STANFORD RSL Technical Report 71-2

The National Aeronautics and Space Administration
Research Contract NAS 9-7313

FINAL REPORT (A) -- PHASE IV

SOFTWARE (COMPUTER PROGRAMMING)

A.A. Marshall (Stanford Univ.) Jun. 1971
60 p

1970/71 STANFORD SPECTRAL DATA MANAGEMENT PROGRAMS

BY

A. A. Marshall
Stanford Remote Sensing Laboratory

Report Prepared Under
NASA Contract NAS 9-7313
"Infrared Spectrometry Studies"
1970/71 STANFORD SPECTRAL DATA MANAGEMENT PROGRAMS

by

A. A. Marshall
Stanford Remote Sensing Laboratory

Report Prepared Under
NASA Contract NAS9-7313
"Infrared Spectrometry Studies"

Approved:

R. J. P. Lyon, Principal Investigator
Department of Mineral Engineering
Stanford University
Stanford, California 94305

June 1971
<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>67-1</td>
<td>&quot;Field Infrared Analysis of Terrain-Spectral Correlation Program&quot;</td>
<td>Part I (by R.J.P. Lyon)</td>
</tr>
<tr>
<td>67-2</td>
<td>&quot;Field Infrared Analysis of Terrain-Spectral Correlation Program&quot;</td>
<td>Part II and Part III (by R.J.P. Lyon)</td>
</tr>
<tr>
<td>67-4</td>
<td>&quot;Computer Reduction and Analysis of an Infrared Image&quot;</td>
<td>(by Keenan Lee)</td>
</tr>
<tr>
<td>68-1</td>
<td>&quot;Infrared Exploration for Coastal and Shoreline Springs&quot;</td>
<td>(by Keenan Lee)</td>
</tr>
<tr>
<td>68-2</td>
<td>&quot;Re-evaluation of the Normative Minerals of Sonora Pass Rock Standards--University of Nevada Reports #7 and #12&quot;</td>
<td>(by Attila Kilinc)</td>
</tr>
<tr>
<td>68-3</td>
<td>&quot;Nearest Neighbor--A New Non-parametric Test Used for Classifying Spectral Data&quot;</td>
<td>(by Paul Switzer)</td>
</tr>
<tr>
<td>68-4</td>
<td><strong>Final Report</strong> &quot;Field Analysis of Terrain&quot;--NGR-05-020-115 (contains all the drawings and logic diagrams for Stanford CVF Spectrometer and Digital Data Recording System)</td>
<td>(by R.J.P. Lyon)</td>
</tr>
<tr>
<td>69-1</td>
<td>&quot;Mission 78--Flights 1 and 2 Ninety-Day Report&quot;</td>
<td>(by R.J.P. Lyon)</td>
</tr>
<tr>
<td>69-2</td>
<td>&quot;Quantitative Geological Analysis of Multiband Photography from the Mono Craters Area, California&quot;</td>
<td>(by G.I. Ballew)</td>
</tr>
<tr>
<td>69-3</td>
<td>&quot;The Stanford Infrared Spectra Processing Package&quot;</td>
<td>(by John Moore with subsequent modifications by Michael Heathman)</td>
</tr>
<tr>
<td>69-4</td>
<td>&quot;Thermal Dynamics at the Earth-Air Interface: The Implications for Remote Sensing of the Geologic Environment&quot;</td>
<td>(by Rossman Smith)</td>
</tr>
<tr>
<td>69-5</td>
<td>&quot;Infrared Spectrometry Studies: Final Report Phase I&quot;</td>
<td>(by R.J.P. Lyon)</td>
</tr>
</tbody>
</table>
"Infrared Spectrometry Studies: Final Report Phase II" (by R. J. P. Lyon and Attila Kilinc)

"Infrared Exploration for Shoreline Springs at Mono Lake, California, Test Site" (by Keenan Lee)

"Detailed Ground Study of 8-13 μm Infrared Imagery, Carrizo Plains, California" (by R. Campbell, Jr., L. D. Hoover and F. Querol-Sune)

"Terms in Geologic Remote Sensing: A Condensed Glossary" (by R. J. P. Lyon)

"Geologic Interpretation of Airborne Infrared Thermal Imagery of Goldfield, Nevada" (by I. A. Kilinc and R. J. P. Lyon)


"Geophysical Analysis of Thermal Infrared Imagery near Goldfield Nevada: Experimental and Correlation Analysis" (by W. B. Ervine)


"Pseudo-Radar: Very High Contrast Aerial Photography at Low Sun Angles" (by R. J. P. Lyon, Jose Mercado and Robert Campbell, Jr.), now published in Photogrammetric Engineering, 36, (12), 1257-1261

"Remote Sensing in Exploration for Mineral Deposits" (by R. J. P. Lyon and Keenan Lee), now published in Economic Geology, 65, 785-800

"Phenomena and Properties of Geologic Materials Affecting Microwaves - A Review" (by D. Oberste-Lehn)

"1969/70 Stanford Spectral Data Management System" (by Michael Heathman)

"Operational Calibration of an Airborne Infrared Spectrometer Over Geologically-Significant Terrains", (by R. J. P. Lyon and A. A. Marshall)

71-3 "Stanford Digital Data System." Final Report (B) -- Phase IV.


71-6 "Spectral Data from Flights 1 and 3, Mission 108." Final Report (C) -- Phase IV (IR Spectral Emittance Data - Airborne).
I. Introduction

This is a report on the data management programs used by the Stanford Remote Sensing Laboratory to access, modify, and reduce the data obtained from both the NASA IR airborne spectrometer, and Stanford's SG-4 field spectrometer. Many details covered in previous reports are not repeated here. References are provided below.

These programs are written in Fortran IV and S/360 Assembler Language, and are currently running on a S/360 model 67 (operating under OS/MFT) at the Stanford Computation Center Campus Facility.

References


II. Program Descriptions

1. **Program Cal**

   Cal computes instrument calibration functions using NASA spectra. The required function is computed for each member of a group of spectra, and the mean and standard deviation over the group are printed and plotted. Currently the functions computed by Cal are not used for any further processing within the system.

   If the option INSTRANS is specified, the instrument response correction function is computed. This function may be used to correct for the non linear response of the spectrometer. It is computed by ratioing a theoretical blackbody spectrum to an observed blackbody spectrum. Since the spectrometer measures the radiation difference between the outside world and an internal reference, the theoretical blackbody mentioned above is the difference between two absolute radiance curves, one calculated using the target temperature, and the other calculated using the internal reference temperature.

   If the option AIRPATH is specified, the airpath absorption function is computed. Airborne blackbody spectra (from lakes, oceans etc.) are corrected for the instrument response and for the reflectance of water. The ratio of these corrected spectra to a theoretical blackbody spectrum is the airpath absorption function. This function describes the effect of the air mass on the radiance levels seen by the spectrometer.
If the option EMITT is specified, the ground rock emittance spectrum is computed. Each ground rock spectrum is corrected for instrument response and subtracted from a theoretical blackbody spectrum calculated at the internal spectrometer reference temperature. This gives an estimate of the absolute radiance of the target. The ratio of this to an absolute blackbody radiance curve gives the emittance spectrum for the rock.

Cal uses Splot for line printer plotting, Irrad for theoretical radiance calculations, Tcalc to estimate target temperature if unknown, and Sigma to compute standard deviations.

2. Program Prep

Prep is used to access and save small groups of spectra within the NASA data base. The spectra are time coded in increasing order. The program reads sequentially though the data base until the group is found. Any spectra within the group whose temperature variance is above a given tolerance is rejected. The spectra alternate between up ramp (6.8-13.4 microns) and down ramp (13.4-6.8 microns) recording, but the output file contains only spectra of a given ramp code. The group average spectrum and standard deviation is printed and plotted for each group processed.

Prep uses Splot for plotting, Table for data listing, Xlate to convert time, Rdnasa to read the data base, Unpack to unpack identification bytes, and Dater to provide the date and time for the printed output.
3. **Program Proc**

Proc is used to process spectral groups produced by Prep. Since the data saved by Prep is contained in individual datasets, Proc finds groups by dataset name alone. The standard processing steps are as follows: the raw spectra are ratioed to a blackbody spectrum; the tails of the spectra are clipped since they contain little useful information; the ratioed spectra are smoothed to minimize the effects of random noise; and finally they are each normalized so the mean "radiance" of each spectrum is zero, with a standard deviation of one, allowing valid comparison of spectra with different mean intensities.

The processed spectra are output onto a single file in card image format so that they may be read by classification programs such as BMD07M. The group average spectrum for each group is saved on a separate file so that the individuals may be further processed by program Discard.

Proc uses Splot for plotting, Table for data listing, Dater for date and time, Norm for normalizing spectra, and Sm for smoothing spectra.
4. **Program Discard**

Discard is used to delete from spectral groups spectra which vary greatly from the group mean. The program reads the output produced by Proc and computes for each member of a group the distance in Euclidean space from the group mean. If this distance is greater than a given tolerance, the spectrum is deleted from the group. There is no firm reason to think the information about a group is any better after this processing, but it has been found that spectra rejected by this method correspond well with the spectra which the classification programs cannot identify correctly.

Discard uses no subroutines.

5. **Program Trkload**

Trkload is used to copy ground based ("truck") spectra tapes to disk. The organization of the disk file is different from the NASA data base in that individual spectra may be accessed directly. An index with pointers to the raw spectra is created which may be searched by later programs in order to find spectral groups. A program which does this searching and saves the groups in a format compatible with Proc has not been written yet, since the ground system is not fully operational.

Trkload uses Rdtrak to read and convert the raw data tapes, and Daload to create the direct access file. Daload is used to bypass the formatting of direct access files which the FORTRAN direct access routines must do.
III. Program Examples

1. Program Cal

```plaintext
//CAL JOB (.J032,332,,10),MARSHALL
//JOBLIB DD DSN=J032.PROGLIB,DISP=SHR
//WHYNOT EXEC PGM=CAL
//FT20F001 DD DSN=J032.PRE40,DISP=SHR
//FT30F001 DD DSN=J032.SHALL,DISP=SHR
//FT06F001 DD SYSOUT=A
//FT05F001 DD *
// 108-1
INTRANS 60. 40. 20 MX108-1 PREFLIGHT RB
AIRPATH 60. 0.0 30 MX108-1 SHALLOW LAKE
/*
In this example, the dataset J032.PRE40 is used to calculate the instrument response correction function, and the dataset J032.SHALL is used to calculate the airpath absorption function.

2. Program Prep

```plaintext
//PREP JOB (.J032,332,,10),MARSHALL
//JOBLIB DD DSN=J032.PROGLIB,DISP=SHR
//WHYNOT EXEC PGM=PREP
//NASA DD DSN=J032.FLIGHT1,DISP=SHR,DCB=OPTCD=C
//FT20F001 DD DSN=J032.ROCKA,VOL=SER=USER07,UNIT=2314,
//  DISP=(, CATLG), SPACE=(TRK, 5, RLSE), DCR=(RECFM=VRS,
//  BLKSIZE=7294, LRECL=400)
//FT30F001 DD DSN=J032.ROCKR,VOL=SER=USER07,UNIT=2314,
//  DISP=(, CATLG), SPACE=(TRK, 5, RLSE), DCR=*,FT20F001
//FT06F001 DD SYSOUT=A
//FT05F001 DD *
&PARMS TEMP=150., REND
00 20 15 15 12345 15 15 23456 MX108-1 ROCKA
00 30 15 16 12345 15 15 23456 MX108-1 ROCKR
/*
In this example, J032.FLIGHT1 contains raw time-coded spectra from which the datasets J032.ROCKA and J032.ROCKR are created. The data cards contain the ramp code, logical unit number for output, start and stop times, and some identification for each group of spectra.
3. **Program Proc**

```plaintext
//PROC JOB (J032,332,,10),MARSHALL
//JOBLIB DD DSN=J032,PRGLIB,DISP=SHR
//WHYNOT EXEC PGm=PROC
//FT99F001 DD DSN=J032.SHALLAVG,DISP=SHR
//FT20F001 DD DSN=J032.ROCKA,DISP=SHR
//FT30F001 DD DSN=J032.ROCKB,DISP=SHR
//FT07F001 DD DSN=J032.ROCKLIBI,DISP=MOD
//FT08F001 DD DSN=J032.ROCKLIBA,DISP=MOD
//FT06F001 DD SYSOUT=A
//FT05F001 DD *

&PARMS SMOOTH=T, CARD=5, &END
THESr SPECTRA HAVE BEEN RATIOED, SMOOTHED, AND NORMALIZED.
00 20 15 15 12345 15 15 23456 MX108-1 ROCKA
00 30 15 16 12345 15 16 23456 MX108-1 ROCKR
/*

In this example, the two datasets created in the previous example are processed and saved in J032.ROCKLIBI (for individual spectra) and in J032.ROCKLIBA (for the average of each group). Each spectrum is ratioed to an averaged blackbody spectrum contained in J032.SHALLAVG, smoothed, and normalized. Note that the control cards are the same as those used above.

4. **Program Discard**

```plaintext
//RSL JOB (J032,332,,10),MARSHALL
//JOBLIB DD DSN=J032,PRGLIB,DISP=SHR
//WHYNOT EXEC PGm=DISCARD
//FT05F001 DD DSN=J032.ROCKLIBD,DISP=MOD
//FT05F001 DD DSN=J032.ROCKLIBI,DISP=SHR
//FT06F001 DD DSN=J032.ROCKLIBA,DISP=SHR
//FT05F001 DD SYSOUT=A
//FT05F001 DD *

&PARMS LIMIT=30, &END
&PARMS LIMIT=30, &END

In this example, data read from J032.ROCKLIBI are copied to J032.ROCKLIBD rejecting any spectrum whose distance from the group mean is greater than a given tolerance. The group means are contained in J032.ROCKLIBA, and the tolerance for each group is specified using the &PARMS namelist.

In this example, a truck tape called TRUCK, is copied to disk. The spectra are saved in J032.TROCKS, and the identification information is saved in J032.TINDEX. The namelist input specifies that the individual spectra are to be listed, and that rereads should be suppressed in case of an error while reading the tape.
IV. Program Listings

1.1 Program Cal

PROGRAM CAL -- DECEMBER 1970 VERSION

COMPUTES INSTRUMENT CALIBRATION FOR IR SPECTROMETER
STANFORD REMOTE SENSING LABORATORY

PROGRAM OPTIONS

INTRANS -- COMPUTE INSTRUMENT RESPONSE CORRECTION FUNCTION.
AIRPATH -- COMPUTE AIRPATH ABSORPTION SPECTRUM FOR AIRBORNE
BLACKBODY SPECTRA.
EMITT -- COMPUTE TARGET RADIANCE AND EMITTANCE SPECTRUM
FOR KNOWN ROCK TYPES.
SAVETRAN -- READ/WRITE INSTRUMENT RESPONSE FUNCTION.

INTEGER DISK, CARD/5/, PRINT/6/, NMAX/30/
INTEGER INTRN/'INST'/, EMITT/'EMIT'/, AIRPT/'AIRP'/, SAVET/'SAVE'/
INTEGER GET/'GET'/, PUT/'PUT'/, FLT, NAME(8), CNT(88)
REAL RAW(38), DSK(92), IRAD(88), PLNK(88), ASP(88),
* AINS(88), SINS(88), AAIR(88), SAIRED(88),
* AEM(88), SEM(88), SSP(88), SRAD(88)
REAL ZERO(88)/88*0.0/, FACT/0.0/

DEFINE REFLECTANCE CORRECTION FUNCTION
REAL REFLT(88)
* / .9797, .9800, .9805, .9808, .9812, .9818, .9819,
* .9820, .9821, .9821, .9822, .9822, .9823, .9823,
* .9824, .9826, .9828, .9830, .9831, .9833, .9834,
* .9836, .9837, .9839, .9841, .9843, .9845, .9847,
* .9848, .9850, .9853, .9855, .9858, .9861, .9863,
* .9865, .9869, .9873, .9877, .9881, .9885, .9888,
* .9891, .9895, .9899, .9903, .9907, .9910, .9913,
* .9917, .9920, .9923, .9926, .9929, .9930, .9932,
* .9933, .9932, .9931, .9930, .9926, .9922, .9918,
* .9912, .9906, .9900, .9897, .9893, .9890, .9887,
* .9984, .9980, .9974, .9968, .9962, .9857, .9851,
* .9844, .9835, .9824, .9810, .9794, .9778, .9762,
* .9748, .9732, .9715, .9702
* /
C IGNORE 4 WORD HEADER ON DATA READS.
EQUIVALENCE (RAW(I), DSK(S))

C READ MISSION AND FLIGHT IDENTIFICATION.
READ (CARD,54) MISS, FLT

C INITIALIZE SEQUENCE NUMBER ARRAY
DO 2 I = 91,178
  CNT(I-90) = 1

C READ PROGRAM OPTIONS
10 READ (CARD,51,END=99) IOPT, REFT, BBT, DISK, NAME

C IF (IOPT .EQ. SAVET) GOTO 50

C COMPUTE TARGET TEMPERATURE IF UNSPECIFIED.
C IF (BBT .NE. 0.0) GOTO 11
C IF (FACT .NE. 0.0) GOTO 12

C ERROR IN AUTOMATIC TEMPERATURE CALCULATION
WRITE (PRINT,97)
STOP

12 BBT = TCALC (REFT, FACT, DISK)

C BRANCH TO SPECIFIED ROUTINE
11 IF (IOPT .EQ. AIRPT) GOTO 30
IF (IOPT .EQ. EMITT) GOTO 40
IF (IOPT .EQ. INTRN) GOTO 20

C ERROR IN OPTION CODE, STOP.
WRITE (PRINT,61)
STOP

C READ/WRITE RESPONSE FUNCTION
50 IF (NAME(I) .EQ. PUT) WRITE (DISK) AINS
IF (NAME(I) .EQ. GET) READ (DISK) AINS
GOTO 10
INSTRUMENT RESPONSE CORRECTION FUNCTION

THE RESPONSE FUNCTION IS THE RATIO OF A CALCULATED IRRADIANCE CURVE TO AN OBSERVED BLACK BODY SPECTRUM AT A GIVEN TEMPERATURE. IRRADIANCE IS THE DIFFERENCE BETWEEN TWO BLACKBODY RADIATORS, ONE AT THE INTERNAL SPECTROMETER REFERENCE TEMPERATURE, AND ONE AT THE EXTERNAL TARGET TEMPERATURE.

CONTINUE

COMPUTE THEORETICAL NET IRRADIANCE
CALL IRRAD (IRAD, REFT, BBT)

READ IN GROUND BLACKBODY SPECTRA AND COMPUTE RESPONSE OF EACH

DO 26 I = 1, 88
ASP(I) = 0.0
SSP(I) = 0.0
AINS(I) = 0.0
AINS(I) = 0.0
SINS(I) = 0.0
26 CONTINUE

DO 22 I = 1, NMAX
READ (DISK, END=23) DSK

DO 22 J = 1, 88
ASP(J) = ASP(J) + RAW(J)
SSP(J) = SSP(J) + RAW(J)**2
AINS(J) = AINS(J) + IRAD(J)/RAW(J)
SINS(J) = SINS(J) + (IRAD(J)/RAW(J))**2
22 CONTINUE

FIND STANDARD DEVIATIONS

NSPEC = I - 1
EN = NSPEC
CALL SIGMA (ASP, SSP, EN, 88)
CALL SIGMA (AINS, SINS, EN, 88)
FIND OVERALL AVERAGES

AIRAD = AVER (IRAD, 88)
AASP = AVER (ASP, 88)
ASSP = AVER (SSP, 88)
AAINS = AVER (AINS, 88)
ASINS = AVER (SINS, 88)

PRINT AND PLOT RESULTS

WRITE (PRINT,68) MISS, FLT, REFT, 88T, NSPEC, NAME
WRITE (PRINT,67) (CNT(I), IRAD(I), ASP(I),
    SSP(I), AINS(I), SINS(I), I = 1,88)
WRITE (PRINT,66) AIRAD, AASP, ASSP, AAINS, ASINS

WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLLOT (IRAD, ZERO, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT,62)

WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLLOT (ASP, SSP, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT,63)

WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLLOT (AINS, SINS, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT,64)

COMPUTE TEMPERATURE CONVERSION TABLE BASED ON LINEAR
INTERPOLATION THROUGH (0,REFT) AND (AASP,BBT)

FACT = (BBT - REFT) / AASP
RR = 0.0
WRITE (PRINT,93) MISS, FLT, REFT, BBT, NSPEC, NAME

DO 28 I = 1,1101,25
TT = REFT + FACT * RR
WRITE (PRINT,94) RR, TT
RR = RR + 25.0
28 CONTINUE

GOTO 10
AIRPATH ABSORPTION FUNCTION

AIRPATH ABSORPTION IS THE RATIO OF THE THEORETICAL NET IRRADANCE OF A BLACKBODY AT A GIVEN TEMPERATURE TO AN AIRBORNE BLACKBODY (IE LAKES, OCEAN) AT THE SAME TEMPERATURE, MULTIPLIED BY THE INSTRUMENT RESPONSE CORRECTION FUNCTION.

MOD -- WATER REFLECTANCE CORRECTION ADDED.

30 CONTINUE

COMPUTE IRRADIANCE
CALL IRRAD (IRAD, REFT, BBT)

READ IN AIRBORNE BLACKBODY SPECTRA AND FIND AIRPATH OF EACH

DO 31 I = 1,88
ASP (I) = 0.0
SSP (I) = 0.0
AAIR(I) = 0.0
SAIR(I) = 0.0
31 CONTINUE

DO 33 J = 1,NMAX
READ(DISK,END=38) DSK

DO 33 J = 1,88
ASP(J) =ASP(J) + RAW(J)
SSP(J) = SSP(J) + RAW(J) ** 2
T = IRAD(J) * REFLT(J) / RAW(J) / AINS(J)
AAIR(J) = AAIR(J) + T
SAIR(J) = SAIR(J) + T*T
33 CONTINUE
FIND STANDARD DEVIATIONS

\[ \text{NSPEC} = I - 1 \]
\[ \text{EN} = \text{NSPEC} \]
\[ \text{CALL SIGMA (ASP, SSP, EN, 88)} \]
\[ \text{CALL SIGMA (AAIR, SAIR, EN, 88)} \]

FIND OVERALL AVERAGES

\[ \text{AASP} = \text{AVER (ASP, 88)} \]
\[ \text{ASSP} = \text{AVER (SSP, 88)} \]
\[ \text{AAAIR} = \text{AVER (AAIR, 88)} \]
\[ \text{ASAIR} = \text{AVER (SAIR, 88)} \]

PRINT AND PLOT RESULTS

WRITE (PRINT, 68) MISS, FLT, REFT, BBT, NSPEC, NAME
WRITE (PRINT, 65) (CNT(I), ASP(I), SSP(I), AAIR(I), SAIR(I), I = 1, 88)
WRITE (PRINT, 66) AASP, ASSP, AAAIR, ASAIR

WRITE (PRINT, 68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLLOT (ASP, SSP, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT, 86)

WRITE (PRINT, 68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLLOT (AAIR, SAIR, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT, 87)

GOTO 10
CONTINUE

**GROUND ROCK EMITTANCE SPECTRUM**

**EMITTANCE IS FOUND BY RATIOING THE TARGET RADIANCE TO A CALCULATED BLACKBODY RADIATOR AT THE SAME TEMPERATURE.**

**THE TARGET RADIANCE IS FOUND BY SUBTRACTING FROM THE INTERNAL REFERENCE SPECTRUM AN OBSERVED ROCK SPECTRUM MULTIPLIED BY THE INSTRUMENT RESPONSE FUNCTION.**

CONTINUE

**COMPUTE ABSOLUTE INTERNAL RADIANCE**

```
CALL ABSL (PLNK, REFT)
```

**COMPUTE RADIANCE FOR BLACKBODY AT TARGET TEMPERATURE**

```
CALL ABSL (IRAD, BBT)
```

**READ IN SPECTRA AND COMPUTE TARGET RADIANCE**

```
DO 41 I = 1,88
ASP (I) = 0.0
SSP (I) = 0.0
ARAD(I) = 0.0
SRAD(I) = 0.0
AEM (I) = 0.0
SEM (I) = 0.0
CONTINUE
```

```
DO 42 I = 1,NMAX
READ (DISK,END=45) DSK
```

```
DO 42 J = 1,88
SSP(J) = SSP(J) + RAW(J) ** 2
ASP(J) =ASP(J) + RAW(J)
```

**COMPUTE TARGET RADIANCE (T)**

```
T = PLNK(J) - RAW(J) * AINS(J)
ARAD(J) = ARAD(J) + T
SRAD(J) = SRAD(J) + T*T
```
C COMPUTE EMITTANCE (TT)
TT = T/IRAD(J)
AEM(J) = AEM(J) + TT
SEM(J) = SEM(J) + TT ** 2
CONTINUE

C
42
45
NSPEC = I - 1
EN = NSPEC

C FIND STANDARD DEVIATIONS
C
CALL SIGMA (ASP, SSP, EN, 88)
CALL SIGMA (ARAD, SRAD, EN, 88)
CALL SIGMA (AEM, SEM, EN, 88)

C FIND OVERALL AVERAGES
C
AASP = AVER (ASP, 88)
ASSP = AVER (SSP, 88)
AARAD = AVER (ARAD, 88)
ASRAD = AVER (SRAD, 88)
ASEM = AVER (SEM, 88)
AAEM = AVER (AEM, 88)

C PRINT AND PLOT RESULTS
C
WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
WRITE (PRINT,95) (CNT(I), ASP(I), SSP(I),
* ARAD(I), SRAD(I), AEM(I), SEM(I), I = 1,88)
WRITE (PRINT,96) AASP, ASSP, AARAD, ASRAD, AAEM, ASEM

C
WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLOT (ASP, SSP, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT,81)

C
WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLOT (ARAD, SRAD, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT,82)

C
WRITE (PRINT,68) MISS, FLT, REFT, BBT, NSPEC, NAME
CALL SPLOT (AEM, SEM, 0.0, 0.0, PRINT, 88, 91)
WRITE (PRINT,83)

C
GOTO 10
C END OF FILE READ
99 WRITE (PRINT,69)
STOP
C
C
51 FORMAT(A4,T10,2F10.5,12,T40,8A4)
54 FORMAT(I3,1X,I1)
55 FORMAT(A4,12)
61 FORMAT('// RSL0501 OPTION CODE INVALID')
62 FORMAT('//T54,'THEORETICAL NET IRRADIANCE')
63 FORMAT('//T50,'AVERAGED GROUND BLACKBODY SPECTRUM')
64 FORMAT('//T50,'INSTRUMENT RESPONSE CORRECTION FUNCTION')
65 FORMAT(T20,'AVER SPECTRUM',T40,'STANDARD DEV',T60,'AVER ',
   'AIRPATH',T80,'STANDARD DEV//(T10,4E20.3))
66 FORMAT(T11,6E20.3)
67 FORMAT(T23,'DIFFRAD',T40,'AVER SPECTRUM',T60,'STANDARD DEV',
   'T80,'INSTRANS',T100,'STANDARD DEV//(T10,5E20.3))
68 FORMAT(1,T10,'MISSION',I4,' FLIGHT ',I1,' CALIBRATION.'//
   'T10,'INTERNAL REFERENCE TEMPERATURE IS',F4.0,' DEGREES ' 
   'CENTIGRADE/'T10,'EXTERNAL TEMPERATURE IS',F4.0,' DEGREES CENTIGRADE.'//
   'T10,'USED',I3,' SPECTRA -- ',8A4//' */
69 FORMAT('1RSL0011 NORMAL END OF RUN')
81 FORMAT('//T54,'AVERAGED ROCK SPECTRUM')
82 FORMAT('//T60,'TARGET RADIANCE')
83 FORMAT('//T60,'EMITTANCE SPECTRUM')
86 FORMAT('//T47,'AVERAGED AIRBORNE BLACKBODY SPECTRUM')
87 FORMAT('//T51,'AIRPATH ABSORPTION SPECTRUM')
93 FORMAT(1,T10,'MISSION',I4,' FLIGHT ',I1,
   ' TEMPERATURE CONVERSION TABLE.'//
   'T10,'INTERNAL REFERENCE TEMPERATURE IS',F4.0,' DEGREES ' 
   'CENTIGRADE/'T10,'EXTERNAL TEMPERATURE IS',F4.0,' DEGREES CENTIGRADE.'//
   'T13,'READING',T33,'TEMPERATURE')
94 FORMAT(F17.0,F23.1)
95 FORMAT(T10,'AVER SPECTRUM',T30,'STANDARD DEV',T50,'TARGET RAD',
   'T70,'STANDARD DEV',T90,'EMITTANCE',T110,'STANDARD DEV//' 
   '(14,E16.3,5E20.3))
96 FORMAT(4X,E16.3,5E20.3)
97 FORMAT('0RSL0521 CANNOT COMPUTE TARGET RADIANCE')END
1.2 **Subroutine Splot**

```c
SUBROUTINE Splot (MEAN, SD, MIN, MAX, LOG, NPT, COUNT)
INTEGER COUNT
REAL  MIN, MAX, MEAN(NPT), SD(NPT)
REAL  GRAPH(101), YCORD(11), XXXX/'XXX', '****', MARK,
*     PLUS'/+++', MINUS'/---', DOT'/....', BLANK'/
C
XMIN = MIN
XMAX = MAX
NPTS = NPT
ICNT = COUNT
C
IF (XMIN .LT. XMAX) GOTO 10
C
FIND XMIN AND XMAX
C
XMIN = MEAN(1) - SD(1)
XMAX = MEAN(1) + SD(1)
DO 20 I = 2, NPTS
XMIN = AMIN1 (XMIN, MEAN(I) - SD(I))
XMAX = AMAX1 (XMAX, MEAN(I) + SD(I))
20 CONTINUE
FUDGE = .02 * (XMAX - XMIN)
XMAX = XMAX + FUDGE
XMIN = XMIN - FUDGE
C
DELTA = (XMAX - XMIN) / 100.
WRITE (LOG, 54) XMIN, XMAX, DELTA
C
COMPUTE AND PRINT Y COORDINATES
C
YCORD(1) = XMIN
DO 30 I = 2, 11
YCORD(I) = YCORD(I-1) + DELTA * 10.
30 CONTINUE
```
WRITE (LOG, 51) YCORD
WRITE (LOG, 52)
C
DO 50 I = 1, NPTS
C
INITIALIZE GRAPH LINE.
C
MARK = BLANK
IF (MOD(I, 10) .EQ. 0) MARK = DOT
DO 40 J = 1, 101
GRAPH(J) = MARK
CONTINUE
C
DO 30 J = 1, 101, 10
GRAPH(J) = DOT
30 CONTINUE
C
COMPUTE *, -, + POSITIONS.
C
SM = MEAN(I) - XMIN
ISM = SM/DELTA + 0.5
ISD = SD(I) / DELTA
ISL = ISM - ISD
ISH = ISM + ISD
IF (ISM .LT. 2) GOTO 40
LL = MINO (ISM - 1, 101)
DO 60 J = 1, LL
GRAPH(J) = XXXX
60 CONTINUE
C
40 IF (ISH .GE. 1 .AND. ISH .LE. 101) GRAPH(ISH) = PLUS
IF (ISL .GE. 1 .AND. ISL .LE. 101) GRAPH(ISL) = MINUS
IF (ISM .GE. 1 .AND. ISM .LE. 101) GRAPH(ISM) = STAR
C
WRITE (LOG, 53) MEAN(I), ICNT, GRAPH, ICNT
C
ICNT = ICNT + 1
50 CONTINUE
C
WRITE (LOG, 52)
WRITE (LOG, 51) YCORD
RETURN
C
51 FORMAT (17X, 11(E9.2, 1Y))
52 FORMAT (19X, 10('*********'), ' ')
53 FORMAT (3X, E10.2, 15, 1X, 101A1, 15)
END
1.3 **Subroutines Irrad and Absl**

SUBROUTINE IRRAD (IRAD, REFT, BBT)
REAL IRAD(88)
REAL LAM1/6.8/, LAM88/13.4/, C1/37410./, C2/14338./, PI/3.141593/

C DEFINE BLACK BODY RADIANCE FUNCTION
RAD (T, W) = C1 / (PI * (EXP (C2 / (W * T)) - 1.0) * W ** 5)

C COMPUTE NET IRRADIANCE

TEMP1 = REFT + 273.
TEMP2 = BBT + 273.
DLAM = (LAM88 - LAM1) / 87.0

DO 21 I = 1, 88
IRAD(I) = RAD(TEMP1, WW) - RAD(TEMP2, WW)
WW = WW + DLAM
21 CONTINUE

RETURN

C COMPUTE ABSOLUTE RADIANCE

ENTRY ABSL (IRAD, TEMP)

TEMP1 = TEMP + 273.

DO 22 I = 1, 88
IRAD(I) = RAD(TEMP1, WW)
WW = WW + DLAM
22 CONTINUE

RETURN

END
Subroutines TealC, Aver, and Sigma

REAL FUNCTION TCALC (REFT, FACT, DISK)
INTEGER DISK
REAL RAW(88), DSK(92)
EQUIVALENCE (RAW(1), DSK(5))

C
ACC = 0.0
DO 10 I = 1,30
READ (DISK, END=20) DSK
DO 10 J = 1,88
ACC = ACC + RAW(J)
10 CONTINUE

C
20 EN = FLOAT(I-1) * 88
TCALC = REFT + FACT * (ACC/EN)
REWIND DISK
RETURN
END

REAL FUNCTION AVER (A, N)
REAL A(N)
S = 0.0
DO 10 I = 1,N
10 S = S + A(I)
AVER = S / N
RETURN
END

SUBROUTINE SIGMA (MEAN, SD, EN, NPT)
REAL MEAN(NPT), SD(NPT)
DO 10 I = 1,NPT
SD(I) = SQRT ((SD(I) - MEAN(I)**2/EN) / (EN-1.0))
MEAN(I) = MEAN(I) / EN
10 CONTINUE
RETURN
END
2.1 Program Prep

PROGRAM PREP -- SPECTRUM PRE-PROCESSOR

PROGRAM DESCRIPTION

PREP reads raw spectral data in 1969 NASA format and outputs spectra within given time limits in standard format compatible with program task. Printed output consists of the identification header associated with each output spectrum, the recording time in the form HH:MM:SS.MSEC, the minimum, maximum, and average radiometer reading, and the standard deviation for the nine radiometer samples. The average raw spectrum, along with the standard deviation for each counter point is printed and plotted for each group of spectra processed.

RECORD FORMATS

The first twelve bytes are identical in both formats, these represent the identification part of the spectrum (8 bytes) and the time of day in elapsed milliseconds. Next come the spectrometer data points (88) in halfword integers on the tape, and fullword floating point on the output files. Last comes the calibration halfwords. The first nine of these are radiometer readings.

TEMPERATURE VARIANCE

Spectra whose temperature variance is greater than a given limit are now bypassed (2/9/71). A namelist must precede the control cards of the form: &PARMS TEMP=NNN., &END, where NNN is in millivolts.

DECK SETUP

RR UU AA AA AAAAA ZZ ZZ ZZZZZ TTTTTTTTTTTTTTTTTTTTTTTTTTTTT

R -- RAMP CODE (00=UP, 01=DOW)
U -- OUTPUT UNIT NUMBER (A DD CARD MUST BE SUPPLIED)
A -- START TIME IN HH MM SSSS FORMAT
Z -- STOP TIME IN SAME FORMAT
T -- THE REST OF THE CARD MAY CONTAIN A TITLE FOR THE PRINTED OUTPUT.

Any number of input cards may be used but the times must appear in increasing order to avoid re-reading the input dataset.
INTEGER CARD/5/, PRINT/6/, DISK, NMAX/88/, RMAX/9/
INTEGER AH, AM, AS, ZH, ZM, ZS, HR, MN, MS, TITLE(8)
INTEGER BEGIN, END, LAST, TIME/0/, DUMMY/0/
INTEGER NAME(2)/'UP', 'DOWN'/, DATE(5)
INTEGER INBUF(150), HEADER(6), RAD(35), RAMP
INTEGER*2 MISDAY, LINRUN, SITUNS, ERRAMP,
*    MIS, DAY, LIN, RUN, SIT, UNS, ERR
REAL SPECT(88), ASP(88), SSP(88), RSP(88), ZERO(88)/88*0.0/
EQUIVALENCE (INBUF(1), HEADER(1)), (INBUF(95), RAD(1))
EQUIVALENCE (HEADER(1), MISDAY),
*    (HEADER(2), LINRUN),
*    (HEADER(3), SITUNS),
*    (HEADER(4), ERRAMP),
*    (HEADER(5), TIME )

C
C DEFINE NAMELIST
DATA TEMP /150./
NAMELIST /PARMS/ TEMP
C
C DEFINE MILLISECOND CONVERSION FORMULA
MSEC (IH, IM, IS) = 3600000*IH + 60000*IM + IS
C
C READ NAMELIST
READ (CARD,PARMS)
RRMAX = RMAX
RNMAX = NMAX
NREAD = 0
C
C GET DAY DATE & TIME
CALL DATER (DATE)
C
C READ CONTROL CARD
10 READ (CARD,51,END=99) RAMP,DISK,AH,AM,AS,ZH,ZM,ZS,TITLE
   INAME = RAMP+1
   ICNT = 1
   IF (RAMP .EQ. 0) ICNT = 91
   WRITE (PRINT,61) NAME(INAME),AH,AM,AS,ZH,ZM,ZS,TITLE,DATE
C
C CONVERT TO MILLISECONDS
BEGIN = MSEC (AH,AM,AS)
END = MSEC (ZH,ZM,ZS)
C
C CHECK FOR ERRORS
IF (END .GE. BEGIN .AND. END .GE. BEGIN) GOTO 19
WRITE (PRINT,67) TITLE
GOTO 10
C
19 DO 20 I = 1,NMAX

20
ASP(I) = 0.0
SSP(I) = 0.0
CONTINUE
NSPEC = 0
NDEL = 0
AARAD = 0.0
ASRAD = 0.0
GHIGH = -1E70
GLOW = 1E70
WRITE (PRINT,64)
GOTO 15

C

INPUT READ LOOP
C
30 CALL RDNASA (INBUF, IEO\T)
IF (IEOT .EQ. 1) GOTO 40
NREAD = NREAD + 1
C
CHECK FOR ERROR AND WRONG RAMP AT SAME TIME
IF (ERRAMP .NE. RAMP) GOTO 30
C
CHECK FOR WITHIN TIME LIMITS
15 IF (TIME .LT. BEGIN) GOTO 30
IF (TIME .GT. END) GO TO 50
C
SPECTRUM FOUND WITHIN RANGE
NSPEC = NSPEC + 1
C
UNPACK HEADER
CALL UNPACK (MISDAY, MIS, DAY)
CALL UNPACK (LINRUN, LIN, RUN)
CALL UNPACK (SITUNS, SIT, UNS)
C
CONVERT TIME
HR = TIME/3600000
MN = MOD(TIME/60000,60)
NS = MOD(TIME,60000)
C
PROCESS RADIOMETER VALUES
A\RAD = 0.0
RHIGH = -1E70
RLow = 1E70
DO 45 I = 1,RMAX
R = RAD(I)
RHIGH = AMAX1 (RHIGH,R)
RLow = AMIN1 (RLow,R)
AARAD = AARAD + R
CONTINUE
S\RAD = RHIGH - RLOW
GHIGH = AMAX1 (GHIGH,RHIGH)
CONTINUE
GLOW = AMINI (GLOW, RLOW)
ARAD = ARAD/RRMAX
AARAD = AARAD + ARAD
ASRAD = ASRAD + SRAD

WRITE SPECTRUM AND RAD INFO
WRITE (PRINT,63) NSPEC, MIS, DAY, LIN, RUN, SIT, RAMP,
* HR, MN, MS, RLOW, RHIGH, ARAD, SRAD

CHECK FOR UNACCEPTABLE TEMPERATURE VARIANCE
IF (SRAD .LE. TEMP) GOTO 31
NDEL = NDEL + 1
WRITE (PRINT,71)
GOTO 30

SUM SPECTRA
DO 60 I = 1,NMAX
SPECT(I) = INBUF(I+6)
ASP(I) = ASP(I) + SPECT(I)
SSP(I) = SSP(I) + SPECT(I) ** 2
CONTINUE

WRITE OUTPUT RECORD
IF (DISK .NE. 0) WRITE (DISK) HEADER, DUMMY, SPECT, RAD
GOTO 30

END OF READ LOOP
RNSP = NSPEC
AARAD = AARAD / RNSP
ASRAD = ASRAD / RNSP
NSPEC = NSPEC - NDEL
IF (NSPEC .LT. 2) WRITE (PRINT,62)
IF (NSPEC .LT. 2) GOTO 10
WRITE (PRINT,85)
WRITE (PRINT,79) GLOW, GHIGH, AARAD, ASRAD

WRITE OUT AVERAGED SPECTRA, STANDARD DEV, AND REL ERROR
WRITE (PRINT,61) NAME(INAME),AH,AM,AS,ZH,ZM,ZS,TITLE,DATE
WRITE (PRINT,65) NSPEC
IF (RAMP .EQ. 0) WRITE (PRINT,81)
IF (RAMP .EQ. 1) WRITE (PRINT,82)
CALL TABLE (ASP, SSP, NMAX, NSPEC, ICNT, PRINT, 'RELATIVE')

PLOT AVERAGED SPECTRUM
WRITE (PRINT,61) NAME(INAME),AH,AM,AS,ZH,ZM,ZS,TITLE,DATE
WRITE (PRINT,65) NSPEC
IF (RAMP .EQ. 0) WRITE (PRINT,81)
IF (RAMP .EQ. 1) WRITE (PRINT,82)
CALL SPLLOT (ASP, SSP, 0.0, 0.0, PRINT, 88, ICNT)
WRITE (PRINT,84)
C PLOT STANDARD DEVIATION
WRITE (PRINT,61) NAME(INAME),AH,AM,AS,ZH,ZM,ZN,TITLE,DATE
WRITE (PRINT,65) NSPEC
IF (RAMP .EQ. 0) WRITE (PRINT,81)
IF (RAMP .EQ. 1) WRITE (PRINT,82)
CALL SPLOT (SSP, ZERO, 0.0, 100., PRINT, 88, ICNT)
WRITE (PRINT,83)
GOTO 10
C
C END OF FILE EXITS
40 WRITE (PRINT,68)
WRITE (PRINT,69) NREAD
STOP
99 WRITE (PRINT,69) NREAD
WRITE (PRINT,66)
STOP
C
C 51 FORMAT(4(12,1X),15,1X,2(12,1X),15,1X,8A4)
61 FORMAT('1',A4,' RAMP SPECTRUM GROUP (',2(12,1X),15,' TO ',
* 2(12,1X),15,' ) CALLED -- ',13A4)
62 FORMAT(' / / ' RSL0201 INSUFFICIENT RECORDS -- GROUP BYPASSED')
63 FORMAT(10X,17,3X,617,5X,213,16,3X,3F10.0,F10.1)
64 FORMAT(' / / ' RSL0011 NORMAL END OF RUN')
65 FORMAT(10X,17,3X,617,5X,213,16,3X,3F10.0,F10.1)
66 FORMAT(' / / ' RSL0011 NORMAL END OF RUN')
67 FORMAT(' / / ' RSL0321 TIMES NOT SPECIFIED IN INCREASING ORDER'/
* ' RSL0321 ',20A4)
68 FORMAT('0RSLO301 DATA EXHAUSTED -- END OF GROUP NOT FOUND')
69 FORMAT('1RSLO001 ',15,' RECORDS READ')
71 FORMAT('+',T130,'<=')
79 FORMAT('72X,'GROUP: ',3F10.0,F10.1)
81 FORMAT(' COUNTERS RANGE FROM 6.8 TO 13.4 MICRONS')
82 FORMAT(' COUNTERS RANGE FROM 13.4 TO 6.8 MICRONS')
83 FORMAT(' / / ' PLOT OF STANDARD DEVIATION')
84 FORMAT(' / / ' PLOT OF GROUP MEAN')
85 FORMAT(' / / ' PLOT OF STANDARD DEVIATION')
END
**Subroutine Table**

The routine computes and prints the mean, standard deviation, and relative error of each counter point in a group of spectra.

- **AVG** -- A vector containing the sum of the spectra
- **SD** -- A vector containing the sum of the spectra squared
- **NPT** -- The number of counter points
- **NSPCT** -- The number of spectra in the group
- **ICNT** -- The initial counter point sequence number
- **PRINT** -- Printer unit number
- **MODE** -- 'RELATIVE' for relative error, 'STANDARD' for standard error

```fortran
SUBROUTINE TABLE (AVG, SD, NPT, NSPCT, INCT, PRINT, MODE)
REAL AVG(NPT), SD(NPT), RE(100)
INTEGER PRINT, MODE(2), REL /'REL'/

COMPUTE STATISTICS
EN = NSPCT
SQRTN = SQRT (EN)
DO 10 I = 1,NPT
SD(I) = SQRT ((SD(I) - AVG(I)**2/EN) / (EN - 1.0))
AVG(I) = AVG(I) / EN
RE(I) = SD(I) / SQRTN
IF (MODE(1) .EQ. REL) RE(I) = RE(I) / AVG(I)
10 CONTINUE

FIND OVERALL AVERAGES
AAVG = AVER (AVG, NPT)
ASD = AVER (SD, NPT)
ARE = AVER (RE, NPT)
```
PRINT TABLE
WRITE (PRINT,63) MODE
IC = INCT
DO 20 I = 1,NPT
WRITE (PRINT,61) IC, AVG(I), SD(I), RE(I)
IC = IC + 1
20 CONTINUE
WRITE (PRINT,62) AAVG, ASD, ARE
RETURN
C
61 FORMAT (116,2F20.2,F20.5)
62 FORMAT (/T13,'MEAN' ,2F20.2,F20.5)
63 FORMAT (/T13,'COUNTER',T27,'AVER SPECTRUM',T48,'STANDARD DEV',
* T66,2A4,' ERROR')
END

2.3 Subroutine Xlate

SUBROUTINE Xlate (TIME, HMS)
INTEGER TIME, HMS(3)
C
C TRANSLATE FROM ELAPSED MSEC TO HH:MM:SS.MSEC FORMAT
C
HMS(1) = TIME / 3600000
HMS(2) = MOD (TIME/60000,60)
HMS(3) = MOD (TIME,60000)
C
RETURN
END
2.4 Subroutine Rdnasa

TITLE 'RDNASA -- NASA TAPE READ PROGRAM'
MACRO PROVIDE STANDARD OS LINKAGE
&CSECT LINKS &SAVE,&BASE=12 GIVE CSECT NAME, SAVEAREA NAME, AND GLOBAL BASE REG
LCLC &NAME SAVE IF SPECIFIED
&NAME SETC ' &SAVE' JUMP IF SPECIFIED
AIJ (' &NAME' NE ')').OK SET DEFAULT NAME
&NAME OK SETC 'SAVEAREA' DEFINE EXTERNAL SYMBOL
&CSECT CSECT SAVE CALLERS REGS
STM 14,12,12(13) SAVE POINTERS TO CALLERS SA
BALR &BASE,0 POINT TO CURRENT SA
USING *,&BASE PLANT LINK TO CURRENT SA
LR 10,13 PLANT LINK TO HIGHER SA
LA 13,&NAME BRANCH AROUND SAVEAREA
ST 13,8(0,10) ALLOCATE SAVEAREA
ST 10,4(0,13)
B **76
&NAME DC 18A(0)
MEND TEST FOR SUCCESSFUL OPEN

* MACRO DCB ADDR / BRANCH ADDR
&L TOPEN &DCB,&ADDR DCB ADDR / BRANCH ADDR
&L TN &DCB+48,X'10' TEST OPEN BIT
&L BO &ADDR TAKE BRANCH IF OPEN
MEND PRINT N0GEN
MEND
RDNASA LINKS
****************************************************************
****************************************************************

SUBROUTINE RDNASA (DATA, ILOT)
*
*
DATA -- OUTPUT HALFWORD ARRAY USED BY FORTRAN PROGRAMS.
*
ILOT -- SET TO ONE ON END OF FILE READS.
*
NASA -- DDNAME FOR INPUT DATASET.
*
*
PROGRAM FUNCTION
*
*
THIS ROUTINE READS SPECTRUM DATA RECORDS IN THE 1969 NASA
FORMAT (SEE DSECT). IT MOVES THE RAW DATA INTO THE
MAIN PROGRAM BUFFER AND CLIPS THE FIRST TWO SPECTROMETER
POINTS. THE CLIP IS TO CORRECT FOR THE TWO COUNTER POINT
ASYMMETRY BETWEEN UP AND DOWN RAMP RECORDS.
*
*
UP RAMP ..............................................
*
DOWN RAMP | ...........................................
[---------- LEADING DATA POINT ---------]
*
****************************************************************
DATA EQU 2
IEOT EQU 3
AIEOT EQU 4
L DATA,0(0,1) GET BASE ADDRESS OF DATA
L AIEOT,4(0,1) GET ADDRESS OF IEOT
SR IEOT,IEOT SET DEFAULT ZERO

TOPEN NASA,READ
OPEN NASA ATTEMPT TO OPEN
TOPEN NASA,READ
WTO 'RSL1001 NASA DD CARD MISSING'
ABEND 20

READ GET NASA LOCATE A RECORD
LA 1,4(0,1) SKIP RECORD CONTROL WORD.
MVC 0(NASAHDR,DATA),0(1) MOVE ID HEADER
MVC NASAHDR(REST,DATA),NASAHDR+4(1)

B DONE
EOT CLOSE (NASA,REREAD)
LA IEOT,1 SET END OF FILE INDICATOR
DONE ST IEOT,0(0,AIEOT) STORE IT
L 13,4(0,13)
RETURN (14,12)

NASA DCB DDNAME=NASA,DSORG=PS,RECFM=V,BLKSIZE=NASABUFL+4,
EODAD=EOT,MACRF=GL
TITLE 'NASA RECORD FORMAT'

NASARECD DSECT
NASARCW DS F RECORD CONTROL WORD
NASAMISS DS X MISSION
NASADAY DS X DAY
NASALINE DS X LINE
NASARUN DS X RUN
NASASITE DS X SITE
NASTOUNUS DS X UNUSED
NASAERR DS X ERROR INDICATOR
NASARAMP DS X RAMP CODE
NASATIME DS F TIME IN ELAPSED MSEC
NASAHDR EQU *-NASAMISS HEADER LENGTH
NASASPCT DS 90H SPECTROMETER DATA
NASARAD DS 9H RADIOMETER READING
DS 9H CALIBRATION DATA
DS 9H CALIBRATION DATA
DS 2H CALIBRATION DATA
DS 6H REMAINDER
NASELEN EQU *-NASAMISS RECORD LENGTH
NASABUFL EQU *-NASARCW BLOCK LENGTH
REST EQU *(NASASPCT+4)
TITLE 'STANDARD FORMAT USED BY TASK/PREP/PROC'

STANDRD DSECT
STDRCW DS F RECORD CONTROL WORD
STDMISS DS X MISSION
STDDAY DS X DAY
STDLINE DS X LINE
STDRUN DS X RUN
STDSITE DS X SITE
STDUNUS DS X UNUSED
STDERR DS X ERROR INDICATOR
STDRAMP DS X RAMP CODE
STDTIME DS F TIME IN ELAPSED MILLISECONDS
STDDUMMY DS F TASK PROCESSING HISTORY
STDSPECT DS 88F FLOATING POINT SPECTRAL DATA
STDRAD DS 35H INTEGER RADIOMETER DATA
STDLEN EQU *-STDMISS RECORD LENGTH

END

2.5 Subroutine Unpack

UNPACK LINKS
L R2,0(0,R1) POINT TO FIRST ARG
L R3,4(0,R1) POINT TO SECOND ARG
L R4,8(0,R1) POINT TO THIRD ARG
LH R5,0(0,R2) PICK UP FIRST ARG
N R5,X'000000FF' GET A BYTE
STH R5,0(0,R4) STORE THIRD ARG
LH R5,0(0,R2) PICK UP FIRST ARG
N R5,X'0000FF00' GET A BYTE
SRL R5,8 ALIGN IT
STH R5,0(0,R3) STORE SECOND ARG
L R13,4(0,R13) SCRAM
RETURN (14,12)
COPY REGS
END

31
2.6 Subroutine Dater

TITLE 'DATER -- ZELLER'S CONGRUENCE FOR DAY OF THE WEEK'
PRINT NGEN
DATER LINKS

******************************************************************************
** SUBROUTINE DATER (AREA) -- RETURNS DAY, DATE, AND TIME
** AREA MUST CONTAIN 20 BYTES.
**
** WORD 1 -- THREE CHARACTER DAY OF THE WEEK
** WORD 2/3 -- DATE IN THE FORM MM/DD/YY
** WORD 4/5 -- TIME OF DAY IN THE FORM (HH:MM)
**
** THIS IS AN ADAPTATION OF ZELLER'S CONGRUENCE
**
******************************************************************************

SLASH EQU C'/'
LPAR EQU C'(' 
RPAR EQU C')'
COLON EQU C':'
BLANK EQU C'

L 1,0(0,1) GET AREA ADDRESS
LR 3,1 SAVE AREA ADDRESS
USING RETURN,3 TELL ASSEMBLER
TIME DEC
STM 0,1,SAVE SAVE TIME AND DATE

UNPK RHOUR(3),TIMEHH(2) UNPACK TIME
UNPK RMIN(3),TIMEMM(2) UNPACK TIME
MVI RTIME,BLANK
MVI RLPAR,LPAR
MVI RCSUNCOLON,COLON
MVI RRPAR,RPAR
EJECT

XC TIME,TIME SET HIGHORDER BYTES TO ZERO
CVB 5,SAVE CONVERT YY,DDD TO BINARY
SR 4,4 CLEAR FOR DIVIDE
D 4,C1000 R4 = DDD R5 = YY
EX 5,TESTLEAP TEST FOR LEAP YEAR
BNZ **+10 SKIP IF NOT LEAP YEAR
MVC MCONS+2(2),LEAPFEB MODIFY FOR LEAP YEAR

SR 6,6 SET TO FIND MONTH
LOOP SH 4,MCONS(6) SUBTRACT UNTIL NOT PLUS
BHP OVER MONTH FOUND
LA 6,L'MCONS(0,6) POINT TO NEXT MONTH COUNT
B LOOP CONTINUE SEARCH
ADJUST DAY OF MONTH NUMBER
MONTH NUMBER IN R6 (0-11)
TEST FOR JAN OR FEB
THIS IS REQUIRED BY ZELLER
DECREASE YEAR BY 1
PUT YEAR (0-99) IN R9
CLEAR FOR DIVIDE
FIND FLOOR (YEAR/4)
MONTH NUMBER IN R8
NEED HALFWORD OFFSET
ADD FIRST AND FOURTH TERM
ADD DAY (1-31)
ADD IN YEAR (0-99)
ADD FIRST CENTURY TERM
IN CASE OF NEGATIVE SUM
FIND DAY OF THE WEEK
NEED FULLWORD OFFSET
DO IT THE PL/I WAY
GET ADDRESS OF DAY NAME
PLANT IN RETURN AREA
UNPACK YEAR (0-99)
MOVE TO CORRECT AREA
MOVE IN SLASH
GET DAY INTO PACKED DEC
UNPACK DAY OF THE MONTH
STICK IN VALID ZONE
MOVE IN SLASH
USE ONE-ORIGIN MONTH
GET MONTH INTO PACKED DEC
UNPACK MONTH OF THE YEAR
STICK IN VALID ZONE
CLEAR UNPK GARBAGE
RETURN TO CALLER
TIME MACRO SAVED HERE

MUST BE LOW HALF OF DBLE WD

\[ AL2(29,28,31,30,31,30,31,31,30,31,30,31) \]

\[ AL2(29,28,31,30,31,30,31,31,30,31,30,31) \]

\[ AL2(29) \]

\[ AL2(29) \]

\[ Y(2*CENTURY) \]

\[ Y(CENTURY/4) \]

\[ A(4) \]

\[ A(7) \]

\[ A(1000) \]

\[ X'03' \]

\[ 'RETURN AREA FORMAT' \]

\[ SAT 01/16/71 (15:25) \]

\[ 'RETURN AREA FORMAT' \]

\[ SAT 01/16/71 (15:25) \]
3.1 Program Proc

PROGRAM PROC -- SEPTEMBER 1970
STANFORD REMOTE SENSING LABORATORY

THIS PROGRAM READIES SELECTED IR SPECTRA FOR STATISTICAL ANALYSIS. THE DATA ARE RATIOED TO A BLACKBODY, NORMALIZED AND INVERTED. INDIVIDUAL AND AVERAGED SPECTRA ARE SAVED IN CARD IMAGE FORMAT ON SEPARATE FILES AFTER PROCESSING. ALTHOUGH THERE MAY BE ANY NUMBER OF INPUT DATASETS, ALL OUTPUT APPEARS ON TWO DATASETS, ONE FOR INDIVIDUALS AND ONE FOR COMPOSITES.

DDNAMES REQUIRED

FT05F001 -- INPUT CONTROL CARDS.
FT06F001 -- OUTPUT MESSAGES, TABLES, AND PLOTS.
FT07F001 -- OUTPUT FILE FOR INDIVIDUAL SPECTRA
FT08F001 -- OUTPUT FILE FOR AVERAGED SPECTRA
FTNNF001 -- INPUT DATASETS
FT99F001 -- INPUT BLACKBODY REFERENCE SPECTRUM

RECORD FORMATS

A. INPUT SPECTRA MUST BE IN "STANDARD" FORMAT. THIS MEANS THAT THE DATA WAS PRODUCED BY EITHER TASK OR PREP.
B. THE BLACKBODY DATA MUST BE PRE-AVERAGED AND IS USUALLY GENERATED BY PROGRAM AVERAGE AND SAVED ON DISK.
C. CARD OUTPUT CONSISTS OF AN IDENTIFICATION CARD, FOLLOWED BY THE DATA IN 8F9.4 FORMAT.
D. PRINTED OUTPUT CONSISTS OF LISTINGS AND PLOTS OF THE AVERAGED DATA AFTER PROCESSING.
E. THE CONTROL CARDS CONTAIN A UNIT NUMBER IN COLUMNS 4 AND 5 AND A DESCRIPTIVE NAME FOR THE DATA IN COLUMNS 31 - 70. THIS FORMAT IS THE SAME AS THAT USED BY PREP.
NAMELIST PARAMETERS

These variables may be altered using the &PARMS NAMELIST. The NAMELIST must be present and must be the first data in the input stream. It is followed by a card containing a description of the processing, which appears on the printed output. After this comes the control cards.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Function</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSZ</td>
<td>PLOT WIDTH</td>
<td>2.0</td>
</tr>
<tr>
<td>SMOOTH</td>
<td>SMOOTHING SWITCH</td>
<td>.TRUE.</td>
</tr>
<tr>
<td>ICARDS</td>
<td>INDIV CARDS SWITCH</td>
<td>.TRUE.</td>
</tr>
<tr>
<td>ACARDS</td>
<td>AVERAGE CARDS SWITCH</td>
<td>.TRUE.</td>
</tr>
<tr>
<td>LIST</td>
<td>DATA LISTING SWITCH</td>
<td>.TRUE.</td>
</tr>
<tr>
<td>PLOT</td>
<td>PLOT SWITCH</td>
<td>.TRUE.</td>
</tr>
<tr>
<td>SMTYPE</td>
<td>SMOOTHING TYPE</td>
<td>-9</td>
</tr>
<tr>
<td>BODY</td>
<td>BLACKBODY UNIT NO.</td>
<td>99</td>
</tr>
<tr>
<td>NCLIP</td>
<td>NO. OF POINTS CLIPPED</td>
<td>18</td>
</tr>
<tr>
<td>CNT</td>
<td>INITIAL SEQUENCE NO.</td>
<td>91</td>
</tr>
<tr>
<td>CARD</td>
<td>CONTROL INPUT UNIT</td>
<td>5</td>
</tr>
</tbody>
</table>

INTEGER CARD/5/, PRINT/6/, IOUT/7/, AOUT/8/, BODY/99/, DATE(5)
INTEGER CNT/91/, NCLIP/18/, SMTYPE/-9/, IER/0/
INTEGER NAME(8), HEAD(2), TIME, DISK, HMS(3), HMS2(3), DES(18)
REAL RAW(88), ASP(88), SSP(88), DSK(92), BLB(92), PSZ/2.0/
EQUIVALENCE (DSK(I), HEAD(I)), (DSK(3), TIME)
LOGICAL*1 SMOOTH/.TRUE./, ICARDS/.TRUE./, ACARDS/.TRUE./,
  * LIST /.TRUE./, PLOT /.TRUE./

DEFINE NAMELIST PARAMETERS
NAMELIST /PARMS/ PSZ, SMOOTH, ICARDS, ACARDS, LIST, PLOT,
  * SMTYPE, BODY, NCLIP, CNT, CARD

READ NAMELIST PARAMETERS
READ (CARD,PARMS)
WRITE (PRINT,PARMS)

SET PARAMETERS
CNT = CNT + NCLIP
NMAX = 88 - 2*NCLIP
C READ DESCRIPTOR
READ (CARD,52) DES
WRITE (PRINT,53) DES
C
C GET DAY DATE & TIME
CALL DATER (DATE)
C
C READ & CLIP BLACKBODY, IGNORE FOUR WORD HEADER
READ (BODY) BLB
DO 12 I = 1,NMAX
12 BLB(I) = BLB(I+4+NCLIP)
C
C READ CONTROL CARD
15 READ (CARD,51,END=44) DISK, NAME
C
DO 10 I = 1,NMAX
ASP(I) = 0.0
SSP(I) = 0.0
10 CONTINUE
C
C READ AND PROCESS SPECTRA
DO 30 I = 1,10000
READ (DISK,END=31) DSK
IF (I .EQ. 1) ITIME = TIME
C
C CLIP SPECTRUM, IGNORE FOUR WORD HEADER
DO 13 J = 1,NMAX
13 RAW(J) = DSK(J+4+NCLIP)
C
C RATIO SPECTRUM
DO 26 J = 1,NMAX
26 RAW(J) = RAW(J) / BLB(J)
C
C SMOOTH SPECTRA
IF (SMOOTH) CALL SM (RAW, NMAX, IER, SMTYPE)
IF (IER .EQ. 0) GOTO 17
WRITE (PRINT,67)
STOP
C
C NORMALIZE SPECTRUM
17 CALL NORM (RAW, NMAX)
C
C INVERT SPECTRUM
DO 27 J = 1,NMAX
27 RAW(J) = -RAW(J)
SUM RESULT
DO 25 J = 1,NMAX
ASP(J) = ASP(J) + RAW(J)
SSP(J) = SSP(J) + RAW(J) ** 2
25 CONTINUE

OUTPUT INDIVIDUAL SPECTRUM
CALL XLATE (TIME, HMS)
IF (ICARDS) WRITE (IOUT,71) HEAD, HMS, NAME, I, (RAW(J), J=1,NMAX)

CONTINUE

EOF ON SPECTRUM INPUT
NSPECT = I - 1
IF (NSPECT .LT. 2) WRITE (PRINT,69) NAME
IF (NSPECT .LT. 2) GOTO 15
CALL XLATE (ITIME, HMS2)

PRINT RESULTS
IF (LIST) WRITE(PRINT,62) NAME, HEAD, DATE, NSPECT, HMS2, HMS, DES
IF (LIST) CALL TABLE (ASP, SSP, NMAX, NSPECT, CNT, PRINT, 'STANDARD')

PLOT RESULTS
IF (PLOT) WRITE(PRINT,62) NAME, HEAD, DATE, NSPECT, HMS2, HMS, DES
IF (PLOT) CALL SPLOT (ASP, SSP, -PSZ, PSZ, PRINT, NMAX, CNT)

OUTPUT AVERAGED SPECTRUM AND STANDARD DEVIATION
IF (ACARDS) WRITE (AOUT,71) HEAD, HMS2, NAME, NSPECT,
* (ASP(J), J=1,NMAX)
IF (ACARDS) WRITE (AOUT,71) HEAD, HMS, NAME, NSPECT,
* (SSP(J), J=1,NMAX)

READ NEXT CONTROL CARD
GOTO 15

NO MORE CONTROL CARDS EXIT
44 WRITE (PRINT,66)
STOP
3.2 Subroutine Norm

SUBROUTINE NORM (A, N)
REAL A(N)
SUM = 0.0
SQS = 0.0
DO 10 I = 1,N
SUM = SUM + A(I)
SQS = SQS + A(I)**2
CONTINUE
EN = N
SQS = SQRT ((SQS - SUM ** 2 / EN) / (EN - 1.0))
SUM = SUM / EN
DO 20 I = 1,N
A(I) = (A(I) - SUM)/SQS
CONTINUE
RETURN
END
3.3 Subroutine Sm

SUBROUTINE SM (NDATA, N, IER, NMP)

C SMOOTHING SUBROUTINE WRITTEN BY J.R. MOORE
C
C NDATA=INPUT SPECTRUM & OUTPUT SMOOTHED SPECTRUM
C N=NUMBER OF POINTS
C IER=ERROR MESSAGE--0 IF OK, -1 IF NOT
C NMP=SMOOTHING TYPE
REAL NDATA(100),MDATA(100),NP(20)
IF(N.GT.100.OR.NMP.LT.-20.0R.NMP.GT.20) GO TO 900
NNP=NMP
IF(NMP.LT.0)NNP=-NMP
NXP=NNP
IF(NMP.EQ.-1) NNP=3
MM=NNP-1
M=N-MM
DO 20 I=1,N
20 MDATA(I)=NDATA(I)
DO 10 I=2,NNP
J=I-1
10 NP(I)=NDATA(J)
DO 200 I=1,MM
J=I+MM
DO 11 K=1,MM
KA=K+1
11 NP(K)=NP(KA)
NP(NNP)=NDATA(J)
IF(NMP.LT.0) GO TO 100
GO TO (300,900,900,900,101,900,102,900,103,900,104,900,
1401,900,900,900,402),NNP
100 SUM=17*NP(3)+12*(NP(2)+NP(4))-3*(NP(1)+NP(5))
MDATA(I+2)=SUM/35
GO TO 200
401 SUM=NP(1)+NP(2)+NP(3)+NP(4)+NP(5)+NP(6)+NP(7)+NP(8)+NP(9)+
NP(10)+NP(11)+NP(12)+NP(13)
MDATA(I+6)=SUM/13
GO TO 200
402 SUM=-21*(NP(1)+NP(17))-6*(NP(2)+NP(16))+7*(NP(3)+NP(15))+
118*(NP(4)+NP(14))+27*(NP(5)+NP(13))+34*(NP(6)+NP(12))+
139*(NP(7)+NP(11))+42*(NP(8)+NP(10))+43*NP(9)
MDATA(I+8)=SUM/323
GO TO 200
403 SUM=195*(NP(1)+NP(17))-195*(NP(2)+NP(16))-260*(NP(3)+NP(15))-1117*(NP(4)+NP(14))+135*(NP(5)+NP(13))+415*(NP(6)+NP(12))+
2660*(NP(7)+NP(11))+825*(NP(8)+NP(10))+883*(NP(9))
MDATA(I+8)=SUM/4199
GO TO 200
102 SUM=-2*(NP(1)+NP(7))+(3*(NP(2)+NP(6)))+(6*(NP(3)+NP(5)))+(7*NP(4))
MDATA(I+3)=SUM/21
GO TO 200
103 SUM=-21*(NP(1)+NP(9))+(14*(NP(2)+NP(8)))+(39*(NP(3)+NP(7)))+
154*(NP(4)+NP(6))+59*NP(5)
MDATA(I+4)=SUM/231
GO TO 200
300 SUM=NP(1)+NP(2)+NP(3)
MDATA(I+1)=SUM/3
GO TO 200
104 SUM=-36*(NP(1)+NP(11))+(9*(NP(2)+NP(10)))+(44*(NP(3)+NP(9)))+
160*(NP(4)+NP(8))+(84*(NP(5)+NP(7)))+(89*NP(6))
MDATA(I+5)=SUM/429
GO TO 200
100 CONTINUE
GO TO (300, 900, 900, 900, 101, 900, 106, 900, 107, 900, 108,
1900, 900, 900, 900, 900, 403), NXP
106 SUM=5*(NP(1)+NP(7))-(30*(NP(2)+NP(6)))+75*(NP(3)+NP(5))+131*NP(4)
MDATA(I+3)=SUM/231
GO TO 200
107 SUM=15*(NP(1)+NP(9))-(55*(NP(2)+NP(8)))+(30*(NP(3)+NP(7)))+
1135*(NP(4)+NP(6))+(179*NP(5))
MDATA(I+4)=SUM/429
GO TO 200
108 SUM=18*(NP(1)+NP(11))-(45*(NP(2)+NP(10)))-(10*(NP(3)+NP(9)))+
160*(NP(4)+NP(8))+(120*(NP(5)+NP(7)))+(143*NP(6))
MDATA(I+5)=SUM/429
200 CONTINUE
C
C RETURN MDATA IN NDATA
DO 500 I = 1, N
500 NDATA(I) = MDATA(I)
IER=0
RETURN
900 IER=-1
RETURN
END
4.1 Program Discard

Program Discard

Delete training spectra whose distance from the group mean is unacceptable

<table>
<thead>
<tr>
<th>DDNAME</th>
<th>Purpose</th>
<th>Variable Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT06F001</td>
<td>Listing file</td>
<td>PRINT</td>
</tr>
<tr>
<td>FT05F001</td>
<td>Control card file</td>
<td>CARD</td>
</tr>
<tr>
<td>FT10F001</td>
<td>Output spectra file</td>
<td>OUTPUT</td>
</tr>
<tr>
<td>FT03F001</td>
<td>Individual spectra input file</td>
<td>INDIV</td>
</tr>
<tr>
<td>FT04F001</td>
<td>Average spectrum input file</td>
<td>AVER</td>
</tr>
</tbody>
</table>

The above DDNAMES may be altered using the &PARMS NAMELIST and the rejection level is entered by giving "LIMIT".

A NAMELIST is read for each group.

```
INTEGER PRINT(5), CARD(5), OUTPUT(10), INDIV(3), AVER(4)
INTEGER FLAG, NAME(8), TIME(3)
REAL SPECT(52), ASP(52), LIMIT
REAL*8 WORD(2) /' ','REJECTED'/
```

Define NAMELIST

NAMELIST /PARMS/ LIMIT, PRINT, CARD, OUTPUT, INDIV, AVER

Read NAMELIST

READ (CARD,PARMS,END=88)

Read NAME, number of spectra, average spectrum

READ (AVER,51,END=88) NAME, NSPEC, ASP

WRITE (PRINT,61) NAME
C READ INDIVIDUAL SPECTRA
ICNT = 0
DO 20 I = 1, NSPEC
READ (INDIV,52,END=77) TIME, NAME, ISEQ, SPECT
TALLY = 0.0
DO 15 J = 1, 52
  TALLY = TALLY + (SPECT(J) - ASP(J)) ** 2
C
FLAG = 2
IF (TALLY .GT. LIMIT) GOTO 17
C
WRITE ACCEPTABLE SPECTRUM
WRITE (OUTPUT,52) TIME, NAME, ISEQ, SPECT
ICNT = ICNT + 1
FLAG = 1
C
17 WRITE (PRINT,63) ISEQ, TIME, TALLY, WORD(FLAG)
20 CONTINUE
C
GO READ NEXT GROUP
WRITE (PRINT,62) LIMIT, ICNT
GOTO 10
C
NORMAL END OF FILE EXIT
88 WRITE (PRINT,66)
STOP
C
ERROR END OF FILE EXIT
77 WRITE (PRINT,67)
STOP
C
51 FORMAT (T35,8A4, T68, I3/6(8F9.4/, 4F9.4/////////))
52 FORMAT (T22,213,lb, T35, 8A4, T68, I3/(8F9.4))
61 FORMAT (1H1,T15,8A4, T48, 'TIME', T58, 'DISTANCE', T69, 'DECISION'/)
62 FORMAT ('///T40, 'TOLERANCE', F5.0, ' LEAVES', 13, ' SPECTRA.' )
63 FORMAT (T38,14,'),14,1X,12,16,F10.4,3X,A8)
66 FORMAT ('1RSL0011  NORMAL END OF RUN')
67 FORMAT ('1RSL1451  UNEXPECTED END OF FILE')
END
5.1 **Program Trkload**

```plaintext
PROGRAM TRKLOAD -- TRUCK TAPE TO DISK

THIS PROGRAM READS TRUCK TAPES AND CREATES TWO OUTPUT FILES. DATA RECORDS ARE STORED IN A DIRECT ACCESS DATASET, AND IDENTIFICATION RECORDS ARE STORED IN A SEQUENTIAL DATASET WITH POINTERS TO THE CORRESPONDING DATA.

SPECTAPE DDNAME OF TRUCK TAPE. NO DCB PARAMETERS REQUIRED.
DIRECT DDNAME OF DATA OUTPUT FILE. DCB=(DSORG=DA,BLKSIZE=204)
FT10F001 DDNAME OF IDENTIFICATION FILE. DCB=(RECfm=FB,LRECl=40,BLKSIZE=3520)
FT06F001 DDNAME OF IDENTIFICATION LISTING FILE.
FT04F001 DDNAME OF DATA LISTING FILE.
FT05F001 DDNAME OF PARAMETER INPUT FILE. &PARMS LIST=F, ERRCNT=10, TERR=F, &END

IMPLICIT INTEGER*2 (A-Z)
INTEGER KEY(1), COUNT(0), PRINT(6), INDEX(10), DUMP(4), LRECL
INTEGER ERRCNT(10), CARD(5), NERR(0), NIDS(0), NINV(0), NREADS(0)
INTEGER JUMP, DATE(5), I, J, K, L, M, N
INTEGER DTLEN, IDLEN(20), DTSIZ(48)
LOGICAL LIST(/.FALSE./, TERR/*.FALSE./
DIMENSION SAVElD(6)

RDTRK COMMON DEFINITION
COMMON /TDATA/ INPA(200), IDENT(6), SPECT(48), RADIO(48), MULT(6)
DEFINE DIGITIZED (0,1023) TO DECIVOLTS (-100,100) FORMULA
DVOLT(RAW) = (200*RAW - 102300) / 1023
DEFINE AND READ NAMELIST
NAMELIST /PARMS/ ERRC'T, LIST, TERR
READ (CARD,PARMS,END=2) CONTINUE

INITIALIZE
DTLEN = DTSIZ*4 + 12
IF (TERR) CALL NOERR
CALL DATER (DATE)
WRITE (PRINT,65) DATE
ASSIGN 11 TO JUMP
```
CALL RDTRK (LRECL)
NREADS = NREADS + 1
IF (LRECL .EQ. IDLEN) GOTO 12
IF (LRECL .LT. 0) GOTO 80
IF (LRECL .EQ. 0) STOP

BUFL = LRECL/2
WRITE (PRINT,61) NREADS, LRECL, (INPA(J), J = 1,BUFL)
NINV = NINV + 1
GOTO 11

DO 10 I = 1,6
10 SAVEID(I) = IDENT(I)
SAVKEY = KEY

READ INPUT TAPE
ASSIGN 20 TO JUMP
CALL RDTRK (LRECL)
NREADS = NREADS + 1

IF (LRECL .EQ. DTLEN) GOTO 30
IF (LRECL .EQ. IDLEN) GOTO 40
IF (LRECL .EQ. 0) GOTO 50
IF (LRECL .LT. 0) GOTO 80

BAD LRECL, IGNORE RECORD
NINV = NINV + 1
BUFL = LRECL/2
WRITE (PRINT,61) NREADS, LRECL, (INPA(J), J = 1,BUFL)
WRITE (PRINT,67)
GOTO 20

DATA RECORD FOUND
DO 31 M = 1,DTSIZ
SPECT(M) = DVOLT(SPECT(M))
31 RADIO(M) = DVOLT(RADIO(M))
DO 32 M = 1,6
32 MULT(M) = DVOLT(MULT(M))
CALL DLOAD (SPECT, KEY)
IF (.NOT. LIST) GOTO 49

WRITE (DUMP,72) KEY, (SPECT(N), N = 1,DTSIZ)
WRITE (DUMP,73) (RADIO(N), N = 1,DTSIZ)
WRITE (DUMP,74) MULT

KEY = KEY + 1
COUNT = COUNT + 1
GOTO 20
C IDENTIFICATION RECORD FOUND
40 IF (COUNT .NE. 0) GOTO 47
C IDENTIFICATION RECORD CONTAINS NO DATA
WRITE (PRINT,62) SAVEID
NINV = NINV + 1
GOTO 45
C WRITE IDENTIFICATION RECORD
47 NIDS = NIDS + 1
WRITE (INDEX,66) SAVEID, SAVKEY, COUNT
WRITE (PRINT,64) NIDS, SAVEID, SAVKEY, COUNT
SAVKEY = KEY
COUNT = 0
C 45 DO 46 I = 1,6
46 SAVEID(I) = IDENT(I)
GOTO 20
C END OF FILE EXIT
50 IF (COUNT .NE. 0) GOTO 48
C IDENTIFICATION RECORD CONTAINS NO DATA
WRITE (PRINT,62) SAVEID
NINV = NINV + 1
GOTO 60
C WRITE FINAL IDENTIFICATION RECORD
48 NIDS = NIDS + 1
WRITE (INDEX,66) SAVEID, SAVKEY, COUNT
WRITE (PRINT,64) NIDS, SAVEID, SAVKEY, COUNT
NREADS = NREADS - 1
KEY = KEY - 1
WRITE (PRINT,63) NREADS, NIDS, KEY, NINV, NERR
IF (LIST) WRITE (DUMP,63) NREADS, NIDS, KEY, NINV, NERR
STOP

C
READ ERROR ROUTINE

WRITE (PRINT,69) NREADS, (INPA(J), J = 1,160)
NERR = NERR + 1
IF (NERR .LE. ERRCNT) GOTO JUMP, (11, 20)

C
TOO MANY ERRORS
WRITE (PRINT,71) NREADS
STOP

FORMAT(///' RSL0421 RECORD',15,' INVALID',14,' BYTES'///
* (' RSL0421',16Z6))

FORMAT(///' RSL0401 IDENTIFICATION RECORD CONTAINS NO DATA'///
* ' RSL0401 DAY IS ',19/
* ' RSL0401 TIME IS ',313/
* ' RSL0401 SAMPLE IS ',19/
* ' RSL0401 SITE IS ',19///)

FORMAT('1RSL0001',16,' RECORDS READ'/
* ' RSL0001',16,' IDENTIFICATION RECORDS SAVED'/
* ' RSL0001',16,' DATA RECORDS SAVED'/
* ' RSL0001',16,' INVALID RECORDS FOUND'/
* ' RSL0001',16,' PERMANENT READ ERRORS'/
* ' RSL0011 NORMAL END OF RUN')

FORMAT(T15,14,'') DAY =',14,'; TIME =',313,'; SAMPLE =',
* 14,'; SITE =',14,'; START =',15,'; COUNT =',13)

FORMAT(1'T35,'IDENTIFICATION RECORDS SAVED ON ',5A4///<
65 FORMAT(815)
66 FORMAT(///)

FORMAT(///' RSL0441 RECORD NO',15,' PERMANENT READ ERROR'///
* 10(' RSL0441',16Z6)/////)

FORMAT(///' RSL0461 I/O ERROR COUNT EXCEEDED ',15,
* ' RECORDS READ')

FORMAT(1'T32,'RECORD NO.',15//' SPECTROMETER DATA'/(8I10))

FORMAT(///' RADIOMETER DATA'/(8I10))

FORMAT(///' MULTIPLEXED DATA'//6110)
END
5.2 Subroutine Rdtrk

TITLE 'SG-4 SPECTROMETER TAPE READ ROUTINE'

* MACRO
&L BCD &TO,&FROM CONVERT FROM PACKED BCD
&L LH TEM2,&FROM TO HALFWORD INTEGER
&L SDL TEMP,24 PICK UP BCD HALFWORD
&L SRL TEM2,26 SEPARATE BYTES
&L LA BCD,'F' GET UNITS DIGIT
&L NR BCD,TEMP LOAD MASK
&L MH BCD,=Y(100) GET HUNDREDS DIGIT
&L AR BCD,TEM2 SCALE
&L LH TEM2,&FROM ADD UNITS DIGIT
&L SR TEMP,TEMP PICK UP BCD HALFWORD
&L STH BCD,&TO CLEAR TEMP
&L SLL TEMP,20 GET RIGHT HALF OF TENS DIGIT
&L SRL TEM2,10 GET LEFT HALF OF TENS DIGIT
&L SRL TEMP,28 ALIGN LEFT HALF
&L OR TEMP,TEM2 PUT HALFS TOGETHER
&L MH TEMP,=Y(10) SCALE
&L AR BCD,TEMP SUM
&L STH BCD,&TO STORE HALFWORD RESULT

* MACRO
&L TENBIT &TO,&FROM CONVERT FROM SG CODE TO 1*2
&L LH TEM2,&FROM TO/FROM ARE HALFWORDS
&L SDL TEMP,51 PICK UP DATA
&L SRDL TEMP,27 GET RID OF SYNC BIT
&L SDL TEM2,19 ALIGN
&L OR TEMP,TEM2 ALIGN
&L STH TEMP,&TO PUT TOGETHER
&L MEND STORE CONVERTED DATA
WRITE TO OPERATOR MACRO
WRITE LIMIT NUMBER OF TIMES
GO SET UP MESSAGE AREA
GO PRINT OUT MESSAGE AREA
MACRO FORM ERROR
MESSAGE ADDR MUST BE GIVEN
COUNTER NAME SYMBOL
PICK UP COUNTER
DECREMENT AND JUMP
IGNORE WRITE REQUEST
RESTORE COUNTER
LOAD ARG LIST POINTER
ISSUE WTO SVC
JUMP COUNTER
SAVE COUNTER HERE
DEFINE WTO MESSAGE AREA
LABEL SYMBOL NEEDED
BYTE COUNT NEEDED
GET ON A FULLWORD BOUNDARY
DEFINE MESSAGE LENGTH FOR OS
REQUIRED BY OS
ALLOCATE BLANK MESSAGE AREA

* SGNSIZ EQU 10
SGDSIZ EQU 48
SUBROUTINE RDTRK (LRECL)

LRECL -- SIZE IN BYTES OF CURRENT RECORD, SET TO ZERO ON EOF READS.
SPECTAPE -- DDNAME FOR INPUT DATA SET
TDATA -- FORTRAN COMMON, HALFWORD INTEGERS

COMMON /TDATA/ INPA(200), IDENT(6), SPECT(48), RADIO(48), MULT(6)

THIS FORTRAN CALLABLE SUBROUTINE READS DATA READ FROM 7-TRACK MAG TAPE GENERATED BY STANFORDS SG-4 SPECTROMETER SYSTEM.
THE RAW DATA IS CONTAINED IN TWO DIFFERENT RECORD FORMATS, EACH OF A DIFFERENT PHYSICAL LENGTH AND DATA RECORDING MODE.
THE IDENTIFICATION RECORD CONTAINS DATA IN A PACKED BCD FORMAT WHERE EACH PAIR OF SIX BIT BYTES CONTAIN THREE FOUR BIT BCD CHARACTERS.

TAPE BCD FORMAT: 001FGHIJ 000ABCDE
CONVERTED FORMAT: 000000AB CDEFGHIJ

TAPE BCD FORMAT: 00EF IJKL 00ABCD GH
CONVERTED FORMAT: ABCD + 10*EFGH + 100*IJKL

THE DATA IS RETURNED IN COMMON TO FORTRAN, ALL NUMBERS ARE CONVERTED TO 16 BIT TWO'S COMPLEMENT INTEGERS.

L LRECL,0(0,PARM) GET ARG ADDRESS
SR COUNT,COUNT SET COUNT TO ZERO
TITLE 'OPEN, READ, CLOSE SECTION'
OPEN SPECTAPE,READ
TOPEN SPECTAPE
WTO 'RSL1001 SPECTAPE DD CARD MISSING'
ABEND 20,DUMP

50
<table>
<thead>
<tr>
<th>READ</th>
<th>READ</th>
<th>DECB, SF, SPECTAPE, INPA, 'S'</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK</td>
<td>DECB</td>
<td></td>
</tr>
<tr>
<td>LTR</td>
<td>COUNT, COUNT</td>
<td>DID WE GET AN ERROR?</td>
</tr>
<tr>
<td>DM</td>
<td>EXIT</td>
<td>IF SO EXIT</td>
</tr>
<tr>
<td>L</td>
<td>CBASE = V(TDATA)</td>
<td>ESTABLISH COMMON BASE REG</td>
</tr>
<tr>
<td>USING</td>
<td>INPA, CBASE</td>
<td>GET BLOCK BYTE COUNT</td>
</tr>
<tr>
<td>BAL</td>
<td>LINKR, BLKSIZE</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>COUNT = A(SGIDSIZ)</td>
<td>CHECK FOR IDENT RECORD</td>
</tr>
<tr>
<td>BE</td>
<td>IDCONV</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>COUNT = A(SGDTDSIZ)</td>
<td>CHECK FOR DATA RECORD</td>
</tr>
<tr>
<td>BE</td>
<td>DATACONV</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>EXIT</td>
<td>RECORD LENGTH ERROR</td>
</tr>
</tbody>
</table>

* EODAD | CLOSE | (SPECTAPE, LEAVE) | LEAVE FOR MULTIPLE FILES |
* EXIT  | COUNT, 0(0, LRECL) | RETURN LRECL TO FORTRAN |
| L     | SAVER, 4(0, SAVER) |                             |
| RETURN | (14, 12) |                             |
| TITLE | 'IDENTIFICATION CONVERSION ROUTINE' |                             |

IDCONV | DS | 0H |
| BCD   | DAY, SGDAY |                             |
| BCD   | TIMEH, SGTIME |                             |
| BCD   | TIMEH, SGTIME+2 |                             |
| BCD   | SAMPLE, SGSAMPLE |                             |
| BCD   | SITE, SGSITE |                             |

* SR | TEMP, TEMP | FIX TIME |
| LH  | TEM2, TIMEM | LOAD LOWEST THREE DIGITS |
| D   | TEMP = $'100' | EXTRACT LOW ORDER TWO DIGITS |
| STH | TEMP, TIMES | STORE SECONDS |
| ST  | TEM2, CSAVE | SAVE LOW ORDER MINUTES DIGIT |
| LH  | TEM2, TIMEH | LOAD HIGH ORDER THREE DIGITS |
| SR  | TEMP, TEMP | CLEAR EVEN REGISTER |
| D   | TEMP = $'10' | EXTRACT HIGH ORDER TWO DIGITS |
| STH | TEM2, TIMEH | SAVE HOUR DIGITS |
| MH  | TEMP = $'10' | SCALE HIGH ORDER MINUTE DIGIT |
| A   | TEMP, CSAVE | ADD LOW ORDER MINUTE DIGIT |
| STH | TEMP, TIMEM | SAVE MINUTES |
| B   | EXIT |                             |
CSAVE | DS | F |
DATA CONV
DS OH
LA POINT, SGCHANLA
LA STEP, 4
LA LIMIT, SGMULT-4
SR INDEX, INDEX

DLOOP
DS OH
TENBIT SPECT(INDEX), 0(0, POINT)
TENBIT RADIO(INDEX), 2(0, POINT)
LA INDEX, 2(0, INDEX)
BXLE POINT, STEP, DLOOP

MLOOP
DS OH
TENBIT MULT(INDEX), SGMULT(INDEX)
LA INDEX, 2(0, INDEX)
BCT LIMIT, MLOOP
B EXIT
TITLE 'ROUTINE TO TURN OFF ERROR RETRY BITS'
ENTRY NOERR

NOERR
USING *, 15
BR 14
DROP 15
TITLE 'INPUT BLKSIZE ROUTINE'

BLKSIZE
DS OH
L POINT, DECB+16
L TEMP, 12(0, POINT)
N TEMP, MASK
L COUNT, SPECTAPE+60
N COUNT, MASK
SR COUNT, TEMP
BR LINKR
DS 0F
MASK DC X'0000FFFF'
TITLE 'READ ERROR ROUTINE'

SYNAD
DS 0H
SYNADAF ACSR=MES=8SAM
STM 14,1,ERRSAV SAVE OS REGISTERS
MVC STATUS(S7),=CL27'RS1101 I/O ERROR INFO --'
MVC STATUS+27(78),50(PARM)
WTOP STATUS, LIMIT=20, MF=E
L COUNT, =F'-1' SET ERROR FLAG
SYNADRLS
LM 14,1,ERRSAV RESTORE THE REGISTERS
BR 14 RETURN TO CHECK MODULE

* ERSAV DC 4A(0)
STATUS WTOP 27+78, MF=L
SPECTAPE DCB DDNAME=SPECTAPE, DSOE=PS, RECFM=U, BLKSIZE=400, MACRF=R,
EODAD=EODAD, SYNAD=SYNAD

LTORG
TITLE 'COMMON DEFINITION'

TDATA COM
INPA DS 50D 400 BYTE INPUT AREA

* ORG INPA BACK TO START OF INPUT AREA
SGIDENT EQU * IDENTIFICATION RECORD FORMAT
SGNOISE DS (SGNSIZ)X NOISE BYTES
SGDAY DS 2X THREE DIGIT (BCD) DAY
SGTIME DS 4X SIX DIGIT TIME HH.MM.SS
SGSAMPLE DS 2X SAMPLE IDENTIFICATION
SGSITE DS 2X SITE IDENTIFICATION
SGIDSIZ EQU *-SGIDENT DEFINE SIZE OF IDENT RECORD

* ORG INPA BACK TO START OF INPUT AREA
SGDATA EQU * DATA RECORD FORMAT
SGCHANLA DS 2X FIRST SPECTROMETER HALFWORD
SGCHANLB DS 2X FIRST RADIOMETER HALFWORD
DS (4*(SGDSIZ-1))X REMAINDER OF SPECT/RAD DATA
SGMULT DS (2*6)X MULTIPLEX DATA
SGDTSIZ EQU *-SGDATA DEFINE SIZE OF DATA RECORD

* ORG , RESET LOCATION COUNTER
IDENT DS 6H ALLOCATE RESULT AREA
* ORG IDENT TO DEFINE IDENT SUBFIELDS
DAY DS 2X CONVERTED FROM ABOVE
TIMEH DS 2X
TIMEM DS 2X
TIMES DS 2X
SAMPLE DS 2X
SITE DS 2X
*SPECT DS 48H CONVERTED SPECTRUM AREA
RADIO DS 48H CONVERTED RADIOMETER AREA
MULT DS 6H CONVERTED MULTIPLEX AREA
* COMLENG EQU *-INPA LENGTH SHOULD_agree_with_MAIN
* TITLE 'REGISTER DEFINITIONS'

PARM EQU 1
TEMP EQU 2
TEM2 EQU TEMP+1
STEP EQU 4
LIMIT EQU 5
LRECL EQU 6
BCD EQU 7
COUNT EQU 8
POINT EQU 9
INDEX EQU 10
CBASE EQU 11
BASE EQU 12
SAVER EQU 13
LINKR EQU 14
END
5.3 **Subroutine Daload**

PRINT Nogen

DALOAD LINKS

*****************************************************************

**SUBROUTINE DALOAD (DATA, KEY)**

**DATA** -- LOCATION OF DATA TO BE WRITTEN

**KEY** -- ERROR CHECKING FEATURE, IF ZERO

NO ERROR CHECKING WILL BE DONE,

ELSE IT MUST AGREE WITH THE KEY

OF THE BLOCK CURRENTLY BEING WRITTEN.

**DIRECT** -- DDNAME OF DIRECT ACCESS DATASET.

BLKSIZE MUST APPEAR IN JCL.

**NOGEN**

*****************************************************************

L DATA,0(0,PARM) GET POINTERS TO ARGS
L KEY,4(0,PARM)
CLC BLKCNT,=F'0' FIRST TIME THRU?
BNE OPENED
OPEN (DIRECT,(OUTPUT))
TOPEN DIRECT,OPENED
WTO 'RSL1001 DIRECT DD CARD MISSING'
ABEND 20,DUMP
OPENED L TEMP,BLKCNT
LA TEMP,1(0,TEMP) INCREMENT BLOCK COUNT
ST TEMP,BLKCNT
S TEMP,0(0,KEY) ERROR CHECK
C TEMP,BLKCNT WAS KEY ZERO?
BE WRITE
C TEMP,=F'0' WAS KEY EQUAL TO BLKCNT?
BE WRITE
WTO 'RSL1201 DIRECT ACCESS KEY INVALID'
B ABEND
WRITE DEC8, SF, DIRECT,(2)
CHECK DEC8
L SAVER, 4(0,SAVER)
RETURN (14,12)
TITLE 'DATA CONTROL BLOCK'
PRINT GEN
DIRECT DCB DDNAME=DIRECT,DSORG=PS,OPTCD=C,RECFM=F,MACRF=WL
BLKCNT DC F'0'
TITLE 'REGISTER DEFINITIONS.'
PARM EQU 1
DATA EQU 2
KEY EQU 3
TEMP EQU 4
TEM2 EQU 5
BASE EQU 12
SAVER EQU 13
LINKR EQU 14
END
DISTRIBUTION LIST

NASA - WASHINGTON

J. DeNoyer/Arch Park. 1

NASA - HOUSTON

T. Barnett
Larry York/W. E. Hensley 4

Technical Information Dissemination Branch 4

NASA - GODDARD

Warren Hovis 1

USGS

W. H. Hemphill 1
K. Watson 1
S. Gawarecki 1

OTHERS

Branner Library 1
Dave Landgrebe 1
Jack Quade 1
Keenan Lee 1
R. K. Moore 1
V. Myres 1
R. B. MacDonald 1
Files 1

25