LARS Contract Report 041579

Quarterly Progress Report

Digital Processing of Landsat MSS and Topographic Data to Improve Capabilities for Computerized Mapping of Forest Cover Types

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I. OVERALL STATUS AND PROGRESS TO DATE

A. Evaluation of Digital Topographic Data

As a result of the detailed evaluations of the classification results that involved the use of the DMA elevation data, it became apparent that a series of additional tests were needed in order to obtain a more in-depth understanding of certain characteristics of the elevation, slope, and aspect data channels of the DMA data set. The first of these tests involved a comparison between DMA elevation data and elevations obtained from 1:24,000 topographic maps. This comparison was based upon 341 randomly located X-Y coordinates in the Landsat/topographic data set. The elevation of each of these coordinate locations was obtained from the DMA data tape, and then the elevation for the same location on the ground was determined from U.S.G.S. 1:24,000 scale, 7½ minute topographic quadrangle maps. Differences in elevation between the two data sources were tabulated in 25 meter increments. The results of this comparison are shown in Figure 1.

As indicated by Figure 1, for only 128 out of the 341 pixels (37.5%), the elevations on the DMA data tape there were within ± 25 meters of the "true elevations" as obtained from the 7½ minute topographic maps; 217 pixels (63.6%) were within ± 50 meters; 257 pixels (75.4%) were within ± 75 meters; and 285 of the 341 pixels (83.6%) were within ± 100 meters of the elevation indicated on the 7½ minute topo map. This analysis would indicate that the elevation data obtained from the DMA data tape is probably adequate for use in mapping forest cover types, in that a difference of 50 or 75 meters in elevation data alone should not cause an excessive number of misclassifications.

It had also been noted during the analysis of the data that an excessively large number of pixels seemed to be occurring right at the 200 ft. elevation increments. (Note: The USGS 1:250,000 scale maps from which the DMA data tapes were generated have a 200 foot contour interval.) To verify this impression, a histogram was generated showing the number of pixels occurring at each elevation level. This histogram is shown as Figure 2, and indicates that approximately one-half of all the X-Y coordinates on the data tape have elevations that are at the 200 ft. contour intervals! It is believed that the reason so many X-Y coordinates were assigned to the 200 ft. contour intervals is due to the cell size of the data being digitized in conjunction with the large amount of topographic relief in the study site. Use of the 1:250,000 scale topo maps for the digitization process resulted in 64 meter cell sizes. Because of the large amount of topographic relief present in the San Juan Mountain study area, the 200 ft. contour lines fall relatively close together, and therefore, these contour lines cross or touch a proportionally high number of the 64 meter cells. It is therefore clear that the actual elevational characteristics of the area are not well represented by the DMA digitized data tape for this particular area having very rugged relief.

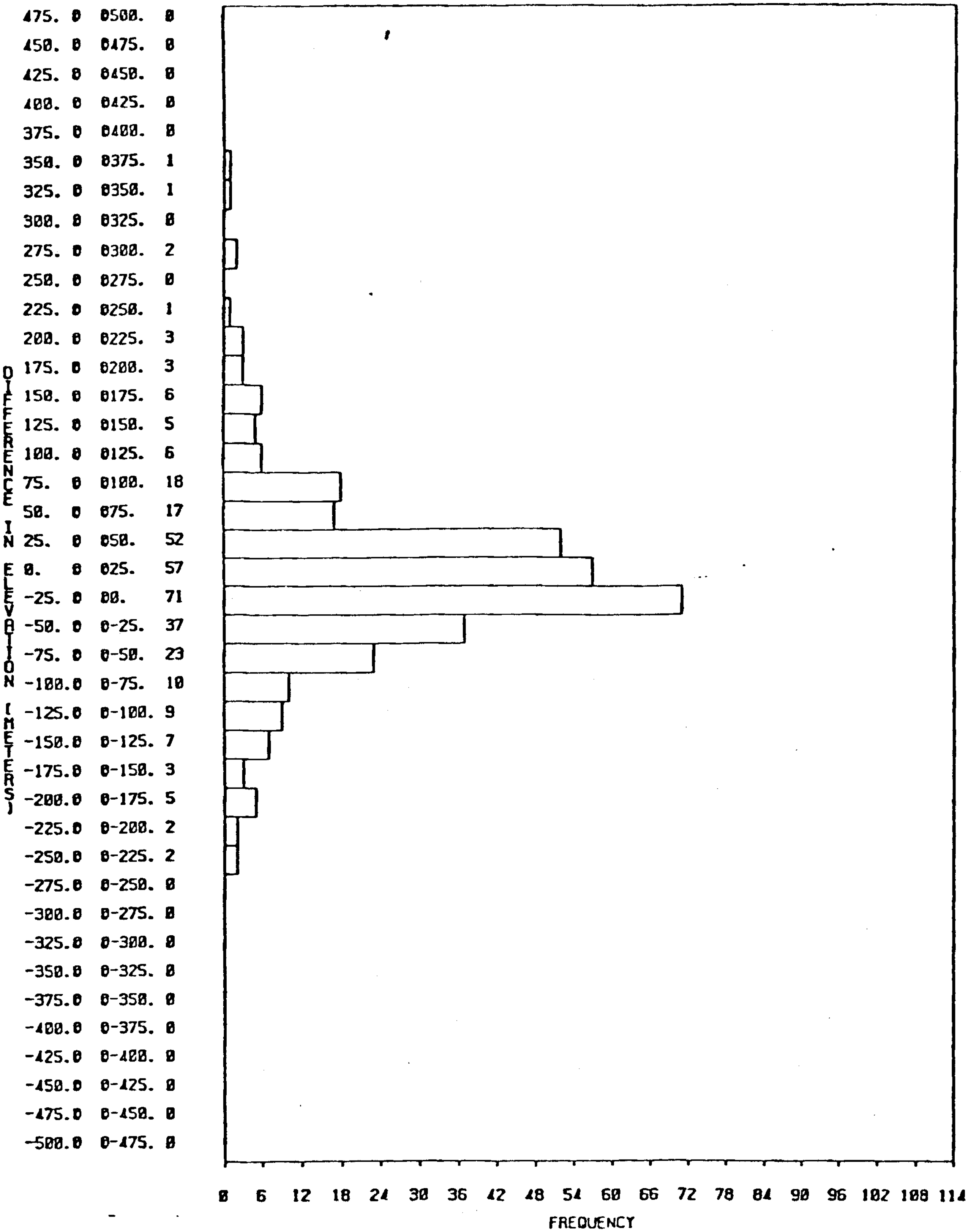

Figure 1. Histogram showing the difference in elevation on the D.M.A. data tape from the elevation for that pixel manually interpreted on 7½' U.S.G.S. topographic maps, using a random sample of 341 pixels.

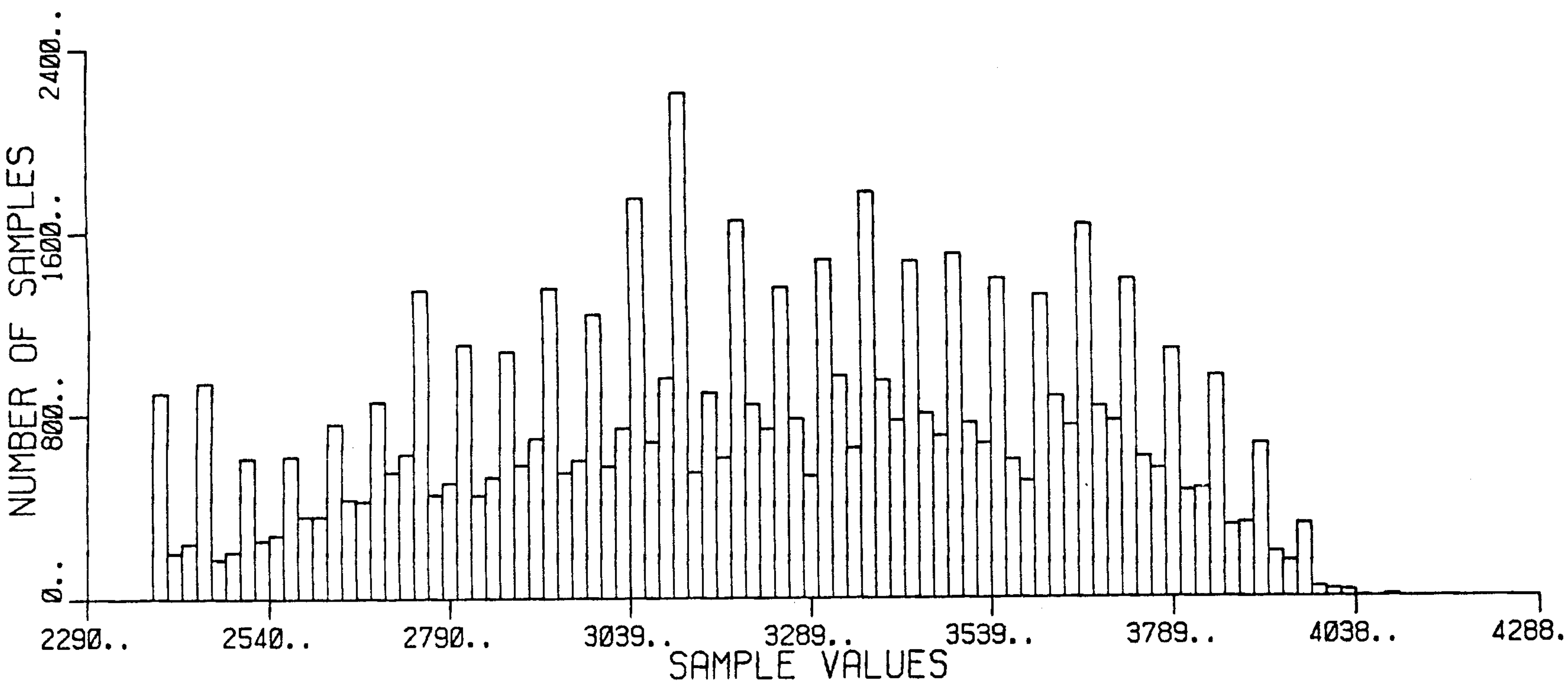

Figure 2. Histogram of the DMA elevation data for the San Juan Mountain test site area. Sample values represent elevation in meters.

The characteristics of the elevation data consequently caused the slope and aspect channels to have serious deficiencies, in that if two grid cells having a 200 ft. difference in elevation were only one or two cells apart, the slope between such cells could be represented as being much steeper than actually was the true situation. Another possible cause of errors in the slope and aspect channels could be due to variations in geometric accuracy of the location of the DMA elevation data cell in relation to the true location on the map, in conjunction with variations in location of the Landsat data cell. Such variations could cause problems in areas having distinct changes in slope or aspect, such as along ridge lines.

It is not certain how many of the randomly defined pixels used in the test data set for this study were affected by such possible differences between the true topographic position and the topographic characteristics represented on the DMA data tape, nor how significant the differences are for each individual pixel. However, it is likely that the topographic characteristics of at least some of the test pixels are not properly represented on the topographic data tape. This would indicate that small, randomly located test fields, rather than individual test pixels would be a better approach for quantitatively evaluating the classification results.

This evaluation of the topographic data characteristics tends to lead us to believe that some of the results of the analysis of the Colorado data (which indicated that slope and aspect are not particularly important), may in fact not be representative of the true significance of these ancillary data channels, especially the aspect data. Data sets having finer spatial resolution, or data such as the Washington GRIDS data set, should be more effective in defining the value of the aspect and slope data for such comparisons among different analysis techniques.

B. Final Documentation of the Colorado Landsat/Topographic Study

Due to the desire for the annual report to represent a rather finalized version of the analysis of the Colorado data, permission was received from our technical monitor, Mr. David Amsbury, to delay submission of the annual required by the contract until analysis and evaluation of the Colorado data results could be completed and documented. Therefore, work continued during this quarter on this task. The documentation is in the process of being typed and edited, and will be published as a Contract Report during the coming quarter. This additional analysis and evaluation of the results obtained has proven very valuable in defining approaches that will be more meaningful and effective in the analysis of data from central Washington.

C. Application of the Digital Topographic Analysis Technique to a Test Site in Central Washington

On March 2nd, a meeting was held in Olympia, Washington with Messrs. Roger Harding, Bob Scott, and Tim Gregg of Washington DNR and Roger Hoffer of Purdue to coordinate activities for using combined Landsat and topographic data for a test site in central Washington. Previous conversations by phone and an exchange of correspondence had indicated that a site in central Washington would be preferable to DNR personnel. Analysis of Washington

GRIDS data by Tim Gregg indicated that the west half of the Okanogan quadrangle would be utilized. This area involves a block of 24 townships (three townships E-W x eight townships N-S). Most of this area is managed by either DNR or the U.S. Forest Service (as part of the Okanogan National Forest). The area is contained entirely within a Landsat frame collected on August 15, 1977. Objectives of the analysis were discussed and tentative dates for field work were determined. It was also decided that at the time of the development of training statistics, it would be desirable for Tim Gregg to come to Purdue to assist in the analysis process.

D. Evaluation of the P-1 Procedure for Potential Application to the Washington GRIDS Data

Development of the P-1 Procedure at NASA/JSC for analyzing Landsat data has stimulated interest at LARS in the potential utility of this approach for analyzing forest cover types for situations in which a set of data points of known cover type is available to use in the analysis process. Such a situation exists in Washington, where the GRIDS data set could be of potential use as input in the P-1 analysis procedure. U.S. Forest Service permanent sample plots could also be of potential value in conjunction with an analysis procedure such as P-1. Therefore, it seemed that P-1 would offer another possible analysis approach for the Washington data. As an initial step toward the possible use of P-1 on the Washington data, a study was undertaken by Ross Nelson to evaluate the influence of the various parameters that the user must define in applying the P-1 analysis technique, and to compare the ease and effectiveness of using P-1 as compared to a more supervised analysis procedure using the GRIDS data (or some other statistically defined set of individual data points) as training data. The TSRS spectral data from the Colorado data set is being used for this analysis, since the Washington GRIDS data is not yet available. This evaluation of the P-1 Procedure for possible application to the Washington GRIDS data should be completed during the next quarter.

II. PROBLEMS ENCOUNTERED

Due to the large number of individual pixels being used as test fields, and in order to evaluate the results both as a function of forest cover type and by quadrangle, classifications had to be run on a quadrangle-by-quadrangle basis and then summarized manually by cover type and for the entire test area. A considerable amount of time was consumed in this process, thereby delaying evaluation of the classification results. This work has now been completed. It is clear, however, that this procedure will need to be modified before completing the Washington study area so that similar manual compilation processes are not required.

Two other problems have developed in conjunction with the Washington data, the first being a requirement to reformat the GRIDS data. This problem is being overcome by DNR personnel, who plan to send LARS the GRIDS data tape by early June. The second problem involved the use of Landsat data, in that the wrong half of the Landsat data frame was sent to LARS for reformatting. Again, the DNR is sending the correct portion of the frame to LARS, and it should be reformatted and ready for analysis during the next quarter.

III. PERSONNEL STATUS

The personnel actively involved in this project during this reporting period (January 16, 1979 - April 15, 1979) were as follows (average percentage of time over the three months):

Dr. L. Bartolucci	13%
R. Crosley	23%
S. Davis	20%
M. Fleming	75%
Dr. R. Hoffer	50%
N. Kline	5%
L. Lang	42%
R. Latty	25%
R. Nelson	30%
Dr. J. Peterson	5%
B. Prather	25%
W. Shelley	4%

IV. EXPECTED ACCOMPLISHMENTS

During the next quarter, the contract report for the analysis of the Colorado data will be completed, duplicated and submitted to JSC. The final analysis procedures for working with the Washington data will be defined and discussed with DNR personnel during a field trip to Washington in early June. During that field trip, LARS personnel will also spend time in the test site area becoming familiar with the characteristics of the cover types and topographic characteristics of the area. Landsat data will be reformatted and made ready for analysis. Analysis will be initiated on the GRIDS data set which actually contains all the information required for developing the Topographic Distribution Model.