# An SVM Fuzzy logic classification for land cover

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**Abstract:** In attendance days remote sensing is most used application in many sectors. This remote sensing use changed images like multispectral, hyper spectral or ultra spectral. The remote sensing image classification is one of the noteworthy method to classify image. In which each state is classified by SVM classification with fuzzy logic. In this we experiment fuzzy logic like spatial, spectral and texture methods in that poles apart sub methods to be worn for image classification.

**Keywords:** Hyper spectral images, multispectral images, image processing, remote sensing, classification, SVM, fuzzy logic.

## I. INTRODUCTION

The hit of any GIS [10, 11] claim depends on the quality of the geographical data used. GIS [15] wealth "Geographic Information System". In all-purpose it amorphous as computer assist systems for the incarcerate, cargo space, reclamation, scrutiny and put on show of spatial/spectral data. This will assemble the high-quality biological data for input. To cram this we take an remote sensing.

### *A. Hyper spectral Remote Sensing*

The hyper spectral remote sensing [1, 8, 2, 17] is an superior tool that provide high spatial/spectral resolution data from a remoteness.

The nearly everyone powerful tools worn in the ground of remote sensing are hyper spectral imaging (HSI) and Multispectral Imaging (MSI)

while the mid 1950's various airborne sensors have recoded spectral information [8] on the Earth surface in the wavelength district extending from 400 to 2500 nm. preliminary from the early 1970's, [9] a large numeral of space borne multispectral sensors boast be launched, on board the LANDSAT, SPOT and Indian Remote Sensing (IRS) run of satellites.

Hyper spectral image akin to supplementary spectral image which collect in turn from across the electromagnetic spectrum. Such as the human eye sight visible to see three bands (red, green, and blue), spectral imaging divide the spectrum into lots of extra bands. This skill of isolating images into bands which is extensive away from the visible.

Engineers build sensors and giving out system to afford such competence for relevance in agriculture, mineralogy, physics, and surveillance. Hyper spectral sensors seem at stuff by means of a enormous segment of the electromagnetic spectrum. Convinced objects leave exceptional 'fingerprints' crosswise the electromagnetic spectrum. These 'fingerprints' are acknowledged as spectral signatures and enable recognition of the equipment that make up a scanned object. For example, a spectral signature in support of oil help mineralogists to uncover new oil fields.

Hyper spectral imaging is part of a class of techniques frequently referred to as spectral imaging or spectral analysis. Hyper spectral imaging is associated to multispectral imaging. The dissimilarity stuck between hyper and multi-spectral is now and again based on an illogical "number of bands" or on the brand of capacity, depending on what is fitting to the rationale.

Multispectral image deal with quite a few images at discrete and to some extent narrow bands. Being "discrete and a bit narrow" is what distinguishes multispectral in the observable from colour photography. A multispectral sensor may have a lot of bands covering the gamut from the visible to the long wave infrared. Multispectral images do not fabricate the "spectrum" of an object. Land sat is an admirable example of multispectral imaging.

Hyper spectral deal with imaging slender spectral bands more than a unremitting spectral range, and fabricate the spectra of all pixels in the scene. So a sensor with only 20 bands can also be hyper spectral when it covers the range from 500 to 700 nm with 20 bands each 10 nm wide.

'Ultra spectral' could be aloof for interferometer type imaging sensors with a awfully fine phantom resolution. These sensors often have (but not necessarily) a squat spatial resolution of quite a lot of pixels only, a ceiling forced by the high data rate.

In this we do the hyper spectral remote sensing classification, someplace image classification is a practice of sorting pixels in to creature classes, base on pixel values. This classification is worn to dispense corresponding levels with respect to groups. This classification is regularly used as pulling out techniques in digital remote sensing. Most of the digital image psychotherapy is very nice to have a good image to show a degree of colours contains a mixture of features of the primary terrain, but it is useless if you don't discern what the colours mean.

There are two foremost classification methods are Supervised Classification and Unsupervised Classification. The unsupervised classification is the detection of natural groups. The supervised classification is the progression of sampling the known identity to classify and unclassified pixels to one of quite a lot of informational classes.

## II. SUPPORT VECTOR MACHINE

Specific attention has been dedicated to support vector Machines [19] for the classification of remotely sensed images Recently (Hermes et al., 1999; Roli & Fumera, 2001; Hung et al., 2002). The interest in growing Support Vector Machines is confirmed by their successful implementation in numerous other pattern recognition applications like biomedical applications (El-Naqa et al., 2002), image compression (Robinson & Kecman,2003), and three dimensional object recognition (Pontil & Verri, 1998). These applications are justified by three reasons: Intrinsic efficiency with respect to traditional classifiers results in high classification accuracy, only limited effort is necessary for architecture design. It is possible to solve the learning problem according to linearly constrained quadratic programming methods. It is a supervised machine learning technique. SVM's turn around the notion of a margin either side of the hyper plane that separates two data classes. Maximizing the margin and thereby creating the highest possible distance between the separating hyper plane and the instances on either side of it has been proven to reduce an upper bound on the expected generalization error (Vapnik, 1995).If the training data is linearly separable, then a pair (w, b) Exists such that

$$W^T X_I + b \geq 1 \quad \text{For all } X_I \in p$$

$$W^T X_I + b \leq -1 \quad \text{For all } X_I \in N$$

With the decision rule given by

$$f_{w,b}(\mathrm{X}) = \mathrm{sgn}(\mathrm{W}^T X + b) \qquad (1)$$

Where it is possible to linearly separate two classes, an optimum separating hyper plane can be found by minimizing the squared norm of the separating hyper plane ( Kotsiantis.S.B, 2007).The minimization can be setup as a convex quadratic programming (QP) problem

$$\min imise_{w,j} \varphi(\mathrm{w}) = \frac{1}{2}\|w\|^2 \qquad (2)$$

Subject to

$$\mathrm{y}_i(W^T X_I + b) \geq 1 \quad \text{i=1.........L}$$

In the case of linearly separable data, once the optimum separating hyper plane is found, data points that lie on its margin are known as support vector points and the solution is represented as a linear combination. Some other data points are ignored.SVM are binary algorithm, thus made use of error correcting output coding to reduce a multiclass problem to a set of binary classification problems (Crammer& Singer, 2002). SVM have often found to provide higher classification accuracies than other widely used pattern recognition techniques, such as maximum likelihood and the multilayer preceptor neural network classifiers. SVM classification has been applied to a hyper spectral image with 17 spectral bands from 450nm to 950nm. The ground resolution is two meters and the image was calibrated to reflectance by means of empirical line method. SVM Classification results with reduced false alarms for thematic classification. Artificial forest areas are difficult to classify, since trees are small and there is lot of shadows and it was correctly classified with spectral-angle based kernel method. Also, fields are classified with homogeneous area which outfit thematic mapping for land use (Mercier.G & Lennon,M, 2003).

## III. METHODOLGY

### *A. Fuzzy logic*

Traditional rule-based classification is base on harsh binary rules, for illustration: objects summit the policy for "hierarchy" are classified as "hierarchy," substance summit the rules for "urban" are classified as "urban," and matter conference neither rule remain unclassified. Fuzzy logic [20] is an imperative ingredient in ENVI Feature Extraction rule-based classification. Fairly than classifying an object as fully "spot on" or "phony" (as in binary rules), fuzzy logic use a membership function to signify the extent than an object belong to a feature type. In sequence extraction from remote sensing data is partial by ear splitting sensor dimensions with partial spectral and spatial motion, signal dreadful conditions on or after image pre-processing, and imprecise transitions between land-use classes. The majority remote sensing images contain miscellaneous pixels that be in the right place to one or more classes. Fuzzy logic help lighten this predicament by simulate ambiguity or partial in sequence that is unswerving with human reckoning. The yield of each fuzzy rule is a poise map, somewhere values embody the grade that an object belongs to the feature type amorphous by this rule. In classification, the object is assign to the feature brand that has the maximum assurance value. through rule-based classification, you can have power over the level of fuzzy logic of each circumstance while you erect regulations.

### *B. Fuzzy Support vector machine*

When dealing with standard SVMs [21], all training vectors are presumed to belong entirely to either class +1 or class -1, And moreover are assumed to contain equal weight or relevance. However in many applications this assumption may not hold, As some training vectors may have more importance than Others, and sometimes we may not be entirely certain that the Purported classification $d_i$ of a training vector x is actually Correct.

Fuzzy theory deals with these issues by saying that training Vector belongs, for example, 90% to class +1 and 10% to class -1. This may be achieved by associating a fuzzy Membership $0 < s_i \leq 1$ with each training pair $(x_i, \mathrm{d}_i)$ [7].

The pair is then regarded as having a membership of $s_i$ To class $d_i$; and a membership $1 - s_i$ to class - $d_i$(although The latter is usually ignored in FSVM theory [7]). This may Be incorporated into the SVM framework by modifying the Primal training problem as follows

$$\min_{w\in\mathbb{R}^{d_H}, b\in\mathbb{R}, \xi\in\mathbb{R}^N} L(\mathrm{W}, \mathrm{b}, \xi) = \frac{1}{2}W^T W + \frac{C}{N} S^T \xi \quad (3)$$

Such that: $$d_i(\mathrm{W}^T \varphi(\mathrm{x}_i) + \mathrm{b}) \geq 1 - \xi_i \forall_i \in \mathbb{N}_N$$
$$\xi \geq 0$$

Where the error penalty (or empirical risk) of each training Pair $(x_i, \mathrm{d}_i)$ is weighted by its membership $s_i$ of class $d_i$, so that those training pairs with smaller $s_i$ values (i.e. those Training pairs that are less relevant or reliable) will have less Impudence on the decision surface than those with larger s values. The dual formulation of the fuzzy SVM (FSVM) training problem is

$$\min_{\alpha \in \mathbb{R}^N} Q(\alpha) = \frac{1}{2}\alpha^T G\alpha - 1^T \alpha \quad (4)$$

Such that:
$$0 \leq \alpha \leq \frac{C}{N} S$$
$$d^T \alpha = 0$$

and the decision function is the same as that of the standard SVM, and:

$$\xi_i = MAX\{0, 1 - \mathrm{d}_{ig}(\mathrm{X}_i)\} \forall_i \in \mathbb{R}_N \quad (5)$$

## IV. STUDY AREA

These area fallout to come across the supervised classification on SVM with teaching sites which take in with the reason of interest (ROI). By means of this we chiefly used to come across the diverse areas to find in an image each reason will correspond to as a class in which it may obtain each class as training sites we can correspond to with polygon or point. By this we can acquire numerous bands and to horizontal the areas then we will get the SVM classification image as shown in fig2. This image we will get in the ENVI zoom. By using the SVM image we will demeanour the feature extraction to that image and opt for the band to that opt for scale level and merge level to find the refinement in thresholding advanced state is elected for that position it has spectral, spatial, texture state in that we include to prefer the creating rules and in that we have decide on the add trait to rule in that we can opt for each position have poles apart methods. In the method at texture we elected maxband in spectral we elected entropy and in spatial rect_fit and we encompass to opt for the fuzzy tolerance and to set the function nature possibly will be s_type or linear and to hit upon the vector level to be levelled so that we have to horizontal the level as the respected output will be the fuzzy SVM classification image as revealed in fig3. The performance of the fuzzy SVM classification is as revealed in TABLEII

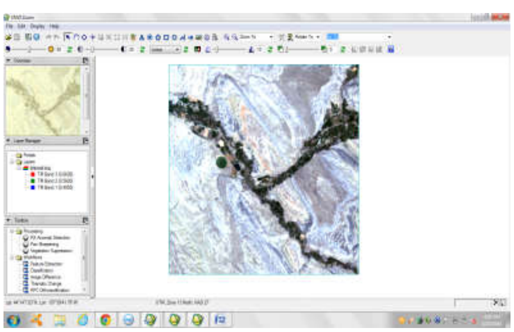

**Fig. 1** Input Image

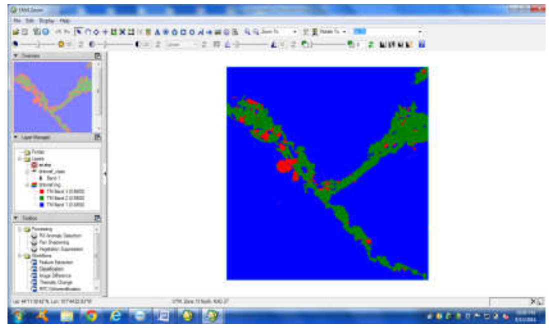

**Fig. 2** Support vector machine Image

**TABLE I:** SHOWS THE BANDWIDTHS OF SVM CLASSIFICATION

| S. No. | No. of Bands | Value |
|---|---|---|
| 1 | Band 1 | 0.4850 |
| 2 | Band 2 | 0.5600 |
| 3 | Band 3 | 0.6600 |

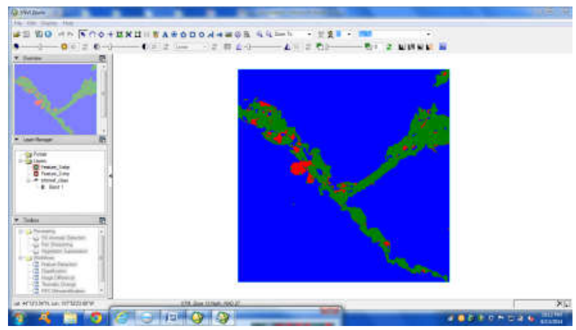

**Fig. 3** Fuzzy Support vector machine Image

## V. PERFORMANCE

File Name: bhtmref_class

Segment Scale Level: 60.0
Merge Level: 30.0
Refine: 1.00000 to 3.00000

Attributes Computed:
Spatial
Spectral
Texture

Classification: Rule-Based
Rule Set:
1 #1 (1.000): If maxband_1 [1.0314, 2.8980], then object belongs to "Feature_1".
2 #2 (1.000): If tx_entropy [0.0046, 0.1504], then object belongs to "Feature_2".
3 #3 (1.000): If rect_fit [0.4417, 0.9866], then object belongs to "Feature_3".

Export Options:
VectorOutputDirectory:
C:\Users\folder\AppData\Local\Temp\

Feature Info:
Feature_1 Type: Polygon
Feature_2 Type: Polygon
Feature_3 Type: Polygon
Smoothing: Threshold of 1

**TABLE II**

PERFORMANCE OF THE FUZZY SUPPORT VECTOR MACHINE CLASSIFICATION

| Feature Name | Feature Count | Total Area | Mean Area | Min Area | Max Area |
|---|---|---|---|---|---|
| Feature_1 | 18 | 30845620 | 2438540.40 | 5300 | 380019034 |
| Feature_2 | 14 | 28626750 | 2044767.90 | 4500 | 28343250 |
| Feature_3 | 4 | 20725200 | 51813000 | 2700 | 130174650 |

## VI. CONCLUSION

In this document we demeanour the fuzzy logic by rule based classification for spatial, spectral, texture methods we only classified maxband, entropy, and rect_fit and for that feature count, total area, mean area, min area, max area We can demeanour all the stage in the rule based process which will illustrate the feature extraction and we know how to state different method of spectral, spatial, texture. In this we barely conduct feature extraction on SVM but we can carry out on poles apart methods of supervised classification and unsupervised classification.

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