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Task Assignment 132
December 1984

NAS5-28200
NASA-CR-174221

CHARACTERIZING THE SCIENTIFIC POTENTIAL OF SATELLITE SENSORS

GSFC ATR – Dr. J. Barker
SAR Task Leader – Dr. Y. Lee

Task Objective:

The objective of this task is to provide analytical and programming support to characterize the potential of the Landsat Thematic Mapper (TM) digital imagery for scientific investigations in the earth sciences and in terrestrial physics. Secondary objectives of this task include providing technical support to define lower atmospheric and terrestrial surface experiments for the space station and providing technical support to the Research Optical Sensor (ROS) study scientist for advanced studies in remote sensing.

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Work Performed:

The following work was performed in the areas indicated.

100 TM Radiometric Calibration

Eleven TM radiometric calibration programs developed last month have been tested and evaluated. Several software problems have been found and solved. The correction algorithm used for coherent noise correction has been modified. Unsuccessful correction of bright target saturation in the background region has been examined.

Three software errors have been found and solved as follows.

- Integer Overflow – Because the VAX integer*2 format used in the calibration has a sign bit, the maximum value cannot be 65,535. The problem was solved by using 14-bit calibration (maximum value 16,383) instead of 16-bit calibration. The original 8-bit TM data then is expanded approximately 64 times.

- Divide by Zero – During the calibration of masks for scan-correlated shifts, a threshold value for separating lower and higher states was calculated using the data from both forward and reverse scans. This technique of thresholding may deflect either all forward scans or all reverse scans as being in either a higher or lower state. The average value of each state is calculated by summing the values for each state and dividing by the state population. When all forward or reverse scans are in one state, the opposite state will have a zero population and the divide-by-zero problem will occur. This problem has been solved by defining separate threshold values for forward and reverse scans.

(E85-10044 NASA-CR-174221) CHARACTERIZING THE SCIENTIFIC POTENTIAL OF SATELLITE SENSORS (SAR, Inc.) 13 p HC A02/MF A01 CSCL 08B
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- Nonexist File Group – This error was caused by mistakenly defining the image I/O file name in several programs. It has been corrected.

Since most of the output files from the 11 calibration programs are in 14-bit format, it is necessary to convert the files into byte format for display on the Interactive Analysis Terminal (IAT). A program, IBCON.PDF, has been implemented for this purpose. It performs a linear stretch between the minimum and maximum values to convert 14-bit image data into 8-bit data.

The algorithm for coherent noise correction has been examined. The results from the scan-by-scan correction procedure utilizing single-band resequenced data did not show a consistent characteristic through scans in the band 1, channel 9, noise image. The line-by-line correction procedure suggested by the ATR has been implemented.

A problem in applying a bright target saturation correction in the background region is under examination. It may be due to error in the boundary mask or the recovery time constants.

200 Image Processing on LAS/VAX

The following raw, calibrated, and corrected image groups have been created and stored on the Barker2 disk. These image groups may be deleted and recreated after applying the BTS correction in the background region and examining the results.

- CSF4 – The raw image group includes images of bands 1 through 4 of a 512 x 12 subscene at (SP, SL) = (2101, 2337) of scene 40392-18152 over San Francisco.
- CBTS – BTS corrected images of the CSF4 group.
- CSCS – BTS+SCS corrected images of the CSF4 group.
- CCN – BTS+SCS+CN corrected images of the CSF4 group.
- CCAL – BTS+SCS+CN+TRAPP (IC+H) calibrated images of the CSF4 group.

230 Image Processing on IDIMS/HP

Black-and-white pixel print files were created for the following San Francisco subscenes (Scene ID 40392-18152):

Name	Band	SP, SL, NP, NL	Processing Information
SFB.B1	1	6629, 1, 294, 384	Background data without corrections
SFB.CN1.L	1	6629, 1, 294, 384	Background data with coherent noise correction applied on a line-by-line basis
SFB.CN1.S	1	6629, 1, 294, 384	Background data with coherent noise correction applied on a scan-by-scan basis
NOISE1.L	1	6629, 1, 294, 384	Noise image from line-by-line method
NOISE1.S	1	6629, 1, 294, 384	Noise image from scan-by-scan method
NOISE1.16.9	1	6629, 1, 294, 384	Noise image for 32 scans of channels 9 and 16 from scan-by-scan and line-by-line corrections
SFM.B1	1	1825, 1889, 294, 384	No corrections applied
SFM.B2	2	1825, 1889, 294, 384	No corrections applied
SFM.B3	3	1825, 1889, 294, 384	No corrections applied
SFM.B4	4	1825, 1889, 294, 384	No corrections applied
SFM.BT1.T	1	1825, 1889, 294, 384	BTS correction using truncation
SFM.BT2.T	2	1825, 1889, 294, 384	BTS correction using truncation

Black-and-white negatives were made and sent to the photographic laboratory to have view graphs and five prints made of each.

These products were reviewed by the ATR and found to have low contrast over water and high contrast over land.

300 Production Support

Becasue of a lack of source code of dump utilities for the file on the CALFILE tape, it is difficult to generate data from the tape (for example, the housekeeping data) in the digital form. The CALFILE processing will continue as before, producing a photocopied output book of the following files: TAG, Quality Assurance Data File (QAD), Housekeeping Data File (HSD), Ephemeris Data File (ESD), Systematic Correction Data File (SCD), Control Point Data File (CPD), Long-Term Parameter File (LT-PAR), Short-Term Parameter File (ST-PAR), Histogram File (HISTPLT), Scan Characteristics Record (SCH), and Reduced Calibration File (CAL). A specified data file may be created independently if requested by the ATR by manually copying sections from the photocopied output book or editing the output file stored on the VAX system.

The incorrect telemetry data on the 45 BRU tapes received from SBRC have been confirmed with B. Cooley at SBRC. The correct data have been recovered from Aug. 30, 1983, BARVID printouts. SBRC will examine problems of BURST data and data from bands 5, 6, and 7. No further action will be taken on processing the 45 tapes until data verification is received from SBRC.

Six CALFILE tapes and one CALDUMP tape were processed for the following scene IDs:

ID	Location
4060815463	Birmingham
5001415460	Birmingham
4039218152	San Francisco
5012917075	White Sands
5014216365	Unknown

Four blue books were generated for each scene.

Two chosen SBRC tapes (#1038, 5 window, and #1071, 8 window) have been run successfully.

Two BURST files were retrieved from the SBRC tapes (#0138, #1039) and have been processed with TRAPP. The full scan line was plotted for each file.

All the BRU data files from the 45 SBRC tapes have been copied and merged onto eight BRU multifile tapes – #309, #310, #311, #312, #313, #314, #315, #316.

Twenty-one calibrated and corrected subimages of San Francisco were created and transferred onto tape for producing pseudocolor pixel prints.

400 Software Development

Linear regression software is being developed to correlate the start of scan time with the shutter background (Section 410) and to correlate background data between channels within a band (Section 420) and between channels in different bands (Section 430). Since there should be no correlations in the background data in the absence of systematic errors, the outputs from these programs are designed to 1) investigate the origin of systematic radiometric variability, such as coherent noise and scan-correlated shift, and 2) serve as figures-of-merit to evaluate the effectiveness of correction for these systematic errors.

410 Linear Regression Coefficient Tables, Part I

This software performs the following optional regressions of shutter background digital number (DN) versus:

- Start of scan in seconds (P0)
- Difference between adjacent scans of the start of scan in seconds (DP0)
- Difference of DP0 from the average value of DP0 in seconds (DDP0)

The output from this software consists of four pages, as follows:

The first page is a list of pairs of averaged shutter background (BOBS) and either P0, DP0, or DDP0 by scan line for the selected band and channel (see Appendix 1, results of Landsat-4 BRU tape GSFC #37).

The second page is a list of backgound residuals (BCALC-BOBS) calculated from linear regression of BOBS versus PO, DPO, or DDPO by scan line for the selected band and channel (see Appendix 2, results of Landsat-4 BRU tape GSFC #37).

Pages 3 and 4 contain eight tables of derived values for all 100 channels (see Appendixes 3 and 4, results of Landsat-4 BRU tape GSFC #37).

- A0(DN), intercept of linear regression
- SDA0(DN), standard deviation of the intercept
- A1(DN/sec), slope of linear regressions
- SDA1(DN/sec), standard deviation of the slope
- R, correlation coefficient
- Randomness of background residuals
- SB(DN), standard error of background
- $100*(1-R^2)$, unaccounted variances in percent

All the above outputs are in floating point format as requested by the ATR, and have become part of TRAPP's output. A brief description of this software development can be found in the previous monthly report; for the details, contact P. Lee, SAR.

420 Linear Regression Coefficient Tables, Part II

This part of the analyses study channels correlations within a band by regressing the shutter background data for channel I versus the shutter background data for channel J. Five different optional output can be chosen, as follows:

- All scans versus all other scans
- Even scans versus even scans
- Odd scans versus odd scans
- Even scans versus odd scans
- All of the above

Therefore, a maximum of 28 pages may be generated for the 7-band data when the final option above is chosen. Each page of output contains the following three tables:

- Correlation coefficient, R, and the unaccounted variance, 100 $(1-R^2 2)$
- The intercept and standard deviations of the intercept
- The slope and standard deviation of the slope

The following two new routines have been implemented and tested:

- Subroutine RCORR02 – This routine generates the output tables for the within-band regressions.

- Subroutine RCFORM – This routine formats all output variables from the within-band regression.

Minor changes in routines RCINJBRU, RCUSERIN, and RCNMAIN to link the above new routine to the TRAPP subroutine library make these new tables part of the standard TRAPP output.

430 Linear Regression Coefficient Tables, Part III

This part of the analyses study channels correlations between bands by regressing the shutter background data for reference channels of each band. The software outputs three pages and nine tables. The new routines under development are as follows:

- Subroutine RCCORR03 – This routine generates output tables for the between-band regressions.

- Subroutine RCOUT – This routine formats the output variables.

- Subroutine RCIN – This routine allows the user to prompt the input and shows it on a screen for double checking.

700 Image Science Studies

The contouring program on the I2S was tested by the ATR. It was found that a 512 x 512 image takes 30 minutes to process and uses 80 percent of the VAX 11/780 CPU.

TM images of Jiddah, Saudi Arabia (Scene ID 5009707171, path 170, row 45, June 6, 1984), and northern Chile (Scene ID 5012914060, path 1, row 77, July 8, 1984) were shown to the ATR on the Land Analysis System (LAS). The Jiddah scene has random speckle noise in all bands, and the Chile scene has response differences between back and fore scans in band 7.

The ATR and SAR discussed the following questions concerning the image science studies:

1. What are the scientific objectives of doing corrections to TM data versus the applications?

2. What type of parametric error analysis can SAR perform to quantitatively assess the improvement in TM image data quality after doing radiometric corrections?

3. How can the impact of these improvements be demonstrated in science studies?

All results for the January TM workshop for science studies will be demonstrated using the San Francisco scene.

Problem Areas:

230 Image Processing on IDIMS/HP

No image processing was performed on the HP-3000 during December 10-21 because the Laboratory for Terrestrial Physics Computing Facility is under reconstruction.

Schedule Conformance:

Work is proceeding as planned.

Work Planned for Next Month:

100 TM Radiometric Calibration

Task personnel will reexamine parameters for bright target saturation.

200 Image Processing on LAS/VAX

Calibrated and corrected image and background files and the difference image files will be created.

230 Image Processing on IDIMS/HP

Pixel prints will be created of image and background data files for various types of calibrations.

300 Production Support

SAR personnel will update apparent gain versus time plot for both Landsat-4 and -5 TM.

SAR personnel will continue to process new CALDUMP and CALFILE tapes (6 sets).

400 Software Development

Major emphasis will be placed on analyzing and implementing the different background linear regressions. A task member will continue to implement and test between-band linear regression coefficients and make any format changes to the previously developed software upon the ATR's request.

700 Image Science Studies

Work will start on assessing the impact upon information extraction of doing various types of radiometric calibrations to the data.

Deliverables Submitted:

Graphics: 12 black-and-white negative pixel print films of raw and corrected TM images and background data
Originator: J. Wang and W. Hallada

Computer Utilization:

The estimated computer time used this month is as follows:

Minutes	Computer
1501 (wall clock)	HP-3000 (IDIMS)
200 (wall clock)	VAX 11/780 (LAS)

TABLE OF SCAN START TIME PO VS BACKGROUND BOBS (DN) FOR BAND 1 ,CHANNEL 4

	SCAN 1-50	CHANN	SCAN 51-100	CHANN	SCAN 101-150	CHANN	SCAN 151-200	CHANN	SCAN 201-250	CHANN	SCAN 251-300	CHANN	SCAN 301-350	CHANN	SCAN 351-400	CHANN
1	4.7754	2.62	8.3419	2.42	11.9084	2.56	15.4743	2.58	19.0407	2.58	22.6072	2.66	26.1731	2.44	29.7395	2.36
2	4.8469	2.32	8.4133	2.50	11.9792	2.26	15.5457	2.50	19.1122	2.46	22.6780	2.70	26.2445	2.36	29.8110	2.32
3	4.9185	2.78	8.4843	2.48	12.0508	2.74	15.6173	2.64	19.1832	2.68	22.7497	2.50	26.3161	2.44	29.8820	2.78
4	4.9893	2.80	8.5558	2.50	12.1223	2.80	15.6881	2.48	19.2546	2.48	22.8211	2.62	26.3875	2.66	29.9534	2.62
5	5.0609	2.70	8.6274	2.64	12.1933	2.50	15.7598	2.76	19.3262	2.46	22.8921	2.44	26.4586	2.52	30.0250	2.58
6	5.1324	2.66	8.6982	2.34	12.2647	2.46	15.8312	2.58	19.3970	2.32	22.9635	2.76	26.5300	2.56	30.0965	2.56
7	5.2034	2.64	8.7698	2.66	12.3363	2.50	15.9022	2.42	19.4687	2.48	23.0351	2.86	26.6010	2.66	30.1675	2.44
8	5.2748	2.52	8.8413	2.50	12.4071	2.64	15.9736	2.34	19.5401	2.42	23.1060	2.56	26.6724	2.64	30.2389	2.42
9	5.3464	2.60	8.9123	2.40	12.4788	2.54	16.0452	2.80	19.6111	2.76	23.1776	2.52	26.7441	2.48	30.3105	2.66
10	5.4172	2.42	8.9837	2.76	12.5502	2.56	16.1161	2.66	19.6825	2.46	23.2490	2.50	26.8155	2.62	30.3813	2.54
11	5.4889	2.50	9.0553	2.52	12.6212	2.72	16.1877	2.42	19.7542	2.76	23.3200	2.66	26.8865	2.70	30.4530	2.74
12	5.5603	2.52	9.1262	2.30	12.6926	2.38	16.2591	2.34	19.8250	2.42	23.3914	2.50	26.9579	2.72	30.5244	2.44
13	5.6313	2.56	9.1978	2.60	12.7642	2.52	16.3301	2.58	19.8966	2.70	23.4631	2.64	27.0295	2.46	30.5954	2.72
14	5.7027	2.44	9.2692	2.34	12.8351	2.64	16.4015	2.64	19.9680	2.46	23.5345	2.32	27.1004	2.54	30.6668	2.50
15	5.7743	2.40	9.3402	2.64	12.9067	2.48	16.4732	2.54	20.0390	2.74	23.6055	2.40	27.1720	2.50	30.7384	2.62
16	5.8452	2.44	9.4116	2.48	12.9781	2.48	16.5440	2.30	20.1105	2.28	23.6769	2.36	27.2434	2.60	30.8093	2.58
17	5.9168	2.54	9.4833	2.74	13.0491	2.58	16.6156	2.74	20.1821	2.74	23.7480	2.56	27.3144	2.66	30.8809	2.56
18	5.9882	2.70	9.5541	2.60	13.1206	2.46	16.6870	2.60	20.2535	2.52	23.8194	2.50	27.3856	2.58	30.9523	2.54
19	6.0592	2.70	9.6257	2.54	13.1922	2.60	16.7581	2.62	20.3245	2.42	23.8910	2.52	27.4575	2.58	31.0233	2.58
20	6.1306	2.52	9.6971	2.50	13.2630	2.42	16.8295	2.70	20.3959	2.34	23.9624	2.76	27.5283	2.56	31.0949	2.58
21	6.2023	2.68	9.7681	2.60	13.3346	2.50	16.9011	2.36	20.4670	2.72	24.0334	2.66	27.5999	2.44	31.1664	2.48
22	6.2731	2.54	9.8396	2.48	13.4060	2.40	16.9725	2.52	20.5384	2.38	24.1049	2.50	27.6713	2.40	31.2372	2.48
23	6.3447	2.58	9.9112	2.72	13.4771	2.68	17.0435	2.42	20.6100	2.70	24.1765	2.38	27.7423	2.56	31.3088	2.38
24	6.4161	2.46	9.9820	2.62	13.5485	2.58	17.1150	2.42	20.6814	2.48	24.2473	2.48	27.8138	2.40	31.3802	2.54
25	6.4871	2.58	10.0536	2.62	13.6201	2.76	17.1860	2.62	20.7525	2.70	24.3189	2.72	27.8854	2.28	31.4513	2.54
26	6.5586	2.36	10.1251	2.64	13.6915	2.50	17.2574	2.44	20.8239	2.54	24.3903	2.66	27.9562	2.38	31.5227	2.40
27	6.6302	2.54	10.1961	2.56	13.7626	2.56	17.3290	2.68	20.8955	2.86	24.4614	2.62	28.0278	2.74	31.5943	2.70
28	6.7010	2.30	10.2675	2.68	13.8340	2.54	17.4004	2.44	20.9663	2.44	24.5328	2.60	28.0993	2.62	31.6651	2.72
29	6.7726	2.60	10.3391	2.74	13.9050	2.68	17.4715	2.38	21.0379	2.70	24.6044	2.34	28.1703	2.58	31.7367	2.66
30	6.8441	2.52	10.4105	2.34	13.9764	2.44	17.5429	2.50	21.1094	2.36	24.6752	2.62	28.2417	2.56	31.8082	2.44
31	6.9151	2.36	10.4816	2.76	14.0480	2.46	17.6145	2.48	21.1804	2.32	24.7468	2.32	28.3133	2.82	31.8792	2.80
32	6.9865	2.66	10.5530	2.68	14.1195	2.52	17.6853	2.26	21.2518	2.50	24.8183	2.66	28.3841	2.46	31.9506	2.60
33	7.0581	2.68	10.6240	2.56	14.1905	2.60	17.7569	2.50	21.3234	2.74	24.8893	2.58	28.4558	2.52	32.0222	2.64
34	7.1295	2.72	10.6954	2.62	14.2619	2.38	17.8284	2.48	21.3942	2.34	24.9607	2.34	28.5272	2.56	32.0931	2.50
35	7.2006	2.68	10.7670	2.78	14.3335	2.52	17.8994	2.52	21.4659	2.64	25.0323	2.80	28.5982	2.66	32.1647	2.62
36	7.2720	2.84	10.8385	2.64	14.4043	2.80	17.9708	2.56	21.5373	2.62	25.1032	2.30	28.6696	2.58	32.2361	2.52
37	7.3430	2.48	10.9095	2.44	14.4760	2.86	18.0424	2.54	21.6083	2.46	25.1748	2.64	28.7412	2.46	32.3071	2.38
38	7.4144	2.76	10.9809	2.56	14.5474	2.68	18.1133	2.42	21.6797	2.74	25.2462	2.58	28.8121	2.42	32.3785	2.42
39	7.4860	2.60	11.0525	2.80	14.6184	2.84	18.1849	2.64	21.7513	2.72	25.3172	2.60	28.8837	2.58	32.4502	2.70
40	7.5575	2.72	11.1233	2.48	14.6898	2.52	18.2563	2.68	21.8222	2.62	25.3886	2.54	28.9551	2.50	32.5210	2.56
41	7.6285	2.76	11.1950	2.58	14.7614	2.42	18.3273	3.02	21.8938	2.50	25.4603	2.74	29.0261	2.52	32.5926	2.72
42	7.6999	2.56	11.2664	2.34	14.8323	2.46	18.3987	2.40	21.9652	2.66	25.5311	2.44	29.0976	2.46	32.6640	2.62
43	7.7715	2.52	11.3374	2.64	14.9039	2.58	18.4704	2.64	22.0362	2.52	25.6027	2.34	29.1692	2.52	32.7350	2.44
44	7.8424	2.56	11.4088	2.56	14.9753	2.38	18.5412	2.26	22.1077	2.44	25.6741	2.56	29.2400	2.70	32.8065	2.60
45	7.9140	2.54	11.4805	2.88	15.0463	2.70	18.6128	2.64	22.1793	2.68	25.7451	2.42	29.3116	2.34	32.8781	2.92
46	7.9854	2.40	11.5513	2.58	15.1178	2.58	18.6842	2.58	22.2501	2.60	25.8166	2.64	29.3830	2.42	32.9495	2.74
47	8.0564	2.62	11.6229	2.68	15.1894	2.60	18.7553	2.62	22.3217	2.60	25.8882	2.70	29.4541	2.74	33.0205	2.74
48	8.1278	2.50	11.6943	2.50	15.2602	2.52	18.8267	2.48	22.3931	2.60	25.9590	2.38	29.5255	2.36	33.0920	2.68
49	8.1995	2.36	11.7653	2.64	15.3318	2.36	18.8983	2.94	22.4642	2.76	26.0306	2.56	29.5971	2.66	33.1630	2.56
50	8.2703	2.32	11.8368	2.44	15.4032	2.46	18.9691	2.52	22.5356	2.42	26.1020	2.38	29.6685	2.50	33.2344	2.54

TABLE OF BACKGROUND RESIDUALS (BCALC-BOBS) FOR BAND 1 ,CHANNEL 4
WHERE BCALC=A0+A1*PO IN DN

	1-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400
1	-0.0609	0.1386	-0.0019	-0.0224	-0.0230	-0.1035	0.1160	0.1955
2	0.2391	0.0586	0.2381	0.0575	0.0970	-0.1435	0.1960	0.2355
3	-0.2209	0.0706	-0.1819	-0.0825	-0.1230	0.0565	0.1160	-0.2245
4	-0.2409	0.0586	-0.2420	0.0775	0.0770	-0.0635	-0.1040	-0.0645
5	-0.1409	-0.0815	0.0580	-0.2025	0.0970	0.1165	0.0360	-0.0245
6	-0.1010	0.2185	0.0980	-0.0225	0.2370	-0.2035	-0.0040	-0.0045
7	-0.0810	-0.1015	0.0580	0.1375	0.0770	-0.3035	-0.1040	0.1154
8	0.0390	0.0585	-0.0820	0.2175	0.1370	-0.0035	-0.0841	0.1354
9	-0.0410	0.1585	0.0180	-0.2425	-0.2030	0.0364	0.0759	-0.1046
10	0.1390	-0.2015	-0.0020	-0.1025	0.0970	0.0564	-0.0641	0.0154
11	0.0590	0.0385	-0.1620	0.1375	-0.2031	-0.1036	-0.1441	-0.1846
12	0.0390	0.2585	0.1780	0.2174	0.1369	0.0564	-0.1641	0.1154
13	-0.0010	-0.0415	0.0379	-0.0226	-0.1431	-0.0836	0.0759	-0.1646
14	0.1190	0.2185	-0.0821	-0.0826	0.0969	0.2364	0.0159	0.0554
15	0.1590	-0.0816	0.0779	0.0174	-0.1831	0.1564	0.0559	-0.0646
16	0.1189	0.0784	0.0779	0.2574	0.2769	0.1964	-0.0441	-0.0246
17	0.0189	-0.1816	-0.0221	-0.1826	-0.1831	-0.0036	-0.1041	-0.0047
18	-0.1411	-0.0416	0.0979	-0.0426	0.0369	0.0564	-0.0242	0.0153
19	-0.1411	0.0184	-0.0421	-0.0626	0.1369	0.0363	-0.0242	-0.0247
20	0.0389	0.0584	0.1379	-0.1426	0.2168	-0.2037	-0.0042	-0.0247
21	-0.1211	-0.0416	0.0579	0.1974	-0.1632	-0.1037	0.1158	0.0753
22	0.0189	0.0784	0.1579	0.0373	0.1768	0.0563	0.1558	0.0753
23	-0.0211	-0.1616	-0.1222	0.1373	-0.1432	0.1763	-0.0042	0.1753
24	0.0989	-0.0617	-0.0222	0.1373	0.0768	0.0763	0.1558	0.0153
25	-0.0211	-0.0617	-0.2022	-0.0627	-0.1432	-0.1637	0.2758	0.0153
26	0.1988	-0.0817	0.0578	0.1173	0.0168	-0.1037	0.1758	0.1552
27	0.0188	-0.0017	-0.0022	-0.1227	-0.3032	-0.0637	-0.1842	-0.1048
28	0.2588	-0.1217	0.0178	0.1173	0.1168	-0.0437	-0.0643	-0.1648
29	-0.0412	-0.1817	-0.1222	0.1773	-0.1432	0.2162	-0.0243	-0.1048
30	0.0388	0.2183	0.1178	0.0573	0.1967	-0.0638	-0.0043	0.1152
31	0.1988	-0.2017	0.0978	0.0773	0.2367	0.2362	-0.2643	-0.2448
32	-0.1012	-0.1217	0.0378	0.2972	0.0567	-0.1038	0.0957	-0.0448
33	-0.1212	-0.0017	-0.0423	0.0572	-0.1833	-0.0238	0.0357	-0.0848
34	-0.1612	-0.0618	0.1777	0.0772	0.2167	0.2162	-0.0043	0.0552
35	-0.1213	-0.2218	0.0377	0.0372	-0.0833	-0.2438	-0.1043	-0.0648
36	-0.2813	-0.0818	-0.2423	-0.0028	-0.0633	0.2562	-0.0243	0.0351
37	0.0787	0.1182	-0.3023	0.0172	0.0967	-0.0838	0.0956	0.1751
38	-0.2013	-0.0018	-0.1223	0.1372	-0.1833	-0.0238	0.1356	0.1351
39	-0.0413	-0.2418	-0.2823	-0.0828	-0.1633	-0.0439	-0.0244	-0.1449
40	-0.1613	0.0782	0.0377	-0.1228	-0.0634	0.0161	0.0556	-0.0049
41	-0.2013	-0.0218	0.1377	-0.4629	0.0566	-0.1839	0.0356	-0.1649
42	-0.0013	0.2182	0.0977	0.1571	-0.1034	0.1161	0.0956	-0.0649
43	0.0387	-0.0818	-0.0224	-0.0829	0.0366	0.2161	0.0356	0.1151
44	-0.0013	-0.0019	0.1776	0.2971	0.1166	-0.0039	-0.1444	-0.0449
45	0.0186	-0.3219	-0.1424	-0.0829	-0.1234	0.1361	0.2156	-0.3649
46	0.1586	-0.0219	-0.0224	-0.0229	-0.0434	-0.0839	0.1356	-0.1850
47	-0.0614	-0.1219	-0.0424	-0.0629	-0.0434	-0.1439	-0.1845	-0.1250
48	0.0586	0.0581	0.0376	0.0771	-0.0434	0.1760	0.1955	-0.1250
49	0.1986	-0.0819	0.1976	-0.3829	-0.2034	-0.0040	-0.1045	-0.0050
50	0.2386	0.1181	0.0976	0.0371	0.1365	0.1760	0.0555	0.0150

LINEAR REGRESSION COEFFICIENTS FOR SHUTTER BACKGROUND VS SCAN START TIME
(B(DN) VS PO(SEC);B=A0+A1*PO)

INTERCEPT,A0(DN)

CHANNEL	BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
16	2.6961	2.3543	2.7142	2.1971	2.6304	2.4805	
15	2.4129	2.2239	2.1969	2.0731	2.5371	2.1243	
14	2.6601	2.2789	2.5275	2.1019	2.5983	2.4318	
13	2.4008	2.2455	2.2561	2.0531	2.5620	2.1286	
12	2.5131	2.1608	2.3693	2.0881	2.5578	2.3834	
11	2.4042	2.2804	2.1222	2.0938	2.5307	2.2525	
10	2.5399	2.2114	2.4522	2.1502	2.5926	2.4445	
9	2.4056	2.2006	2.2829	2.1037	2.5312	2.2306	
8	2.7055	2.3410	2.5491	2.4768	2.7546	2.4489	
7	2.4123	2.2564	2.3358	2.0930	2.5761	2.8163	
6	2.6999	2.5577	2.4629	2.4229	2.7412	2.4034	
5	2.6073	2.3519	2.3978	2.1347	2.5259	2.1905	
4	2.5598	2.5055	2.4221	2.2207	2.5904	2.3685	19.0050
3	2.5794	2.4864	2.5681	2.4190	19.0050	2.3508	73.9989
2	2.6173	2.4968	2.4322	2.2033	2.5004	2.3331	73.9996
1	3.1215	3.0195	3.0482	2.8854	2.7284	2.7730	73.9999
<ODD>	2.54301	2.38385	2.40103	2.23196	4.62456	2.3583473	.99942
<EVEN>	2.62395	2.36204	2.49119	2.23262	2.63323	2.4117646	.50233
<ALL>	2.58348	2.37295	2.44611	2.23229	3.62890	2.3850560	.25087
ODDSD	0.24857	0.27219	0.29408	0.28873	5.81098	0.27902	0.00071
EVNSD	0.07786	0.14392	0.10679	0.14286	0.07356	0.0485838	.88703
ALLSD	0.18278	0.21064	0.21874	0.22006	4.10099	0.1954327	.49722

STANDARD DEVIATION OF INTERCEPT,SDA0(DN)

BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
0.0089	0.0029	0.0071	0.0017	0.0017	0.0026	
0.0111	0.0020	0.0037	0.0009	0.0022	0.0023	
0.0075	0.0026	0.0034	0.0013	0.0015	0.0023	
0.0106	0.0022	0.0034	0.0007	0.0015	0.0032	
0.0022	0.0019	0.0029	0.0013	0.0019	0.0028	
0.0082	0.0026	0.0022	0.0010	0.0015	0.0024	
0.0054	0.0015	0.0022	0.0013	0.0065	0.0042	
0.0100	0.0019	0.0029	0.0014	0.0016	0.0023	
0.0103	0.0021	0.0044	0.0021	0.0019	0.0032	
0.0083	0.0021	0.0033	0.0010	0.0020	0.0092	
0.0078	0.0025	0.0027	0.0023	0.0056	0.0029	
0.0101	0.0029	0.0037	0.0014	0.0019	0.0031	
0.0022	0.0014	0.0034	0.0021	0.0018	0.0029	0.0000
0.0101	0.0036	0.0041	0.0023	0.0000	0.0032	0.0001
0.0101	0.0017	0.0025	0.0018	0.0021	0.0028	0.0001
0.0129	0.0037	0.0062	0.0019	0.0014	0.0029	0.0001
0.01016	0.00262	0.00369	0.00133	0.00151	0.00359	0.00010
0.00679	0.00207	0.00357	0.00175	0.00288	0.00294	0.00004
0.00847	0.00234	0.00363	0.00154	0.00220	0.00326	0.00007
0.00150	0.00072	0.00116	0.00054	0.00067	0.00229	0.00004
0.00326	0.00054	0.00158	0.00040	0.00199	0.00055	0.00005
0.00301	0.00068	0.00134	0.00050	0.00160	0.00164	0.00005

SLOPE,A1(DN/SEC)

CHANNEL	BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
16	-0.00389	-0.00074	-0.00087	-0.00077	-0.00034	-0.00021	
15	-0.00501	-0.00087	-0.00104	-0.00024	-0.00052	0.00101	
14	-0.00258	-0.00077	-0.00129	-0.00004	-0.00054	-0.00068	
13	-0.00481	-0.00153	-0.00112	-0.00009	-0.00042	0.00052	
12	0.00103	0.00080	-0.00037	0.00035	-0.00064	-0.00096	
11	-0.00359	-0.00104	-0.00032	-0.00002	0.00028	0.00082	
10	-0.00193	-0.00105	-0.00072	-0.00055	-0.00160	-0.00099	
9	-0.00409	-0.00085	-0.00009	-0.00003	-0.00173	-0.00148	
8	-0.00420	-0.00089	-0.00084	-0.00018	0.00010	0.00006	
7	-0.00315	-0.00163	-0.00121	0.00007	0.00311	0.00028	
6	-0.00283	-0.00039	-0.00075	-0.00019	0.00057	-0.00047	
5	-0.00421	-0.00152	-0.00167	-0.00011	-0.00033	0.00159	
4	-0.00014	-0.00047	-0.00115	-0.00003	-0.00108	-0.00037	0.00000
3	-0.00385	-0.00129	-0.00086	0.00062	0.00000	0.00018	0.00009
2	-0.00392	-0.00092	0.00042	0.00058	-0.00039	0.00144	0.00003
1	-0.00443	-0.00164	-0.00171	-0.00115	0.00019	0.00067	0.00002
<ODD>	-0.00414	-0.00131	-0.00100	-0.00012	0.00007	0.00045	0.00005
<EVEN>	-0.00231	-0.00056	-0.00070	-0.00010	-0.00049	-0.00027	0.00002
<ALL>	-0.00323	-0.00093	-0.00085	-0.00011	-0.00021	0.00009	0.00004
ODDSD	0.00062	0.00032	0.00058	0.00049	0.00138	0.00090	0.00005
EVNSD	0.00189	0.00059	0.00053	0.00044	0.00067	0.00078	0.00002
ALLSD	0.00166	0.00060	0.00056	0.00045	0.00108	0.00089	0.00004

STANDARD DEVIATION OF SLOPE,SDA1(DN/SEC)

BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
0.00002	0.00001	0.00002	0.00000	0.00000	0.00001	
0.00003	0.00000	0.00001	0.00000	0.00001	0.00001	
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	
0.00001	0.00000	0.00001	0.00000	0.00000	0.00001	
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	
0.00001	0.00000	0.00001	0.00000	0.00002	0.00001	
0.00002	0.00000	0.00001	0.00000	0.00000	0.00001	
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	
0.00002	0.00000	0.00001	0.00000	0.00000	0.00002	
0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	
0.00001	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	0.00000
0.00002	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000
0.00003	0.00001	0.00001	0.00000	0.00000	0.00001	0.00000
0.00002	0.00001	0.00001	0.00000	0.00000	0.00001	0.00000
0.00002	0.00000	0.00001	0.00000	0.00001	0.00001	0.00000
0.00002	0.00001	0.00001	0.00000	0.00001	0.00001	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix 3

LINEAR REGRESSION COEFFICIENTS FOR SHUTTER BACKGROUND VS SCAN START TIME
B(DN) VS PO(SEC);B=A0+A1*PO)

CORRELATION COEFFICIENT R

CHANNEL	BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
16	0.05683	0.03389	0.01604	0.05748	0.02646	0.01066	
15	0.05863	0.05597	0.03649	0.03659	0.03062	0.05779	
14	0.04491	0.03856	0.04989	0.00381	0.04821	0.03874	
13	0.05937	0.09101	0.04306	0.01542	0.03691	0.02109	
12	0.06208	0.05484	0.01653	0.03457	0.04326	0.04519	
11	0.05708	0.05300	0.01861	0.00295	0.02447	0.04383	
10	0.04704	0.09070	0.04214	0.05451	0.03207	0.03115	
9	0.05340	0.06420	0.00392	0.00310	0.13789	0.08425	
8	0.05332	0.05404	0.02504	0.01101	0.00703	0.00255	
7	0.04937	0.10293	0.04834	0.00902	0.20310	0.00398	
6	0.04718	0.02065	0.03705	0.01064	0.01314	0.02118	
5	0.05415	0.06732	0.05867	0.01006	0.02261	0.06642	
4	0.00873	0.04448	0.04394	0.00178	0.07733	0.01711	0.00000
3	0.04995	0.04647	0.02721	0.03546	0.00000	0.00733	0.09774
2	0.05039	0.07142	0.02194	0.04117	0.02430	0.05711	0.05831
1	0.04490	0.05796	0.03615	0.07722	0.01845	0.02963	0.02926
<ODD>	0.05336	0.06747	0.03406	0.02373	0.05926	0.03929	0.06350
<EVEN>	0.04631	0.05107	0.03157	0.02687	0.03398	0.02921	0.02916
<ALL>	0.04983	0.05927	0.03281	0.02530	0.04662	0.03425	0.04633
ODDSD	0.00503	0.01978	0.01730	0.02534	0.07164	0.02882	0.04842
EVNSD	0.01622	0.02213	0.01327	0.02281	0.02230	0.02088	0.04123
ALLSD	0.01216	0.02197	0.01495	0.02335	0.05289	0.02486	0.04173

STANDARD ERROR OF THE ESTIMATE SB(DN)

CHANNEL	BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
16	0.5641	0.1812	0.4489	0.1103	0.1070	0.1648	
15	0.7039	0.1279	0.2356	0.0540	0.1410	0.1446	
14	0.4729	0.1654	0.2134	0.0829	0.0919	0.1443	
13	0.6682	0.1367	0.2154	0.0460	0.0949	0.2044	
12	0.1365	0.1204	0.1843	0.0827	0.1220	0.1759	
11	0.5189	0.1613	0.1408	0.0653	0.0951	0.1534	
10	0.3385	0.0955	0.1400	0.0827	0.4119	0.2632	
9	0.6323	0.1218	0.1814	0.0895	0.1025	0.1450	
8	0.6498	0.1359	0.2782	0.1325	0.1217	0.1994	
7	0.5265	0.1298	0.2073	0.0648	0.1237	0.5799	
6	0.4943	0.1563	0.1678	0.1458	0.3562	0.1837	
5	0.6405	0.1854	0.2348	0.0876	0.1202	0.1966	
4	0.1362	0.0873	0.2158	0.12	0.1146	0.1804	55.1330
3	0.6362	0.2287	0.2601	0.14	19.0527	0.2055	0.0078
2	0.6411	0.1060	0.1594	0.1163	0.1318	0.1763	0.0045
1	0.8145	0.2330	0.3906	0.1225	0.0866	0.1860	0.0045
<ODD>	0.64260	0.16559	0.23325	0.08425	2.47710	0.22694	0.00619
<EVEN>	0.42918	0.13099	0.22597	0.11038	0.18215	0.1859827	.56875
<ALL>	0.53591	0.14829	0.22961	0.09731	1.32963	0.2064613	.78747
ODDSD	0.09478	0.04536	0.07341	0.03394	6.69759	0.14492	0.00232
EVNSD	0.20621	0.03436	0.09973	0.02518	0.12605	0.0349538	.98168
ALLSD	0.19022	0.04278	0.08468	0.03187	4.72710	0.1040127	.56366

TEST ON RESIDUALS FOR RANDOMNESS
(*: NOT NORMAL)
IF FOLLOWING VALUES <= 0.0516 -- NORMAL

BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
0.2315*	0.0940*	0.1036*	0.0929*	0.0525*	0.0332	
0.2640*	0.1039*	0.0866*	0.1372*	0.0277	0.0270	
0.2122*	0.1524*	0.0787*	0.1498*	0.0598*	0.0510	
0.2697*	0.0763*	0.0707*	0.1707*	0.0666*	0.0425	
0.0376	0.1105*	0.0948*	0.1456*	0.0485	0.0591*	
0.2649*	0.1138*	0.0746*	0.1368*	0.0485	0.0410	
0.1815*	0.0493	0.0504	0.0716*	0.1791*	0.0723*	
0.2566*	0.0891*	0.1146*	0.1633*	0.0244	0.0340	
0.2615*	0.0689*	0.1841*	0.0664*	0.0516*	0.0806*	
0.2488*	0.0905*	0.0710*	0.1475*	0.0318	0.0373	
0.2240*	0.0856*	0.0659*	0.0561*	0.0442	0.0394	
0.2566*	0.1052*	0.0854*	0.1218*	0.0389	0.0297	
0.0901*	0.0481	0.1048*	0.0500	0.8389*	0.0498	0.8389*
0.2579*	0.0961*	0.1092*	0.0833*	0.8389*	0.0524*	0.4776*
0.2398*	0.0352	0.0707*	0.0726*	0.0475	0.0515	0.4776*
0.2640*	0.0512	0.1008*	0.0447	0.0682*	0.0397	0.4975*
0.26031	0.09076	0.08936	0.12566	0.14313	0.03795	0.48755
0.18477	0.08050	0.09412	0.08813	0.16526	0.05211	0.65825
0.22254	0.08563	0.09174	0.10689	0.15419	0.04503	0.57290
0.00657	0.01970	0.01724	0.04233	0.28163	0.00798	0.01407
0.07930	0.03871	0.04105	0.03890	0.27591	0.01788	0.25548
0.06691	0.03014	0.03051	0.04380	0.26957	0.01525	0.17756

UNACCOUNTED VARIANCE, 100(1-R**2) (%)

BAND1	BAND2	BAND3	BAND4	BAND5	BAND7	BAND6
99.677	99.885	99.974	99.670	99.930	99.989	
99.656	99.687	99.867	99.866	99.906	99.666	
99.798	99.851	99.751	99.999	99.768	99.850	
99.648	99.155	99.815	99.976	99.864	99.956	
99.615	99.699	99.973	99.881	99.813	99.796	
99.674	99.719	99.965	99.999	99.940	99.808	
99.779	99.177	99.822	99.703	99.897	99.903	
99.715	99.588	99.998	99.999	98.099	99.290	
99.716	99.708	99.937	99.988	99.995	99.999	
99.756	98.941	99.766	99.992	95.875	99.998	
99.777	99.957	99.863	99.989	99.983	99.955	
99.707	99.547	99.656	99.990	99.949	99.559	
99.992	99.802	99.807	100.000	99.402	99.971	100.000
99.750	99.784	99.926	99.874	100.000	99.995	99.045
99.746	99.490	99.952	99.831	99.941	99.550	99.660
99.798	99.664	99.869	99.404	99.966	99.912	99.914
99.7131099	.5105599	.8576399	.8875199	.1998299	.7729799	.47950
99.7625199	.6963099	.8849299	.8822799	.8410499	.8769299	.82998
99.7378199	.6034399	.8713899	.8848999	.5204399	.8247599	.65474
0.05294	0.30032	0.11165	0.20315	1.49009	0.25193	0.61499
0.11100	0.25387	0.08560	0.13623	0.19411	0.14998	0.24044
0.08780	0.28525	0.09712	0.16712	1.07861	0.20731	0.43161

Task Assignment 132
December 1984

SUBTASK #00
FINANCIAL DATA AND LABOR-HOUR UTILIZATION

Financial Data

Cumulative total to date:	$ 33,253
Projected total to complete:	$ 90,923
CTR estimated total:	$ 124,176

Labor-Hour Utilization

Category	Hours this Month On-Site	Hours this Month Off-Site	Cumulative Hours On-Site	Cumulative Hours Off-Site
PM		3.6		11.8
TAM		9.0		32.0
LPA	19.5	18.0	64.0	68.5
SAP	40.0		137.0	
AP	80.0		276.0	84.0
JAP	160.0		480.0	
SP	158.0		406.0	40.0
Support		30.7	16:0	112.9
	457.5	61.3	1,379.0	349.2