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INVESTIGATION OF SEVERAL ASPECTS OF LANDSAT-4 DATA QUALITY

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Quarterly Progress Report

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The Thematic Mapper scene of Sacramento, CA (44/33) acquired during the TDRSS test on August 12, 1983 was received in TIPS format. The common scene of NE Arkansas was also received in TIPS format. Quadrants for both scenes were tested for band-to-band registration using our reimplemented block correlation techniques. (The loss of several computers almost simultaneously last fall forced the reimplementation.)

The results for band-to-band registration for Quadrant 4 of the NE Arkansas scene are given in Table 1. Although the earlier results we reported included correlation blocks from the entire scene (i.e. Scrounge format) and not just Quadrant 4, the results for the misregistrations between bands in the same focal plane are almost identical to the earlier results, generally within hundreths of a pixel. In all these cases, the 95% confidence intervals for a given band pair overlap between the Scrounge and TIPS results. For band pairs between the cooled and uncooled focal planes (3 vs. 5 and 3 vs. 7) the results for Quadrant 4 show that the corrections for the initial misregistration have been applied. The along-scan misregistration had been measured as +0.49 pixels. In Quadrant 4 data, the along-scan misregistration is -0.10 pixels which indicates an over-correction has been made although the misregistration is well within the allowable misregistration of 0.3 pixels between focal planes. The across-scan misregistration had been +0.25 pixels for bands 3 vs. 5 and +0.16 pixels for bands 3 vs. 7. In Quadrant 4 data, the misregistrations have been reduced to +0.10 and +0.04 pixels, respectively. The misregistration of bands 5 vs. 7 remains the same at -0.06 pixels and could explain part of the difference in misregistration between band pairs 3 vs. 5 and 3 vs. 7. In fact, the consistency of our measurements tempts one to predict that the along-scan correction applied was 0.59 pixels and the across-scan correction applied was 0.12 pixels.

The thermal band misregistration with the Scrounge product of the NE Arkansas scene showed a three pixel offset in both directions. Table 1 gives the across-scan misregistration of bands 6 vs. 7 as +0.39 pixels and the along-scan misregistration as -0.12 pixels for Quadrant 4 of the TIPS product. The across-scan misregistration exceeds
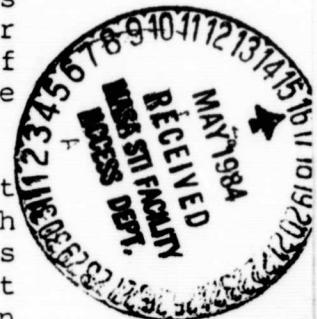
the specified maximum misregistration of 0.2 pixels. Since the thermal pixels, as acquired, are four times larger than the others, the measured misregistrations probably should be divided by four in order to be consistent. In that case, the misregistration is well within the specification.

Results for the block correlation analysis for Quadrant 1 of the Sacramento scene for August 12, 1983 in TIPS format are shown in Table 2. These results are very similar to those shown in Table 1 for the NE Arkansas scene in TIPS format. All the measured misregistrations are less than the specified maximums. Except for band pairs 3 vs. 5 and 3 vs. 7 the 95% confidence limits overlap for corresponding band pairs between the two sets of results. For these two band pairs the across-scan shifts are greater for the Sacramento scene by approximately 0.06 pixels and the along-scan shifts switch from negative to positive with a total magnitude of 0.24 pixels. Granted that one might not expect tests of the band-to-band misregistrations between two different scenes taken a year apart to be consistent at a level of hundreths of a pixel, but that seems to be the case except for band pairs 3 vs. 5 and 3 vs. 7. One is lead to suspect that the cooled and uncooled focal plane offsets used may have been different for the two data sets. Using the same logic we used for the NE Arkansas results, we are tempted to deduce that the across-scan correction applied was 0.08 pixels and the along-scan correction applied was 0.35 pixels instead of 0.12 and 0.59 pixels, respectively for the NE Arkansas scene.

We requested, but have not yet received, geometrically corrected P-tapes in order to test geodetic accuracy. In preparation we installed a program from EROS which calculates a predicted location of a pixel from the header information on a Scrounge tape. We intend to modify the program for use with TIPS format data and derive predicted vs. observed location from the geometrically corrected tapes.

The system MTF analysis for the San Francisco scene (44/34) of December 31, 1982 is complete. The thermal band did not have sufficient contrast for the targets used and was not analyzed. Bands 3, 4, 5 and 7 yielded satisfactory MTF measurements with effective IFOVs (EIFOVs) of 33.6, 40.8, 41.9 and 40.0 meters, respectively. The target used was the San Mateo Bridge which cuts the scan lines at approximately 45 degrees. Consequently, the along-scan EIFOV and the across-scan EIFOV contributed about equally in this measurement. Bands 1 and 2 were also analyzed but the results were too noisy due to low contrast for proper interpretation. Professor Schowengerdt has begun work on the August 12, 1983 San Francisco scene. His Progress Report to Ames is attached to and made part of this report.

TABLE 1

Summary statistics for band-to-band registration of
Thematic Mapper band combinations for the NE Arkansas
scene of August 22, 1982 (Quadrant 4) in TIPS format.
All correlation blocks with the correlation coefficient
<0.6 were discarded (<0.3 for bands 6 vs. 7). The unit
of misregistration (shift) is pixels.

TM Bands	Shift Direction	Number of Blocks	Mean Shift	Std. Dev.	95% Confid. Interval for Mean Shift
3 vs 1	Across-scan	197	-.04	.06	-.04 to -.03
	Along-scan	197	-.04	.06	-.05 to -.04
3 vs 2	Across-scan	203	.02	.07	.01 to .03
	Along-scan	203	-.02	.05	-.03 to -.01
3 vs 4	Across-scan	56	.00	.14	-.04 to .04
	Along-scan	56	.07	.17	.03 to .11
3 vs 5	Across-scan	168	.10	.15	.06 to .12
	Along-scan	168	-.10	.17	-.12 to -.07
3 vs 7	Across-scan	198	.04	.11	.02 to .06
	Along-scan	198	-.10	.10	-.11 to -.08
5 vs 7	Across-scan	207	-.06	.09	-.07 to -.05
	Along-scan	207	.00	.10	-.01 to .02
6 vs 7	Across-scan	130	.39	1.99	.05 to .73
	Along-scan	130	-.12	1.80	-.43 to .19

TABLE 2

Summary statistics for band-to-band registration of
Thematic Mapper band combinations for Quadrant 1 of
the Sacramento, CA scene of August 12, 1983 in TIPS
format. All correlation blocks with the correlation
coefficient <0.6 were discarded (<0.3 for bands 6 vs
7. The unit of misregistration (shift) is pixels.

TM Bands	Shift Direction	Number of Blocks	Mean Shift	Std. Dev.	95% Confid. Interval for Mean Shift
3 vs 1	Across-scan	181	-.04	.08	-.05 to -.03
	Along-scan	181	-.05	.06	-.06 to -.04
3 vs 2	Across-scan	182	.01	.08	.00 to .02
	Along-scan	182	-.03	.04	-.03 to -.02
3 vs 4	Across-scan	134	.01	.22	-.03 to .05
	Along-scan	134	.02	.17	-.01 to .06
3 vs 5	Across-scan	177	.17	.14	.15 to .19
	Along-scan	177	.14	.15	.12 to .16
3 vs 7	Across-scan	166	.11	.11	.09 to .12
	Along-scan	166	.14	.15	.12 to .16
5 vs 7	Across-scan	183	-.06	.09	-.07 to -.04
	Along-scan	183	-.01	.08	-.04 to .00
6 vs 7	Across-scan	131	.29	1.35	.06 to .52
	Along-scan	131	-.03	1.23	-.18 to .24