Final Report

INVESTIGATIONS INTO MIRROR FABRICATION METROLOGY ANALYSIS

Contract No. NAS8-38609, D.O. 74
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Submitted by:

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1. ABSTRACT

This final report describes the work performed under this delivery order from June 1993 through August 1994. The scope of work included three distinct tasks in support of the AXAF-I program. The objective of the first task was to perform investigations of the grinding and polishing characteristics of the zerodur material by fabricating several samples. The second task was to continue the development of the integrated optical performance modeling software for AXAF-I. The purpose of third and final task was to develop and update the database of AXAF technical documents for an easy and rapid access.

The MSFC Optical and metrology shops were relocated from the B-wing of Building 4487 to Room BC 144 of Building 4466 in the beginning of this contract. This included dismantling, packing and moving the equipment from its old location, and then reassembling it at the new location. A total of 65 zerodur samples, measuring 1" x 2" x 6" were ground and polished to a surface figure of $\lambda/10$ p-v, and a surface finish of 5Å rms were fabricated for coating tests. A number of special purpose tools and metal mirrors were also fabricated to support various AXAF-I development activities. In the metrology area, the ZYGO Mark IV interferometer was relocated and also upgraded with a faster and more powerful processor. Surface metrology work was also performed on the coating samples and other optics using ZYGO interferometer and WYKO profilometer.

A number of new features have been added to the GRAZTRACE program to enhance its analysis and modeling capabilities. A number of new commands have been added to the command mode GRAZTRACE program to provide a better control to the user on the program execution and data manipulation. Some commands and parameter entries have been reorganized for a uniform format. The command mode version of the convolution program CONVOLVE has been developed. An on-line help system and a user's manual have also been developed for the benefit of the users.

The database of AXAF technical documents continues to progress. The titles, company name, date and location of over 390 documents have been entered in this database. This database provides both a data search and retrieval function, and a data adding function. These functions allow a user to quickly search the data files for documents or add new information. A detailed user's guide has also been prepared. This user guide includes a document classification guide, a list of abbreviations, and a list of acronyms, which have been used in compiling this database of AXAF-I technical documents.

install and certify the upgrade to the ZYGO Mark IV Interferometer system. The system is now a ZYGO Mark IV-xp that has a faster and more powerful processor.

The fabrication of 55 AXAF coating samples was completed. The samples measure 1 x 2 x 6 inches and are made of Zerodur. The 2 x 6 inch optical surface was ground and polished to a surface figure of one-tenth wave P-V (at 632.8 nm.) and a surface finish of better than 5 angstroms (RMS). The other surfaces were buffed to an inspection shine.

Also, for polishing the samples, the old lap was stripped off the 48-inch planetary polisher and the entire machine was cleaned. This was necessary since the machine was contaminated when it was moved from MSFC Building 4487 and set up in the new Building 4466. The repairs were also performed on the continuous polisher to ensure a problem-free operation including the replacement of the drive belt on spider and the replacement/adjustment of the spring on pan sweep.

UAH personnel also performed a controlled grind on the optical surface of an additional 10 bars. These bars will be used as coating witness samples to be tested in a synchrotron chamber by SAO personnel. The final polishing was performed on these bars to obtain a figure of 0.3 λ to 0.5 λ prior to deblocking the individual bars. After deblocking, the bars were tested individually to ascertain the figure readings. The bars that met 0.1 λ requirement were wrapped up and set aside (5 total). The remaining bars are being placed, 2 at a time in a septum, on 48" continuous polisher and polished until the figure requirement is met.

UAH personnel also provided support to AXAF-I program by fabricating various tooling, in the machine shop and in the glass shop. Using the WYKO profilometer, various measurements on several AXAF nickel-plated samples were performed to explore various polishing techniques. This also required fabrication of appropriate tooling.

Ed Horton resigned form UAH near the beginning of this delivery order. However, he was replaced by Greg Martin without any adverse effect on the work to be accomplished.

4. DEVELOPMENT OF PERFORMANCE PREDICTION SOFTWARE (TASK 2)

The first software task was the development of an image evaluation program to model the detector scan output. The high frequency surface errors had to be taken into account as surface scattering. The geometric ray trace result obtained by GRAZTRACE had also to be convolved with the scattering data in the detector scan model.

The convolution program CONVOLVE is an image analysis software package. With the CONVOLVE and GRAZTRACE programs, the performance of an x-ray system can be predicted through modeling of various detector scans. The program convolves the x-ray source distribution, the GRAZTRACE image data and the mirror surface scattering data. The

b. File exist check has been added to the program. In the "restore" command, the file check will tell the user to retry if the file does not exist. In the "save" command, the file check will notify the user to either overwrite or retry if the file already exists.

c. EDI command common area error has been fixed.

d. ZLI command has been added to set the "zlim" parameter.

e. Help file access from any directory has been provided by defining the full path.

f. Parameter entry order in multi-field commands has been reorganized to have a uniform format.

g. Inquiry command has been enhanced to allow the users to check all multi-dimensional data at any level.

h. Sequential file execution mode has been implemented to allow the command mode GRAZTRACE to perform macro and batch running.

i. Temporary file for the built-in editor now has a random file name to prevent the error caused by multiple execution of the program in the same directory.

j. SES and OUT commands have been added to save the executed commands and output text to files. ECH command has also been added to echo the command input.

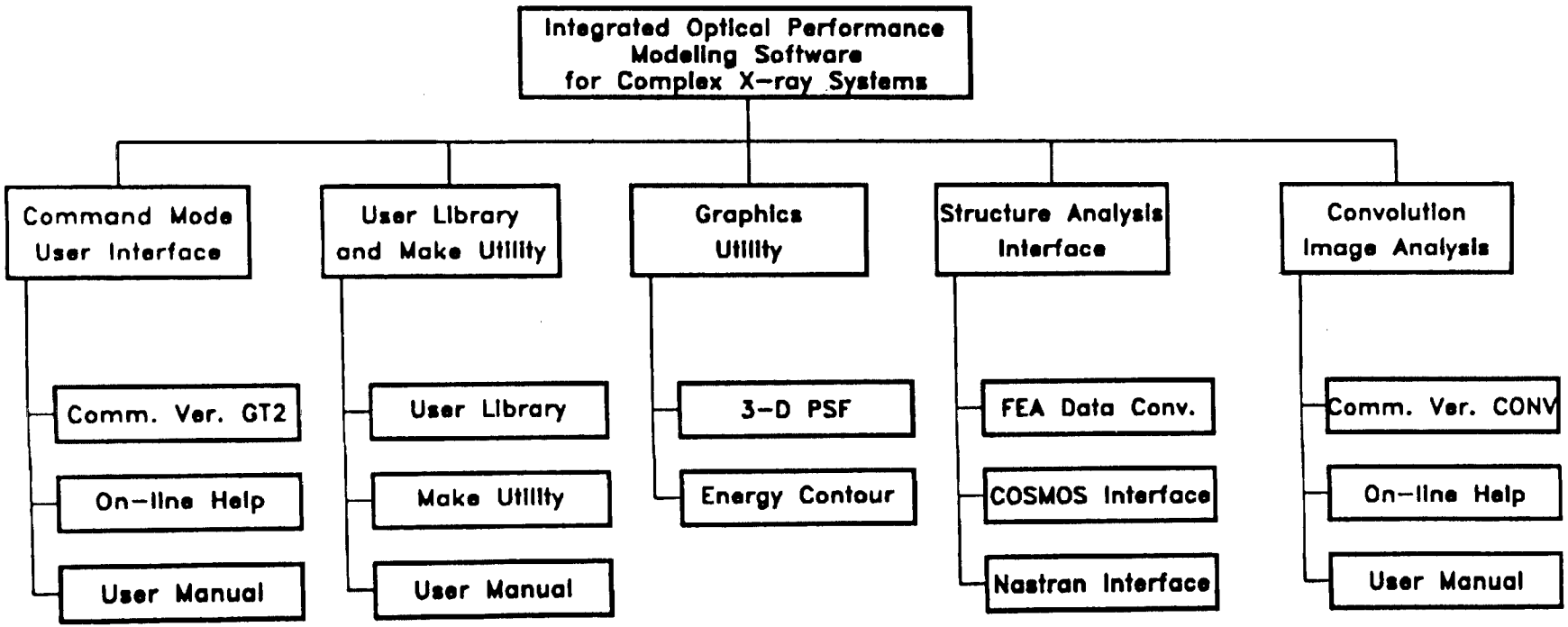
k. Recover feature has been added to allow the user to recover the whole session after an abnormal termination of the program.

l. Source codes and help file have been put into SCCS (source code control system) to monitor the changes, and to protect them from accidental deletion. Now several people can work on the code development without interfering with each other.

A general purpose translation program has been completed to convert the output data files of finite element analysis programs such as NASTRAN and COSMOS/M to GRAZTRACE deformation file (.dfm file). This translation program can accept data in the form of standard output files or list files, and provides the flexibility of using randomly spaced grid points for FEA. Also, there is no restriction on the number and order of node points. When the translation program is executed, the user can interactively perform coordinate transformation, origin shift and scaling and axial length changes. This translation program was tested and evaluated for predicting the effects of structural distortions for the Solar X-ray Imager (SXI) electroformed mirror.

A similar scheme will be used for developing a translation program to convert the surface metrology data to a format compatible for GRAZTRACE input. A meeting was held at MSFC to discuss the interface of metrology data with the GRAZTRACE program. MSFC

SOFTWARE FOR AXAF-I PERFORMANCE ANALYSIS



origin and content. Documents having the same classification code are further ordered by date.

In addition to the classification guide, there are two other appendices. Appendix B contains a list of 234 abbreviations related to the AXAF project. Appendix C contains a list of 383 acronyms, also associated with the AXAF project.

Data Files

Initially it was thought that some automated method could be developed, using the powerful UNIX operating system utilities for (text) pattern searching and processing, to standardize the existing data files. However, the non-uniformity of the data files coupled with the fact that the actual documents themselves were in disarray soon made it clear that the best approach to establishing the database and organizing the documents would be to start from ground zero.

Once the work of creating a standard format for the new data files and writing the database program was done, work on establishing the data files commenced. The work on the data files began by pulling all of the documents from a particular company out of its filing cabinet. The documents were then sorted and entered into the database. Then, each document was placed in its own manila folder with a new detailed label and re-filed. Once all of the documents from one company were completed, the process was repeated for the documents from another.

Present State of the Database

Work on entering the documents into the database has slowed, in part, because the UAH person is also working on another contract with Dr. Amzajerdian and Mr. Gary Spiers.

As of the date of this report, documents from five of the nine active AXAF files have been entered into the database and organized: TRW, Inc., Science Instruments, OCLI, Eastman Kodak Co., and SAO.

Currently, the documents from Schott Glaswerke are being entered into the database. The four remaining files whose documents have yet to be entered and subsequently re-filed are HDOS, Project (MSFC), TMA (Technology Mirror Assembly, an AXAF predecessor), and AXAF S (spectroscopic). There are, as of yet, no documents associated with an eleventh and inactive file which is for Ball Aerospace, Inc.

APPENDIX 1

CONVOLVE
User Manual

Command Mode
X-ray Image Analysis Program

Section 1. INTRODUTION

Command Mode CONVOLVE allows the users to interactively use the convloution program in image analysis through various detector scans modelling. The command structure and format are the same as those in command mode GRAZTRACE. Commands cover input selections, control commands, and scans modeling.

1.1 Command summary

More than 30 commands have been furnished in the command interpreter.

Input selections:

IMF define image ray data file name

EEF define scattering distribution file name

CNV convolve imaging and scatering data

Control commands:

EXI exit the program

CAN cancel all the options

SYS operating system shell

Image analysis:

SCA scan area

GRD grid scan

WIN write intensity file

BLB block bounded energy distribution

Section 2. SAMPLE SESSION

This section contains a detailed and realistic "sample session" in CONVOLVE command mode. This sample session will give user a quick start to become familiar with CONVOLVE program.

The progam can be invoked by typing CONV. The command mode prompt CONVOL> will show up. Key in any command interactively, followed by a carriage return <Enter>. To quit the program, use the Exit command. The program will prompt the user to confirm exiting the program.

```
zeus{chen}49>conv
```

```
*******************************
*                             *
*       IMAGE ANALYSIS        *
*                             *
*******************************
```

```
CONVOL>IMF sxi3.gtray ! select input image file
Read in  scattering file
sxi3.gtray

1 ray intercept file: sxi3.gtray

 rays      20000
 energies  4
 net z shift   0.00000000000000000E+00
 input focal length   0.6573753635237400E+03
 comments 20

 energy values:
 1    -0.10000000000000000E+01

 2     0.27700000000000000E+00
```

```
 weight total   0.1687263016540063E+03
 weight average   0.8436315082700317E-02
 weight rms   0.1529528425530240E-03
 wmin=   0.8164165942176118E-02,   wmax=   0.8693121510592393E-02
CONVOL>EEF sxi.mod.eeout ! select input scattering file
Read in  scattering file
sxi.mod.eeout


 ascii encircled energy file: sxi.mod.eeout

 ee values        380
 assumed focal length   0.6573753635237400E+03
 energy   0.2770000000000000E+00
 comments  5

 sxi similar to sxt case 3

 core reduced to 2.06 arc seconds rms diameter

 (design spreading of on-axis image removed)

 psd down to 0.05 cyc/mm

 d.e.zissa, october 1, 1992


 integrated probablilty values        759
            per centage=   0.04,   displacement (arc sec)=   -239.1730
 no.  1,    per centage=   1.00,   displacement (arc sec)=    -11.3440
 no.  2,    per centage=   2.00,   displacement (arc sec)=     -8.3162
 no.  3,    per centage=   3.00,   displacement (arc sec)=     -6.9237
 no.  4,    per centage=   4.00,   displacement (arc sec)=     -6.0493
 no.  5,    per centage=   5.00,   displacement (arc sec)=     -5.4212
 no.  6,    per centage=   6.00,   displacement (arc sec)=     -4.9344
 no.  7,    per centage=   7.00,   displacement (arc sec)=     -4.5383
 no.  8,    per centage=   8.00,   displacement (arc sec)=     -4.2052
 no.  9,    per centage=   9.00,   displacement (arc sec)=     -3.9186
 no. 10,    per centage=  10.00,   displacement (arc sec)=     -3.6674
 no. 11,    per centage=  11.00,   displacement (arc sec)=     -3.4440
 no. 12,    per centage=  12.00,   displacement (arc sec)=     -3.2426
 no. 13,    per centage=  13.00,   displacement (arc sec)=     -3.0590
 no. 14,    per centage=  14.00,   displacement (arc sec)=     -2.8901
 no. 15,    per centage=  15.00,   displacement (arc sec)=     -2.7333
 no. 16,    per centage=  16.00,   displacement (arc sec)=     -2.5869
 no. 17,    per centage=  17.00,   displacement (arc sec)=     -2.4494
 no. 18,    per centage=  18.00,   displacement (arc sec)=     -2.3198
 no. 19,    per centage=  19.00,   displacement (arc sec)=     -2.1972
 no. 20,    per centage=  20.00,   displacement (arc sec)=     -2.0809
 no. 21,    per centage=  21.00,   displacement (arc sec)=     -1.9705
 no. 22,    per centage=  22.00,   displacement (arc sec)=     -1.8653
 no. 23,    per centage=  23.00,   displacement (arc sec)=     -1.7651
 no. 24,    per centage=  24.00,   displacement (arc sec)=     -1.6695
 no. 25,    per centage=  25.00,   displacement (arc sec)=     -1.5782
```

```
 no. 80,    per centage=  80.00,    displacement (arc sec)=      2.0809
 no. 81,    per centage=  81.00,    displacement (arc sec)=      2.1972
 no. 82,    per centage=  82.00,    displacement (arc sec)=      2.3198
 no. 83,    per centage=  83.00,    displacement (arc sec)=      2.4494
 no. 84,    per centage=  84.00,    displacement (arc sec)=      2.5869
 no. 85,    per centage=  85.00,    displacement (arc sec)=      2.7333
 no. 86,    per centage=  86.00,    displacement (arc sec)=      2.8901
 no. 87,    per centage=  87.00,    displacement (arc sec)=      3.0590
 no. 88,    per centage=  88.00,    displacement (arc sec)=      3.2426
 no. 89,    per centage=  89.00,    displacement (arc sec)=      3.4440
 no. 90,    per centage=  90.00,    displacement (arc sec)=      3.6674
 no. 91,    per centage=  91.00,    displacement (arc sec)=      3.9186
 no. 92,    per centage=  92.00,    displacement (arc sec)=      4.2052
 no. 93,    per centage=  93.00,    displacement (arc sec)=      4.5383
 no. 94,    per centage=  94.00,    displacement (arc sec)=      4.9344
 no. 95,    per centage=  95.00,    displacement (arc sec)=      5.4212
 no. 96,    per centage=  96.00,    displacement (arc sec)=      6.0493
 no. 97,    per centage=  97.00,    displacement (arc sec)=      6.9237
 no. 98,    per centage=  98.00,    displacement (arc sec)=      8.3162
 no. 99,    per centage=  99.00,    displacement (arc sec)=     11.3440
            per centage=  99.96,    displacement (arc sec)=    239.1730
CONVOL>ENE ? ! check energy pointer
iener =  2
CONVOL>IMA ? ! check image pointer
ima =  1
CONVOL>CNV ! perform convolution
   CNV>GO ! execute the option

 iener=  2
 nmult=           5
 asig2=   0.0000000000000000E+00,   csig2=   0.0000000000000000E+00
 xsig2=   0.0000000000000000E+00,   ysig2=   0.0000000000000000E+00
 ugauss= (  0.1000000000000000E+01,   0.0000000000000000E+00)
 xlen2=   0.0000000000000000E+00,   ylen2=   0.0000000000000000E+00
 urect= (  0.1000000000000000E+01,   0.0000000000000000E+00)
 diam2=   0.0000000000000000E+00

CONVOL>SCA ! scan area
   SCA>GO

 scanarea output
 scan direction (  0.1000000000000000E+01,     0.0000000000000000E+00)
 scan length for centroid calculation   0.3187045698606638E+00
 scan width   0.3187045698606638E-01
 energy flag  2
 centroid ( -0.1594535593398104E-05,     0.8707513390032706E-14)
 total weight in full scan   0.5015319716534087E+03
 unweighted points in full scan      94366
 fraction of weight for centroid calculation   0.9999681625259412E+00
CONVOL>GRD ! grid scan
   GRD>GO
 lgrdscn rectangular detector scan
      19 x points and      19 y points
 x full width of scan points   0.1800000000000000E+00
```

```
  0.046  0.008  0.002  0.001  0.000  0.000  0.000  0.000  0.000
y= -0.020|  0.000  0.000  0.000  0.000  0.000  0.000  0.001  0.003
0.009  0.013
  0.009  0.003  0.001  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.030|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.001
0.002  0.002
  0.002  0.001  0.000  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.040|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.001  0.001
  0.001  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.050|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000
  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.060|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000
  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.070|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000
  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.080|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000
  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
y= -0.090|  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000
  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
CONVOL>BLB ! blocked bounded energy distribution
   BLB>GO

1blockbed bounded energy distribution
 scan width   0.50000000000000000E-02
 center ( -0.1594535593398104E-05,     0.8707513390032706E-14)
 scan direction (  0.10000000000000000E+01,     0.00000000000000000E+00)
 normalization   0.5015319716534087E+03
 energy flag 2

 bed values:

 no.     full width(sec)      fraction       full width

    1              0.0500       0.0316         0.00016
    2              0.1000       0.0560         0.00032
    3              0.1500       0.0770         0.00048
    4              0.2000       0.0955         0.00064
    5              0.2500       0.1116         0.00080
    6              0.3000       0.1267         0.00096
    7              0.3500       0.1406         0.00112
    8              0.4000       0.1537         0.00127
    9              0.4500       0.1661         0.00143
   10              0.5000       0.1783         0.00159
   11              0.5500       0.1892         0.00175
   12              0.6000       0.1996         0.00191
   13              0.6500       0.2091         0.00207
   14              0.7000       0.2187         0.00223
   15              0.7500       0.2273         0.00239
```

no.	position (arc sec)	fraction	position
1	-0.1250	0.95939	-0.00040
2	15.5635	0.00188	0.04960
3	31.2520	0.00016	0.09960
4	46.9405	0.00004	0.14960
5	62.6290	0.00000	0.19960
6	78.3176	0.00000	0.24960
7	94.0061	0.00000	0.29960
8	109.6946	0.00001	0.34960
9	125.3831	0.00000	0.39960
10	141.0716	0.00000	0.44960
11	156.7601	0.00000	0.49960
12	172.4486	0.00000	0.54960
13	188.1371	0.00000	0.59960
14	203.8256	0.00000	0.64960
15	219.5141	0.00000	0.69960
16	235.2027	0.00000	0.74960
17	250.8912	0.00000	0.79960
18	266.5797	0.00000	0.84960
19	282.2682	0.00000	0.89960
20	297.9567	0.00000	0.94960

CONVOL>**PNS** ! pinhole detector scan
PNS>**GO**
lpinscan circular pinhole detector scan
diameter of scan 0.50000000000000E-02
scan direction (0.10000000000000E+01, 0.00000000000000E+00)
scan center (-0.1594535593398104E-05, 0.8707513390032706E-14)
energy flag 0
normalization 0.5015319716534087E+03

profile values:

no.	position (arc sec)	fraction	position
1	-23.5328	0.00000	-0.07500
2	-21.0556	0.00000	-0.06711
3	-18.5785	0.00000	-0.05921
4	-16.1014	0.00000	-0.05132
5	-13.6242	0.00000	-0.04342
6	-11.1471	0.00000	-0.03553
7	-8.6700	0.00000	-0.02763
8	-6.1928	0.00000	-0.01974
9	-3.7157	0.00000	-0.01184
10	-1.2386	0.00000	-0.00395
11	1.2386	0.00000	0.00395
12	3.7157	0.00000	0.01184
13	6.1928	0.00000	0.01974
14	8.6700	0.00000	0.02763
15	11.1471	0.00000	0.03553
16	13.6242	0.00000	0.04342
17	16.1014	0.00000	0.05132
18	18.5785	0.00000	0.05921
19	21.0556	0.00000	0.06711

```
   11              22.0000         0.9798          0.07012
   12              24.0000         0.9835          0.07649
   13              26.0000         0.9862          0.08286
   14              28.0000         0.9883          0.08924
   15              30.0000         0.9899          0.09561
   16              32.0000         0.9911          0.10199
   17              34.0000         0.9923          0.10836
   18              36.0000         0.9932          0.11473
   19              38.0000         0.9940          0.12111
   20              40.0000         0.9946          0.12748
CONVOL>EXI ! exiting the program
EXITING THE PROGRAM ? (Y/N)Y
zeus{chen}49>
```

INPUT SELECTIONS

Select input data.

COMMAND MNEMONICS

IMF EEF CNV

THE TASK — **Define image ray data file name**

Command Syntax	
Screen Prompt	Explanation
IMF [filspec]	
	Define image ray data file name to be used in convolution image analysis.
EEF [filspec]	
	Define scattering distribution data file name to be used in convolution image analysis.

COMMAND MNEMONICS

? GO CAN SYS EXI

DATA INPUT DESCRIPTION

Command Syntax	
Screen Prompt	Explanation
?	
	? in data field entry will allow to check current value
GO	
	Execute the option using all previously entered option inputs and then return control to the command level
CAN	
	Cancel all inputs to this option and return control to the command level
SYS ['OP_SYS_COMMAND']	
	Execute operating system commands
EXI	
	Exit from CONVOL to the operating system. When EXI is typed in, a query is issued requiring a Yes or No answer (Y or N); a Y will cancel any option you are in and complete the exit. (Default is N.)

CONVOLUTION (CNV)

CNV convolves scattering distribution with ray distribution.

COMMAND MNEMONICS

MUL AGA CGA SSI UGA REC URE DIA ENE DBG

DATA INPUT DESCRIPTION

Command Syntax		
Screen Prompt	Explanation	Default
MUL multiplicity		
Multiplicity	Cancel the default set and set desired random multiplicity	5
AGA asig		
axial sigma	Set axial gaussian sigma in arc sec	0
CGA csig		
circumferential sigma	Set circumferential gaussian sigma in arc sec	0
SSI xsig ysig		
x sigma, y sigma	Set x and y sigma of fixed gaussian distribution in arc sec	0, 0
UGA ugauss(1) ugauss(2)		
direction	Set direction of x axis of gaussian distribution	1, 0
REC xlen ylen		
widths	Set rectangular distribution width in arc sec	0, 0

SCAN AREA (SCA)

SCA find centroid and normalization of scan

COMMAND MNEMONICS

USC SLE DSI ENE

DATA INPUT DESCRIPTION

Command Syntax		
Screen Prompt	Explanation	Default
USC uscan(1), uscan(2)		
Scan direction	Set scan direction vector	1, 0
SLE flen		
Scan length	Define range of scan in mm	100*fac
DSI width height		
Detector size	Define detector size in mm	10*fac, 10*fac
ENE iener		
Energy pointer	Set energy pointer	2

PRINT INTENSITY (WIN)

WIN prints out grid of intensity values.

COMMAND MNEMONICS

NGR WGR

DATA INPUT DESCRIPTION

Command Syntax		
Screen Prompt	Explanation	Default
WGR xwidth ywidth		
Grid widths	Set grid size in mm	0.1, 0.1

BLOCK SCAN (BLS)

BLS block scan

COMMAND MNEMONICS

NPTS DSI SLE CEN USC NOR ENE

DATA INPUT DESCRIPTION

Command Syntax		
Screen Prompt	Explanation	Default
NPTS		
Number of points	Set sample number	20
DSI width height		
Detector size	Set detector size	10*fac, 10#fac
SLE flen		
Scan length	Set scan length	100*fac
CEN xcem ucem		
Center of scan	Set center of scan	0, 0
USC uscan(1) uscan(2)		
Direction vector	Set scan direction vector	1,0
NOR fnorm		
Normalization	Set normalization factor	
ENE iener		
Energy pointer	Set energy pointer	2

PINHOLE SCAN (PNS)

PNS scans pinhole detector

COMMAND MNEMONICS

NPT DIA CEN USC NOR ENE

DATA INPUT DESCRIPTION

Command Syntax		
Screen Prompt	Explanation	Default
NPT npts		
Number of points	Set sample number	20
DIA diam		
Detector diameter	Set detector diameter	0
CEN xcen ycen		
Center of grid	Set center of grid	0, 0
USC uscan(1), uscan(2)		
Scan direction	Set scan direction vector	1, 0
NOR fnorm		
Normalization	Override normalization factor	
ENE iener		
Energy pointer	Set energy pointer	2

CONVOL

INTERCEPT SHIFT (SHI)

SHI shifts ray intercepts in axial (z) direction and updates net shift value

THE TASK — Intercept shift

Command Syntax		
Screen Prompt	Explanation	Default
SHI shift		
	Shift the ray intercept plane along axial direction by (shift) and update net shift value (zshift)	

APPENDIX 2

AXAF DATABASE USER'S GUIDE

OVERVIEW

The AXAF database program allows you to both search the AXAF data files for information related to a specific key word or time (period), and to add new entries to the AXAF data files. In order to use the database, you must first change to the directory named AXAFDB. Then type "axafdb<RETURN>." The database program will guide you from there.

GENERAL

The data files do not contain the actual documents. Rather, "header information" (the date, the title, the location, and the filing order of the document) is stored in the data files in one line records. Utilizing this header information allows for quick, automated searches through large numbers of documents. Many abbreviations and acronyms are used in order to fit as much of the title information as possible into each data record. A list of abbreviations may be found in Appendix B and a list of acronyms may be found in Appendix C.

LIMITATIONS OF THE DATA SEARCH & RETRIEVAL FUNCTION

The data search and retrieval function takes the key word that you enter, which is simply a character string representing a word, word fragment, acronym, abbreviation, date, or etc., and searches the data file you specify for an occurrence of that string, either alone or within a larger string.

However, the search and retrieval function cannot perform multi-level searches. For example: Say you want to find all the documents in the Smithsonian Astrophysical Observatory (SAO) files on the X-ray Detection System. Entering "XDS<SPACE> SAO<RETURN>" when the search and retrieve function prompts you for a key word will return an error.

See SUGGESTIONS ON SEARCHING for a complete discussion of search methods.

MAIN DATABASE MENU

When the AXAF database program is run, the main menu will appear which looks like the following:

*** AXAF database ***

Do you want to:

1. Search the database
2. Update the database
3. Quit the database

Enter the number of your selection...

At the prompt, enter the number corresponding to the function you wish to perform.

SORT THE FINDINGS ALPHABETICALLY OR CHRONOLOGICALLY

Next, you will be asked if you want the findings of the search sorted chronologically, with the most recent date last, or alphabetically. If you want the findings sorted chronologically, enter "C." To have the findings sorted alphabetically, enter "A."

DISPLAY THE FINDINGS

The program will search the specified data file for the character string you entered. Then it will sort its findings in the format you indicated and display them. The findings will be displayed one screen at a time. To get the next screen of the findings to display, press the SPACE bar once. To see just the next line of the findings, press the RETURN key once. If you wish to stop displaying the findings in mid stream, press the "Q" key.

PRINT THE FINDINGS

When all of the findings for a particular key word have been displayed or when you abort the display process by pressing the "Q" key, you will be asked if want a hard copy of the findings. If so, enter "Y" and the findings will be printed on pvenus. If you elect not to have the findings printed out, enter "N."

SEARCH AGAIN

Next, you will be asked if you want to search on another key word. If not, enter "N." If so, enter "Y" and you will also be asked if you want to search the same data file. If you want to search the same data file, enter "Y." If not, enter "N" and you will be shown the data file menu again and asked to select a new file to search. Finally, you will be asked to enter the key word for the new search and the process will start over.

SUGGESTIONS ON SEARCHING

There are a number of ways which you can search the database for information. You can search by document date, classification code, title, or location. You may also search for a word, word fragment, abbreviation, or acronym occurring in the information for which you are looking.

SEARCHING BY DATE

Each document in the database has a date. The dates are of the format yearmonthday (i.e. for a document whose date is June 14, 1994, the date in the database for that document would be 19940614 where 1994 is the year, 06 is the month, and 14 is the day). If you know any part of the date of the document or documents you want to find, then, when you are prompted to enter the key word, enter a year (e.g. 1993), or a month (e.g. 199312 for December 1993), or a day (e.g. 19931229 for December 29, 1993), and the database will return information on all the documents which fall into that particular time frame.

If you know a key word, such as "MIRROR," that is in the title of the document or documents you are searching for, typing "MIR<RETURN>" when you are prompted to enter the key word for the search will direct the database to display information on all the documents whose title contains the string "MIR."

DATA UPDATING FUNCTION

The database data updating function allows you to catalog information about old or new AXAF documents into the database. You will be prompted to enter four (4) items of information about the document you are cataloging: the FILENAME, the DATE, the CLASSIFICATION CODE, and the TITLE.

After entering the items, you will be shown the new entry and asked to confirm whether or not it is correct.

Finally, you will be asked if you want to add another entry to the current data file or to another data file. If you want to add another entry to the current data file, you will be returned to the place where you are prompted for the date of the document and the process will continue from there. If you want to add entries to a different data file, you will be returned to the file menu where you can select a different file to update and the whole process will repeat from there.

The most important thing to remember when adding new entries is to insure that they are entered accurately. You will have two opportunities to review the items of each entry. The first time will be just after you enter a particular item of information. The second time will be just before the new entry is added to the database, where you will see the complete entry as it will appear in the data files.

FILE NAME

The data updating function first displays a menu of the individual data files, most all of which are directly associated with a company working on the AXAF project. There are at present eleven (11) individual data files. The menu looks like this:

SELECT A FILE TO UPDATE

1. AXAF BALL
2. AXAF HDOS
3. AXAF KODAK
4. AXAF OCLI
5. AXAF PROJ
6. AXAF S
7. AXAF SAO
8. AXAF SCHOTT
9. AXAF SI
10. AXAF TMA
11. AXAF TRW

Enter the number of your selection...

TITLE

In this section you are prompted for the title of the document. The title will be, at most, forty (40) printing characters. (Printing characters are alphanumerics, underscores, hyphens, and etc.) The letters used must be all capital. You should use the abbreviations and acronyms listed in Appendices B and C in order to fit as much of the title as possible into the entry. Once the title is entered, the program will echo it to you for confirmation. If it is correct, respond by entering "Y." If the title is incorrect, enter "N" and you will be asked to enter the title again. If an error occurs, simply heed the error message and re-enter the title accordingly. Use the scale on the line just above the prompt to gauge how many characters you have typed.

It is important that the words which are completely spelled out are spelled correctly. Otherwise, when using a particular word for a search, you will not be able to find information on a document which contains that word misspelled.

VERIFYING & ADDING

Now, the complete new entry is presented to you just as it will appear in the data file. This is the last chance to abort adding the entry to the data file. You will be asked to confirm that the entry is correct and that you desire to add it to the data file you specified. If you want to add the entry, enter "Y." If you decide not to add the new entry, enter "N."

MORE DATA

Next, you will be asked if you want to add another entry to the data file you are currently updating. If so, enter "Y" and the program returns to the DATE section and begins asking you for information about the new entry. If you are done adding information to the current data file, enter "N" and you will be asked if data is to be added to another file. If you want to add data to another file, enter "Y" and the program returns to the FILE NAME section and asks you to select another file to update. If not, enter "N" and the program returns to the Main Menu.

MISCELLANEOUS

This section contains information on various topics not directly related to the operation of the database.

REMOVING UNWANTED ENTRIES FROM THE DATA FILES

At this time, there is no provision for deleting unwanted entries from the database. The only way to do this is to textedit the individual data file, remove the unwanted entry by "cutting" out that specific line, and then saving the data file. You must also do the same to the master data file.

Since the operating system keeps backup copies of files (denoted by an "%" symbol at the end of the file name), it would be prudent to remove the backup file from the disk once you are through deleting entries. Otherwise, you will be using almost twice the necessary disk space for that particular file.

PRELIMINARY DESIGN AUDIT (PDA)
VETA-II (V2)
MIRROR BLANKS (MBL)

OPTICAL COATING LABOROTORY, INC. (OC)
COATING PROGRAM (CP)
CLEANING (CLNG)
COATING (CTG)

AXAF PROJECT (AP)

AXAF SPECTROSCOPIC (AS)

SMITHSONIAN ASTROPHYSICAL OBSERVATORY (SA)
FINAL REPORT (FR)
GENERAL (GEN)
FEA (FEA)
FLAT STUDY (FS)
FLEXURE MOUNT (FLEX)
LAMAR (LAMAR)
OSAC (OSAC)
THERMAL PRECOLLIMATOR VIGNETTING STUDY (TPVS)
HRMA (HRMA)
VETA-I (V1)
ALIGNMENT (ALGNMNT)
BLUEPRINT (BLPRNT)
EXTRA LESSONS (EL)
FULL WIDTH HALF MAXIMUM (FWHM)
X-RAY DETECTION SYSTEM (XDS)
LEON VAN SPEYBROECK (LVS)
MIRRORS (MIR)
COATING & REFLECTIVITY (CTG)
CONTAMINATION (CONTAM)
FABRICATION (FAB)
METROLOGY (MET)
SPECIFICATION (SPEC)
MIRROR BLANK (MBL)
MONTHLY REPORTS (MR)
QUARTERLY REVIEWS (QR)
SCIENCE INSTRUMENTS (SI)
TRIP REPORTS (INCLUDING SCHEDULE REVWS & MTGS) (TR)
HUGHES DANBURY OPTICAL SYSTEMS/PERKIN-ELMER (HDOS)

STRUCTURE & MECHANICAL SUBSYSTEM (SM)
THERMAL CONTROL SUBSYSTEM (TC)
ELECTRICAL & POWER SUBSYSTEM (EP)
COMMUNICATION & COMMAND & DATA MANAGEMENT SUBSYSTEM (CC)
POINTING CONTROL & ASPECT DETERMINATION SUBSYSTEM (PA)
FLIGHT SOFTWARE (FS)

SCIENCE INSTRUMENTS (SI)
FOCAL PLANE SCIENCE INSTRUMENTS (FPSI)
HIGH RESOLUTION CAMERA & LOW ENERGY TRANSMISSION GRATING
OBJECTIVE TRANSMISSION GRATING (OTG)

COMPAR - COMPARISON
COMPUT - COMPUTATION
CONCENT - CONCENTRATION
CONFIG - CONFIGURATION
CONST - CONSTANT
CONT - CONTINUE / CONTINUATION
CONTAM - CONTAMINIATION
CONTING - CONTINGENCY
CRCTNG - CORRECTING
CRIT - CRITERIA
CRITCL - CRITICAL
CTG - COATING
CVR - COVER
CVRG - COVERAGE
CYL - CYLINDER
D
DAT - DATA
DB - DECIBEL (db)
DC - DIRECT CURRENT (dc)
DECONV - DECONVOLUTION
DECR - DECREASE
DEF - DEFINITION
DEMO - DEMONSTRATION
DESGN - DESIGN
DET - DETECTOR
DEV - DEVELOPMENT / DEVICE
DIA - DIAMETER
DIAG - DIAGONAL / DIAGRAM
DICT - DICTIONARY
DIFCLT - DIFFICULT
DIST - DISTANCE
DISTOR - DISTORTION
DISTR - DISTRIBUTION
DLVRY - DELIVERY
DOC - DOCUMENT / DOCUMENTATION
DRWNG - DRAWING
E
EFFCTV - EFFECTIVE
ELEM - ELEMENT
ENHANC - ENHANCEMENT
ENV - ENVIRONMENT
EQUIP - EQUIPMENT
ESTIM - ESTIMATE
EV - ELECTRON VOLT (eV)
EVAL - EVALUATE, EVALUATION
EXEC - EXECUTIVE

MAT - MATERIAL
MBL - MIRROR BLANK
MEAS - MEASUREMENT
MECHAN - MECHANISM
MGMT - MANAGEMENT
MIR - MIRROR
MIRCLS - MIRROR CELLS
MM - MILLIMETER (mm)
MODIF - MODIFICATION
MTG - MEETING
N
NI - NICKEL (Ni)
NMI - NAUTICAL MILE (nmi)
O
OB - OBSERVATORY / OBSERVATION
OBSTR - OBSTRUCTION
OPER - OPERATING / OPERATION
OVRVW - OVERVIEW
P
PARAM - PARAMETERS
P-E - PERKIN-ELMER
PERF - PERFORMANCE
PKG - PACKAGE
PLSHNG - POLISHING
PRECIS - PRECISION
PRED - PREDICTIONS
PRELIM - PRELIMINARY
PREP - PREPARE
PRES - PRESENTATION
PROC - PROCUREMENT
PROCED - PROCEDURE
PROG - PROGRAM
PROP - PROPERTY / PROPOSAL
PSI - POUNDS PER SQUARE INCH (psi)
PT - PLATINUM (Pt)
PUB - PUBLICATION
Q
QLTY - QUALITY
R
RECOM - RECOMMEND / RECOMMENDATION
RED - REDUCTION
REDESGN - REDESIGN
REF - REFERENCE
REL - RELATED
REPL - REPLICATION
REQ - REQUIREMENTS

VERIF - VERIFICATION
VIBR - VIBRATION
VOL - VOLUME
W
WRKNG - WORKING
X
XLATION - TRANSLATION
XMITTAL - TRANSMITTAL
XPORT - TRANSPORT
Y
Z
ZEROD - ZERODUR

BER - BIT ERROR RATE
BMLY - BARE MIRROR LIFT YOKE
BND - BEAM NORMALIZATION DETECTOR
BOD - BRIGHT OBJECT DETECTOR
BSSD - BALL SPACE SYSTEMS DIVISION
C
CA - CLEAR APERTURE
CAAS - CELL ASSEMBLY ALIGNMENT SYSTEM
CALDS - COMPUTER ADIDED LAP DESIGN SOFTWARE CSCI (AXAF POD) (IBM BASED)
CAP - CENTER APERTURE PLATE
CAPA - CENTER APERTURE PLATE ASSEMBLY
CATS - COUNTER APERTURE TRANSLATION SYSTEM
CBA - CENTER BAFFLE ASSEMBLY
CCD - CHARGE COUPLED DEVICE
C&CDM - COMMAND AND COMMUNICATION AND DATA MANAGEMENT SUB-SYSTEM
CD - CENTROID DETECTOR
CDA - CRITICAL DESIGN AUDIT
CDM - COMMAND AND DATA MANAGEMENT
CDR - CRITICAL DESIGN REVIEW
CEI - CONTRACT END ITEM
CFE - CONTRACTOR / CUSTOMER FURNISHED EQUIPMENT
CIDS - CIRCULARITY AND INSIDE DIAMETER GAUGE
CIDSS - CIRCULARITY AND INNER DIAMETER STATION CSCI (PC BASED)
CIL - CRITICAL ITEMS LIST
CM - CONTAMINATION MONITOR
CMP - CONTAMINATION MONITORING PLAN
CPSS - COATING PROCESS SELECTION STUDY
CPU - CENTRAL PROCESSING UNIT
CR - CLEAN ROOM
CRU - CONTINGENCY REPLACEABLE UNIT
CS - CALIBRATION SPECTROMETER
CSC - COMPUTER SOFTWARE COMPONENT
CSCI - COMPUTER SOFTWARE CONFIGURATION ITEM
CTD - CHARGE TRANSFER DEVICE
CTE - COEFFICIENT OF THERMAL EXPANSION
CWS - CONTAMINATION WITNESS SAMPLES
D
DATAFILT - DATA FILTERING ANALYSIS CSC (VAX BASED)
DB - DATA BASE SOFTWARE CSC (VAX BASED)
DDA - DOOR DRIVE ASSEMBLY
DDT&E - DESIGN, DEVELOPMENT, TEST, & EVALUATION
DOD - DEPARTMENT OF DEFENSE
DOF - DEGREE OF FREEDOM
DR - DATA REQUIREMENTS

GSF - GLASS SUPPORT FIXTURE
GSFC - GODDARD SPACE FLIGHT CENTER
GT - GLASS THICKNESS
GT - GUIDE TUBE
GVS - GUIDE TUBE VACUUM SUBSYSTEM
GVW - GATE VALVE WINDOW
GWA - GROUND WIRE ATTACHMENT
H
H - HYPERBOLOID
HATS - HRMA ALIGNMENT TEST SYSTEM
HCE - HRMA CONTROL ELECTRONICS
HDOS - HUGHES DANBURY OPTICAL SYSTEMS
HEAO - HIGH ENERGY ASTRONOMICAL OBSERVATORY
HETA - HRMA ENGINEERING TEST ARTICLE
HETG - HIGH ENERGY TRANSMISSION GRATING
HGA - HIGH GAIN ANTENNA
HIRA - HARDWARE INSERTION AND RETRACTION ASSEMBLY
HMA - HRMA MODULE ASSEMBLY
HMSS - HRMA MODULE SUPPORT STRUCTURE
HOSC - HUNTSVILLE OPERATIONS SUPPORT CENTER
HPA - HRMA POSITIONING CONTROL
HRC - HIGH RESOLUTION CAMERA
HRI - HIGH / HRMA RESOLUTION IMAGER
HRMA - HIGH RESOLUTION MIRROR ALIGNMENT/ASSEMBLY
HST - HUBBLE SPACE TELESCOPE
HVAC - HEATING, VENTILATION, AIR CONDITIONING
HW - HARDWARE
I
IAS - IMAGE ACQUISITION SYSTEMS
IC - INSTRUMENT CHAMBER
I&C - INSTRUMENTATION AND COMMUNICATION
ICD - INTERFACE CONTROL DRAWING / DOCUMENT
ICR - INSTRUMENT CHAMBER ROOM
ICVS - INSTRUMENT CHAMBER VACUUM SUBSYSTEM
ID - INNER DIAMETER, INTERFACE DEFINITION
ID GAUGE - INSIDE DIAMETER GAUGE FOR ODGM
IDD - INTERFACE DEFINITION DOCUMENT
IE - INCLUDED ENERGY
IP - INSTRUMENTATION PROCESSOR
IRD - INTERFACE REQUIREMENTS DOCUMENT
IRU - INERTIAL REFERENCE UNIT
ISC - INNER SUPPORT CYLINDER
ISU - INSTRUMENT SWITCHING UNIT
ITCV - INTEGRATED TEST CONFIGURATION VETA-1
J
JSC - JOHNSON SPACE CENTER

NOAO - NATIONAL OPTICAL ASTRONOMY OBSERVATORY
NSLS - NATIONAL SYNCROTRON LIGHT SOURCE
NSTS - NATIONAL SPACE TRANSPORTATION SYSTEM
NVR - NON-VOLATILE RESIDUE
O
OA - OPTICAL AXIS
OAS - OPTICAL ALIGNMENT SYSTEM
OB - OPTICAL BENCH
OBA - OPTICAL BENCH ASSEMBLY
OBC - ON-BOARD COMPUTER
OD - OUTER DIAMETER
ODBF - OUTSIDE DIAMETER BLOCKING FIXTURE
ODGM - OUTSIDE DIAMETER GRINDING AND POLISHING MACHINE
ODGM - OUTSIDE DIAMETER GRINDING AND POLISHING MACHINE CSCI (PC BASED)
ODGM-PROCESS - ODGM ANALYSIS SOFTWARE CSC (VAX BASED)
OGM - OBJECTIVE GRATING MECHANISM
OM - OPERATIONS MANAGER CSC (VAX BASED)
OMV - ORBITAL MANEUVERING VEHICLE
OPM - OPTICAL POSITION MONITOR
OPS - OPTICAL POINT SOURCE
ORI - OPERATING READINESS INSPECTION
ORU - ORBITAL REPLACEABLE UNIT
OSC - OUTER SHIPPING CONTAINER
OSC - OUTER SUPPORT CYLINDER
OSM - OPTICAL STRUCTURE AND MECHANISMS
OTG - OBJECTIVE TRANSMISSION GRATING
P
P - PARABOLOID
PAO - PRODUCT ASSURANCE ORGANIZATION
PAS - PROBLEM ASSESMENT SYSTEM
PCADS - POINTING CONTROL AND ASPECT DETERMINATION SUBSYSTEM
PCH - PROGRAM CRITICAL HARDWARE
PCS - PROPORTIONAL COUNTER SUBSYSTEM
PD - PRELIMINARY DRAFT
PDA - PRELIMINARY DESIGN AUDIT
PDR - PRELIMINARY DESIGN REVIEW
PFRS - POSITIVE FLUID RETENTION SYSTEM
PHA - POLISHING HISTORY ANALYSIS SOFTWARE CSCI (VAX BASED)
PID - PROPORTIONAL INTEGRAL DERIVATIVE
PMB - PERFORMANCE MEASUREMENT BASELINE
PMM - PRECISION METROLOGY MOUNT
PMMR - PROGRAM MANAGER'S MONTHLY REVIEW
PM&P - PARTS, MATERIALS, & PROCESSES
PMS - PERFORMANCE MEASUREMENT SYSTEM
PMS - PRECISION METROLOGY STATION

SI - SCIENCE INSTRUMENTS
SIAH - SCIENCE INSTRUMENT ACCOMMODATION HARDWARE
SIM - SCIENCE INSTRUMENT MODULE
SMG - SURFACE MAP GENERATION SOFTWARE CSCI (VAX BASED)
SMS - SURFACE MONITORING SYSTEM
SO - SERVICING OPERATIONS
SPIE - SOCIETY OF PHOTO-OPTICAL INSTRUMENTATION ENGINEERS
SPL - SOUND PRESSURE LEVEL
SQCD - SUBAPERTURE QUADRANT CENTROID DETECTOR
SR - SCHEDULE REVIEW
SRR - SYSTEM REQUIREMENTS REVIEW
SS - SPACE STATION
SSA - S-BAND SINGLE ACCESS
SSA - STRUCTURE SUPPORT ASSEMBLY
SSE - SPACE SUPPORT EQUIPMENT
SSS - SHIPPING SUPPORT STRUCTURE
SSTA - STAR SENSOR TELESCOPE ASSEMBLY
STA - STATION: ARCHITECTURAL COORDINATE SYSTEM
STACC - STANDARD TELEMETRY AND COMMAND COMPONENT
STDN - SPACECRAFT TRACKING AND DATA NETWORK
STE - SPECIAL TEST EQUIPMENT
STS - SPACE TRANSPORTATION SYSTEM
SUBANAL - SUB-APERTURE ANALYSIS SOFTWARE CSC (VAX BASED)
SVS - SOURCE VACUUM SUBSYSTEM
S/W - SOFTWARE
T
TBD - TO BE DETERMINED
TBR - TO BE RESOLVED / REVISED
TBS - TO BE SUPPLIED
TC - THERMAL CONTROL
TCS - THERMAL CONTROL SUBSYSTEM
TDRSS - TRACKING ND DATA RELAY SATELLITE SYSTEM
TFA - TRANSFER FIXTURE ASSEMBLY
TIM - TECHNICAL INTERCHANGE MEETING
TIRF - TOWER INITIALIZATION REFERENCE FIXTURE
TMA - TECHNOLOGY MIRROR ASSEMBLY
TPA - THERMAL PANEL ASSEMBLY
TPVS - THERMAL PRECOLLIMATOR VIGNETTING STUDY
TR - TRIP REPORT
TRD - TECHNICAL REVIEW DOCUMENTATION
TRI - TILT REFERENCE INTERFEROMETER
TRW - TRW, INC.
TS - TELESCOPE SYSTEM
TST - TECHNICAL SUPPORT TEAM
TTC - TELESCOPE THERMAL CONTROL
U