Table

A sample line of output of the Solid Table is:

```
1RPP      -75.0000   75.0000  -36.0000   36.0000   12.0000   48.0000    2    3
```

The number in columns 1-3 (the number is 1 in the example above) is the new solid number. If the solid number is greater than 1000, only the last three digits are used. The number in columns 70-75 ("2" in the example above) is the solid number used in the MAGIC target description data. The number in columns 76-80 ("3" in the example above) is the card or line count of the GIFT target description data.

Those ARB or BOX solids which have been converted to an RPP have the following message printed:

```
BOX   3 HAS BEEN CONVERTED TO A RPP.
```

4.2 Region Table

A sample line of output of the Region Table is:

```
1 0R    1      -2      -6      -7      -8      -9     -100R     30R     4      2    81
```

The number in columns 1-5 (the number is 1 in the example above) is the new region number. The number in columns 71-75 ("2" in the example above) is the region number used in the MAGIC target description data. The number in columns 76-80 ("81" in the example above) is the card or line count of the GIFT target description data.

The solid numbers in columns 6-69 in the MAGIC target description used to describe a region are replaced with the new solid numbers represented in the new Solid Table of the output.

4.3 Region Identification Table

A sample line of output for the Region Identification Table is:

```
1         100          0          BODY                                    2    96
```

Columns 71-80 are used for labeling as described for the Region Table above. Any alphanumeric region description data located in columns 71-80 of the MAGIC target description data will be deleted.

4.4 Summary Table

The Summary Table contains the number and listing of solids and regions deleted from the MAGIC target description data. In the sample below,1 solid and 1 region were deleted: the solid deleted and region deleted were both numbered "1":

```
NUMBER OF SOLIDS DELETED     1
     1

NUMBER OF REGIONS DELETED    1
     1
```

```
                                                                      NRUTER
C      EDIT-COMGEOM PROGRAM
C
C      PROGRAM DELETES ALL REGIONS IDENTIFIED AS AIR 1
C      AND CHANGES 'MAGIC' BODIES TO 'GIFT' BODIES
C        ARRAYS ARE DIMENSIONED FOR 1000 REGIONS AND 2500 SOLIDS
C
C      INPUT
C        SPECIFY INPUT AND OUTPUT UNITS
C           6-10  IN   - INPUT UNIT - IF 0 DEFAULTS TO CARD READER IN=5
C          10-15  IOUT - OUTPUT UNIT - IF 0 DEFAULTS TO PRINTER IOUT=6
C        TITLE CARD
C        CONTROL CARD
C        SOLID TABLE
C        REGION TABLE FOLLOWED BY -1 CARD
C        IDENT TABLE FOLLOWED BY BLANK CARD
C
C      UNIT IN  - INPUT OLD COM GEOM DESCRIPTION
C      UNIT IOUT- OUTPUT NEW COM GEOM DESCRIPTION (EDITED)
C      UNIT 10  - NEW REGION TABLE   (TEMPORARY - BINARY)
C      UNIT 11  - OLD SOLID TABLE    (TEMPORARY - BINARY)
C      UNIT 12  - OLD REGION TABLE   (TEMPORARY - BINARY)
C
C
       DIMENSION TITLE(18)
       DIMENSION RPP(18), SOL(18), ISOLID(2500)
       DIMENSION IOP(9), ISOL(9)
       DIMENSION KARD(11), IDENT(12,1000)
       EQUIVALENCE (SOL(2),SOLTYP)
       LOGICAL DELETE, PRNT
       DATA BOX,ARB /3HBOX,3HARB /                                    BOX/ARB
       DATA ATE /4H8   /                                              ARB
       DATA ARS /3HARS/
       DATA BLANK / 3H    /
       DATA END / 3HEND /
C
     1 FORMAT(5X,2I5)
     2 FORMAT(1H1,10HUNIT IN = ,I4/
    1        1H ,10HUNIT OUT =,I4//)
    10 FORMAT(17A4,A2,I10)
    15 FORMAT(1H ,17A4,A2,I10)
    20 FORMAT(3I10,40X,I10)
    25 FORMAT(1H ,3I10,40X,I10)
    30 FORMAT(17A4,A2,2I5)
    31 FORMAT(I3,A3,16A4,2I5)
    32 FORMAT(I8,9(A2,I5))                                                BRLESC
    35 FORMAT(1H ,17A4,A2,2I5)
    36 FORMAT(1H ,I3,A3,16A4,2I5)
    40 FORMAT(I5,1X,9(A2,I5),1X,2I5)
    41 FORMAT(5X,1X,9(A2,I5),1X,2I5)
    42 FORMAT(I5,70X,I5)
    43 FORMAT(75X,I5)
    45 FORMAT(1H ,I5,1X,9(A2,I5),1X,2I5)
    46 FORMAT(1H ,5X,1X,9(A2,I5),1X,2I5)
    47 FORMAT(1H ,I5,70X,I5)
    48 FORMAT(1H ,75X,I5)
    50 FORMAT(3I10,10X,7A4,A2,2I5)
    55 FORMAT(1H ,3I10,10X,7A4,A2,2I5)
C
```

```
C          INITIALIZE
C
      READ 1 , IN , IOUT
      IF (IN.EQ.0) IN = 5
      IF (IOUT.EQ.0) IOUT = 6
      WRITE(6,2) IN,IOUT
      NCARD = 0
      INCCRD = 1
C     CALL DISC (10,200) $ CALL DISC (11,200) $ CALL DISC (12,200)          BRLESC
      REWIND 10
      REWIND 11
      REWIND 12
      IF (IN.NE.5) REWIND IN
      IF (IOUT.NE.6) REWIND IOUT
      PRNT=.FALSE.
      IF(IOUT.EQ.6) PRNT=.TRUE.
C     PRNT=.TRUE.                                                           BRLESC
C          CLEAR IDENT STORAGE
      DO 90 I=1,12
      DO 90 L=1,1000
   90 IDENT(I,L)=0
C          CLEAR SOLID TABLE
      DO 91 I=1,2500
   91 ISOLID(I)=0
C
C          READ AND WRITE TITLE CARD
C
      READ (IN,10) TITLE
      NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,15) TITLE, NCARD
      IF(.NOT.PRNT) WRITE(IOUT,10) TITLE, NCARD
C
C          READ CONTROL CARD
C
      READ (IN,20) NRPP, NSOL, NREGON
      NSOLID = NRPP + NSOL
C
C          READ SOLIDS AND STORE ON UNIT 11
C
      IF (NRPP.EQ.0) GOTO 101
      DO 100 I=1,NRPP
      READ (IN,30) RPP
      WRITE (11) RPP
  100 CONTINUE
  101 MSOL=0
  102 READ (IN,31) SOL
      IF (SOLTYP.EQ.BLANK) GOTO 103
      MSOL=MSOL+1
      IF (MSOL.GT.NSOL) GOTO 104
  103 WRITE (11) SOL
      GOTO 102
C 104 CALL SETCWD (4)                                                       BRLESC
C     DECODE (80,32,SOL(1)) IREG, (IOP(I),ISOL(I),I=1,9)                    BRLESC
  104 WRITE (10,31) SOL                                                     UNIVAC
      REWIND 10                                                              IBM
      READ  (10,40) IREG, (IOP(I),ISOL(I),I=1,9)                             AND
      REWIND 10                                                               CDC
      SOLTYP = END
      WRITE (11) SOL
C
```

```
C          READ REGIONS AND STORE ON UNIT 12
C
  110 WRITE (12) IREG,IOP,ISOL
      IF (IREG.LT.0) GOTO 111
      READ (IN,40) IREG, (IOP(I),ISOL(I),I=1,9)
      GOTO 110
C          CHECK FOR REGION RPP
  111 READ (IN,50) KARD
      IF (KARD(1).NE.0) GOTO 121
C
C          READ IDENT TABLE AND STORE IN ARRAY IDENT
C
  120 READ (IN,50) KARD
      IF (KARD(1).EQ.0) GOTO 200
  121 L=KARD(1)
      IDENT(1,L)=0
      IF (KARD(3).EQ.1) GOTO 120
      IF (KARD(2).EQ.999) GOTO 120
      DO 122 I=1,11
      IDENT(I,L) = KARD(I)
  122 CONTINUE
      IDENT(12,L)= KARD(1)
      GOTO 120
C
C          READ OLD REGION TABLE FROM UNIT 12
C          DELETE AIR 1
C          FLAG SOLIDS USED IN REGION DESCRIPTION
C          STORE NEW REGION TABLE ON UNIT 10
C
  200 NEWREG=0
      NREG=0
      REWIND 12
  210 READ (12) IREG,IOP,ISOL
      IF (IREG) 290,220,230
C          SAME REGION
  220 IF (DELETE) GOTO 210
      GOTO 250
C          NEW REGION
  230 NREG=NREG+1
      IF (IDENT(1,NREG).NE.0) GOTO 240
      DELETE = .TRUE.
      GOTO 210
C          KEEP THIS REGION
  240 DELETE = .FALSE.
      NEWREG = NEWREG + 1
      IDENT(1,NREG) = NEWREG
C          FLAG SOLIDS USED
  250 DO 251 I=1,9
      IF (ISOL(I).EQ.0) GOTO 251
      L = IABS (ISOL(I))
      ISOLID(L) = 1
  251 CONTINUE
C          STORE NEW REGION
      WRITE (10) NEWREG,IOP,ISOL,IREG
      GOTO 210
C          END OF REGIONS FLAG
  290 WRITE (10) IREG,IOP,ISOL,IREG
C
C          SET UP SOLIDS
C
```

```
      NEWSOL = 0
      DO 300 I=1,NSOLID
      IF (ISOLID(I).EQ.0) GOTO 300
      NEWSOL = NEWSOL + 1
      ISOLID(I) = NEWSOL
  300 CONTINUE
      NEWRPP = 0
      IF (NRPP.EQ.0) GOTO 310
      DO 301 I=1,NRPP
      IF (ISOLID(I).NE.0) NEWRPP=NEWRPP+1
  301 CONTINUE
C
C         WRITE NEW CONTROL CARD
C
  310 NEWSOL = NEWSOL - NEWRPP
      NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,25) NEWRPP,NEWSOL,NEWREG,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,20) NEWRPP,NEWSOL,NEWREG,NCARD
C
C         WRITE NEW RPP CARDS
C
      REWIND 11
      IF (NRPP.EQ.0) GOTO 330
      DO 320 IRPP=1,NRPP
      READ (11) RPP
      IF (ISOLID(IRPP).EQ.0) GOTO 320
      NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,35) RPP,IRPP,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,30) RPP,IRPP,NCARD
  320 CONTINUE
C
C         WRITE NEW SOLID TABLE
C
  330 NSOL=NRPP
  340 READ (11) SOL
      IF (SOLTYP.EQ.END) GOTO 400
      IF (SOLTYP.NE.BLANK) GOTO 350
C         SAME SOLID
      IF (DELETE) GOTO 340
      GOTO 370
C         NEW SOLID
  350 NSOL = NSOL + 1
      IF (ISOLID(NSOL).NE.0) GOTO 360
      DELETE = .TRUE.
      GOTO 340
C         KEEP THIS SOLID
  360 DELETE = .FALSE.
      NEWSOL = MOD( ISOLID(NSOL) , 1000 )
C         CHANGE 'MAGIC' ARS TO 'GIFT' ARS
      IF(SOLTYP.NE.ARS) GOTO 364
      DO 362 I=4,18
      IF(SOL(I).NE.BLANK) GOTO 370
  362 CONTINUE
      READ(11) SOL
      SOLTYP=ARS
      GOTO 370
C         CHECK BOX OR ARB FOR DEGENERATION TO AN RPP BODY
  364 IF(SOLTYP.NE.BOX) GOTB 365
      CALL CKBOX (SOL,NEWSOL,NCARD,INCCRD,NSOL,IOUT,PRNT)
      GOTO 340
```

```
  365 IF(SOLTYP.NE.ARB) GOTO 370
      IF(SOL(3).NE.ATE.AND.SOL(3).NE.BLANK) GOTO 370
      CALL CKARB (SOL,NEWSOL,NCARD,INCCRD,NSOL,IOUT,PRNT)
      GOTO 340
C         WRITE NEW SOLID
  370 NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,36) NEWSOL,(SOL(I),I=2,18),NSOL,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,31) NEWSOL,(SOL(I),I=2,18),NSOL,NCARD
      GOTO 340
C
C         WRITE NEW REGION TABLE
C
  400 REWIND 10
  410 READ (10) NEWREG,IOP,ISOL,IREG
      IF (NEWREG.LT.0) GOTO 490
      DO 420 I=1,9
      IF (ISOL(I).EQ.0) GOTO 420
      L = IABS (ISOL(I))
      ISOL(I) = ISIGN (ISOLID(L),ISOL(I))
  420 CONTINUE
      NCARD = NCARD + INCCRD
      IF (IREG.EQ.0) GOTO 430
      NREG = IREG
      IF(PRNT) WRITE(IOUT,45) NEWREG,(IOP(I),ISOL(I),I=1,9),NREG,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,40)NEWREG,(IOP(I),ISOL(I),I=1,9),NREG,
     1                            NCARD
      GOTO 410
  430 IF(PRNT) WRITE(IOUT,46)(IOP(I),ISOL(I),I=1,9),NREG,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,46)(IOP(I),ISOL(I),I=1,9),NREG,NCARD
      GOTO 410
C         END OF REGION FLAG
  490 NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,47) NEWREG,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,42) NEWREG,NCARD
C         BLANK CARD FOR REGION RPP
      NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,48) NCARD
      IF(.NOT.PRNT) WRITE(IOUT,43) NCARD
C
C         WRITE NEW IDENT TABLE
C
      DO 500 L=1,NREGON
      IF (IDENT(1,L).EQ.0) GOTO 500
      NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,55) (IDENT(I,L),I=1,12),NCARD
      IF(.NOT.PRNT) WRITE(IOUT,50)(IDENT(I,L),I=1,12),NCARD
  500 CONTINUE
C         END OF TABLE FLAG
      NCARD = NCARD + INCCRD
      IF(PRNT) WRITE(IOUT,48) NCARD
      IF(.NOT.PRNT) WRITE(IOUT,43) NCARD
C
C         LIST SOLIDS DELETED
C
      NSOL = 0
      DO 1000 I=1,NSOLID
      IF (ISOLID(I).NE.0) GOTO 1000
      NSOL = NSOL + 1
      ISOLID(NSOL) = I
 1000 CONTINUE
```

```
      PRINT 1001 , NSOL
      IF (NSOL.NE.0) PRINT 1002 , (ISOLID(I),I=1,NSOL)
C
 1001 FORMAT(1H1,'NUMBER OF SOLIDS DELETED',I5 )
 1002 FORMAT(1H ,10I5)
C
C          LIST REGIONS DELETED
C
      NREG = 0
      DO 2000 I=1,NREGON
      IF (IDENT(1,I).NE.0) GOTO 2000
      NREG = NREG + 1
      ISOLID(NREG) = I
 2000 CONTINUE
      PRINT 2001 , NREG
      PRINT 2002 , (ISOLID(I),I=1,NREG)
C
 2001 FORMAT(1HO,'NUMBER OF REGIONS DELETED', I5 )
 2002 FORMAT(1H ,10I5)
C
      STOP
      END


      SUBROUTINE CKARB(SOL,NEWSOL,NCARD,INCCRD,NSOL,IOUT,PRNT)
C
C     THIS SUBROUTINE CHANGES AN ARB TO A RPP
C
      DOUBLE PRECISION X,Y,Z,A,B,C
      DIMENSION SOL(18),X(8),Y(8),Z(8),R(6),IV(4,6),A(6),B(6),C(6)
      DIMENSION TEMP(10)                                          UNIV/CDC
      LOGICAL PRNT
      DATA ARB /3HARB/
      DATA ATE /4H8   /
      DATA BLANK /4H    /
      DATA RPP /3HRPP/
      DATA IV / 1,2,3,4, 5,6,7,8, 1,5,8,4, 2,3,7,6, 1,2,6,5, 4,3,7,8/
    1 FORMAT(2A3,16A4)
    2 FORMAT(6F10.0)
    3 FORMAT(10X,6F10.0)
    4 FORMAT(1H ,I3,A3,A4,6F10.4,2I5)
    5 FORMAT(1H ,I3,7X,6F10.4,2I5)
    6 FORMAT(5H ARB ,I3,29H HAS BEEN CONVERTED TO A RPP.)
    7 FORMAT(6(1X,4I1))
    8 FORMAT(10X,6(1X,4I1))
    9 FORMAT(15A4)
   10 FORMAT(1H ,I3,7X,6(1X,4I1),30X,2I5)
   11 FORMAT(I3,A3,A4,6F10.4,2I5)
   12 FORMAT(I3,7X,6F10.4,2I5)
   13 FORMAT(I3,7X,6(1X,4I1),30X,2I5)
      TOL=.0001
      HSOL=SOL(3)
C          CONVERT TO FLOATING POINT FORMAT
C     REWIND 12                                                    IBM
      DO 100 I=1,8,2
      ENCODE(60,9,TEMP(1))(SOL(J),J=4,18)                         UNIVAC
      DECODE(60,2,TEMP(1)) X(I),Y(I),Z(I),X(I+1),Y(I+1),Z(I+1)     AND CDC
C     DECODE(60,2,SOL(4)) X(I),Y(I),Z(I),X(I+1),Y(I+1),Z(I+1)     BRLESC
C     WRITE(12,1) SOL                                              IBM
  100 IF(N.NE.4.OR.HSOL.NE.ATE) READ(11) SOL
```

```
C      IF(HSOL.EQ.BLANK) WRITE(12,1) SOL                                IBM
C      REWIND 12                                                        IBM
C      DO 101 I=1,8,2                                                   IBM
C  101 READ(12,3) X(I),Y(I),Z(I),X(I+1),Y(I+1),Z(I+1)                   IBM
C      IF(HSOL.EQ.BLANK) READ(12,8) IV                                  IBM
C      IF(HSOL.EQ.BLANK) DECODE(30,7,SOL(4)) IV                         BRLESC
       IF(HSOL.EQ.ATE) GOTO 110                                         UNIVAC
       ENCODE(32,9,TEMP(1))(SOL(J),J=4,11)
       DECODE(30,7,TEMP(1))IV                                                CDC
C          FIND EQUATION OF FACES, TEST FOR RPP
  110  NZ=0
       DO 120 I=1,6
       CALL EQFACE (AP,BP,CP,X(L),Y(L),Z(L),1,2,3)
       IF(ABS(A(I)).LE.TOL) NZ=NZ+1
       IF(ABS(B(I)).LE.TOL) NZ=NZ+1
  120  IF(ABS(C(I)).LE.TOL) NZ=NZ+1
       IF(NZ.EQ.12) GOTO 200
C          FAILED, REMAINED AN ARB
       NCARD=NCARD+INCCRD
       IF(PRNT)WRITE(IOUT,4)NEWSOL,ARB,HSOL,(X(I),Y(I),Z(I),I=1,2),NSOL,
      1                NCARD
       IF(.NOT.PRNT) WRITE(IOUT,11)NEWSOL,ARB,HSOL,(X(I),Y(I),Z(I),I=1,2)
      1                                ,NSOL,NCARD
       DO 130 I=3,8,2
       NCARD=NCARD+INCCRD
       IF(PRNT)WRITE(IOUT,5)NEWSOL,X(I),Y(I),Z(I),X(I+1),Y(I+1),Z(I+1),
      1                        NSOL,NCARD
       IF(.NOT.PRNT)WRITE(IOUT,12)NEWSOL,X(I),Y(I),Z(I),X(I+1),Y(I+1),
      1                               Z(I+1),NSOL,NCARD
  130  CONTINUE
       IF(HSOL.EQ.ATE) RETURN
       NCARD=NCARD+INCCRD
       IF(PRNT)WRITE(IOUT,10) NEWSOL,IV,NSOL,NCARD
       IF(.NOT.PRNT) WRITE(IOUT,13) NEWSOL,IV,NSOL,NCARD
       RETURN
C          CONVERT TO RPP
  200  DO 210 I=2,8
       IF(X(I).NE.X(1))X(2)=X(I)
       IF(Y(I).NE.Y(1))Y(2)=Y(I)
  210  IF(Z(I).NE.Z(1))Z(2)=Z(I)
       R(1)=AMIN1(X(1),X(2))
       R(2)=AMAX1(X(1),X(2))
       R(3)=AMIN1(Y(1),Y(2))
       R(4)=AMAX1(Y(1),Y(2))
       R(5)=AMIN1(Z(1),Z(2))
       R(6)=AMAX1(Z(1),Z(2))
       NCARD=NCARD+INCCRD
       IF(PRNT)WRITE(IOUT,4) NEWSOL,RPP,BLANK,R,NSOL,NCARD
       IF(.NOT.PRNT) WRITE(IOUT,11) NEWSOL,RPP,BLANK,R,NSOL,NCARD
       WRITE(6,6) NSOL
       RETURN
       END


       SUBROUTINE CKBOX (SOL,NEWSOL,NCARD,INCCRD,NSOL,IOUT,PRNT)
C
C      THIS SUBROUTINE CONVERTS A BOX TO A RPP
C
       DIMENSION SOL(18),B(12),TEMP(10),R(6)
       LOGICAL PRNT
```

```
      DATA BOX /3HBOX/
      DATA RPP /3HRPP/
    1 FORMAT(2A3,16A4)
    2 FORMAT(6F10.0)
    3 FORMAT(10X,6F10.0)
    4 FORMAT(1H ,I3,A3,4X,6F10.4,2I5)
    5 FORMAT(1H ,I3,7X,6F10.4,2I5)
    6 FORMAT(5H BOX ,I3,29H HAS BEEN CONVERTED TO A RPP.)
    7 FORMAT(15A4)
    8 FORMAT(I3,A3,4X,6F10.4,2I5)
    9 FORMAT(I3,7X,6F10.4,2I5)
C          CONVERT TO FLOATING POINT FORMAT
      ENCODE(60,7,TEMP(1))(SOL(I),I=4,18)                              UNIVAC
      DECODE(60,2,TEMP(1))(B(I),I=1,6)                                  AND CDC
C     DECODE(60,2,SOL(4))(B(I),I=1,6)                                  BRLESC
C     REWIND 12                                                        IBM
C     WRITE(12,1) SOL                                                  IBM
      READ(11) SOL
       ENCODE(60,7,TEMP(1))(SOL(I),I=4,18)                             UNIVAC
      DECODE(60,2,TEMP(1))(B(I),I=7,12)                                 AND CDC
C     DECODE(60,2,SOL(4))(B(I),I=7,12)                                 BRLESC
C     WRITE(12,1) SOL                                                  IBM
C     REWIND 12                                                        IBM
C     READ(12,3) B                                                     IBM
C          CHECK FOR RPP
      NZ=0
      DO 100 I=4,12
  100 IF(B(I).EQ.0.0) NZ=NZ+1
      IF(NZ.EQ.6) GOTO 200
C          FAILED, REMAINS A BOX
      NCARD=NCARD+INCCRD
      IF(PRNT) WRITE(IOUT,4) NEWSOL,BOX,(B(I),I=1,6),NSOL,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,8) NEWSOL,BOX,(B(I),I=1,6),NSOL,NCARD
      NCARD=NCARD+INCCRD
      IF(PRNT) WRITE(IOUT,5) NEWSOL,(B(I),I=7,12),NSOL,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,9) NEWSOL,(B(I),I=7,12),NSOL,NCARD
      RETURN
C          CONVERT BOX TO RPP
  200 B(4)=B(1)+B(4)+B(7)+B(10)
      B(5)=B(2)+B(5)+B(8)+B(11)
      B(6)=B(3)+B(6)+B(9)+B(12)
      R(1)=AMIN1(B(1),B(4))
      R(2)=AMAX1(B(1),B(4))
      R(3)=AMIN1(B(2),B(5))
      R(4)=AMAX1(B(2),B(5))
      R(5)=AMIN1(B(3),B(6))
      R(6)=AMAX1(B(3),B(6))
      NCARD=NCARD+INCCRD
      IF(PRNT) WRITE(IOUT,4) NEWSOL,RPP,R,NSOL,NCARD
      IF(.NOT.PRNT) WRITE(IOUT,8) NEWSOL,RPP,R,NSOL,NCARD
      WRITE(6,6) NSOL
      RETURN
      END


      SUBROUTINE EQFACE (X,Y,Z,A,B,C,K,L,M)
C
C     THIS SUBROUTINE CALCULATES A,B,C OF THE EQUATION OF FACE AX+BY+CZ=1.0
C     IT ALSO CALCULATES THE POINT OF INTERSECT OF THREE PLANES
C
```

```
      DOUBLE PRECISION A,B,C,D,X,Y,Z
      DIMENSION X(8),Y(8),Z(8)
      D=X(K)*Y(L)*Z(M)+X(M)*Y(K)*Z(L)+X(L)*Y(M)*Z(K)-X(M)*Y(L)*Z(K)-X(L)
     1*Y(K)*Z(M)-X(K)*Y(M)*Z(L)
      IF(D.EQ.0.0)  D=.00001
      A=(Y(K)*(Z(L)-Z(M))+Y(L)*(Z(M)-Z(K))+Y(M)*(Z(K)-Z(L)))/D
      B=(Z(K)*(X(L)-X(M))+Z(L)*(X(M)-X(K))+Z(M)*(X(K)-X(L)))/D
      C=(X(K)*(Y(L)-Y(M))+X(L)*(Y(M)-Y(K))+X(M)*(Y(K)-Y(L)))/D
      RETURN
      END
```

Appendix B: A Sample Input for Code

```
                                                                                1
 I/O      5    6
SAMPLE INPUT USED IN NWC DOCTUMENTATION
          1         24         12
-10000.       10000.      -10000.       10000.      -10000.       10000.
2  BOX      75.        -36.         12.        -150.        0.          0.          BODY
2           0.          72.         0.           0.         0.          36.
3  BOX      74.        -35.         13.        -148.        0.          0.          (1.0)
3           0.          70.         0.           0.         0.          34.
4  ARB      75.        -36.         12.          75.        36.         12.         FRONT
4           75.         36.         48.          75.       -36.         48.
4           100.        0.          12.         100.        0.          12.
4           100.        0.          12.         100.        0.          12.
4           1234 6435 6128 6237 7415 7415
5  ARB     -75.        -36.         12.         -75.        36.         12.         REAR
5          -75.         36.         48.         -75.       -36.         48.
5          -100.       -24.         12.        -100.        24.         12.
5          -100.        24.         20.        -100.       -24.         20.
5           1234 5678 3487 1265 2376 1485
6  ELL      20.         0.          48.         -20.        0.          48.         BUBBLE
6           50.
7  ELL   7  0.           0.          48.          24.        0.          0.          (1.0)
7           14.
8  RCC      60.        -36.         12.         -0.         8.          0.          WHEEL
8           12.
9  RCC      60.         36.         12.          0.        -8.          0.          WHEEL
9           12.
10 RCC     -60.        -36.         12.          0.         8.          0.          WHEEL
10          12.
11 RCC     -60.         36.         12.          0.        -8.          0.          WHEEL
11          12.
12 BOX     -70.        -20.         15.         40.        0.          0.          ENGINE
12          0.          40.         0.           0.         0.          30.
13 RAW     -70.        -20.         45.          0.         0.         -10.         (ENGINE)
13          0.          10.         0.          40.         0.          0.
14 RAW     -70.         20.         45.          0.         0.         -10.         (ENGINE)
14          0.         -10.         0.          40.         0.          0.
15 ARB     -70.        -10.         45.         -70.        10.         45.         (ENGINE)
15         -70.         0.          35.         -70.        0.          35.
15         -30.        -10.         45.         -30.        10.         45.
15         -30.         0.          35.         -30.        0.          35.
15          3124 7658 1375 2376 1265 1265
16 ARS
16                  4          5
16         -70.        -20.         15.         -70.       -20.         15.                    1
16         -70.        -20.         15.         -70.       -20.         15.                    2
16         -70.        -20.         15.                                                        3
16         -70.        -20.         15.         -70.       -10.         15.                    4
16         -70.        -10.         25.         -70.       -20.         35.                    5
16         -70.        -20.         15.                                                        6
16         -30.        -20.         15.         -30.       -10.         15.                    7
16         -30.        -10.         25.         -30.       -20.         35.                    8
16         -30.        -20.         15.                                                        9
16         -30.        -20.         15.         -30.       -20.         15.                   10
16         -30.        -20.         15.         -30.       -20.         15.                   11
16         -30.        -20.         15.                                                       12
17 ARS
17                  5          4
17         -70.         20.         15.         -70.        20.         15.                    1
17         -30.         20.         15.         -30.        20.         15.                    2
```

17		-70.	20.	15.	-70.	10.	15.		3
17		-30.	10.	15.	-30.	20.	15.		4
17		-70.	20.	15.	-70.	10.	25.		5
17		-30.	10.	25.	-30.	20.	15.		6
17		-70.	20.	15.	-70.	20.	35.		7
17		-30.	20.	35.	-30.	20.	15.		8
17		-70.	20.	15.	-70.	20.	15.		9
17		-30.	20.	15.	-30.	20.	15.		10
18	REC	0.	0.	24.	0.	0.	28.	TRUNK	
18		0.	7.5	0.	5.	0.	0.		
19	SPH	0.	0.	52.	5.			HEAD	
20	TEC	0.	-7.5	49.	20.	0.	-12.	ARM	
20		0.	0.	3.	0.	2.	0.		
20		2.							
21	TEC	0.	7.5	49.	20.	0.	-12.	ARM	
21		0.	0.	3.	0.	2.	0.		
21		2.							
22	TRC	-2.	-4.5	27.	32.	0.	-12.	LEG	
22		3.	2.						
23	TRC	-2.	4.5	27.	32.	0.	-12.	LEG	
23		3.	2.						
24	TOR	21.5	0.	37.	1.	0.	0.	STEERING	
24		8.	1.					WHEEL	
25	ARB	21.5	-6.	33.5	21.5	6.	33.5	CENTER	
25		21.5	0.	44.	40.	0.	37.	STEERING	
25		21.5	-6.	33.5	21.5	6.	33.5	WHEEL	
25		21.5	0.	44.	40.	0.	37.		
25		3127	2146 4328	1345	3127	3127			

1		1	-2	-4	-5	-6	-8	-9	-10	-11
2	OR	2	-3	-7	-8	-9	-10	-11OR	40R	5
3		6	-7	-2						
4		8								
5		9								
6		10								
7		11								
8	OR	3	-18	-19	-20	-21	-22	-23	-24	-25
		-8	-9	-10	-11	-12OR	7	-18	-19	-20
		-21	-24	-250R	130R	140R	150R	160R	17	
9		3	12	-13	-14	-15	-16	-17		
10	OR	180R	190R	200R	210R	220R	23			
11		3	24	-25						
12		3	25							
-1										

1		01	OUTSIDE AIR
2	100		BODY
3	101		BUBBLE
4	151		WHEEL RIGHT FRONT
5	152		WHEEL LEFT FRONT
6	153		WHEEL RIGHT REAR
7	154		WHEEL LEFT REAR
8		02	AIR INSIDE
9	200		ENGINE
10	300		MAN
11	400		STEERING WHEEL
12	401		STEERING SHAFT

<<

Appendix C: Sample Output of Code

```
UNIT IN =    5
UNIT OUT =   6


SAMPLE INPUT USED IN NWC DOCTUMENTATION                                          1
          0         24         11                                              2
  1RPP       -75.0000   75.0000  -36.0000   36.0000   12.0000   48.0000    2   3
BOX   2 HAS BEEN CONVERTED TO A RPP.
  2RPP       -74.0000   74.0000  -35.0000   35.0000   13.0000   47.0000    3   4
BOX   3 HAS BEEN CONVERTED TO A RPP.
  3ARB        75.0000  -36.0000   12.0000   75.0000   36.0000   12.0000    4   5
  3           75.0000   36.0000   48.0000   75.0000  -36.0000   48.0000    4   6
  3          100.0000    0.0000   12.0000  100.0000    0.0000   12.0000    4   7
  3          100.0000    0.0000   12.0000  100.0000    0.0000   12.0000    4   8
  3         1234 6435 6128 6237 7415 7415                                    4   9
  4ARB        -75.0000  -36.0000   12.0000  -75.0000   36.0000   12.0000    5  10
  4           -75.0000   36.0000   48.0000  -75.0000  -36.0000   48.0000    5  11
  4          -100.0000  -24.0000   12.0000 -100.0000   24.0000   12.0000    5  12
  4          -100.0000   24.0000   20.0000 -100.0000  -24.0000   20.0000    5  13
  4         1234 5678 3487 1265 2376 1485                                    5  14
  5ELL       20.        0.        48.       -20.       0.        48.        6  15
  5          50.                                                            6  16
  6ELL   7   0.         0.        48.        24.       0.        0.         7  17
  6          14.                                                            7  18
  7RCC       60.       -36.       12.       -0.        8.        0.         8  19
  7          12.                                                            8  20
  8RCC       60.        36.       12.        0.       -8.        0.         9  21
  8          12.                                                            9  22
  9RCC      -60.       -36.       12.        0.        8.        0.        10  23
  9          12.                                                           10  24
 10RCC      -60.        36.       12.        0.       -8.        0.        11  25
 10          12.                                                           11  26
 11RPP       -70.0000  -30.0000  -20.0000   20.0000   15.0000   45.0000   12  27
BOX  12 HAS BEEN CONVERTED TO A RPP.
 12RAW      -70.       -20.       45.        0.        0.       -10.       13  28
 12           0.        10.        0.       40.        0.        0.        13  29
 13RAW      -70.        20.       45.        0.        0.       -10.       14  30
 13           0.       -10.        0.       40.        0.        0.        14  31
 14ARB       -70.0000  -10.0000   45.0000  -70.0000   10.0000   45.0000   15  32
 14          -70.0000    0.0000   35.0000  -70.0000    0.0000   35.0000   15  33
 14          -30.0000  -10.0000   45.0000  -30.0000   10.0000   45.0000   15  34
 14          -30.0000    0.0000   35.0000  -30.0000    0.0000   35.0000   15  35
 14         3124 7658 1375 2376 1265 1265                                   15  36
 15ARS                4         5                                          16  37
 15         -70.       -20.       15.       -70.       -20.       15.       16  38
 15         -70.       -20.       15.       -70.       -20.       15.       16  39
 15         -70.       -20.       15.                                       16  40
 15         -70.       -20.       15.       -70.       -10.       15.       16  41
 15         -70.       -10.       25.       -70.       -20.       35.       16  42
 15         -70.       -20.       15.                                       16  43
 15         -30.       -20.       15.       -30.       -10.       15.       16  44
 15         -30.       -10.       25.       -30.       -20.       35.       16  45
 15         -30.       -20.       15.                                       16  46
 15         -30.       -20.       15.       -30.       -20.       15.       16  47
 15         -30.       -20.       15.       -30.       -20.       15.       16  48
 15         -30.       -20.       15.                                       16  49
 16ARS                5         4                                          17  50
 16         -70.        20.       15.       -70.        20.       15.       17  51
 16         -30.        20.       15.       -30.        20.       15.       17  52
 16         -70.        20.       15.       -70.        10.       15.       17  53
```

```
16          -30.          10.          15.          -30.          20.          15.          17    54
16          -70.          20.          15.          -70.          10.          25.          17    55
16          -30.          10.          25.          -30.          20.          15.          17    56
16          -70.          20.          15.          -70.          20.          35.          17    57
16          -30.          20.          35.          -30.          20.          15.          17    58
16          -70.          20.          15.          -70.          20.          15.          17    59
16          -30.          20.          15.          -30.          20.          15.          17    60
17REC         0.           0.          24.           0.           0.          28.          18    61
17            0.           7.5          0.           5.           0.           0.          18    62
18SPH         0.           0.          52.           5.                                    19    63
19TEC         0.          -7.5         49.          20.           0.          -12.         20    64
19            0.           0.          3.            0.           2.           0.          20    65
19            2.                                                                          20    66
20TEC         0.           7.5         49.          20.           0.          -12.         21    67
20            0.           0.          3.            0.           2.           0.          21    68
20            2.                                                                          21    69
21TRC        -2.          -4.5         27.          32.           0.          -12.         22    70
21            3.           2.                                                            22    71
22TRC        -2.           4.5         27.          32.           0.          -12.         23    72
22            3.           2.                                                            23    73
23TOR        21.5          0.          37.           1.           0.           0.          24    74
23            8.           1.                                                            24    75
24ARB          21.5000     -6.0000      33.5000      21.5000      6.0000      33.5000      25    76
24             21.5000      0.0000      44.0000      40.0000      0.0000      37.0000      25    77
24             21.5000     -6.0000      33.5000      21.5000      6.0000      33.5000      25    78
24             21.5000      0.0000      44.0000      40.0000      0.0000      37.0000      25    79
24           3127 2146 4328 1345 3127 3127                                               25    80
   1 OR       1     -2      -6      -7      -8      -9     -100R    30R     4            2    81
   2          5     -6      -1       0       0       0       0       0      0            3    82
   3          7      0       0       0       0       0       0       0      0            4    83
   4          8      0       0       0       0       0       0       0      0            5    84
   5          9      0       0       0       0       0       0       0      0            6    85
   6         10      0       0       0       0       0       0       0      0            7    86
   7 OR       2    -17     -18     -19     -20     -21     -22     -23    -24            8    87
             -7     -8      -9     -10    -110R      6     -17     -18    -19            8    88
            -20    -23    -240R    120R    130R    140R    150R     16      0           8    89
   8          2     11     -12     -13     -14     -15     -16       0      0           9    90
   9 OR    170R    180R    190R    200R    210R     22       0       0      0          10    91
  10          2     23     -24       0       0       0       0       0      0          11    92
  11          2     24       0       0       0       0       0       0      0          12    93
  -1                                                                                        94
                                                                                            95
        1         100          0          BODY                                           2    96
        2         101          0          BUBBLE                                         3    97
        3         151          0          WHEEL RIGHT FRONT                              4    98
        4         152          0          WHEEL LEFT FRONT                               5    99
        5         153          0          WHEEL RIGHT REAR                               6   100
        6         154          0          WHEEL LEFT REAR                                7   101
        7           0          2          AIR INSIDE                                     8   102
        8         200          0          ENGINE                                         9   103
        9         300          0          MAN                                           10   104
       10         400          0          STEERING WHEEL                                11   105
       11         401          0          STEERING SHAFT                                12   106
                                                                                           107
```

```
NUMBER OF SOLIDS DELETED     1
     1

NUMBER OF REGIONS DELETED     1
     1
```

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