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Study of Recreational Land and Open Space
Using SKYLAB Imagery
Monthly Progress Report, January 1975

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CURRENT ACTIVITY

Activity for the month of January involved a preliminary analysis of S-192 data quality. The data had previously been converted from 9-track, NASA format to 7-track ERIM format. During that process, the doubly sampled thermal band (SDO's 15 and 16) was deleted in order to reduce the total number of channels to the maximum of 20 allowed by the ERIM IBM 7094 computer system.

Because of limited dynamic range noted in previous S-192 data, our first step was to assess the range for the current data set. Dynamic range in this case is defined as the range of integers over which data values representative of total scene variability are distributed. This was assessed for each SDO by histogramming data values from a uniformly distributed cloud-free sample of 7300 pixels (every tenth pixel in every tenth scan line) on one entire tape covering the test site. Dynamic range varied greatly by spectral band, being as low as 28 integer values in SDO's 1 and 2 (.52 - .56 μm) and as large as 118 integer values in SDO 19 (.98 - 1.03 μm). Table 1 indicates the ranges for all 20 SDO's.

Next, a graymap of a portion of the test site was generated using SDO 19. The large dynamic range of this SDO allowed for a suitable level-set that depicted many of the major scene classes. Training sets of homogeneous compositions were outlined on the graymap with the aid of high-altitude photography. These training sets were for known scene classes that typified the scene composition and included water, dark muck soil, stubble, green sod grass, herbaceous brush, and hardwood forest. One twenty-channel signature was extracted for each scene class except water, for which three separate signatures were extracted.

Signature means ± one standard deviation were plotted in each of the 20 SDOs. Standard deviations on the order of 10 percent or less of the dynamic range were noted to occur for most signatures in 18 of the 20 SDOs. Excessively large standard deviations were noted for an occasional signature mean in a few SDOs, but these were attributed to the presence of bad scan lines in that particular channel. Random occurrence of such bad scan lines in most SDO's have been observed in this and other data sets. Excessively large standard deviations were noted for most signatures in SDO's 10 (.78 - .88 μm) and 18 (.46 - .51 μm).

In each SDO, the standard deviations of most of the signatures were nearly the same regardless of the value of the mean itself, indicating the absence of a photon noise limited condition. In other words, variance around a signature mean is due to the natural variability of the scene class and inherent fixed system noise. A rough measure of system "noise" was obtained by inspecting integer values in each SDO from a matrix of 150 pixels on a lake surface of assumed uniform reflectance. The rms fluctuations in integer value are stated for each SDO in Table 1. By dividing the previously determined dynamic range for each SDO by the corresponding rms "noise" fluctuations, a measure of signal-to-noise can be stated (Table 1).

The results of Table 1 indicate generally better signal-to-noise ratios for SDOs of the near-IR and mid-IR (.68 - 2.35 μm) spectral regions than for the remaining SDOs of the visible and thermal spectral regions. This situation is caused by the limited dynamic range of the visible and thermal SDOs since rms "noise" fluctuations for most SDOs do not change radically. Exceptions are noted for the high "noise" values of SDOs 10 and 18 which result in low signal-to-noise ratios. These SDOs will be deleted from further processing efforts. In order to reduce the cost and simplify the analysis of subsequent data processing, all even numbered SDOs of the high sampling density spectral bands will also be deleted.

TABLE 1. - STATISTICS OF SIGNALS FROM S-192 TAPE COVERING SOUTHEAST MICHIGAN

SDO	Spectral region (μm)	Dynamic Range (integer values)	RMS "noise" fluctuations (integer values)	Signal-to-noise (integer values)
1	.52- .56	28	2.56	10.94
2	.52- .56	28	2.41	11.62
3.	.56- .61	30	3.05	9.84
4	.56- .61	30	3.06	9.80
5	.62- .67	38	4.75	8.00
6	.62- .67	38	4.90	7.75
7	.68- .76	70	4.32	16.20
8	.68- .76	70	4.51	15.52
9	.78- .88	95	4.50	21.11
10	.78- .88	95	20.00	4.75
11	1.55- 1.75	73	2.78	26.26
12	1.55- 1.75	73	3.01	24.25
13	2.10- 2.35	52	3.55	14.65
14	2.10- 2.35	52	3.80	13.68
17.	1.20- 1.30	106	5.64	18.79
18	.46- .51	92	14.12	6.52
19	.98- 1.03	118	5.91	19.97
20	1.09- 1.19	105	3.98	26.38
21	10.20-12.50	41	4.50	9.11
22	.41- .46	38	5.58	6.81

FUTURE WORK

During the January reporting period, we have noticed instances of spatial misregistration of the data values among the spectral bands. Activity during the next month will attempt to quantify the magnitude of this problem and determine its significance for the processing objectives of this task. We will also review the spectral signature data already analyzed to estimate the degree to which it is possible to discriminate various scene classes.

In addition, we will initiate the task of using the S-192 data for mapping and analyzing terrain. We will continue our previous contacts with personnel in the Wildlife Division of the Michigan Department of Natural Resources to discuss specific uses of processed S-192 data for wildlife habitat analysis and to select terrain and vegetation classes of greatest significance for these purposes.

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