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COMPUTER PROGRAM DOCUMENTATION

D1FLTD TO DRIVE SINDA BOUNDARY NODES

USER'S GUIDE

Job Order 52-309

CPD 921

Prepared By

Lockheed Engineering & Management Services Co., Inc.

Houston Division

Houston, Texas

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For

STRUCTURES AND MECHANICS DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LYNDON B. JOHNSON SPACE CENTER

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16. Abstract

This document provides information about using the subroutine D1FLTD to drive SINDA boundary nodes from word addressable Orbital Data Reduction Center (ODRC) flight data.

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D1FLTD, SINDA boundary nodes, ODRC, word-addressable

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1. INTRODUCTION

The thermal model correlation process will commence when measured thermocouple data is available from the Orbital Flight Tests (OFT) of the Shuttle. For this effort it will be necessary to convert some of the System Improved Numerical Differencing Analyzer (SINDA) diffusion or arithmetic nodes to boundary nodes and then drive these boundary nodes to the temperature profile of a flight measurement. An efficient way to provide this capability within the SINDA and OFT software systems is to provide a new SINDA routine, D1FLTD, for use in VARIABLES 1 of SINDA, to access the processed (word-addressable) Orbital Data Reduction Center (ODRC) flight data and store the appropriate measurement temperature in the desired SINDA temperature location.

2. DISCUSSION

The ODRC flight data that is to be used for driving the boundary nodes must be assigned a logical unit number and must reside on a word-addressable file. Figure 1 shows a typical runstream. The user must also provide two SINDA constants for the word positions of the first and last words of the temperature record for each measurement identifier (MID), i.e. each call to D1FLTD, used in the model. D1FLTD is then called from the VARIABLES 1 block to obtain the SINDA boundary node temperature for any MID on the file at any time point, as shown in the sample model in figure 2.

2.1 D1FLTD

D1FLTD reads the ODRC file to obtain the temperature data for the desired MID and interpolates to obtain the SINDA boundary node temperature at the desired time point. The arguments to D1FLTD are: IN, the logical unit number of the ODRC file; TIME, the time point at which the boundary node temperature is to be interpolated; SCALE and FACTOR, which when used in the equation t = (TIME + SCALE) *FACTOR relates SINDA time to ODRC time; M, the MID for which the boundary node temperature is desired; KX and KY, the unique constants which will contain pointer to the first and last words, respectively, of the temperature data

```
@RUN,R/R 170SDX,E/3206,ES3-L77777,30,500
@QUAL ES3
@ASG,A UAFILE1.          . ASSIGN ODRC FILE
@ASG,A UAFILE2.          . ASSIGN ODRC FILE
@USE 8,UAFILE1
@USE 3,UAFILE2
@ADD %SINDA.ASSIGN       . SINDA PREPROCESSOR

@ADD FILE  .MODEL        . ADD THE SINDA MODEL
@ADD %SINDA.SINDA/PROC   . SINDA PROCESSOR
@FIN
```

FIGURE 1. - TYPICAL RUNSTREAM TO USE D1FLTD.

```
BCD 3THERMAL LPCS
BCD 9  TERMINAL SINDA CHECKOUT
END
BCD 3NODE DATA
SIM 1,14,1,70.,A2,0.25
GEN 101,2,1,70.,-1.0
     -103,70.,0.
     -104,70.,0..
END
BCD 3SOURCE DATA
     104,7200.
END
BCD 3CONDUCTOR DATA
SIM   1,6,1,1,1,2,1,A1,2.0
SIM   8,6,1,8,1,9,1,A1,2.0
SIM   15,2,1,1,7, 103,1, A1,4.
SIM  17,2,1,7,7,101,1,A1,4.
SIM   41,7,1,1,1,8,1,A1,3.40E-03
END
BCD 3CONSTANTS DATA
     NLOOP,500
     DAMPD,.5
     DAMPA,.2
     DRLXCA,0.01
     ARLXCA,0.01
     SIGMA,.171E-08
     1,0
     103,0
     2,0
     104,0
END
BCD 3ARRAY DATA
    1  $REFRASIL K
     400.,0.36,600.,0.50,  800.,0.68,  1000.,0.89,  1200.,1.18,END
     2  $REFRASIL CP
     400.,0.205,  1000.,0.23,  1600.,0.252,  3000.,0.280,END
END
BCD 3EXECUTION
F    DIMENSION X(2000)
F    NDIM=2000
F    NTH=0
F      TIMEO=0.
F     TIMEND=1.4
F     OUTPUT=.1
        SNFRDL
END
BCD 3VARIABLES 1
    D1FLTD(8,TIMEO,1.,0.,12HV58T0301A   ,K1,K103,T103)
    D1FLTD(3,TIMEO,1.,0.,12HV58T0101A   ,K2,K104,T104)
END
BCD 3VARIABLES 2
END
BCD 3OUTPUT CALLS
    TPRNTF
END
BCD 3END OF DATA
```

FIGURE 2. - SAMPLE MODEL USING D1FLTD.

for the MID; and Tn, the SINDA temperature location of the node that is being driven. In the term Tn, n is the node number of the boundary node being driven. The following is an example of a D1FLTD call in a SINDA model:

D1FLTD (IN, TIME, SCALE, FACTOR, M, KX, KY, Tn)

When an MID is accessed for the first time, KX and KY should both be zero. Then D1FLTD will read the dictionary of MIDs from the ODRC file, calculate the values for KX and KY, and return these new KX and KY values for use in any subsequent calls to D1FLTD for that particular MID.

D1FLTD adds the values of SCALE and TIME and multiplies the result by FACTOR to calculate the ODRC time TM. SCALE and TIME must both be in the time units of the SINDA problem (TIME being derived from one of the SINDA time constants TIMEO, TIMEM, or TIMEN). FACTOR provides the means to convert from SINDA units to ODRC units, and thus will be one of the values from table I.

Table I. FACTORS to CONVERT SINDA times to ODRC times

SINDA Units	ODRC Units	FACTOR
hours	hours	1.
	minutes	60.
	seconds	3600.
minutes	hours	0.0166667
	minutes	1.
	seconds	60.
seconds	hours	2.778×10^{-4}
	minutes	0.0166667
	seconds	1.

The ODRC time array is then searched to find TM or the time closest to it. If TM is in the time array, D1FLTD sets Tn to the temperature corresponsing to that time in the MID data record. Otherwise,Tn is interpolated using the times on either side of TM and the temperatures corresponding to those times. Tn is then returned to the model.

3.0 CONCLUSION

D1FLTD, the new subroutine which allows the capability to drive SINDA boundary nodes from word-addressable ODRC flight data, is currently available on the ES3*SINDA file. This document discusses how D1FLTD is used by the SINDA models and illustrates the use of D1FLTD in a sample model.