

AD-762 086

A COMPUTER PROGRAM TO PLOT AN ISOMETRIC
PROJECTION OF A SOLUTION SPACE SURFACE

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Prepared for:

Advanced Research Projects Agency

August 1968

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Advanced Research Projects Agency Department of Defense, ARPA order 829
Program code number 6D30

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Subroutine ISOPLT was developed for the computer produced display of a solution space surface. The solution space, for the sample plots given in Appendix B, is that of various flow functions of a time dependent, viscous, incompressible fluid flow for various boundary configurations. Also shown in Appendix B is the surface plot of

$$\text{SIN} (8 * (X-1) / X_L + 1/4 (Y-1)) + 1.0 \quad (1)$$

Appendix A gives a sample of the calling sequence for equation (1) in the MAIN program, and also a listing of subroutines ISOPLT.

The algorithm used in ISOPLT can be stated as:

1. Draw the right most line first, moving from right to left.
2. Lift the pen (blank the display vector) when a line segment drops below (vertical reference) any previously drawn line segment, when the line segment again moves above the vertical reference line.)

PROGRAM VARIABLES

TA(I,J) - functional value at the point I,J

M - number of columns in TA

N - number of rows in TA

XP - size of plot (in inches) in horizontal direction

YP - size of plot in vertical direction

BND(I,J) - mode point type

BND(I,J) = 0 interior point

= 1 boundary point

= 2 exterior point

A(I,J) - spacing between nodes at (I,J)

$A(I+1,J)$ = distance from $A(I,J)$ to $A(I+1,J)$

$A(I,J+1)$ = distance from $A(I,J)$ to $A(I,J+1)$

.

.

etc.

In the program for which ISOPLT was developed, both $A(I,J)$ and $BND(I,J)$ were calculated from the intersection of a physical boundary description and a mesh grid. In general, however, the arrays $A(I,J)$ and $BND(I,J)$ may be initialized as shown in the sample MAIN program in Appendix A.

APPENDIX A

20

```

@I FOR MAIN
  DIMENSION TA(61,26), BND(61,26), A(61,26)
  INTEGER BND
  COMMON /D1/ CALCMP, TYPE
  DATA CALCMP/'CALCMP'/
  DATA TYPE/'CALCMP'/

  M = 61
  N = 26
  CALL IDPLOT
  CALL PLOT(3 0,6.0,-3)

  DO 1 I=1,M
  DO 1 J=1,N
  X = 8.0*FLOAT(I-1)/FLOAT(M-1)
  TA(1,J) = SIN(X + 0.25*FLOAT(J-1)) + 1.
  A(1,J) = 1.0
1  BND(1,J) = 0

  DO 2 I=1,M
  BND(1,1) = 1
2  BND(1,N) = 1

  DO 3 J=1,N
  BND(1,J) = 1
3  BND(M,J) = 1

  XP = 5.0
  YP = 2.5

  CALL ISOPLT(M,N,XP,YP,TA,BND,A)
  CALL PLOT(9.0,-3.0,-3)
  CALL FINI
  CALL EXIT
  END

```

@1 FOR ISOPLT

```
SUBROUTINE ISOPLT(M,N,XP,YP,TA,BND,A)
DIMENSION BND (61,26), A(61,26)
DIMENSION TA(61,26), U(75), V(75), T(75), S(75), TEM(75)
DIMENSION UA(75), VA(75)
REAL M1, M2
LOGICAL DOWN, FIRST
DIMENSION FL(3000)
COMMON/PL1/ SCALE, FL
COMMON /D1/ CALCMP, TYPE
INTEGER BND, FL, TYPE, CALCMP
```

```
N1 = N + 1
N2 = N + 2
DY = 80*YP/FLOAT(N-1)
DX = DY
X = XP + DX
ANG = 0.86602540
ER = 0.2*ANG*DX
ZSCALE = 0.0
DO 1 J=1,N
DO 1 I=1,M
IF(BND(I,J).EQ.2) GO TO 1
ZSCALE = AMAX1(ZSCALE, ABS(TA(I,J)))
```

1 CONTINUE

```
DO 10 I1=1,M
I = M + 1 - I1
```

```
X = X - DX
Y = -DY
U(1) = ANG*X
V(1) = -.5*X
UA(1) = 0.0
VA(1) = 0.0
JJ = 1
```

```
NN = M - 1
DO 2 J=1,NN
JJ = JJ + 1
UA(JJ) = 0.0
VA(JJ) = 0.0
Y = Y + DY
U(JJ) = ANG*(X + Y)
IF(BND(I,J).EQ.0) GO TO 31
IF(BND(I,J).EQ.1) GO TO 30
V(JJ) = .5*(Y-X)
IF(J.EQ.N) GO TO 2
IF(BND(I,J+1).EQ.2) GO TO 2
UA(JJ) = ANG*DY*(1.-A(I,J+1))
VA(JJ) = .5*DY*(1.-A(I,J+1))
JJ = JJ + 1
U(JJ) = U(JJ-1)
V(JJ) = .5*(Y-X) + TA(I,J+1)/ZSCALE
UA(JJ) = UA(JJ-1)
VA(JJ) = VA(JJ-1)
GO TO 2
```

31 V(JJ) = .5*(Y-X) + TA(I,J+1)/ZSCALE


```

UA(JJ) = ANG*DY*(1.-A(I,J+1))
VA(JJ) = 5*DY*(1.-A(I,J+1))
IF(J EQ.NN) GO TO 22
IF(BND(I,J+1) EQ 0) GO TO 2
IF(J+2 GT.N) GO TO 2
IF(BND(I,J+2) LT.2) GO TO 2
22 JJ = JJ + 1
U(JJ) = U(JJ-1)
V(JJ) = 5*(Y-X)
UA(JJ) = UA(JJ-1)
VA(JJ) = VA(JJ-1)
GO TO 2
30 IF(BND(I,J+1) EQ 2) IA(I,J+1) = 0.0
V(JJ) = 5*(Y-X) + IA(I,J+1)/ZSCALE
UA(JJ) = ANG*DY*(1.-A(I,J+1))
VA(JJ) = 5*DY*(1.-A(I,J+1))
IF(J.LT.NN) GO TO 2
JJ = JJ + 1
U(JJ) = U(JJ-1)
V(JJ) = 5*(Y-X)
2 CONTINUE
DOWN = .TRUE.

IF(II GT.1) GO TO 19
C PLOT FIRST LINE WITHOUT HIDDEN LINE ALGORITHM...
CALL PLOT1(U(1), V(1), 3)
DO 21 J=2,JJ
21 CALL PLOT1(U(J)-UA(J), V(J)-VA(J), 2)
DO 23 K=2,JJ
23 T(K) = -10.0
GO TO 33

19 CALL PLOT1(U(1), V(1), 3)
DO 20 K=2,J
20 CALL PLOT1(U(K)-UA(K), V(K)-VA(K), 2)
S(1) = U(1)
T(1) = V(1)
FIRST = .FALSE.
IF(V(4).LT.T(3)) FIRST = .TRUE.

DO 8 K=4,JJ
DO 43 KK=1,N1
IF(ABS(S(KK)-U(KK)) GT.ER) GO TO 43
IF(V(KK)-T(KK)) 50, 12, 12
50 IF(DOWN) GO TO 14
CALL PLOT1(U(KK), V(KK), 3)
DOWN = .FALSE.
GO TO 8
43 CONTINUE
PRINT 44, K
44 FORMAT(1H0, 30X, 8HHELP... , 2HL=I3)
RETURN

12 FIRST = .FALSE.
13 IF(.NOT. DOWN) GO TO 14
CALL PLOT1(U(KK)-UA(KK), V(KK)-VA(KK), 2)
GO TO 8

14 M1 = (T(KK) - T(KK-1))/(S(KK) - S(KK-1))

```

```

IF(ABS(U(K)-U(K-1)).GT.ER) GO TO 4
SS = U(K)
GO TO 5
4 M2 = (V(K) - V(K-1))/(U(K) - U(K-1))
SE = (M2*U(K-1) - M1*S(KK-1) + T(KK-1) - V(K-1))/(M2 - M1)
5 TT = M1*(SS - S(KK-1)) + T(KK-1)
IF(S(KK-1)-ER.GT.SS .OR. SS.GT.S(KK)+ER) GO TO 16
IF(DOWN) GO TO 27
CALL PLOT1(SS, TT, 3)
CALL PLOT1(U(K)-UA(K), V(K)-VA(K), 2)
DOWN = TRUE.
GO TO 8
27 CALL PLOT1(SS-UA(K), TT, 2)
16 CALL PLOT1(U(K)-UA(K), V(K)-VA(K), 3)
DOWN = FALSE.

8 CONTINUE

33 S(2) = U(1)
DO 40 K=2,N
DO 45 J=K,JJ
IF(U(J) GT.S(K)+ER) GO TO 40
45 CONTINUE
40 S(K+1) = U(J)
C STORE THE MAXIMUM VALUE OF THE V(K) LINE IN ARRAY T(K)
T(1) = V(1)
DO 41 K=2,N1
TEM(K) = -10 0
DO 42 KK=K,JJ
IF(U(KK)-S(K)) 42, 51, 42
51 TEM(K) = AMAX1(V(KK), T(K-1), TEM(K))
42 CONTINUE
41 CONTINUE
DO 11 K=2,N1
11 T(K) = TEM(K)
6 CONTINUE
10 CONTINUE

IF(TYPE.NE.CALCMP) CALL SNDFLE(FL)

RETURN

SUBROUTINE PLOT1(A,B,KK)
DIMENSION FL(3000)
COMMON /D1/ CALCMP, TYPE
COMMON/PLT/ SCALE, FL
COMMON/PLT2/ ISW, IX1, IY1
INTEGER TYPE, CALCMP, FL

IF(TYPE NE.CALCMP) GO TO 1

CALL PLOT(A,B,KK)
GO TO 6

1 IF(KK.LT 0) GO TO 6
IX = 70.0*A + 300.0
IY = 70.0*B = 600.0
GO TO (2,2,3), KK
2 IF(KK.EQ ISW) GO TO 7

```

```
CALL ITYPE(0)
CALL ILINE(FL,IXI,IYI,IA)
CALL ITYPE(3)
ISW = 2
7 CALL ILINE(FL,IX,IY,IA)
GO TO 6
3 ISW = 3
IXI = IX
IYI = IY
6 RETURN
END
```

APPENDIX B





