GEOSPATIAL SOIL IMAGE CLASSIFICATION USING FUZZY LOGIC

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Abstract

This research is Soil classification method uses region based soil feature estimate which considers various features of soils like dryness, humidity, grinds and more. The method splits the entire geospatial image into some sectors small region, and for each region of the image to extracts the features of soil and performs approximation about the class support. Similarly, the method maintains some rules which are generated from the classified images of the trained set and using them the methodcomputes the plant growth support for each class with the help of fuzzy rules.

Keywords: Fuzzy set; soil classification; geospatial image.

1. INTRODUCTION

The image classification has been studied in various articles and the input set of images can be grouped under different names. The classification of image can be identified in different approaches according to different features like color, feature, shape, objects oriented and so on. The color values based image classification uses the color features to perform image classification and the shape based method extracts the shapes from the image and uses the shapes to perform image classification.

The images taken from satellite called as geospatial images, has number of features and the image may have the features of agriculture lands, sea shore, and other areas. Such images represent the features of the soil, and from the soil image the features of soil can be extracted. The extracted soil features can be used to perform soil classification. The color feature or the gray features are used to perform image classification as well as soil classification.

Fuzzy system is a fuzzy logic based system. In this system fuzzy logic can be the basis for the representation of the various kinds of knowledge or it can model the interactions and relationships among the system variables. Fuzzy logic provides innovative tools to handle the complex and ill-defined systems where classical tools become unsuccessful. Fuzzy systems are universal approximates of non linear functions. Two aspects are important in fuzzy system one generating the best rule set and second tuning the membership functions. These should relate properly the independent and dependent variable.

2. REVIEW OF LITERATURE

The Image classification, which can be described as identification of objects in a scene captured by a vision system, is one of the essential tasks of a robotic system. The procedure of accurate object identification is known to be more difficult for computers than for people. The recently developed image acquisition systems (for instance, radar, lidar, and hyper spectral imaging technologies) capture more data from the image scene than a human vision system. Therefore, efficient processing systems must be developed to use these data for accurate image classification

The most standard image processing algorithms do not take the local structure or the spatial arrangement of neighborhood pixels into consideration. This spatial data is crucial in urban mapping once victimization high-resolution pictures, as a result of most of the urban categories contain the variety of spectrally completely different options or objects organized in advanced spatial forms varied makes an attempt, together with some new spatial techniques. They were created to enhance the spectral analysis of remotely detected information.

The presented a novel extended FCM algorithm, PFCM algorithm that can incorporate both local spatial contextual information and feature space information into the image segmentation. The algorithm is formulated by incorporating the spatial neighborhood information into the original FCM algorithm with a penalty term, which is inspired by the NEM algorithm and is modified to satisfy the criterion of the FCM algorithm.

Planned Texture-Based Classification of Indian Soils using Local Binary Pattern and Artificial Neural Networks Data mining techniques. They are playing the vital role in a significant number of fields. In this work, a ground classification methodology has been developed supporting soil properties. Within the study space, there's nice diversity concerning soil composition and occurrence.

3. GEOSPATIAL SOIL IMAGE CLASSIFICATION

The local soil feature discusses the process of soil function approximation performed at each region of the image to classify them into some classes. Also, the classifier improves to focuses on the plant growth approximation based on the rule sets being generated. The entire process has been split into some stages particularly Image improvement, Regional Soil Feature Extraction, Rule Set Generation, Soil Feature Approximation, Soil Classification and Plant Growth Estimation.

3.1 Image Enhancement

The geospatial image captured by the satellite has additional noise that is introduced by the satellite camera that must be removed before proceeding into following stages. The approach applies the physicist filter with a distinct location to eliminate the noise from the input image. The noise removed models are going to be wont to perform the feature extraction

3.2 Regional Soil Feature Extraction

At this stage, the method first splits the entire image into some the sectional images. The whole image is converted into a regional picture. In the second step, the process extracts various features of the local geospatial model like water, humidity, dryness, grinds, color and so on. The feature extraction is performed for each local image obtained in the previous stage. The extracted features function into the feature vector which will be used to implement feature approximation.

Algorithm:
Step1: Start
Step2: Extract Color values of local image Img.

$$Cv = \int_{i=1}^{size(Img)} \int_{j=1}^{3} \sum Img(i,j)$$

Where Cv= Color values
Step3: Compute $Hg = \int_{i=1}^{size(Cv)} \sum Cv(i)(2) \nexists Hg$
Where Hg= Histogram of Green Pixels.
Step4: ComputeHb = $\int_{i=1}^{size(Cv)} \sum Cv(i)(3) \nexists Hg$
Where Hb= Histogram of Blue Values.

Step5: Identify Hw= $\int_{i=1}^{size(Cv)} \sum Cv(i)(1) > 200$
WhererHw= pixels with white colors.
Step6: Convert Rimg = Convert Img into gray scale.
Where Rimg= image into gray scale.
Step7: ComputeGv = $\int_{i=1}^{size(Rimg)} StdDev(\sqrt{Dist\big(Rimg(i), Rimg(i+1)\big) > 10})$ Where Gv= Guinness value.
Step8: Compute Hv=

$$\int_{i=1}^{size(Rimg)} StdDev(\sqrt{(Rimg(i), Rimg(i+1)) > 200)\&\&Dist\big(Rimg(i), Rimg(i+1)\big) > 10})$$

Where Hv= Humidity value
Step9: Compute Wsf = $\frac{\sum Hb}{size(Img)}$
Where Wsf= Water Source Factor

Step10:Compute Pf = $\frac{\sum Hg}{size(Img)}$

Where Pf=Plant Factor

Step11: GenerateFv = {Hv,Wsf,Pf,Gv}.

Where Fv= Feature Vector

Step12: Stop.

3.3 Rule Set Generation For Fuzzy

The fuzzy rules area unit regarding creating a collection of variable values for every attribute being thought-about from the results of feature extraction part. First, the plan of action makes the small-scale footage through the feature extraction section then for every feature vector obtained the tactic computes the various values for every attribute or live to be thought about. In training phase, the process generates such rules with the benefits of plant growth which is also an input for the system. By creating range values, the method makes some regulations which will be used to perform plant growth estimation.

Algorithm:

Step1: Start

Step2: Compute range value for Humidity factor

Min, Max = Compute Minimum and Max values of humidity.

Step3: For each feature Fi from Fvs

Min = $\int_{i=1}^{size(Fvs)} Min(min, Fvs(Hv))$

Max = $\int_{i=1}^{size(Fvs)} Max(max, Fvs(Hv))$

End

Step4: For each feature Fi from Fvs

Compute WMin = $\int_{i=1}^{size(Fvs)} Min(min, Fvs(Wsf))$

Compute WMax = $\int_{i=1}^{size(Fvs)} Max(max, Fvs(wsf))$

End

Where Wmin=minumvalue of water source factor and Wmax = max value of water source factor

Step5: For each feature Fi from Fvs

Compute PMin = $\int_{i=1}^{size(Fvs)} Min(min, Fvs(Pf))$

Compute PMax = $\int_{i=1}^{size(Fvs)} Max(max, Fvs(Pf))$

End

Where Pmin= minimum value of Plant factor and Pmax= max value of Plant factor

Step6: For each feature Fi from Fvs

Compute GMin = $\int_{i=1}^{size(Fvs)} Min(min, Fvs(Gv))$

Compute GMax = $\int_{i=1}^{size(Fvs)} Max(max, Fvs(Gv))$

End

Where GMin=minimum value of Grindness and GMax=max value of Grindness

Step7: For each attribute Ai of feature vector

Split the range into N ranges.

Rvs = $\int_{i=1}^{4} Split(Min, Max)or4$

Where Rvs= Range of vectors

End

Step8: For each range values

Generate Ri = {Range(A_1), Range(A2), Range(A3), Range(A4), GF}

Where Ri= Rule

Add to Rule set.

End

Step9: Stop.

The above-presented algorithm computes range values from the feature vector given and based on the values the method generates the rule to perform plant growth estimation.

3.4 Soil Feature Approximation

The soil feature approximation is that the process of computing plant protein supported numerous options given and therefore the rule sets offered. The tactic computes plant growth support issue for every attribute gift within the feature vector. Supported computed support issues of every factor thought of the tactic perform AN approximation of plant growth. The approximated price is going to be accustomed cypher the plant growth estimation.

Algorithm:

Step1: Start Hv, SWF, Pf, GA

Step2: Compute HSF = $\int_{i=1}^{size(Rs)} \frac{(\sum Hv(Rs(i))<>Fv.Hv).Pg}{size(\sum Hv(Rs(i))<>Fv.Hv)}$

Where HSF=Humidity Support Factor

Step3: Compute WSF = $\int_{i=1}^{size(Rs)} \frac{(\sum WSF(Rs(i))<>Fv.wsf).Pg}{size(\sum Wsf(Rs(i))<>Fv.wsf)}$

Where WSF= water support factor

Step4: Compute PSF = $\int_{i=1}^{size(Rs)} \frac{(\sum Pv(Rs(i))<>Fv.Pv).Pg}{size(\sum Pv(Rs(i))<>Fv.Pv)}$

Where PSF= Plant Support Factor

Step5: Compute GSF = $\int_{i=1}^{size(Rs)} \frac{(\sum Gv(Rs(i))<>Fv.Gv).Pg}{size(\sum Gv(Rs(i))<>Fv.Gv)}$

Where GSF= Grindness Support Factor

Step6: Compute MFSF = $\frac{PSF}{WSF} \times \frac{HSF}{GSF}$

Where MFSF= Multi Feature Support Factor

Step7: Stop

The above-discussed algorithm computes the multi-feature support factor for the plant growth which is used to estimate the plant growth.

3.5 Soil Classification

The method computes the multi-feature support factor for each class with the given input feature vectors. Based on the multi-feature support factor computed the method decides the class of image to perform soil classification.

Algorithm:

Step1: Start

Step2: For each class Ci from Soil Class Sc

Step3: Compute Multi-Feature Support Factor.

Step4: End

Step5: Choose the most valued support factor and class Ci = Max(MFSF).

Step6: Stop.

The above pseudo code computes the multi-feature support factor for each class to select the type with the maximum comfort factor.

3.6 Plant Growth Estimation

The plant growth estimation is performed by computing the plant growth support on each attribute thought of. The plan of action computes multi-feature support issue for each class and selects the type of image then the tactic computes the plant protein victimization the calculated MFSF price and also the values of growth obtained earlier.

Algorithm:

Step1: Start

Step2: Read MFSF value.

Step3: Compute GF = MFSF$\times \frac{\sum GF(Ci)}{size(Ci)}$

Where GF= Growth Factor

Step4: Stop.

The above-discussed algorithm computes the plant growth using the calculated multi-feature support factor.

4. RESULT AND DISCUSSION

4.1 Soil support

As water is the most limiting factor in the arid to semi-arid areas, soil support determination is of major significance. Soil support influences crop growth not only by affecting nutrient availability, but also nutrient transformations and soil biological behavior. Therefore soil support is routinely measured in most field trials. While it can be assessed in the field by the neutron probe, the gravimetric approach is more flexible, as samples can be readily taken from any soil situation.

Compute Soil Support SS = $Sp(ID \times GD) \big/ (\sum Sps(ID \times GD)/size(Sps(Pc))$

4.2 Water support

The water-support is defined as the amount of water held in the soil after the excess gravitational water has drained away and after the rate of downward movement of water has materially ceased. Stage of field capacity is attained in the field of saturation; this is the upper limit of plant-available soil moisture. We must distinguish between soil water content, (the percent water on an oven-dry weight basis), and the soil water potential (the energy status of water in the soil), which is usually expressed in pressure units.

Compute Water Support Ws = $Sp(Ws) \big/ (\sum Sps(Ws)/size(Sps(Pc))$

4.3 Plant Support

Plant support is defined as the arrangement of the soil particles. With regard to structure, soil particles refer not only to sand, silt and clay but also to the aggregate or structural elements, which have been formed by the aggregation of smaller mechanical fractions. The size, shape and character of the soil structure varies, which could be cube, prism and platter likes. Depending upon the stability of the aggregate and the ease of separation, the structure is characterized

Compute plant support Ps = $Sp(PD) \big/ (\sum Sps(Ps)/size(sps(pc))$

The measurements to have practical significance, the disruptive forces causing disintegration should closely compare with the forces expected in the field. The field condition, particularly with respect to soil moisture, should be compared with the moisture condition adopted for soil disintegration in the laboratory. The sampling of soil and subsequent disintegration of clods in relevance to seed bed preparation for upland crops should be carried out under air dry conditions for dry sieve analysis. A rotary sieve shaker would be ideal for dry sieving.

Compute Plant Growth Factor PGF = $\frac{(SS+Ws+Ps)}{3}$

Table 4.1: Comparison of different parameters of soil classification

Method	Classification Accuracy	False Classification	Plant Growth Estimation Ratio
RGB	87	11.6	84.7
LAW	89	9.4	87.6
EM	91	7.3	89.3
SIC	99.4	0.7	98.7

Table 4.1 shows the comparative result of soil classification and plant growth estimation produced by proposed method on different soil type.

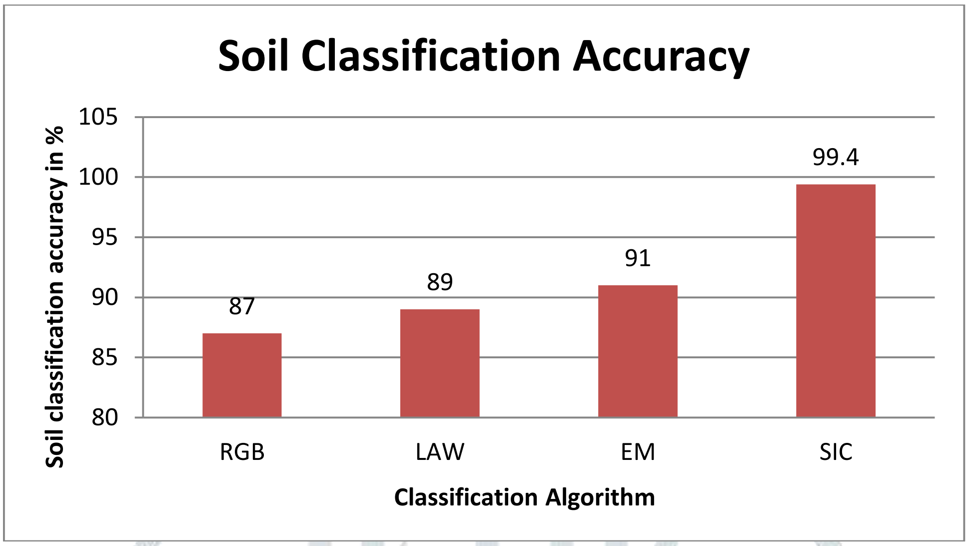

Figure 4.1: Comparison of soil classification accuracy

Figure 4.1, shows the comparative result on soil classification produced by different methods and the result shows that the proposed method has produced more classification accuracy.

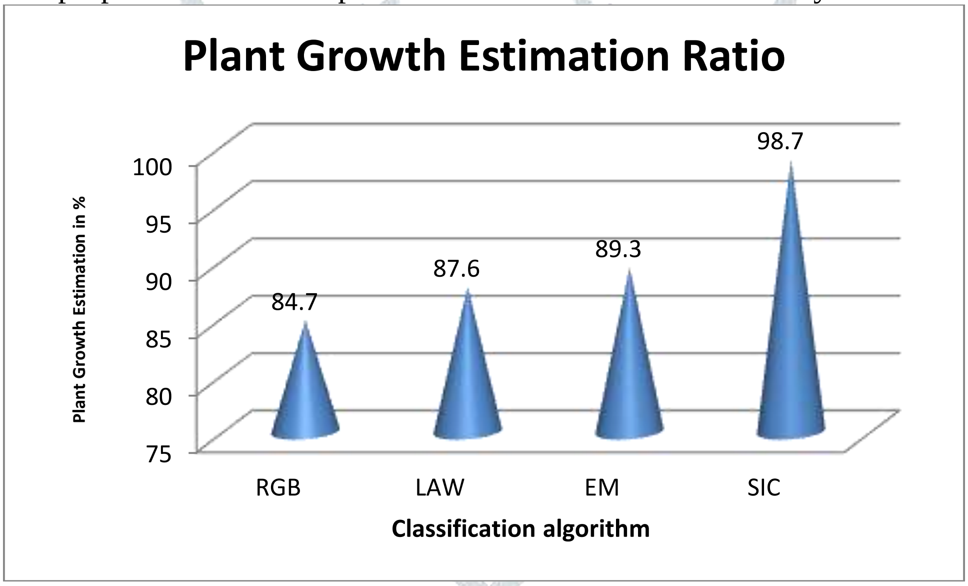

Figure 6.4 Comparison of plant growth estimation efficiency

Figure 6.4 shows the comparative results of plant growth estimation made by completely different ways, and it shows clearly that the projected technique has made additional estimation potency than different ways.

5. CONCLUSION

The soil classification method is a regional soil feature approximation based soil classification algorithm for the estimation of plant growth of different soils using the images obtained from the satellite. This method enhances the input image quality by applying the Gabor filter and generates number of small scale images. From each small scale image, the method extracts the features like water flow, color, humidity and grandness. Using the features being extracted the method generates the rule set from the earlier trace of feature being identified and plant growth estimated. Using the fuzzy rule generated, the method computes the multi feature support factor to estimate the plant growth. The method produces efficient results in plant growth estimation and improves the classification ratio.

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