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COMPUTER PROGRAM DOCUMENTATION

ADDITION OF A DEMAND PLOTTING CAPABILITY TO SINDA

Job Order 52-309

CPD-914

Prepared By

Lockheed Electronics Company, Inc.
Systems and Services Division
Houston, Texas

Contract NAS 9-15800

For

STRUCTURES AND MECHANICS DIVISION

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1. INTRODUCTION

Until recently, SINDA would only support plotting of data within a SINDA execution in the batch mode using the subroutine PLOTX1. However, in the batch mode there were long delays, usually a day or two, between submitting the deck and receiving the plots on microfilm. A demand version of PLOTX1 was desired to provide immediate access to plots during SINDA executions. As graphics terminals became more available, the new routine DISPX1 was designed and written to provide this demand mode capability.

2. DISCUSSION

The Display Integrated Software System and Plotting Language (DISSPLA) was the plotting package used in writing the new subroutine DISPX1. DISSPLA has the capability of plotting in both the batch and demand modes and has software interfaces to several plotting devices. DISPX1 was written to interface with the Tektronix terminal to plot in the demand mode. It has DISPX1, DISPX2, DISPX3, DISPX4, DISPL1, and DISPL2 as entry points. These correspond to the entry points PLOTX1, PLOTX2, PLOTX3, PLOTX4, PLOTL1, and PLOTL2, respectively, of subroutine PLOTX1, the routine which plots the data within a SINDA execution in the batch mode. See reference 1 for information pertaining to PLOTX1. DISPX1 and the SINDA elements needed to use it are discussed below.

2.1 DISPX1

DISPX1, or one of its corresponding entry points, can be used within the SINDA model to plot from one to four linear-linear, linear-log, or log-log plots per frame with any number of curves per plot. Each curve to be plotted requires a separate call to DISPX1 within the SINDA model. If there are two or more plots per frame, the DISSPLA routine ENDGR must be called within the model after the last curve of each plot. The DISSPLA routine ENDPL must be called within the model after the last plot has been completed on each frame. Two options are available using the one integer parameter of ENDPL, IPLOT.

When IPLOT = 0, no summary is written on the plot. When IPLOT < 0, a summary is written. The summary draws time, date, job name and the plot number (IPLOT) in the binding margin of the plot. The DISSPLA routine DONEPL must be called within the model when the plotting is completed. This routine terminates the DISSPLA plotting system. Figure 1 lists a sample problem using the entry point DISPX2, ENDPL, and DONEPL. This problem only has one plot per frame so ENDGR is not needed, but a call to ENDPL is required after each frame. Figure 2 is a sample plot generated by executing the problem in Figure 1.

The SINDA execution is done in a BRKPT file to avoid writing all the intermediate output to the terminal screen and to allow the intermediate output to be saved. However, DISSPLA cannot plot to the terminal from within a BRKPT file, so an ERTRAN call is made in the model to end the BRKPT file. This puts DISPX1 in direct interface with the Tektronix and enables DISPX1 to plot to the terminal. This ERTRAN call can be seen in the model in Figure 1.

```
      BCD 3THERMAL SPCS
      END
      BCD 3NODE DATA
          1,70.,1.0
          2,70.,1.0
          -3,-460.,0.
          -4,70.,0.
      END
      BCD 3SOURCE DATA
          1,7.37,2,7.37
      END
      BCD 3CONDUCTOR DATA
      CAL -1,1,3,1.,1.,1.713E-9,60.
      CAL -2,2,3,1.,0.5,1.713E-9,60.
      END
      BCD 3CONSTANTS DATA
          TIMEND=100.
          OUTPUT=2.5
          1=1
          2=0
      END
      BCD 3ARRAY DATA
          1,SPACE,50,END
          2,SPACE,50,END
          4,0.,5.,10.,15.,20.,25.,30.,35.,40.,45.,50.,55.,60.,65.,70.
          75.,80.,85.,90.,95.,100.,END                                  90:)
          5,70.,101.22,130.99,159.13,185.49,209.95,232.42,252.87
          271.28,287.72,302.26,315.01,326.11,335.71,343.94,350.98
          356.95,362.01,366.27,369.85,372.85,END
          -30
      BCD 9     TIME     MINUTES
          END
          -40
      BCD 9     Q      BTU/MIN
          END
          -50
      BCD 9     TWO NODE MODEL E1=1.0  E2=0.5
          END
      END
      BCD 3EXECUTION
F     DIMENSION X(100)
F     NTH=0
F     NDIM=100
F     TOLD1=70.
F     TOLDA=70.
          CNFRUD
M     K1=K1-1
M     A2=XK1
M     A1=XK1
M     K2=1
M     T1=70.
M     T2=70.
M     J=K1
M     WRITE(6,101)K1,K2
M     WRITE(6,102)(A(1+I),I=1,45)
M     WRITE(6,102)(A(2+I),I=1,45)
F101  FORMAT(6I10)
F102  FORMAT(6F10.4)
F     TIMEO=0.
          CNFRUD
F     CALL ERTRAN(6,'@BRKPT PRINTS')
           DISPX2(1,0.,100.,0.,40.,47,A30,A40,A50,-K1,A1,A2,1)
          ENDPL(0)
          IOWAIT(30)
          DONEPL
      END
      BCD 3VARIABLES 1
M     IF(K2.GT.0)CALL STP2AS(TIMEO,A1,A2,01)
      END
      BCD 3VARIABLES 2
F     DATA TA/0./
M     IF(K2.GT.0)GO TO 10
          D1D1DA(TIMEN,A4,A5,TA)
M     DELT1=T1-TOLD1
M     DELTA=TA-TOLDA
M     T1=TA
M     TOLD1=T1
M     TOLDA=TA
M     I=K1
M     K1=K1+1
M     A(1+I)=TIMEN
M     A(2+I)=C1*(DELTA-DELT1)/(TIMEN-TIMEO)
F10   CONTINUE
      END
      BCD 3OUTPUT CALLS
          TPRNTF
          QFPRNT
      END
      BCD 3END OF DATA
```

Figure 1. - Sample SINDA model using DISPX1 and an ERTRAN ∇BRKPT.

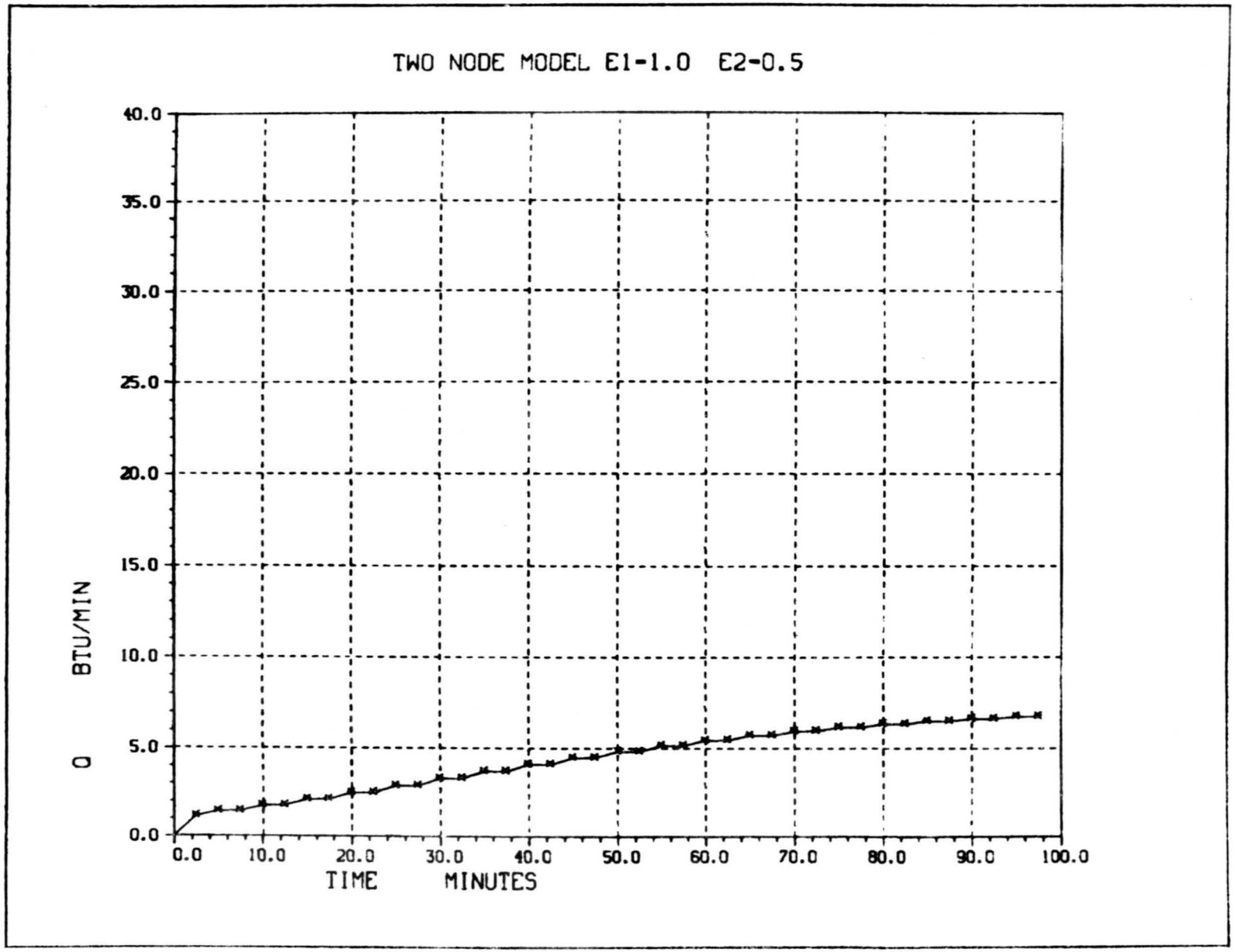

Figure 2. - Sample plot from SINDA model.

2.2 SINDA ELEMENTS

In a normal demand execution without plotting, the ▽ADD element *SINDA.COMPLE is used to effect the processor portion of SINDA. When plotting is desired, the new ▽ADD element *SINDA.DEMAND/PLOT is required. This element is similar to *SINDA.COMPLE, differing only in the map element. In *SINDA.DEMAND/PLOT the map element *SINDA.FMAP of *SINDA.COMPLE is replaced with the map element *SINDA.DPLOT/MAP which is required for collecting the DISSPLA software. Figure 3 lists the elements *SINDA.DEMAND/PLOT, *SINDA.DPLOT/MAP, and a typical runstream using these two elements to allow plotting within the SINDA execution. In this runstream can be seen the initial ▽BRKPT to a print file which the ERTRAN call to ▽BRKPT in the SINDA model, cf. Figure 1, must close so the output can be returned to the terminal and plotting can be started.

DEMAND/PLOT

```
1       @ED  OPSBLKSINDA.,TPFS.SINDA
2       @
3       @ED  OPSBLKEXECTN.,TPFS.EXECTN
4       @
5       @ED  OPSBLKVARBL1.,TPFS.VARBL1
6       @
7       @ED  OPSBLKVARBL2.,TPFS.VARBL2
8       @
9       @ED  OPSBLKOUTCAL.,TPFS.OUTCAL
10      @
11      @FOR,S   SINDA,SINDA
12      @FOR,S   EXECTN,EXECTN
13      @FOR,S   VARBL1,VARBL1
14      @FOR,S  VARBL2,VARBL2
15      @FOR,S   OUTCAL,OUTCAL
16      @PREP
17      @MAP,S    $SINDA.DPLOT/MAP,TPFS.RUN
18      @XQT
```

SINDA RUNSTREAM

```
1       @QUAL ES3
2       @ASG,A $SINDA
3       @DELETE,C PQ.
4       @ASG,CP PQ,F40
5       @BRKPT PRINT$/PQ
6       @ADD $SINDA.K20
7       @ADD $SINDA.JOHNK1/PLOT
8       @ADD $SINDA.DEMAND/PLOT
9       @FREE PQ.
10      @SYM,U PQ.
```

DPLOT/MAP

```
1       LIB $SINDA.
2         IN   SINDA,EXECTN,INPUTT,VARBL1,VARBL2,OUTCAL
3        NOT  $SINDA.NTRAN/PB
4       IN $SINDA.DISPX1
5       CLASS  L$$$$$$$$$$$
6       CLASS  $F$$$$$$$$$$
7       LIB  $SINDA
8       LIB  DISSPLA$LIB
9       LIB ES3-L74338$PLOT
10      END
```

Figure 3. - SINDA elements DEMAND/PLOT, DPLOT/MAP. Sample runstream JOHNK1/XQT.

3. CONCLUSION

DISPX1, the new demand mode routine using the DISSPLA plotting package to plot the data within a SINDA execution, is currently available on the ES3*SINDA file. This document discusses how DISPX1 is used by the SINDA models and illustrates the use of DISPX1 in a sample model. The Appendix contains a user description of the new routine DISPX1 which is suitable for inclusion in the SINDA manual.

4. REFERENCE

1. SINDA User's Manual (No. 14690-H001-R0-00 of April 1971) Document, Revision 2, TRW, 1971, pp. 6.7-8, 6.7-11.

APPENDIX

DESCRIPTION OF DISPX7
FOR
INCLUSION IN THE SINDA MANUAL

PLOT PACKAGE

SUBROUTINE NAMES DISPX1 or DISPX2 or DISPL1 or DISPL2 or DISPX3 or DISPX4

PURPOSE

These routines call upon the Display Integrated Software System and Plotting Language (DISSPLA). They will produce up to four graphs per frame and several variables may be plotted per graph. A suitable grid will be drawn. The grid lines will have reasonable numerical indicia and a centered title will be printed for both axes and at the top of the graph.

DISPX1 and DISPL1 will compute the minimum and maximum values of the stored X and Y arrays to be plotted and call upon DISPX2 or DISPL2 which use the values as grid limits for the graph. The user may set the grid limits by calling DISPX2 and DISPL2 directly. The X, Y, and top titles (XT, YT and TT, respectively) must consist of nine alphanumeric words of six characters each.

DISPX3 and DISPX4 are similar to DISPX1 and DISPX2 but have additional arguments which allow the user to modify the grid as desired.

RESTRICTIONS

The X and Y values must be floating point numbers. The user must call subroutine DONEPL after all his plotting is done, ENDPL after each frame, and ENDGR after each graph if there is more than one graph per frame. No limit may be zero for log plots.

CALLING SEQUENCE

```
DISPX1 (N,IS,TX(DV),TY(DV),TT(DV),NP,AX(DV),AY(DV),LSTEP)
or
DISPX2 (N,XL,XR,YB,YT,IX,TX(DV),TY(DV),TT(DV),NP,AX(DV),AY(DV),LSTEP)
or
DISPL1 (N,IS,TX(DV),TY(DV),TT(DV),NP,AX(DV),AY(DV),LM,LSTEP)
or
DISPL2 (N,XL,XR,YB,YT,IS,TX(DV),TY(DV),TT(DV),NP,AX(DV),AY(DV),LM,LSTEP)
or
DISPX3 (N,IS,TX(DV),TY(DV),TT(DV),NP,AX(DV),AY(DV),DX,DY,LSTEP)
or
DISPX4 (N,XL,XR,YB,YT,IS,TX(DV),TY(DV),TT(DV),NP,AX(DV),AY(DV),DX,DY,LSTEP)
```

Where

N is the integer number of graphs per frame (1,2,3 or 4); if zero, the grid from the previous plot call is used.

IS is the integer identifying the plotting symbol (1-144).

TX is the address of the X title.

TY is the address of the Y title.

TT is the address of the top title.

NP is the integer number of XY values or points to be plotted; if negative the points will be connected by straight lines.

AX is the address of the X array.

AY is the address of the Y array.

XL is the floating point X axis left limit.

XR is the floating point X axis right limit.

YB is the floating point Y axis bottom limit.

YT is the floating point Y axis top limit.

LM is an integer identifying the log plotting mode:
if less than zero plot log X versus linear Y,
if equal to zero plot log X versus log Y,
if greater than zero plot linear X versus log Y.

DX,DY these floating point values are used in spacing the grid lines which are centered on the zero values. If zero, no grid lines will be drawn.

LSTEP is the integer number indicating the frequency of the plotting symbols on the curve (every LSTEP points).