LARS Information Note 011769
Purdue University

# Digitization, Reformating and Overlay of Scanner Data

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This information note reports on the processing of Michigan multispectral scanner data taken during September of 1967. Data collection and processing were initiated at the request of Harry W. Smedes of U. S. Department of the Interior, Geological Survey, Denver, Colorado.

## Digitization and Reformating

Three runs were processed. The run numbers assigned by LARS are 18, 31, and 34 of 1967. Each run was digitized and reformatted in two passes. Table 1 describes each run and indicates wavelength bands for both passes of each run.

The first pass of run 18 was 12-channel visible data. Due to changes in sun illumination and thus changes in amplitude of the sun sensor calibration pulse, it was necessary to redigitize the data and make signal gain adjustments. The second pass of run 18 was 4-channel IR data. This data was processed in one turnaround with no particular problem. Gray-scale pictorial prints suggested that all 16 channels of run 18 were of good quality. Total time to process this was 10 man hours. This includes $3\frac{1}{2}$ hours of A-to-D converter time, $4\frac{1}{4}$ hours of on-computer time. The on-computer time includes 3.63 hours of computer meter time.

The first pass of run 31 was 4-channel IR data. This data presented a particular problem in that the 4 data signals were not time-coincident. This is the result of the physical arrangement of the 4 detectors in the scanner itself. Channel 4 was used as a reference and

signals from channels were shifted and made time-coincident during reformatting. This required considerable changes in the computer processing program. Pass two of run 31 was one-channel IR data and was processed without difficulty. Gray-scale prints suggested the following on data quality. Channels 1 and 2 of the 4-channel data were poor due to an AC ripple riding on the data. The ripple was of sufficient amplitude to distort very badly any features which show in the gray-scale prints. Channels 3 and 4 and the single channel IR data were of good quality. Passes 1 and 2 of run 34 were processed in the same way as run 31. The same computer program changes needed to process pass 1 of run 31 were used to process pass 1 of run 34. The usefulness of the 4-channel IR data of run 34 is questionable. At different times during the run each of the four channels was disturbed by complete attenuation, change in DC insertion, or a change in signal gain. The single channel IR data for run 34, however, looks good. Total time to process runs 31 and 34 was 25 hours. This includes 6 hours of A-to-D time and 6 hours of on-computer time. The on-computer time includes 4 hours of computer meter time.

## Overlay

Scanner data overlay was carried out to combine the 12-channel visible and 4-channel IR imagery for run 18 into one coincident digital data storage tape. This process is necessary if the multispectral pattern recognition processor is to use the IR data. The scanners producing the visible and IR data are separate and the resulting data storage tape runs are both separate and non-coincident. The LARS scanner data overlay system was developed to combine data from separate scanners so that all wavelength bands are stored on tape in spatial coincidence.

The setup phase of overlay consists of pictorially printing out data from the separate tapes and defining initial approximate alignment points on punched cards. This process was carried out for one visible band channel (.62-.66 micron) and all four of the IR channels. The process took 2 man hours. Inspection of the IR imagery revealed that the 8-14 micron data was shifted laterally by approximately 20 samples with respect to the other three IR channels. This problem dictated a two-pass overlay approach: one to combine the visible band data and the three coincident IR channels, and a second to add the 8-14 micron channel.

Automatic overlay was attempted and the results were not satisfactory. The LARS overlay system requires a reasonably sharp edge structure in the imagery if the correlation process is to reliably achieve spatial coincidence between the two sets of imagery being combined. The forest and meadow surface cover of the Yellowstone area does not have sufficient edge structure to enable automatic overlay with the present system. This first attempt took 3 man hours.

The overlay system is structured such that manual overlay can be carried out if the automatic correlation process will not work. Pictorial printouts were re-examined and overlay coordinates were selected visually as accurately as humanly possible. The alignment data was punched on cards. The two passes to combine the visible and IR channels required 3.5 man hours.

The present LARS Data Storage Tape format is limited to a total of 12 channels of data. Thus, four of the twelve original visible band channels had to be dropped to make space for the four IR channels. Earlier overlay work suggested that channels 2, 4, 6 and 8 of the visible band be dropped. The wavelengths dropped are--channel 2: .44-.46 micron, channel 4: .48-.50 micron, channel 6: .52-.55 micron, and channel 8: .58-.62 micron.

Any combination of channels can be dropped and added by the overlay system. The results of the overlay appear to be reasonable. Ten points were checked in the run and the average error in resolution elements was 3.64 units comparing one IR channel to one visible channel on the overlay tape. Complete details on the overlay tape can be furnished on request.

The overlay system performs a border enhancement process in the course of an overlay job. The output of this process can be displayed pictorially as an aid to persons studying the imagery visually. The border representation for the Yellowstone data was very "noisy" for the reason given above and therefore of no use. Another method of enhancing boundaries using the overlay system is thresholding of the unaltered imagery. The 8-14 micron channel was thresholded at several data levels and useful outlines of hot spots in the imagery were produced. This process took 3 man hours.

The times given are total man hours spent on the task. The computer was operating during most of this time. The sum of computer meter time for the work described was 5.65 hours. The engineering support total is 9.5 man hours.

TABLE 1

| LARS RUN | LARS System RUN | Wavelength Bands | (microns) | Data Quality | Field of View | Target Area | Time |
|---|---|---|---|---|---|---|---|
| 18 | 26700180 | 1 | .40-.44 | Good | 80° | Path 21 | 1444 |
| | | 2 | .44-.46 | Good | " | | |
| | | 3 | .46-.48 | Good | " | | |
| | | 4 | .48-.50 | Good | " | | |
| | | 5 | .50-.52 | Good | " | | |
| | | 6 | .52-.55 | Good | " | | |
| | | 7 | .55-.58 | Good | " | | |
| | | 8 | .58-.62 | Good | " | | |
| | | 9 | .62-.66 | Good | " | | |
| | | 10 | .66-.72 | Good | " | | |
| | | 11 | .72-.80 | Good | " | | |
| | | 12 | .80-1.00 | Good | " | | |
| | 36700180 | 1 | 1.0-1.4 | Good | 40° | | |
| | | 2 | 2.0-2.6 | Good | " | | |
| | | 3 | 4.5-5.5 | Good | " | | |
| | | 4 | 8.0-14.0 | Good | " | | |
| | 56700180 | 1 | .40-.44 | Good | 80° | | |
| | | 2 | .46-.48 | Good | " | | |
| | | 3 | .50-.52 | Good | " | | |
| | | 4 | .55-.58 | Good | " | | |
| | | 5 | .62-.66 | Good | " | | |
| | | 6 | .66-.72 | Good | " | | |
| | | 7 | .72-.80 | Good | " | | |
| | | 8 | .80-1.00 | Good | " | | |
| | | 9 | 1.0-1.4 | Good | 40° | | |
| | | 10 | 2.0-2.6 | Good | " | | |
| | | 11 | 4.5-5.5 | Good | " | | |
| | | 12 | 8.0-14.0 | Good | " | | |
| 31 | 36700310 | 1 | 4.5-5.5 | Poor | " | Path 23 | 0406 |
| | | 2 | 4.5-5.5 | Poor | " | | |
| | | 3 | 8.0-14.0 | Good | " | | |
| | | 4 | 8.0-14.0 | Good | " | | |
| | 46700310 | 1 | 8.0-14.0 | Good | 80° | | |
| 34 | 36700310 | 1 | 4.5-5.5 | Poor | 40° | Path 23 | 2427 |
| | | 2 | 4.5-5.5 | Poor | " | | |
| | | 3 | 8.0-14.0 | Poor | " | | |
| | | 4 | 8.0-14.0 | Poor | " | | |
| | 46700310 | 1 | 8.0-14.0 | Good | 80° | | |