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TOPIC : DIGITAL IMAGE PROCESSING

ABSTRACT:

Signal processing is a discipline in electrical engineering and in mathematics that deals with analysis and processing of analog and digital signals , and deals with storing , filtering , and other operations on signals. These signals include transmission signals , sound or voice signals , image signals , and other signals.

Out of all these signals , the field that deals with the type of signals for which the input is an image and the output is also an image is done in image processing. As it name suggests, it deals with the processing on images.

It can be further divided into analog image processing and digital image processing.

DATA ANALYSIS:

"Data analysis" derives meaning or significance from raw data: it answers questions like "how much?", "how high?", or "how often?". Since Igor aims to serve a wide range of disciplines, it provides many analysis capabilities to choose from. We present them here in our somewhat arbitrary categories:

Curve Fitting

Linear and non-linear fits
Built-in and user-defined functions
Multi-variate fits involving unlimited independent variables

Peak Analysis

Peak and level-crossing detection
Fitting multiple overlapping peaks
Baseline removal

Signal Processing

Multi-dimensional mixed-radix FFT, wavelet, Hough transforms
Integration and differentiation of data
Convolution and correlation
Smoothing and filtering

Statistics

Descriptive statistics such as mean, standard deviation and higher central moments
Statistical Tests
Probability Distribution Functions, Cumulative Distribution Functions and Inverse CDFs

Histograms, Sorting, Resampling, Correlations and Linear Regression

A digital remotely sensed image is typically composed of picture elements (pixels) located at the intersection of each row i and column j in each K bands of imagery. Associated with each pixel is a number known as Digital Number (DN) or Brightness Value (BV), that depicts the average radiance of a relatively small area within a scene

IMAGE RECTIFICATION AND REGISTRATION

Geometric distortions manifest themselves as errors in the position of a pixel relative to other pixels in the scene and with respect to their absolute position within some defined map projection. If left uncorrected, these geometric distortions render any data extracted from the image useless. This is particularly so if the information is to be compared to other data sets, be it from another image or a GIS data set. Distortions occur for many reasons. Screen Colour Gun Assignment Blue Gun Green Gun Red Gun Green Infrared Red 84 Digital Image Processing For instance distortions occur due to changes in platform attitude (roll, pitch and yaw), altitude, earth rotation, earth curvature, panoramic distortion and detector delay. Most of these distortions can be modelled mathematically and are removed before you buy an image. Changes in attitude however can be difficult to account for mathematically and so a procedure called image rectification is performed. Satellite systems are however geometrically quite stable and geometric rectification is a simple procedure based on a mapping transformation relating real ground coordinates, say in easting and northing, to image line and pixel coordinates. Rectification is a process of geometrically correcting an image so that it can be represented on a planar surface , conform to other images or conform to a map (Fig. 3). That is, it is the process by which geometry of an image is made planimetric. frequency defined as number of changes in Brightness Value per unit distance for any particular part of an image. If there are very few changes in Brightness Value once a given area in an image, this is referred to as low frequency area. Conversely, if the Brightness Value changes dramatically over short distances, this is an area of high

frequency. Spatial filtering is the process of dividing the image into its constituent spatial frequencies, and selectively altering certain spatial frequencies to emphasize some image features. This technique increases the analyst's ability to discriminate detail. The three types of spatial filters used in remote sensor data processing are : Low pass filters, Band pass filters and High pass filters.

A straightforward method of extracting edges in remotely sensed imagery is the application of a directional first-difference algorithm and approximates the first derivative between two adjacent pixels. The algorithm produces the first difference of the image input in the horizontal, vertical, and diagonal directions. The Laplacian operator generally highlights point, lines, and edges in the image and suppresses uniform and smoothly varying regions. Human vision physiological research suggests that we see objects in much the same way. Hence, the use of this operation has a more natural look than many of the other edge-enhanced images.

The satellites cover different portions of the electromagnetic spectrum and record the incoming radiations at different spatial, temporal, and spectral resolutions. Most of these sensors operate in two modes: multispectral mode and the panchromatic mode. The panchromatic mode corresponds to the observation over a broad spectral band (similar to a typical black and white photograph) and the multispectral (color) mode corresponds to the observation in a number of relatively narrower bands. For example in the IRS – 1D, LISS III operates in the multispectral mode. It records energy in the green (0.52 – 0.59 µm), red (0.62-0.68 µm), near infrared (0.77- 0.86 µm) and mid-infrared (1.55 – 1.70 µm). In the same satellite PAN operates in the panchromatic mode. SPOT is another satellite, which has a combination of sensor operating in the multispectral and panchromatic mode. Above information is also expressed by saying that the multispectral mode has a better spectral resolution than the panchromatic mode.

Unsupervised classification
Unsupervised classifiers do not utilize training data as the basis for classification. Rather, this family of classifiers involves algorithms that examine the unknown pixels in an

image and aggregate them into a number of classes based on the natural groupings or clusters present in the image values. It performs very well in cases where the values within a given cover type are close together in the measurement space, data in different classes are comparatively well separated. The classes that result from unsupervised classification are spectral classes because they are based solely on the natural groupings in the image values, Minakshi Kumar 95 the identity of the spectral classes will not be initially known. The analyst must compare the classified data with some form of reference data (such as larger scale imagery or maps) to determine the identity and informational value of the spectral classes. In the supervised approach we define useful information categories and then examine their spectral separability; in the unsupervised approach we determine spectrally separable classes and then define their informational utility. There are numerous clustering algorithms that can be used to determine the natural spectral groupings present in data set. One common form of clustering, called the "K-means" approach also called as ISODATA (Interaction Self-Organizing Data Analysis Technique) accepts from the analyst the number of clusters to be located in the data. The algorithm then arbitrarily "seeds", or locates, that number of cluster centers in the multidimensional measurement space. Each pixel in the image is then assigned to the cluster whose arbitrary mean vector is closest. After all pixels have been classified in this manner, revised mean vectors for each of the clusters are computed. The revised means are then used as the basis of reclassification of the image data. The procedure continues until there is no significant change in the location of class mean vectors between successive iterations of the algorithm. Once this point is reached, the analyst determines the land cover identity of each spectral class. Because the K-means approach is iterative, it is computationally intensive. Therefore, it is often applied only to image sub-areas rather than to full scenes. Supervised classification Supervised classification can be defined normally as the process of samples of known identity to classify pixels of unknown identity. Samples of known identity are those pixels located within training areas. Pixels located within these areas term the training samples used to guide the classification algorithm to assigning specific

spectral values to appropriate informational class.

Classification Accuracy Assessment Quantitatively assessing classification accuracy requires the collection of some in situ data or a priori knowledge about some parts of the terrain which can then be compared with the remote sensing derived classification map. Thus to assess classification accuracy it is necessary to compare two classification maps 1) the remote sensing derived map, and 2) assumed true map (in fact it may contain some error). The assumed true map may be derived from in situ investigation or quite often from the interpretation of remotely sensed data obtained at a larger scale or higher resolution.

WORKING METHOD:

Kappa coefficient Kappa analysis is a discrete multivariate technique for accuracy assessment. Kappa analysis yields a Khat statistic that is the measure of agreement of accuracy. The Khat statistic is computed as 102 Digital Image Processing Khat = ∑ ∑ ∑ + + + − + + r i i 2 r ii i i r N (x *x) N x (x *x) Where r is the number of rows in the matrix xii is the number of observations in row i and column i, and xi+ and x+i are the marginal totals for the row i and column i respectively and N is the total number of observations.