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CORRECTION OF ATMOSPHERIC EFFECTS ON LANDSAT DATA

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The Mexican Ministry of Agricultural and Water Resources, by means of the National Water Planning Commission, has applied remote sensing since 1972 to inventory land use in Mexico. The purpose of this work has been to develop the techniques which permit to eliminate the atmospheric influence on LANDSAT data and reduce them to values related with intrinsic properties of the objects of interest on earth. The result was an algorithm (SIADATM) incorporated to SIADIS system, a system of automatic interpretation of satellite images, which works in a PDP 11/70 computer. SIADATM is based on an energy conservation equation and the corrective terms are the atmospheric transmittance and all the contributions due to scattering in the sensor's view path, which do not come from the object on earth. Some hypothesis must be assumed about atmospheric structure, atmospheric scattering and surface reflectance in order to calculate each correction term. In SIADATM were considered a plane parallel atmosphere, scattering in simple form according to Rayleigh's theory and a Lambertian model of surface reflectance. Since it was assumed an atmosphere scattering in simple form, some of the components of the correction due to scattering in the view path vanish. The only terms which remain are the reflected radiation in the object's surroundings and the direct solar radiation in the view path. So, the atmospheric correction is carried out with three terms, from which only one is now calculated from LANDSAT data, and is so called the surroundings contribution. The others are obtained from measurements made on ground, and have been carried out by the Geophysics Institute of the National University of Mexico. In this work, the LANDSAT data of some selected pilot zones were corrected by SAIDATM algorithm and then classified by pattern recognition techniques by SAIDIS system. The results obtained are promising since an improvement in security classification has been observed. Likewise, a better definition of frontier between classes has been observed. Now, the advantages of the use of these reduced values in multitemporal analysis, water quality, plague detection, etc., are investigated.

TEXTURE EDGE DETECTION BY PROPAGATION AND SHRINKING

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The problem of detecting edges between differently textured regions is important in the process of segmentation of remotely sensed images. However, the concept of texture is difficult to be precisely defined and there seems to be no unique way to characterize texture. One possible approach is through the use of edge detection algorithms and in these terms texture is conceived as edgeness per unit area. Regions that possess a wide variation in tone will be characterized by a high concentration of local edges and the opposite is true for smooth regions.

The algorithm for texture edge detection that is proposed in this paper is based on the detection of local edges followed by the processes of propagation and shrinking of regions and the determination of the periphery of the resulting sets. The local edge detection method is formulated in statistical terms and it leads to the solution of a hypothesis testing problem. Similar results could be obtained by using differentiation techniques like the gradient, for example. After the local edges are detected, a propagation process, followed by a shrinking process, will tend to eliminate the holes and the isolated points in the binary image defined by the local edges. The border of the textured regions is obtained by determining the periphery of the resulting connected components sets S's through the computation of the set of points with unitary distance to $\bar{S}$ (the complement of S). This set can be obtained through a shrinking process.

Variations of the methods of propagation and shrinking were also attempted. These variations are based on thresholds on the number of neighbors (on a 8-neighborhood) of a point, that determine whether the point remain in S, move from S to $\bar{S}$ or vice-versa.

The methods were tested on Landsat images of the State of Mato Grosso, Brasil. Preliminary results seem to indicate that the variations of the propagation and shrinking methods based on the use of thresholds tend to give edges that are more continuous.

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ESTIMATION OF AREAS UNDER DIFFERENT COVER TYPES BY SPECTRAL STRATIFICATION

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Stratification is a procedure for subdividing the heterogeneous population into subpopulations which are internally homogeneous. Spectral stratification, i.e. stratification based on spectral characteristics can be used for classification of multispectral remotely sensed data. In this paper an approach is suggested for estimating the areas under different cover types by taking samples from spectral strata.

The basis of spectral stratification is the multidimensional frequency information from the data. The size of a sampling unit is decided by the coefficient of variation within the data and the size of the samples can be obtained either from the allowable error or the level of significance. The samples are allocated on the basis of the proportional geographical area in each stratum. The samples from each stratum are classified using an unsupervised method namely, the Iterative Self Organizing Clustering system and the area under each class is estimated.

The procedure is tested with the Indian Space Research Organization-MSS data for two test sites each covering approximately 20 Sq. kms. One test site pertains to a planned agricultural research farm and the other belongs to a normal agricultural area. Areas under different cover types are obtained for both the test sites. These results are compared with the results obtained by a supervised approach on pixel by pixel basis using maximum likelihood quadratic discriminant function. In the majority of the classes the results are in agreement where as there are little discrepancies in few cases.

A HILL-SLIDING STRATEGY FOR INITIALIZATION OF GAUSSIAN CLUSTERS IN THE MULTIDIMENSIONAL SPACE

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A hill-sliding technique was devised to extract Gaussian clusters from the multivariate probability density estimates of sample data for the first step of iterative unsupervised classification. The underlying assumption in this approach was that each cluster possessed a unimodal normal distribution. The key idea was that a clustering function proposed could distinguish elements of a cluster under formation from the rest in the feature space. Initial clusters were extracted one by one according to the hill-sliding tactics.

A dimensionless cluster compactness parameter was proposed as a universal measure of cluster goodness and used satisfactorily in test runs with Landsat multispectral scanner data. The normalized divergence, defined by the cluster divergence divided by the entropy of the entire sample data, was utilized as a general separability measure between clusters. An overall clustering objective function was set forth in terms of cluster covariance matrices, from which the cluster compactness measure could be deduced. Minimal improvement of initial data partitioning was evaluated by this objective function in eliminating scattered sparse data points. The hill-sliding clustering technique developed herein has the potential applicability to decomposition of any multivariate mixture distribution into a number of unimodal distributions when an appropriate distribution function to the data set is employed.