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I INTRODUCTION

The purpose of this report is to describe the analytical techniques employed in developing FLIGHT-2, a data reduction and analysis program involving transient data from the SNAP 10A orbital flight vehicle. These techniques are programmed into the computer code described in Section III. A structural flow diagram of the data evaluated at Atomics International is given in Figure 1.

This transient data system is similar to that of the steady state system described in NAA-SR-TDR-10614 (Ref. 1), and the data tape format described in Section II-A is exactly the same. Both the steady state and transient computer codes have been completely checked out with live data received from the SNAP 10A orbital flight vehicle.

FIGURE 1

SNAP 10A FLIGHT DATA HANDLING

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II DESCRIPTION

The function of FLIGHT-2 is to convert the data received on tape from Lockheed Missiles and Space Company (LMSC) to a usable form, to analyze the data, and to describe the results in a meaningful and understandable way.

FLIGHT-2 is designed to receive any number of files of data. Each file usually consists of less than 20,000 points (20,000 time values and 20,000 corresponding data values). If more than 20,000 points are received, every tenth point is used in the analysis. Each file of data corresponds to a given instrument and multiplexer number. The type of output resulting for an instrument is dependent upon the input parameters (options) read in on data cards. Thirteen types of parameters are available. Variable types of printing, plotting, smoothing, normalizing, and other types of analyzing are included in these available options. A more detailed description of this is given in Section III.

III FLIGHT-2 PROGRAM DESCRIPTION

This section of the report describes the FLIGHT-2 code in detail. Included are descriptions of the input experimental data tape and the calculations performed by the code. The running and output options available are described in Section IV.

FLIGHT-2 is written in FORTRAN II and uses the NAA FIB III monitor. The program makes extensive use of the NAA COMFORT (Ref. 2) and SC-4020 (Ref. 3) subroutines.

A. Description of Input Data Tapes

The input data is on a 556 bits/in. floating binary tape. It consists of several files of data at the end of which will be three consecutive end of files, indicating the end of the data. The first record of each file will be an indicative record of three words. Each succeeding record of a file will be a data record.

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The indicative record format will be:

Figure 2

Each file will pertain to only one channel (A.I. instrument number). Any number of files may be on the tape, usually consisting of less than 20,000 data points each (20,000 time values and 20,000 corresponding data values).

Each data record will have up to 234 words alternating time and data values. The data record format will be:

Figure 3

Each word will be 36 bits in standard IBM 7094 floating point form. The tape format is shown in Figure 4.

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FIGURE 4

RAW DATA INPUT TAPE FORMAT

The FLIGHT-2 computer program is also designed to handle batched data if necessary, where several sets of data are put on one tape. A single set of data is described in Figure 4. Batched data usually has three end of files after each set and must have three end of files at the end of the data. If three end of files do not exist at the end of each set of data, the program will recognize a new set of data by a change in the orbit number as described in Figure 2.

B. Structural Flow of FLIGHT-2

A structural flow chart of the calling sequence of individual subroutines in relation to the main program is given in Figure 5, along with a brief explanation of each.

C. Description of Calculations Performed

The control parameters read in on data cards determine the type of calculations performed. The amount of printing done, the type of SC-4020 plotting done, and the statistical calculations executed are all functions of the control parameters. This is explained more thoroughly in Appendix A.

1. Input Data Manipulation

The first thing read in from the raw data tape is a three word indicative record followed by several data records (see Figures 2 and 4). Each file of data corresponds to a given instrument and is completely processed before another file is read. If more than 2000 raw data points are read in, only every tenth point is used in the processing. The data is then printed, plotted, normalized, smoothed, etc., depending on the control parameters. After all the data has been processed, a listing of the standard deviations and their corresponding instrument numbers is printed.

2. Variable Raw Data Printing and Plotting

The raw data printout and plotting are functions of the control parameters read in on data cards. If errors are encountered in the program or in the data, a large amount of output will be desired so that a thorough investigation can be made. Under normal conditions, however, this output will not be necessary, so a different output option is used. Examples of the available options are given in the Appendices.

Figure 5

DIAGRAM OF THE SUBROUTINE CALL SEQUENCE

3. Conversion of the Indicative Data

The indicative data format shown in Figure 2 consists of a three word record at the beginning of each file of data. The three words are made up of BCD characters on a binary tape. Each word consists of several identification symbols which are used and tested in the main program. These seven symbols are transformed into separate right adjusted words to make them more accessible. This is done in the subroutine CONV as shown in Figure 5. This subroutine also tests to see if the instrument I.D. is "AI." If it is not "AI," the method of processing the data is slightly different.

4. Elimination of Wild Points

Each data point is tested individually to see if it is "Wild," and if so, is corrected by the following method. Let Y_i be a given data point.

- (a) A quadratic is first fitted through points:

$$Y_{i-3}, Y_{i-2}, Y_{i-1}, Y_{i+1}, Y_{i+2}, Y_{i+3}$$

- (b) The corresponding residuals, for each point, are computed such that

$$r_i = Y_i - \frac{1}{14} (-2Y_{i-3} + 3Y_{i-2} + 6Y_{i-1} + 6Y_{i+1} + 3Y_{i+2} - 2Y_{i+3})$$

- (c) An estimate of the variance, σ^2 , is given by $\frac{1}{N-1}$ times the sum of the squares of the residuals.

$$\sigma^2 \approx \frac{1}{N-1} \sum_{i=1}^N r_i^2$$

- (d) A point is considered "wild" if

$$r_i^2 \geq K\sigma^2 \quad \text{and is replaced by}$$

$$Y_{i(\text{new})} = \frac{1}{14} (-2Y_{i-3} + 3Y_{i-2} + 6Y_{i-1} + 6Y_{i+1} + 3Y_{i+2} - 2Y_{i+3})$$

where K is an arbitrary choice affecting the number of points corrected.

5. Normalization of the Data

The data is received in units of volts or millivolts and is normalized into such units as degrees, ohms, inches, gallons per minute, etc. Each instrument number has a specific normalization equation that converts it to the proper units. Two sets of these normalization equations are used, depending on whether the data is from the pre-start-up or start-up phase. Identification titles and unit titles, e.g., Control Drum Position (Inches), corresponding to each instrument are read in on data cards and can therefore be used when plotting and printing the data.

6. Smoothing the Data

This particular smoothing technique is good because of the continuous smooth curve that results. It will smooth any number of points and can handle values unequally incremented along the abscissa. It has been tested with various shapes of curves and several degrees of noise and data scatter and worked well on all cases. See Appendix C.

The smoothing technique used here insures continuity of the resulting values and their first derivatives. It consists of a least squares fit to a quadratic equation over defined ranges, with the restriction that the values and their first derivatives match at the range boundaries. No difficulty would be encountered in extending the fit to higher order expressions and in demanding continuity in higher order derivatives if desired.

Consider a set of N data points which have been subdivided into subsets of "I" points as shown in Figure 6. The use of equal subsets is arbitrary and could be set up as a function of the shape of the curve being smoothed. At present the code smoothes one point at a time, I is equal to 1, and works very well on data previously tested.

Figure 6

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The fitting and smoothing procedure follows:

(1) Fit a quadratic, using a "least squares" technique to the points in the range $1 \rightarrow K$. That is fit to the expression

$$f_i(x_i) = \alpha_i + \beta_i x_i + \gamma_i x_i^2$$

where K is an arbitrary choice of the number of desired points used in each fit. Define the error as

$$Q_i = \sum_{i \in K} (y_i - \alpha_i - \beta_i x_i - \gamma_i x_i^2)^2$$

Minimize the error with respect to each of the coefficients,

$$\frac{\partial Q_i}{\partial \alpha_i} = 0 = -2 \sum (y_i - \alpha_i - \beta_i x_i - \gamma_i x_i^2)$$

$$\frac{\partial Q_i}{\partial \beta_i} = 0 = -2 \sum (x_i)(y_i - \alpha_i - \beta_i x_i - \gamma_i x_i^2)$$

$$\frac{\partial Q_i}{\partial \gamma_i} = 0 = -2 \sum (x_i)^2 (y_i - \alpha_i - \beta_i x_i - \gamma_i x_i^2)$$

yielding the following three equations:

$$\alpha_i K + \beta_i \sum x_i + \gamma_i \sum (x_i^2) = \sum y_i$$

$$\alpha_i \sum x_i + \beta_i \sum (x_i^2) + \gamma_i \sum (x_i^3) = \sum x_i y_i$$

$$\alpha_i \sum (x_i^2) + \beta_i \sum (x_i^3) + \gamma_i \sum (x_i^4) = \sum x_i^2 y_i$$

where the summations are all over the range $i = 1$ to K , and which may be easily solved for α_i , β_i , and γ_i , using matrix methods of solution.

The final expression

$$f_1(x) = \alpha_1 + \beta_1 x + \gamma_1 x^2$$

is now used to obtain a smooth function over only the first range of I points. That is,

$$0 < x \leq x_I$$

Since we are using I equal to 1, only one point will be smoothed using this expression.

(2) A second expression is fit over the range of points contained within x_I to x_{K+I} , such that

$$x_I < x < x_{K+I}$$

An expression of the form

$$f_2(\eta) = \alpha_2 + \beta_2 \eta + \gamma_2 \eta^2$$

where the variable η is related to x by

$$\eta = x - x_I$$

The requirement that the values and the first derivatives must be equal at the joining point $x = x_I$, i.e., $\eta = 0$, is introduced by noting

$$f_2(0) = \alpha_2 = f_1(x_I) \equiv A_1$$

$$f_2'(0) = \beta_2 = f_1'(x_I) \equiv B_1$$

for $y_i = A_1 + B_1 x_i + \gamma_2 x_i^2$, where $I < i < K+I$.

Therefore only γ_2 has yet to be determined. This saves a great amount of computer calculating.

The fitting process over this range involves minimizing the error in finding δ_2 .

$$Q_2 = \sum_{i=I}^{K+I} (y_i - A_1 - B_1 x_i - \delta_2 x_i^2)^2$$

$$\frac{\partial Q_2}{\partial \delta_2} = 0 = -2 \sum_{i=I}^{K+I} x_i^2 (y_i - A_1 - B_1 x_i - \delta_2 x_i^2)$$

which leads to

$$\delta_2 \sum_{i=I}^{K+I} x_i^4 = \sum_{i=I}^{K+I} (x_i^2 y_i - A_1 x_i^2 - B_1 x_i^3)$$

and the value of δ_2 . The resulting expression

$$f_2(x - x_I) = \alpha_2 + \beta_2(x - x_I) + \delta_2(x - x_I)^2$$

is now applied to the range

$$x_I < x \leq x_{2I}$$

(3) The next fit is over the range

$$x_{2I} < x \leq x_{K+2I}$$

to a function $f_3(\mu) = \alpha_3 + \beta_3 \mu + \delta_3 \mu^2$

where $\mu = x - x_{2I}$ and α_3 and β_3 may be immediately equated to the value and its derivative, respectively, evaluated at $x = x_{2I}$. Minimization of error with respect to δ_3 yields the value δ_3 . This expression is only applicable to the range

$$x_{2I} < x \leq x_{3I}$$

(4) The process continues to N data points. The number of points used in each fitting, K, is an option read in on data cards. See Appendix A. It generally ranges between five and fifty points and is dependent on the type of data being smoothed. Data with large scatter and few abrupt changes in the average magnitude should be smoothed with large values of K. Transient data having very abrupt changes in magnitude with little scatter should be smoothed with small values of K. It is sometimes necessary to try different values of K to obtain the optimum smoothing.

7. Standard Deviation Calculation

The standard deviation for a transient curve is calculated as follows: Let

P_i = Raw Data Value
 S_i = Smoothed Data Value
 $r_i = P_i - S_i$ = Residual
 σ = Standard Deviation
 N = Number of Data Points

$$\sigma^2 = \frac{\sum_{i=1}^N r_i^2}{N-1}$$

A listing of all instruments and their corresponding standard deviation values is printed in the output. An example is given in Appendix C.

8. Superimposed Plotting of Smoothed and Normalized Raw Data

The smoothed data and raw data are plotted on the same graph for three reasons:

- (a) To get an idea of the amount of data scatter, including maximum and minimum values.
- (b) To compare the smoothed curve with the raw data points.
- (c) To check the smoothing and standard deviation calculations.

An example of this is given in Appendix C, with the values plotted in normalized units.

9. Optional Plotting of the First Derivatives

A plot of the first derivatives of the smoothed data shows the rate of rise for a given instrument as a function of time. A more detailed discussion and a sample plot of this is given in the appendices.

10. Optional Printing of Smoothed Data and the First Derivatives

The amount and type of printing done is a function of the control parameters and can therefore be different for each run. An option to get complete printing of all points is included in the program so that exact values for individual points can be examined if desired. Usually the SC-4020 plots give accurate enough values, and therefore, little printing is necessary. If, however, errors result or it is desired to examine the results more accurately, the print option is available. Examples are given in the appendices.

IV

APPENDICESA. Description of Available Running Options

FLIGHT-2 has thirteen available running options. These options control the amount and type of printing, plotting, and calculating to be done. Examples of these options are given in Appendix B.

- ITRAN = Option indicating whether or not specific cases are to be run.
= 1 = Run only cases specified.
= 2 = Run all cases.
- NCAS = Number of cases to be run.
= 2 = Run only two cases.
- NIN(I) = The specified cases to be run.
= NIN(1) = 5 = Run case five.
= NIN(2) = 9 = Run case nine.
- ITAPE = Raw data input tape drive.
= 9 = Tape is mounted on A6.
- LPRT = Specifies the amount of raw data printing desired.
= 1 = No printing of raw data.
= 2 = Print every tenth point.
= 3 = Print all raw data.
- LSMØ = Specifies the amount of smoothed and normalized printing.
= 1 = No printing of smoothed data.
= 2 = Print all smoothed data.
- LDRV = Specifies the amount of printing of the derivatives of the smoothed normalized data.
= 1 = No printing of derivatives.
= 2 = Print derivative values.

IWIL = Indicates whether or not wild points should
be printed.
= 1 = No printing of wild points.
= 2 = Print wild points.

LCRT = Controls the amount of raw data plotting.
= 1 = No plotting of raw data.
= 2 = Plot raw data as a function of time.

LPLS = Controls the amount of smoothed normalized
data plotting.
= 1 = No plotting of smoothed values.
= 2 = Plot smoothed normalized values.

LPLD = Controls the amount of plotting of the derivatives
of the smoothed data.
= 1 = No plotting of derivatives.
= 2 = Plot the derivative values.

INC1 = Number of points used in calculating the smoothing
coefficient for instruments 89, 90, 91, 113, 116,
117, 118, 119, 154.
= 8 = Use eight points.

INC2 = Smooth coefficient for instruments not mentioned above.
= 25 = Use twenty-five points.

SCAL = Controls the number of wild points corrected.
= 1.0 = Normal number of points corrected.
= 1.1 = More than normal are corrected.
= 0.9 = Less than normal are corrected.

Appendix A

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FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. Data PROGRAMMER E. Hammond DATE 6/10/65 PAGE 1 of 2 JOB NO. 7944-01

NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	1	ITRAN ~ Run only cases specified.
13		
25		
37		
49	73 80	
61	1	
1	2 1	NCAS ~ No. of cases to be run = 2
13	7	NIN(1) = 1, NIN(2) = 7
25		Run cases 1 and 7
37		
49	73 80	
61	2	
1	11	ITAPE ~ Raw Data Tape is mounted
13		on unit 11 = B6
25		
37		
49	73 80	
61	3	
1	3	LPRT ~ Print all raw data
13	2	LSMφ ~ Print the smoothed data
25	1	LDRV ~ Do not print the derivatives
37	2	IWIL ~ Print the wild points
49	2 73 80	LCRT ~ Plot the raw data
61	1	4 LPLS ~ Do not plot the smoothed data

FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. Data PROGRAMMER E. Hammond DATE 6/10/65 PAGE 2 of 2 JOB NO. 7944-01

NUMBER	IDENTIFICATION	DESCRIPTION DO NOT KEY PUNCH
1	2	LPLD ~ Plot the derivatives
13	8	INCL ~ Points used in smoothing spec. instrs.
25	25	INC2 ~ Points used in smoothing other instrs.
37	1 +01	SCAL ~ Normal No. of wild points will
49	73 80	be corrected.
61	5	
1	12	ITAPE ~ 12 = B7
13		
25		
37		
49	73 80	
61	6	
1	1	LPRT ~ No Raw Data Print
13	1	LSMφ ~ No Smoothed Data Print
25	2	LDRV ~ Print the derivatives
37	1	IWIL ~ No Wild Point Printing
49	1 73 80	LCRT ~ No Raw Data Plot
61	2 7	LPLS ~ Plot the Smoothed Data
1	1	LPLD ~ No Plot of Derivatives
13	8	INCL ~ Points used in smoothing spec. instrs.
25	25	INC2 ~ Points used in smoothing other instrs.
37	1 +01	SCAL ~ Normal No. of wild points will
49	73 80	be corrected.
61	8	

INPUT DATA FILE 40
(Raw Data)

INDICATIVE RECORD 70C105 A17 0 CC50C1

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POINT	TIME	DATA	TIME	DATA	TIME	DATA	TIME	DATA
1	0.9147E C1	C.1660E 01	0.1321E 02	C.1272E 01	0.1726E C2	C.1885E-CC	0.2132E 02	0.1040E 01
5	0.2538E C2	C.1893E C1	0.2944E 02	C.1040E 01	0.3350E C2	-C.2754E-00	0.3756E 02	0.2203E 01
9	0.4162E C2	C.1272E 01	0.4568E 02	-C.7393E C0	0.4974E 02	0.3444E 01	0.5380E 02	0.3444E 01
13	0.5786E C2	C.5752E 00	0.6191E 02	C.8076E C0	0.6597E C2	C.1040E 01	0.7003E 02	0.8076E 00
17	0.7409E C2	C.5752E 00	0.7815E 02	C.1660E C1	0.8221E C2	C.1272E 01	0.8627E 02	0.2668E 01
21	0.9032E C2	C.1040E 01	0.9438E 02	C.3212E 01	0.9844E 02	C.3444E 01	0.1025E 03	-0.2754E-00
25	0.1066E C3	C.2668E 01	0.1106E 03	C.1040E 01	0.1147E 03	-C.2754E-00	0.1187E 03	0.5752E 00
29	0.1228E C3	0.1040E 01	0.1269E 03	C.2668E C1	0.1309E C3	C.2203E 01	0.1350E 03	0.5752E 00
33	0.1390E C3	C.1660E 01	0.1431E 03	C.1885E-00	0.1472E C3	C.5752E 00	0.1512E 03	0.3428E-00
37	0.1553E C3	0.2203E 01	0.1593E 03	C.5752E 00	0.1634E C3	C.1885E-00	0.1675E 03	0.1040E 01
41	0.1715E C3	C.5752E 00	0.1756E 03	C.2668E C1	0.1796E C3	C.1428E 01	0.1837E 03	0.1040E 01
45	0.1878E 03	0.8076E 00	0.1918E 03	C.1885E-00	0.1959E C3	C.1040E 01	0.1999E 03	0.1660E 01
49	0.2040E 03	C.2436E 01	0.2081E 03	C.2668E 01	0.2121E C3	C.1885E-00	0.2162E 03	0.1040E 01
53	0.2202E C3	0.3428E-00	0.2243E 03	C.1885E-00	0.2283E 03	C.1893E 01	0.2324E 03	0.1428E 01
57	0.2365E C3	C.2668E 01	0.2405E 03	C.2203E C1	0.2446E 03	C.1428E 01	0.2486E 03	0.3428E-00
61	0.2527E C3	0.2203E 01	0.2568E 03	C.1040E 01	0.2608E C3	C.1040E 01	0.2649E 03	0.2668E 01
65	0.2689E C3	C.1815E 01	0.2730E 03	C.1660E 01	0.2771E C3	C.1040E 01	0.2811E 03	0.2668E 01
69	0.2852E 03	-0.1978E 01	0.2892E 03	C.1040E 01	0.2933E C3	0.2668E 01	0.2974E 03	-0.2754E-00
73	0.3014E C3	0.3428E-00	0.3055E 03	C.1660E 01	0.3095E 03	C.2668E 01	0.3136E 03	0.1040E 01
77	0.3177E 03	0.1040E 01	0.3217E 03	C.5752E 00	0.3258E C3	C.3522E 01	0.3298E 03	-0.4297E-01

APPENDIX C
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WILD POINTS FOR INST. NO. 7

POINT	VALUE	CORRECTED
X(10) =	-0.74	3.19
X(24) =	-0.28	3.42
X(37) =	2.20	0.38
X(42) =	2.67	1.16
X(46) =	0.19	0.82
X(51) =	0.19	1.92
X(61) =	2.20	0.43
X(64) =	2.67	1.59
X(69) =	-1.98	2.19
X(71) =	2.67	0.25
X(75) =	2.67	1.41

SMOOTHED AND NORMALIZED DATA

POINT	TIME	DATA	TIME	DATA	TIME	DATA	TIME	DATA
1	C.9147E C1	C.7124E 02	C.1321E 02	C.7124E 02	C.1726E C2	C.7128E C2	C.2132E 02	0.7148E 02
5	C.2538E C2	C.7182E 02	0.2944E 02	C.7224E 02	0.3350E C2	C.7271E C2	0.3756E 02	0.7321E 02
9	C.4162E C2	0.7370E 02	0.4568E 02	C.7413E 02	C.4974E C2	C.7450E C2	0.5380E 02	0.7478E 02
13	C.5786E C2	0.7499E 02	0.6191E 02	C.7513E 02	C.6597E C2	C.7521E C2	0.7003E 02	0.7524E 02
17	C.7409E C2	C.7522E 02	0.7815E 02	C.7516E 02	C.8221E C2	C.7506E C2	0.8627E 02	0.7492E 02
21	C.9032E C2	0.7474E 02	0.9438E 02	C.7453E 02	C.9844E C2	C.7428E C2	0.1025E 03	0.7399E 02
25	C.1066E C3	0.7367E 02	0.1106E 03	C.7332E C2	C.1147E C3	C.7294E 02	0.1187E 03	0.7252E 02
29	C.1228E C3	0.7208E 02	0.1269E 03	C.7162E C2	C.1309E C3	C.7115E 02	0.1350E 03	0.7066E 02
33	C.1390E C3	0.7019E 02	C.1431E 03	C.6976E C2	C.1472E C3	C.6938E C2	0.1512E 03	0.6904E 02
37	C.1553E C3	0.6874E 02	0.1593E 03	C.6842E 02	C.1634E C3	C.6809E 02	0.1675E 03	0.6777E 02
41	C.1715E C3	0.6746E 02	0.1756E 03	C.6719E 02	C.1796E 03	C.6697E 02	0.1837E 03	0.6682E 02
45	C.1878E C3	0.6676E 02	0.1918E 03	C.6678E 02	C.1959E C3	C.6690E 02	0.1999E 03	0.6711E 02
49	C.2040E C3	0.6738E 02	0.2081E 03	C.6767E C2	C.2121E 03	C.6795E 02	0.2162E 03	0.6820E 02
53	C.2202E 03	0.6843E 02	0.2243E 03	C.6864E 02	0.2283E 03	C.6885E 02	0.2324E 03	0.6902E 02
57	C.2365E C3	0.6914E 02	0.2405E 03	C.6918E 02	C.2446E 03	C.6913E 02	0.2486E 03	0.6899E 02
61	C.2527E C3	0.6876E 02	0.2568E 03	C.6842E 02	C.2608E C3	C.6801E 02	0.2649E 03	0.6750E 02
65	0.2689E C3	0.6693E 02	0.2730E 03	C.6629E 02	0.2771E C3	C.6559E 02	0.2811E 03	0.6484E 02
69	C.2852E C3	0.6404E 02	0.2892E 03	C.6318E 02	0.2933E 03	C.6228E 02	0.2974E 03	0.6135E 02
73	C.3014E C3	0.6041E 02	0.3055E 03	C.5945E 02	0.3095E 03	C.5847E 02	0.3136E 03	0.5746E 02
77	0.3177E 03	0.5639E 02	0.3217E 03	C.5527E 02	0.3258E C3	C.5410E 02	0.3298E 03	0.5289E 02

DERIVATIVES OF SMOOTHED DATA

POINT	TIME	DERV	TIME	DERV	TIME	DERV	TIME	DERV
1	0.9147E C1	0.6442E-02	0.1321E 02	-0.4415E-02	0.1726E C2	0.2615E-01	0.2132E 02	0.7211E-01
5	0.2538E C2	0.9512E-01	0.2944E 02	0.1100E-00	0.3350E 02	0.1222E-00	0.3756E 02	0.1241E-00
9	0.4162E C2	0.1154E-00	0.4568E 02	0.9972E-01	0.4974E C2	0.8029E-01	0.5380E 02	0.6042E-01
13	0.5786E C2	0.4225E-01	0.6191E 02	0.2645E-01	0.6597E 02	0.1276E-01	0.7003E 02	0.6977E-03
17	0.7409E C2	-0.1017E-01	0.7815E 02	-0.2026E-01	0.8221E 02	-0.2984E-01	0.8627E 02	-0.3910E-01
21	0.9032E C2	-0.4814E-01	0.9438E 02	-0.5701E-01	0.9844E C2	-0.6574E-01	0.1025E 03	-0.7431E-01
25	0.1066E C3	-0.8267E-01	0.1106E 03	-0.9080E-01	0.1147E C3	-0.9845E-01	0.1187E 03	-0.1055E-00
29	0.1228E C3	-0.1118E-00	0.1269E 03	-0.1152E-00	0.1309E C3	-0.1193E-00	0.1350E 03	-0.1202E-00
33	0.1390E C3	-0.1107E-00	0.1431E 03	-0.1011E-00	0.1472E C3	-0.8721E-01	0.1512E 03	-0.7768E-01
37	0.1553E C3	-0.7485E-01	0.1593E 03	-0.8014E-01	0.1634E C3	-0.8128E-01	0.1675E 03	-0.7869E-01
41	0.1715E C3	-0.7294E-01	0.1756E 03	-0.6249E-01	0.1796E C3	-0.4557E-01	0.1837E 03	-0.2660E-01
45	0.1878E C3	-0.3723E-02	0.1918E 03	0.1663E-01	0.1959E C3	0.4145E-01	0.1999E 03	0.6064E-01
49	0.2040E C3	0.7168E-01	0.2081E 03	0.7289E-01	0.2121E C3	0.6597E-01	0.2162E 03	0.5740E-01
53	0.2202E C3	0.5357E-01	0.2243E 03	0.5130E-01	0.2283E C3	0.4870E-01	0.2324E 03	0.3788E-01
57	0.2365E C3	0.1969E-01	0.2405E 03	0.9736E-03	0.2446E C3	-0.2332E-01	0.2486E 03	-0.4663E-01
61	0.2527E C3	-0.7022E-01	0.2568E 03	-0.9265E-01	0.2608E C3	-0.1136E-00	0.2649E 03	-0.1333E-00
65	0.2689E C3	-0.1495E-00	0.2730E 03	-0.1655E-00	0.2771E C3	-0.1787E-00	0.2811E 03	-0.1915E-00
69	0.2852E C3	-0.2048E-00	0.2892E 03	-0.2168E-00	0.2933E C3	-0.2260E-00	0.2974E 03	-0.2318E-00
73	0.3014E C3	-0.2348E-00	0.3055E 03	-0.2375E-00	0.3095E C3	-0.2437E-00	0.3136E 03	-0.2553E-00
77	0.3177E C3	-0.2698E-00	0.3217E 03	-0.2833E-00	0.3258E C3	-0.2922E-00	0.3298E 03	-0.3037E-00

SUCCESSFUL READ OF RAW DATA TAPE 10

TOTAL NO. OF A.I. FILES = 63

TOTAL NO. OF FILES NOT A.I. = 0

TOTAL NO. OF FILES = 63

Appendix C
NAA-SR-TDR-11603
Pg. 26

INST. NO. STANDARD DEVIATION

90	0.11107539E 01
91	0.17117103E-00
113	0.32412190E-01
116	0.37330632E-01
117	0.40301213E-01
118	0.37430044E-01
119	0.37693705E-01
154	0.33720607E-01
89	0.16096524E 01
36	0.36841462E 02
16	0.21203303E 02
20	0.13456944E 02
22	0.19857771E 02
28	0.18204852E 02
155	0.45947859E-01
37	0.42758210E 02
44	0.18853679E 02
8	0.30073013E 02
46	0.27625254E 02
135	0.17212197E 11
69	0.42958369E-00
72	0.17158860E-00
73	0.12681502E-00
74	0.16662895E-00
75	0.16935708E-00
76	0.13608117E-00
77	0.16955186E-00
78	0.12362242E-00
79	0.14380137E-00
80	0.14884722E-00
81	0.14711644E-00
137	0.78327320E 06
138	0.39023305E 02
82	0.40287194E-01
152	0.29739393E-01
153	0.27983955E-01
1	0.11309214E 02
3	0.18921639E 02
4	0.20317784E 02
7	0.25414250E 02
10	0.38349254E 02
2	0.89466458E 01
5	0.52340532E 01
6	0.49716950E 01

7944-94
004 000

NAK TUBE 45-INLET TEMP. (MANIFOLD)

FIG. NO. 4

INSTR. NO. A154

REV. NO.

(Example 1)

7944-94
C05 000

NAK TUBE 45-INLET TEMP. (MANIFOLD)

NORMALIZED SMOOTHED DATA

FIG. NO. 5

INSTR. NO. A154

REV. NO.

(Example 1 cont.)

NORMALIZED DATA (DEGREES F)

NAK TUBE 45-INLET TEMP. (MANIFOLD)

SLOPE OF SMOOTHED DATA

FIG. NO. 6

INSTR. NO. A154

REV. NO.

(Example 1 cont.)

NORMALIZED DATA SLOPE

7944-94
007 000

HEAT SHIELD TEMP

FIG. NO. 7
INSTR. NO. A164
REV. NO.

(Example 2)

7944-94
008 000

HEAT SHIELD TEMP

NORMALIZED SMOOTHED DATA

FIG. NO. 8

INSTR. NO. A164

REV. NO.

(Example 2 cont.)

NORMALIZED DATA (DEG F)

HEAT SHIELD TEMP

SLOPE OF SMOOTHED DATA

FIG. NO. 9

INSTR. NO. A164

REV. NO.

(Example 2 cont.)

NORMALIZED DATA SLOPE

7944-95 L
041 000

HEAT SHIELD TEMPERATURE

NORMALIZED SMOOTHED DATA

FIG. NO. 41

INSTR. NO. A1140

REV. NO. 6

(Example 3)

NORMALIZED DATA (DEGREES F)

7944-95 L
042 000

HEAT SHIELD TEMPERATURE

SLOPE OF SMOOTHED DATA

FIG. NO. 42

INSTR. NO. A1140

REV. NO. 6

(Example 3 cont.)

NORMALIZED DATA SLOPE

FINE CONTROL DRUM 2 (FULL RANGE)

7844-01
022 000

FIG. NO. 22

(Example 4)

INSTR. NO. 90

7944-01
025 000

FINE CONTROL DRUM 2 (FULL RANGE)

NORMALIZED SMOOTHED DATA

FIG. NO. 25
INSTR. NO. 90

(Example 4 cont.)

NORMALIZED DATA (DEGRS. ROTATED)

7944-95 L
071 000

RAD. FIN 72-IN. TEMP. DIFF.-TUBE 17

NORMALIZED SMOOTHED DATA

FIG. NO. 71

INSTR. NO. A116

REV. NO. 6

(Example 5)

NORMALIZED DATA (DEGREES F)

7944-95 L
072 000

RAD. FIN 72-IN. TEMP. DIFF.-TUBE 17

SLOPE OF SMOOTHED DATA

FIG. NO. 72

INSTR. NO. A116

REV. NO. 6

(Example 5 cont.)

NORMALIZED DATA SLOPE

7944-95 L
053 000

HEAT SHIELD TEMPERATURE

NORMALIZED SMOOTHED DATA

FIG. NO. 53

INSTR. NO. A1161

REV. NO. 6

(Example 6)

NORMALIZED DATA (DEGREES F)

7944-95 L
045 000

HEAT SHIELD SQUIB TEMP.

NORMALIZED SMOOTHED DATA

FIG. NO. 45

INSTR. NO. A1162

REV. NO. 6

(Example 7)

NORMALIZED DATA (DEGREES F)

7944-95 L
037 000

INSTRUMENT COMPARTMENT FLUX MAPPING

NORMALIZED SMOOTHED DATA

FIG. NO. 37

INSTR. NO. A1168

REV. NO. 6

(Example 8)

NORMALIZED DATA (MILLIVOLTS)

ELAPSED TIME (SECONDS)

APPENDIX DTAPE ASSIGNMENTS

<u>TAPE</u>	<u>NUMBER</u>	<u>ASSIGNMENT</u>
A1	1	System Tape
B2	2	Not Used
B3	3	Not Used
A4	4	Not Used
A2	5	Program Input Tape
A3	6	Print Output Tape
B1	7	Not Used
A5	8	Possible Raw Data Input (Figure 4)
A6	9	Possible Raw Data Input (Figure 4)
A8	10	Possible Raw Data Input (Figure 4)
B6	11	Possible Raw Data Input (Figure 4)
B7	12	Possible Raw Data Input (Figure 4)
B8	13	Possible Raw Data Input (Figure 4)
B4	14	Punch Output Tape
B5	15	System Library Tape
A7	16	CRT Output Tape

V

REFERENCES

1. E. J. Hammond, "FLIGHT-1 (A Data Reduction Program for SNAP 10A Steady State Flight Test Data)," NAA-SR-TDR-10614 (November, 1964).
2. Norman E. Vander Bergh, "COMFORT II," (March 1, 1961)
A NAA computer program description to enable FORTRAN programmers to utilize buffered input-output techniques while reading and/or writing fixed or variable length records.
3. NAA Engineers Computing Manual, Section 74.00.01.
The SC-4020 Cathode Ray Tube Display Computer is a programmable electronic device to pictorially represent mathematical values (General Dynamics Electronics).