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AN INSTALLATION INDEPENDENT VERSION OF THE SANDIA SCORS PLOT SYSTEM

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By S. L. Thompson and N. K. Ruiz

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ABSTRACT

A portable version of the Sandia SCORS plot system is described. The set of computer routines is designed to accompany Sandia programs sent outside of the laboratory and can generate output for any type of plotter that might be available.

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I. INTRODUCTION

The analysis of computed data from large-scale scientific computer program often relies heavily on plot programs whose forms are highly dependent on the software available to the developers. Unfortunately, different installations use different software packages. This creates many problems for complex programs which are used at a number of installations. Each new user must start from scratch in plot code development. This invariably involves the original developer.

Most of the larger programs at SLA employ the SCORS plot system. Its output is in the SD4020 language but interpreters are available for a few other plotters. The SLA SCORS system is old but very powerful since a great deal of development effort has been put into the coding over the years. Some of the plot programs which use this SCORS system are quite complex and took years to develop. Unfortunately, the system is available on only the CDC6600/CDC7600 machines at SLA and SLL. The proliferation of new graphic systems at Sandia in recent years, each with a different software package, has added to the difficulty.

A version of the SCORS system has been constructed for CDC host computers (60 bit words) to remove the installation and equipment dependence. The system can be easily transported from one installation to another and can produce output in the standard form for the new installation. The new user must supply a small amount of coding in FORTRAN for his plot system to do the four following functions:

1. Open the plot file;
2. Advance to a new plot frame and set up a plot frame (without drawing anything on the frame);
3. Draw a vector between two points on the frame defined in 2;
4. Close the plot file.

Generally, these functions are very simple and easy for the user since they are coded in his plot system language in FORTRAN. The number of FORTRAN cards required is on the order of ten. Tests have been run on a number of systems.

The plot system can also be used to generate native mode instructions for various graphic equipment but this is a more complex coding job. Only a limited number of instructions are necessary with the same general functions as previously listed.

The SD4020 has CHARACTRON characters which can cause difficulties when the output is directed to another COM unit. These characters are produced by directing the electron beam through a screen in the CRT. When these instructions are converted to other machines, the characters must be generated by vectors. Some resolution is lost. For simple plots where resolution of these characters is not sufficient, a subroutine PLOTPR is available to remove the problem. This subroutine is not described in the SLA 4020 manual* but the input instructions are reproduced here in Appendix A.

The SD4020 at SLA has color capabilities. Except in one special case, the color instructions will be deleted in the instruction string at the level SCORB in the current version. Since new COM units with color capabilities are to be added at SLA, this feature will be updated when the new equipment is available.

* "SC-4020 Usage with IBM 7090/7094, CDC 3600, UNIVAC 1108, CDC 6600," Sandia Laboratories, Albuquerque, New Mexico, SC-M-70-68, March, 1970 (Revised).

II. HOW THE SYSTEM IS EMPLOYED

The new SCORS system can be installation independent because it uses whatever plot system software is available. To illustrate, let us assume that a plot system URSYS exist on a CDC machine using a SCOPE system (i.e. CDC operating system). URSYS would normally be a library file. If URPLOT is a program (with the same permanent file name) which uses the URSYS plot package, then one usage of URPLOT might be as follows.

```
.  
. .  
. .  
ATTACH,URPLOT,URPLOT,...  
ATTACH,URSYS,URSYS,...  
LIBRARY,URSYS.  
URPLOT.  
. .  
. .  
. .
```

The system can be used in either of two ways. It can produce the finished plotter output file in a single execution as part of the program using the SCORS calls or a post-processing method can be used. The latter procedure is normally more efficient. The new SCORS system has five sets of subroutines or "decks" with the following names.

```
SCORS  
SCORPOP  
SCORA  
SCORB  
SCORC
```

The last of these is modified to call the current plot system URSYS. Let us assume a program called SLAPLT which employs the SCORS system. The following grouping would be used to produce the plots in a single execution

For post-processing the two executions would normally be stacked in a single job and would use the grouping

In this example, the data is transferred between the two executions on a disk or tape file. The file name is that file which SCORS would normally employ for its output to the SD4020 and is defined in SLAPLT by a call to ENTFILM or HDCOPY.

Now the above examples are illustrated using SCOPE control statements. All decks are compiled and library files are generated as shown below (using EDITLIB on SCOPE 2.1 CDC7600 class or SCOPE 3.4 CDC6000 class machines). The files are cataloged as permanent files.

UPDATE or deck file	Program file	Library file
SLAPLT	SLAPLT	
SCORS		LSCORS
SCORPOP	SCORPOP	
SCORA		LSCORA
SCORB		LSCORBC
SCORC		LSCORBC

It is assumed that URSYS exist as a library file. The single execution would be

```

ATTACH,SLAPLT,SLAPLT,...
ATTACH,SCORS,LSCORS,...
ATTACH,SCORBC,LSCORBC,...
ATTACH,URSYS,URSYS,...
LIBRARY,SCORS,SCORBC,URSYS.
SLAPLT.
  
```

For post-processing, the output file from SLAPLT is directed to SCORPOP as the first argument on the execute card. The output file of SCORPOP is the second argument as the program is supplied. It might be necessary to modify this for each installation depending on plotter file require-

ments. The default output name is TAPE⁴1. The control statements would be

```
.  
. .  
. .  
ATTACH,SLAPLT,SLAPLT,...  
ATTACH,SCORS,LSCORS,...  
ATTACH,SCORA,LSCORA,...  
LIBRARY,SCORS,SCORA.  
SLAPLT. (assume output file TAPE10)  
UNLOAD,SCORS,SCORA,SLAPLT.  
ATTACH,SCORPOP,SCORPOP,...  
ATTACH,SCORBC,LSCORBC,...  
ATTACH,UR3YS,URSYS,...  
LIBRARY,SCORBC,URSYS.  
SCORPOP,TAPE10,TAPE41. (TAPE41 is plotter file)  
. .  
. .
```

The SCORS package can produce simultaneous output files (up to 99 at one time). When post-processing this would require a separate SCORPOP execution for each file.

III. USER MODIFICATIONS FOR A PARTICULAR PLOT SYSTEM

All functions which the user must define are in deck SCORC. Details of the additions to the four subroutines in this deck follow. Examples for several plot systems are given in appendices.

APPENDIX

PLOT SYSTEM

B.	DISSPLA	
C.	PLOT10	[for Tektronix terminals]
D.	IGS	[for SD4460]
E.	SCORS	[for SD4020]

The deck SCORC is listed in Appendix F.

INITC2

This is the initialization routine to open the plot file. Any initial plot ID frames required at the installation should be added here. The output file used by the SCORS program is defined by either CALL ENTFLM(NM) or CALL HDCOPY(NM) where NM is the tape number (TAPENM). The value of NM is passed to INITC2 so that this file is available for use by the new plot system. If the user's system has a fixed output unit, then the argument can be ignored except for adding the file name to the program card.

PAGEC2

This is the frame (or page) advance command followed by the plot field definition. The plot coordinate limits are 0 to 1023 in both directions. The field of view or "window" should be square. No lines should be drawn at this point.

LINEC2(X1,Y1,X2,Y2)

This is the vector drawing routine. Instructions should be inserted to draw a line from the point (X1,Y1) to the point (X2,Y2) on the frame defined by PAGEC2. All coordinates are in the range of 0. to 1023.0.

EXITC2

This is the post-plotting routine which closes the plot file. Any final ID frames required for the installation should be generated here.

CHARC2

The SD4020 uses a CHARACTRON character to light a point or single raster coordinate. In the current SCORS system this is treated as a short vector of length 1 (out of 1024). It was found that many plotters do not have the capability of lighting a single point or would not draw a zero length vector which one could use to reproduce this feature. After the system is operating and this short vector is found not satisfactory then the coding can easily be changed to use any feature available in the current system which will produce better results. Replace the CALL LINEC2 (X,Y,X + E, Y + E) by the appropriate call to the new system. This should not be attempted until the other features of the system are checked out.

Appendix A

Appendix A

SUBROUTINES PLOTPR, PSETPR, PLIMPR, PLABPR

PLOTPR is a high-level plot subroutine in the SCORS system similar to PLOTXY and AICRT3, but is more flexible than either. All lettering is large so that plots are suitable for publication and reports as produced. The small SCORS typewriter letters are not used for axis labels or numbering. Grid lines are optional. Multiple plot frames on a single 4020 frame are possible.

PLOTPR has three supporting subroutines for optional use. PSETPR allows changes in margins, axis numbering, and grid densities. PLIMPR is available to aid the user in determining plot limits generated by the program. PLABPR can be used to generate additional labels such as figure captions.

PLOTPR usage is as follows

CALL PLOTPR(KX,KY,X,Y,NP,ND,NV,NS,NC,T,A,O,NF,NXO,XMIN,XMAX,NYO,YMIN,YMAX)

KX	if = 0	plot linear in x.
	if = 1	plot log in x.
KY	if = 0	plot linear in y.
	if = 1	plot log in y.
X		array of abscissas.
Y		array of ordinates.
NP		number of points in x and y arrays.
ND		interval at which points are to be displayed.
NV	if = 0	do not join points.
	if = 1	join points with vectors.
NS	if = 0	do not sort points.
	if = 1	sort points.

NC one hollerith character for plot symbol
 e.g., NC=1H*, NC=1H ,NC=1H.
 or
 integer which selects plot symbol
 e.g., 42 = ., 44 = *. See SCORS manual
 p. 7-2, figure 7-1, for complete list.

T Array containing 50 character plot title (5 words).

A Array containing 50 character abscissa label.

O Array containing 50 character ordinate label.

NF if = 0 film not advanced
 new frame not generated
 if = 1 film advanced
 new frame generated
 grid lines omitted
 if = 2 film advanced
 new frame generated
 grid lines shown
 if = -1 film not advanced
 new frame generated
 grid lines omitted
 if = -2 film not advanced
 new frame generated
 grid lines shown

NXO if = 0 x-axis scale will be computed.
 if = 1 user will supply scale.

XMIN minimum x scale.

XMAX maximum x scale.

NYO if = 0 y-axis scale will be computed.
 if = 1 user will supply scale.

YMIN minimum y scale.

YMAX maximum y scale.

PSETPR usage is as follows

CALL PSETPR (NX,NY,ML,MR,MB,MT,MRX,MRY,NSC3)

values in () are used by PLOTTPR if not changed by PSETPR.

NX = abscissa numbering interval (2)

NY = ordinate numbering interval (1)

ML = left margin in rasters (0)

MR = right margin (0)

MB = bottom margin (0)

MT = top margin (0)

MRX = desired distance between x grid lines in rasters (20)
used only if KX=0 and NF=+2 or -2
MRX≥10

MRY = desired distance between y grid lines in rasters (20)
used only if KY=0 and NF=+2 or -2
MRY≥20

NSC3=0 axis scales in powers of 1000. (0)
floating decimal point position
=1 axis scales in powers of 10
fixed decimal point position
(NSC3 is only used for linear plots)

PLIMPR usage is as follows

CALL PLIMPR(XYLIM)

XYLIM is an array of 4 words returned where

XYLIM(1) = XMIN

XYLIM(2) = XMAX

XYLIM(3) = YMIN

XYLIM(4) = YMAX

PLABPR usage is as follows

CALL PLABPR(LAB1,LAB2)

LAB1 array containing 70 character label(top)

LAB2 array containing 70 character label(bottom).

PLABPR call must follow PLOTTPR call.

The labels are written below the plot with LAB1 above LAB2.

PLOTTPR will not alter any of the parameters in the calling sequence except when N3 = 1 which will probably result in reordering of X and Y arrays.

PLOTTPR checks for off scale points when the user has supplied the scales. They will be plotted on the appropriate boundary.

If NXO=0 or NYO=0, the scales selected by the program are not returned in the call argument list since PLOTTPR does not alter the list. They are available to the user through PLIMPR. It should be noted that if NXO=1, or NYO=1, PLOTTPR might extend the limits slightly from the XMIN, XMAX, YMIN, YMAX inputs.

The variable NF=0 is used to plot additional data on the last frame generated. When NF=-1, -2 a new frame is generated but the film is not advanced. This can be used to plot several graphs on a single 4020 frame in conjunction with the margin variables of PSETTPR.

The T, A, and O arrays contain 50 characters for full size plots. If the margins are increased a smaller number of characters will be displayed. The same is true for LAB1 and LAB2 of PLABPR.

Some resolution is lost when small size plots are generated by margin value resets. The limits (ML+MR), (MB+MT) ≥ 683 are built into the program. This will allow a maximum of 9 plots on a single 4020 frame.

Appendix B

APPENDIX B

DISSPLA System Calls

DISSPLA is a plot package produced by Integrated Software Systems Corporation. The form employed here is the version which uses the post-processor DISSPOP. DISSPLA does not have the capability of lighting a single point.

```
*I SCORC.9
      CALL COMPRS
      CALL BGNPL(-1)

*I SCORC.22
      DATA XYZ /1H /
      CALL ENDPL(0)
      CALL PAGE(11.,11.)
      CALL PHYSOR(0.,0.)
      CALL TITLE(XYZ,1,XYZ,0,XYZ,0,11.,11.)
      CALL GRAF(0.,1023.,1023.,0.,1023.,1023.)

*I SCORC.33
      DATA SX /10.752688E-3/
      DATA SY /10.752688E-3/
      CALL STRIPT(SX*X1,SY*Y1)
      CALL CONNPT(SX*X2,SY*Y2)

*I SCORC.42
      CALL ENDPL(0)
      CALL DONEPL
```

Appendix C

APPENDIX C

Tektronix (PLOT10) System calls

PLOT10 is a Tektronix plot package. The single raster plot feature is the last of the following inserts.

```
*I SCORC.9
C   THIS UPDATE SET IS FOR A
C   TEKTRONICS 4014/4015 WITH 1200 BAUD LINE
CALL INITI(120)
CALL TERM(2,1024)
CALL DWINDO(0.,1023.,0.,1023.)
CALL TWINDO(243,1023,0,780)
CALL CZAXIS(1)
*I SCORC.14
    DIMENSION GLOP(160)
*I SCORC.22
C   FINISHED WITH CURRENT PLOT - TELL USER
C   THE USER SHOULD GIVE RETURN WHEN BELL STOPS
DO 22 L=1,5
22 CALL BELL
    CALL TINGTR(160,GLOP)
    CALL ANMODE
    CALL NEWPAG
*I SCORC.23
    CALL MOVEA(X1,Y1)
    CALL DRAWA(X2,Y2)
*I SCORC.42
    CALL PAGEC2
    CALL FINITI(0,0)
*I SCORC.67,69
    CALL POINTA(X,Y)
```

Appendix D

APPENDIX D

IGS System Calls

The IGS plot package produces native mode instructions for the SD-4060/4460. The plot frame is rectangular with 3572 by 4096 rasters. The single raster plot feature is the last of the following inserts.

```
*I SCORC.3
COMMON /IGSBLK/ Z(200)
*I SCORC.4
CALL MODESG(Z,2)
CALL SUBJEC(Z,0.,.,1023.,1023.)
CALL OBJECT(Z,500.,0.,3571.,3571.)
*I SCORC.15
COMMON /IGSPLK/ Z(200)
*I SCORC.22
CALL PAGEG(Z,2,1,1)
C    PLOT FRAME SET UP IS IN INITC2
*I SCORC.3
COMMON /IGSBLK/ Z(200)
DIMENSION X(2),Y(2)
*I SCORC.33
X(1)=X1
X(2)=X2
Y(1)=Y1
Y(2)=Y2
CALL LINEG(Z,2,X,Y)
*I SCORC.39
COMMON /IGSPLK/ Z(200)
*I SCORC.42
CALL EXITG(Z)

*I SCORC.52
COMMON /IGSBLK/ Z(200)
*O SCORC.67,69
CALL LEGNDG(Z,X,Y,1,1H.)
```

Appendix E

Appendix E

SCORS System Calls

This system can only be used in the post-processor form. It is a special case and would be useful in directing output to two plotters at once, for example, a NOS Tektronix terminal and batch hard copy.

This option will properly treat SD4020 color instructions using the CALL ENTFILM(KOUT) option instead of CALL HDCOPY(KOUT).

Much of the data in the input file for the post-processor is already in SD4020 machine language. This can be used to speed the processing by replacing the CALL PLOT2(N(I)) in SCORPOP by CALL PLOTDD(N(I)). The deck SCORB is then not required, i.e. the post-processor is formed from SCORPOP and SCORC only. The rest of the correction set is as follows

```
*I SCORC.9          CALL HDCOPY(KOUT)
*I SCORC.22         CALL FRAMEV(3)
*I SCORC.33         IX1=X1
                   IY1=Y1
                   IX2=X2
                   IY2=Y2
                   CALL LINEV(IX1,IY1,IX2,IY2)
*I SCORC.42         CALL EXTFILM(0)
*D SCORC.48,73
```

APPENDIX F
Listing of DECK SCORC

	SUBROUTINE INITC2 (ITOUT)	SCORC	2
C		SCORC	3
C	CALL YOUR SETUP ROUTINE HERE -- OPEN PLOT FILE	SCORC	4
C	DRAW REQUIRED INITIAL ID FRAMES	SCORC	5
C	OUTPUT FILE IS IABS(ITCUT) = KOUT	SCORC	6
	KOUT=ITOUT	SCORC	7
	IF (KOUT.LT.0) KOUT=-KOUT	SCORC	8
C	CALL YOUR ROUTINES HERE	SCORC	9
C		SCORC	10
	RETURN	SCORC	11
C	COED NOV. 1975 BY NANCY RUIZ, ORG.5165, SANDIA LABORATORIES,	SCORC	12
C	ALBUQUERQUE, NEW MEXICO	SCORC	13
	END	SCORC	14

	SUBROUTINE PAGE02	SC0FC	15
C	PAGE 02	SC0FC	16
C	THEN	SC0FC	17
C	SET UP SQUARE PLOT FRAME FROM 0. TO 1023. PLOT COORDINATES X AND Y	SC0FC	18
C		SC0FC	19
	COMMON /SC0RSFC/ NFR	SC0FC	20
	DATA NFR/0/	SC0FC	21
C	CALL YOUR ROUTINES HERE	SC0FC	22
C		SC0FC	23
C	NFR IS FRAME COUNT	SC0FC	24
	NFR=NFR+1	SC0FC	25
	RETURN	SC0FC	26
C	CODED NOV. 1975 BY NANCY RUIZ, ORG.5166, SANDIA LABORATORIES,	SC0FC	27
C	ALBUQUERQUE, NEW MEXICO	SC0FC	28
	END	SC0FC	29

	SUBROUTINE LINEC2 (X1,Y1,X2,Y2)	SCORC	30
C	DRAW A LINE FROM X1,Y1 TO X2,Y2	SCORC	31
C		SCORC	32
C	CALL YOUR DRAW VECTOR ROUTINE HERE.	SCORC	33
C		SCORC	34
	RETURN	SCORC	35
C	CODED NOV. 1975 BY NANCY RUIZ, ORG.5166, SANDIA LABORATORIES,	SCORC	36
C	ALBUQUERQUE, NEW MEXICO	SCORC	37
	END	SCORC	38

C	SUBROUTINE EXITC2 (DUMMY)	SCCFC	39
C		SCCFC	40
C	CALL YOUR WINDUP ROUTINE HERE -- PLOT FINAL ID FRAMES IF WISHED,	SCCFC	41
C	CLOSE PLOT FILE.	SCCFC	42
C		SCCFC	43
	RETURN	SCCFC	44
C	CODES NOV. 1975 BY NANCY RUIZ, ORG.5166, SANDIA LABORATORIES,	SCCFC	45
C	ALBUQUERQUE, NEW MEXICO	SCCFC	46
	END	SCCFC	47

	SUBROUTINE CHRC2 (X,Y,KHAR)	SCORC	48
C	DISPLAY CHARACTER KHAR AT POINT (X,Y)	SCORC	49
C	CHANGES CHARACTERON CHARACTER TO VECTOR CHARACTER	SCORC	50
C	SEE SANDIA DOCUMENT SC-M-70-68,P.2-9 FOR THE SD4020 CHARACTER SET.	SCORC	51
C		SCORC	52
	EXTERNAL TABL1V	SCORC	53
	DIMENSION EX(4),EY(4)	SCORC	54
	DATA EX,EY,IEXY /0.,1.,0.,-1.,1.,0.,-1.,0.,1/	SCORC	55
C	TEST FOR BLANK	SCORC	56
	IF (KHAR.EQ.48) GO TO 20	SCORC	57
C	TEST FOR CENTERED PERIOD	SCORC	58
	IF (KHAR.EQ.42) GO TO 10	SCORC	59
	IX=X-3.	SCORC	60
	IY=Y-4.	SCORC	61
	CALL VCHRC2 (IX,IY,KHAR,TABL1V)	SCORC	62
	GO TO 20	SCORC	63
10	CONTINUE	SCORC	64
C	CENTERED PERIOD DRAWN WITH SHORT ROTATING VECTOR	SCORC	65
C	REPLACE NEXT 3 CARDS WITH POINT CALL IF YOUR HAVE ONE	SCORC	66
	CALL LINEC2 (X,Y,X+EX(IEXY),Y+EY(IEXY))	SCORC	67
	IEXY=IEXY+1	SCORC	68
	IF (IEXY.GE.5) IEXY=1	SCORC	69
20	X=X+8.	SCORC	70
	RETURN	SCORC	71
C	CODED BY S.THOMPSON DIV 5166 SLA JUNE,1977.	SCORC	72
	END	SCORC	73

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