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CORRECTING LANDSAT DATA FOR CHANGES IN SUN
ANGLE, HAZE LEVEL, AND BACKGROUND REFLECTANCE

SAR ENHANCEMENT OF LANDSAT IMAGERY

J. F. Potter
Lockheed Electronics Company, Inc.¹
Aerospace Systems Division
Houston, Texas 77058

Harold E. Maurer and Paul K. Clemens
National Aeronautics and Space Administration
Wallops Flight Center
Wallops Island, Virginia 23337

ABSTRACT

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This paper describes a computer program, called ATCOR, which is used to correct signatures obtained from LANDSAT data for differences in sun angle, haze level, and background reflectance.

A set of pre-computed tables is used in the calculations. These tables give the response of the LANDSAT multispectral scanner in each channel as a function of the solar zenith angle, θ , the atmospheric haze level, τ , the target reflectance, R , and the average background reflectance R_B . The tables also provide coefficients a and b such that for fixed, θ , τ , and R_B the sensor response in a particular channel is given by

$$C = aR + b.$$

The minimum value method² is used to determine τ and R_B is determined by averaging over the data. Appropriate a and b coefficients are then looked up in the tables. In most applications the signatures from a given segment (the training segment) are corrected to correspond to the same v values of θ , τ , and R_B as some other segment. This is done by determining the a and b coefficients for each segment independently. From these coefficients the transformation is determined which corrects the training segment statistics.

¹The material of this paper was developed under NASA Contract NAS 9-12200 and prepared for the Earth Observations Division, NASA/JSC. Houston, Texas.

²John F. Potter and Maury A. Mendlowitz, "On the Determination of Haze Levels from LANDSAT Data." Proc. 10th International Symposium on Remote Sensing of Environment. (1975).

The objective of this study is to demonstrate that Synthetic Aperture Radar (SAR) imagery adds information for Earth Survey applications which is not available from LANDSAT imagery alone, and that this information can be extracted by application of machine processing techniques. If optimum use is to be made of SAR imagery then its areas of impact need to be identified. SAR imagery was acquired of portions of the Delmarva Peninsula on August 8, 1973, by a United States Air Force RF-4 aircraft based at Shaw Air Force Base, in South Carolina. LANDSAT imagery (0% of cloud cover) was acquired on the same date. The SAR was a Goodyear Aerospace NA/APQ102A (X-Band). A portion of the SAR data film was optically correlated and a section of the imagery near Wallops was selected on the basis of available (though incomplete) ground truth. The SAR data was registered with the LANDSAT imagery of the same scene and these registered scenes were displayed and/or analyzed on several facilities to identify the impact of the SAR channel. Eleven control points were used to register with a LANDSAT geometrically corrected scene. After distortion correction, the mean error along the track was 0.38 pixels with a standard deviation of 0.694 pixels. The registered data was entered into the LARS library and LARSYS was used for classification via a remote terminal to Purdue/LARS. SEPARABILITY demonstrated preference for SAR data by several classes. Color composites were made both at Purdue/LARS with their image display and at Goddard Space Flight Center with their Image 100. The color composites also demonstrated several areas of value for the SAR data.