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# INFORMATION CONTENT COMPARISON OF THEMATIC MAPPER, MULTISPECTRAL SCANNER AND AIRBORNE THEMATIC MAPPER DATA

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ABSTRACT

A. INTRODUCTION

On August 12, 1983 a test of the Tracking and Data Relay Satellite System in conjunction with the operation of Landsat 4 provided both Thematic Mapper (TM) and Multispectral Scanner (MSS) data over Central California. This was the first TM acquisition over California at a time when the majority of agriculture was in full canopy. In addition, on August 12, NASA Ames Research Center (ARC) acquired Airborne Thematic Mapper (ATM) data with the high altitude U-2 aircraft. Coincident with both of the above acquisitions, personnel from ARC and the University of California, Berkeley collected detailed ground information of the same area. This set of three simultaneously collected multispectral data sets allows for a rigorous comparison of information content by examining the effects of the spatial, spectral and radiometric resolutions.

B. BACKGROUND

Previously, the authors (1,2) carried out a similar study to compare information content among all possible combinations of the three factors, which were varied between TM and MSS approximations. That study employed Daedalus Multispectral Scanner data collected over central California in 1981. Significant results showed that lower spatial resolution and higher radiometric resolution, both independently and in combination, yielded higher classification accuracies.

C. APPROACH

The proposed paper will discuss the procedures and results of a study currently underway at ARC which is taking full advantage of the data collected on August 12, 1983. This study should provide even more definitive results in that, 1) more exact methods of data simulation will be emphasized, 2) and actual TM and MSS data will be available for direct comparison. The results of this phase of the project will serve to defend or discount the results previously published, and to provide a more direct comparison between the information content of TM and MSS data. Information content (measured through classification accuracy) of ATM data will be compared to that of TM data, as well as comparing the information content of TM and MSS data. In addition, validations will be made to measure the degree to which ATM data can be degraded to simulate TM and MSS data.

To carry out this study, systematic degradations of the ATM data are required. The spectral, spatial and radiometric factors are each varied independently between TM and MSS values. This series of degrading three factors through two levels each will generate all possible combinations of the three factors, resulting in eight data sets. TM and MSS data will be directly compared to their simulations, yielding ten individual data sets to be analyzed.

D. DEGRADATIONS

The spectral simulation of the 1981 data was hampered due to the nature of the airborne scanner configuration. Whereas the 1981 configuration included the spectral regions of TM bands 1-4 and 7, the 1983 configuration includes the regions of TM 1-7. Combinations of various ATM channels included MSS bands 1-4 for both the 1981 and the 1983 configurations.

The spatial simulation of the 1981 data was merely an average of nine (three by three window) 25 meter (≈TM) pixels to simulate one 75 meter (≈MSS) pixel. The current analysis employs a point spread function (PSF) for MSS data from Schowengerdt's study (3) of the MSS Modulation Transfer Function (MTF). The ATM data will be convolved with a normalized PSF to obtain a realistic simulation of MSS spatial resolution.

The 1981 8 bit (≈TM) data was proportionally reduced to 6 bit (≈MSS) data. For the 1983 data, the published (4,5,6) gains (radiance/count) of TM, MSS and ATM data will be used to convert the ATM digital counts to radiance. The radiance values will then be converted to either TM or MSS digital counts.

This series of degradations should provide a very close approximation of TM and MSS data. Simultaneously collected TM and MSS data will be directly compared to these simulations. The other six data sets, representing all additional possible combinations of the three resolutions being evaluated, will provide information on how each factor contributes independently and in various combinations, to information content.

E. PRESENT STATUS

San Joaquin County in central California was selected as the study site because of the wide diversity in land cover found there. Truck crops, field crops, vineyards and orchards will be included in the analysis as well as forests, rangeland, water bodies and urban regions. Areas of interest have been extracted from the ATM data and mosaicked to create an image measuring 1795 lines by 1795 samples. Spatial, spectral and radiometric degradations are currently being performed on the ATM mosaic. Subsets of the San Joaquin TM data are being extracted and mosaicked. Statistical training will follow a modified supervised approach. Accuracy assessment will be performed through back-classification of training sites as well as through random test site selection. This will allow for both pure and border pixel accuracy assessment.

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