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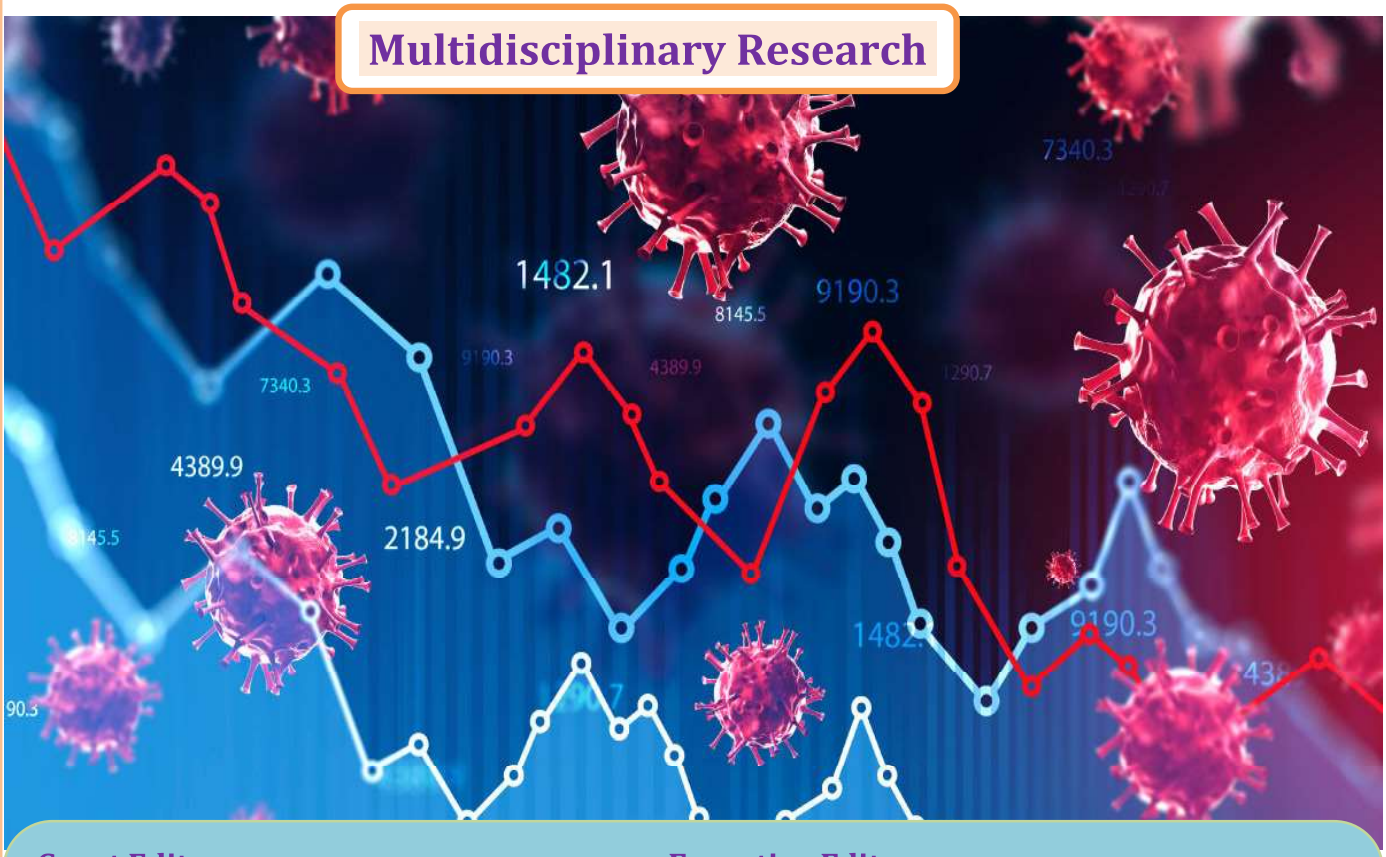
Multidisciplinary Research



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INDEX

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Image Classification Using Fuzzy Logic

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Abstract:

fuzzy logic theory is widely applied in technique. Developed for the storage of the graphical information mainly maps into digital format, Geographical information systems have become one of the main supporting instruments for the decision making in the various fields. This development led to the necessity of reducing processing time by using more advanced applied mathematical and computer science knowledge give the possibility of enhancing spatial data management with the modelling of uncertainty, is fuzzy logic. In this s paper possibilities for increasing the quality of image classification by using fuzzy logic.

Keywords: GIS, image classification, fuzzy logic

Introduction:

Developed of the graphical information mainly maps into digital format, in the last decades geographical information systems have become one of the main supporting instrument for the decision making in the various fields. Geographical informational systems are used for decision support tool in fields like urban planning, investment planning, economic development, impact studies and in critical systems. The evolution of GIS led to the necessity of faster and better results, requirement fulfilled with the increase usage of advanced and applied mathematical and computer science knowledge like spatial databases from computational geometry and fuzzy logic. This paper present possibility for increasing the quality of image classification by using fuzzy set theory.

Methods:

The fuzzy set theory gives the possibility to use computers in representing and processing uncertain data, and information described in a common language and for which no certainty degree can be determine. In fuzzy logic geospatial data are evaluated based on qualitative information and not for quantitative ones. In this way the fuzzy logic theory gives the possibility of enhancing spatial data management with the modelling of uncertainty. Fuzzy logic was implemented successfully in various GIS processes [2]. Data collection analysis and processing remote sensing data for classification algorithms and object recognition Spatial analysis - processing qualitative data, in order to defining relationships between uncertain geospatial objects. Complex operations based on genetic algorithms like object recognition from airborne images [2]. vegetation. In order to define boundaries between such areas, In such cases a widely used procedure is to allocate all grid cells to classes based on fuzzy membership than 0/1 membership. Membership functions are mathematical function which defines the degree of an element's membership in a fuzzy set.

The sigmoidal ("s - shaped") membership function is perhaps the most commonly used function in fuzzy set theory it is produced by a combination of linear and $\cos^2()$ functions [3].

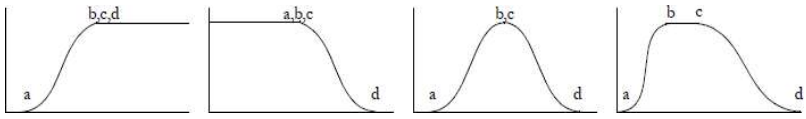

Fig. 1. Sigmoidal Membership Functions

J-shaped functions, which are rather like the sigmoidal membership function but with the rounded top sliced off flat over some distance [3]

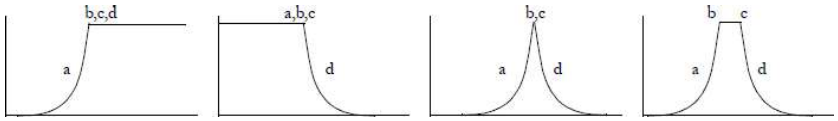

Fig. 2. J-shaped Membership Functions

Linear functions, which are like the J-shaped function but with linear sides, like the slope of a pitched roof, and are thus simple to calculate and have a fixed and well-defined extent, and **User-defined functions,** which are self-explanatory.In most applications membership functions are symmetric, although monotonic increasing or decreasing options are provided in Idrisi [3].

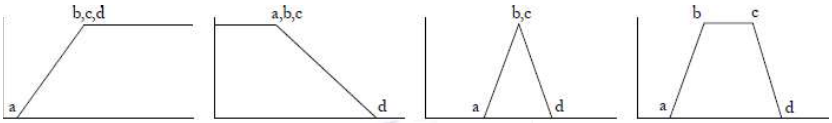

Fig. 3. Linear Membership Functions

The sigmoidal of linear functions will be sufficient. Image classification represents the processing technique, through which the data represented in the image (pixels) is grouped in a certain number of classes.The classification methods are divided in two big categories: supervised clusterization and unsupervised clusterization.

Supervised clusterization is the process of classification assisted by the user. In the process of supervised classification, we can distinguish three stages: learning, assigning and testing. The training stage consists in collection of references, information and data about the image which should be classified, which will be used for defining a vectoral file, for each cluster being defined a layer within the file. The result of the learning stage is represented by the signature type files which are characterizing the information which should be classified. In the second stage: of assigning, the pixels from the image are allocated in the basis of static results in accordance with the signatures files. The final stage is testing of the results by comparing the classified image with the previous data. The pixels which were classified in different clusters are stored in the error matrix and later being analyzed by the user. The membership degree is computed by using fuzzy membership functions like sigmoidal, linear or j-shaped presented before. The evaluation on the training can be done using statistical methods: minimum, maximum, mean, and standard deviation for each band independent and covariance matrix for all the three bands [2]. The most relevant signature file evaluation is creating an error matrix as a matrix of percentages based on pixel counts that allows us to see how many pixels in each training sample were assigned to each class Classes with a very small distance value remain unchanged while classes with higher distance values may change to a neighboring value

if there are a sufficient number of neighboring pixels with class values and small corresponding distance values [3,-8].

Results And Discussions:

Input data. For the procedures of image classification was used an airborne image from the upper hills municipality.

Standardization criteria In order to analyses the standardization criteria for the build area the minimum distortion of the border of it was studied the possibility of using different membership functions, which function should be used depend relationship between the criteria of classification.

Fig. 4. Input image

we used a sigmoidal monotonic decreasing membership function. The result is represented in the image presented in Figure 5a). The test was repeated for linear monotonic decreasing membership function but the result was identical. In the second case we used a j-shaped monotonic increasing membership function. The result is represented in the image presented in Figure 5b).

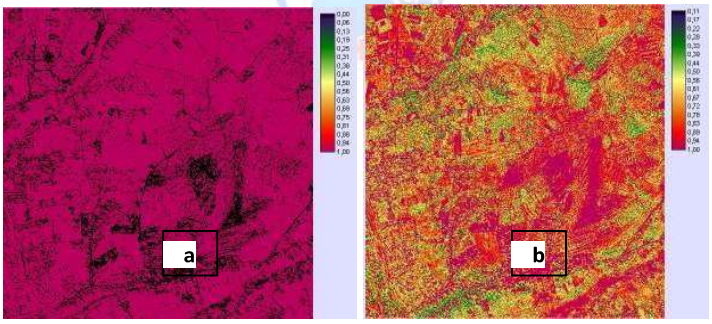

Fig. 5. Membership function (a)Sigmodial and (b) J-shaped

Supervised classification. . The three classes of information defined are: green areas, houses and streets. The signature files were created using a fuzzy membership function based on the j-shaped membership function in this case the accuracy of the signature files are acceptable, over 90 % (table 1).

Table 1. Evaluation of signature files

Data	Stteets	Houses	Green area
Streets	95.45	4.87	1.27
Houses	2.73	93.42	2.83
Green areas	1.82	1.71	95.89

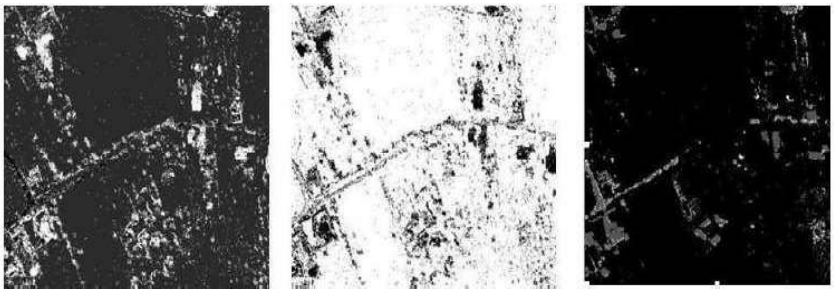

Fig. 6. Supervised classification

The classification of the input images, with the signature files defined before, was done by using a classifying method which combined the Maximum Like hood method with a fuzzy membership function (linear). The output images are represented in the figure 6, each image represent a cluster in the following order houses, green areas, streets..

Conclusions

The quality of raster image classification and object recognition. Supervised classification is offering higher quality. fuzzy based algorithm in all stage of the supervised classification the quality of the result is increased the Fuzzy set theory could be used as a very powerful tool in designing and implementing algorithms for geographical informational systems and also to support spatial decision-making process.

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