



International Journal of Control Theory and Applications

ISSN : 0974-5572

© International Science Press

Special Issue, 2016

Satellite Image Classification Using Genetic Algorithm Based on SVM Classifier

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Abstract: Objectives: SVM is Mainly established for linear multi-class classification through building a finest splitting hyperplane, here the scope is maximized. SVM is useful for core deception to plot the novel key in space into a high dimensional attribute slot to improve the classifier generality ability when the training data is not linear splitable.

Methods/Analysis: GA is a speculator and the empirical search algorithm that is stimulated by means of usual progress. The constitute solutions be determined to a cluster of strings (ie:chromosomes) by means of a few sort of determining methods in the evolution. The best constitute solution is accessed once a sequence of iterative GA calculations Based on Darwins principle of “Survival of the fittest”.

Findings: The GA consists of the elementary process of Selection, Crossover & Mutation, In each process of iteration (called generation). The fitness function is used to assess the eminence of every individual comes out of the chromosomes in the Genetic Algorithm. More fitness individuals are obvious to exist innate toward the next generation.

Improvement: We are ready to create a arrangement of the objects alike that it will exist nearer to the novel image by using GA along with SVM. This is a modest attempt to build detection easier.

Keywords: Support Vector Machine (SVM), Genetic Algorithm, (GA), Classifier, vector machine, vector machine classifier, cross acceptance

1. INTRODUCTION

Though a novelty of the space probe contraption tools, the geographical purpose of globe study information be expanding profoundly. The geographical purpose of panchromatic pictures. High determination remote detecting pictures have viewed as a practical cash-flow to bolster natural observing, land cover, land, urban planning use, and so on. In comparison with core resolution and high resolution remote sensing images afford detailed structural and sensitive information for analysis. Conversely, the phantom reparability corrupts contrasted and the expanding spatial determination. It is known well about the conventional “pixel-based” technique, which simply the spectral distinctiveness be fretful, which are not possible fit for classification of high motion images. [1] During the

signify point, object-oriented classification set up like another option to examine high determination remote detecting has set an incredible achievement.

An image entity is a collection of assorted pixels produced by a method of picture division. Abundant individuality of image objects can be deliberate, counting nature, textural, spectral as well as fitting data to enhance characterization rate. SVM (Support vector machine) has been proven like a capable pattern classification path, also has lately been efficiently accessed in remote sensing area. Support Vector Machine utilizes, the portion capacity delineate low-dimensional information highlights interested in a high measurement, for polynomial kernels, linear kernels, radial basis function kernels.

While SVM is used, choosing an appropriate core function and locate suitable core parameters is the primary issue. In SVM, the commonly used core function is RBF, at this point we just cram the RBF parameter optimization. Generalization C includes the optimized parameters. Another optimization path be headed to estimate the simplification ability of SVM utilizing a slope drop calculation over the arrangement of parameters. The SVM model prefers the parameter by esteem to the maximal generalization capability. However, this process normally time overriding and do not make fine, we represent a GA-mean constraint inflation for SVM.

2. GENETIC ALGORITHM

A GA (Genetic Algorithm) be an analytic explore so as to imitates the method like usual progression. Here analytic be consistently need to produce helpful answers for advancement and inquiry issues. Genetic calculations have a place with the bigger class of developmental calculations, which produce solution to optimization problems using techniques stimulated by common development, for example, transformation, legacy, hybrid and selection.

In a genetic algorithm, a populace of strings, that predetermine contestant result of an optimization problem, emerges toward enhanced results. Conventionally, results are spoken to in paired like a series of 0s & 1s, although new determinations are also feasible. The progression normally begins as of a population of self-assertion formed entities and happen in era. In each era, the condition of every entity in the masses is assessed, different inhabitants are imaginarily selected as of the present masses, also, modified to structure another masses. New masses is next used as a part of the following emphasis of the calculation.

Usually, algorithm terminates when whichever a most excessive amount of eras have been created, a reasonable fitness level will be going after the masses. On the off chance which, the computation has finished since a most extreme number of eras, an agreeable arrangement might or might not have been reached.

(A) A populace of potential manipulated by Genetic algorithms

Answers for an improvement issue. Particularly, they function on the encoded representation of the solutions, corresponding to a hereditary objects of people in life, also not straight to solve itself. Henry Holland's GA determines the arrangements a series of bits as of a parallel letter set. While within life, determination gives a fundamental lashing instrument to enhanced answers for surviving. Every arrangement is connected with a wellness esteem that replicate how great it is, contrasted and different arrangements in a populace. The better the wellness estimation like an entity, the better owned odds of existence with propagation as well as the bigger its illustration within the resulting era. Sequence of hereditary objects in hereditary calculations is recreated throughout a hybrid component that trades bits among the strings. A further operation, called change, causes irregular and arbitrary modification of the bits of strings. Change too has an immediate relationship of personality and assumes the part of recovering mislaid hereditary objects.

Henry Holland s Genetic Algorithm is regularly called as SGA or Simple Genetic Algorithm. Key to the Simple Genetic Algorithm functioning is a populace of parallel strings. Every series of 0s and 1s be the determined adaptation of an answer toward the improvement issue. Utilizing a hereditary administrators hybrid and change

–the calculation makes the ensuing era as strings of the present populace. This generation phase is reshaped awaiting a fancied end basis be coming.

3. SVM-SUPPORT VECTOR MACHINE

SVM is initially produced in straight twin-class grouping through developing an ideal isolating hyperplane, wherever the edge is utmost. If there should be an occurrence of non linearly distinguishable training information, SVM is by a method for piece trap to delineate unique info area into a higher dimensional component area to improve the classifier speculation capacity. In this segment, we will quickly portray the essential ideas for non-straight SVM. [2]

Specified information preparing tests $\{(y_1, z_1), (x_2, y_2), \dots, (y_n, z_n)\}$, where $x_i \in \mathbb{R}^d$ speaks to a preparation occurrence which has a place with a set marked by $z_i \in \{+1, -1\}$. For the non-straight detachable preparing information, the SVM outlines the first information area into a high-dimensional element space by means of portion capacity. [7] The regular capacities that fulfill the Mercer’s state could be served an SVM kernel capacity. As of now, the prominent bits are utilized in SVM counting:

$$\text{RBF kernel: } k(y_i, y_j) = \exp(-\gamma \|z_i - z_j\|^2) \tag{EQ(1)}$$

Linear kernel:

$$K(y_i, y_j) = y_i^T y_j \tag{EQ(2)}$$

Polynomial kernel:

$$K(y_i, y_j) = (y_i^T y_j + 1)^d \tag{EQ(3)}$$

Sigmoid kernel:

$$K(y_i, y_j) = \tanh [(y_i^T y_j + b)] \tag{EQ(4)}$$

The hyperplane separation is distinct as

$$D(y) = v^T \cdot y + c \tag{EQ(5)}$$

wherever v is a m -dimensional vector, c is a bias term.

To get the ideal hyperplane, we have to ease

$$Q(v, c, \xi) = \frac{1}{2} \|v\|^2 + C \sum \xi_i \tag{EQ(6)}$$

Subject to the constraints

$$Z_i (v^T y_i + c) \geq 1 - \xi_i \text{ for } i = 1, \dots, n \tag{EQ(7)}$$

Whereas ξ_i are non-negative floppy values, which

Compute the level of misanalysis of the data y_i . The constant C is a consequence constraint, that completes the transaction among maximal classification rate with minimal training error. Individually identify the attain hyperplane the soft-margin hyperplane, where v is the soft-edge. EQ (6) is a quadratic optimization problem, hence it act hard to resolve as of the v .

To resolve over streamlining issue, we can revolute EQ (6) throughout a Lagrange function:

$$\text{Min max } \{ \frac{1}{2} \|v\|^2 + C \sum \xi_i - \sum \alpha_i [z_i (v \cdot y_i - c) - 1 + \xi_i] - \sum \beta_i \xi_i \} \tag{EQ(8)}$$

Where α_i, β_i are the nonnegative Lagrange multipliers. Its twin form is $\text{Max } \sum \alpha_i - \frac{1}{2} \sum \alpha_i \alpha_i y_i^T y_j$
EQ(9)

Issue to the restraint

$$\sum z_i \alpha_i = 0, C > = \alpha_i >= 0 \text{ for } i = 1, \dots, n \tag{EQ(10)}$$

Wherever the consequent non-negative C represents the upper bound at this point. At long last, we obtain a better choice hyperplane

$$D(y) = \sum \alpha_i z_i K(y_i, y_j) + b \tag{EQ(11)}$$

Wherever k (y_i, y_j) the kernel function proves over. The set S means a vector relating toward the non-zero Lagrange multipliers I, that represent the alleged support vectors (SVs). [3]

4. PARAMETER PROCESSTECHNIQUE BASED ON GENETIC ALGORITHM AND SUPPORT VECTOR MACHINE

Support Vector Machine has made an overwhelming progress within the characterization of satellite images. Powerful classifier is outlined by, the parameters of the Support Vector Machine model must be designed legitimately ahead of time. Within this segment, we can portray the Support Vector Machine parameter advancement access that in light of Genetic calculation.

A. Fitness function

The fitness function be a sort of target capacity to assess the eminence of each genetic material. Genetic Algorithm based Support Vector Machine parameter development method, majority troublesome job is to plan a fitness function to create SVM parameters that are solid and compelling for SVM models. K-fold's cross acceptance be a broadly utilized method to survey the speculation capacity of a SVM classifier. At this point, we concern k-fold's cross-acceptance characterization ratio for the Genetic Algorithm fitness function. Advanced cross-acceptance arrangement ratio speaks to more noteworthy Support Vector Machine classifier speculation capacity on the specified preparing information. In k-fold's cross-acceptance, preparing statistics U are arbitrarily partitioned similarly within k subsets U₁... U_k, a classifier is prepared with k-1 subsets also the subset U_i (i=1, ... k) is utilized.

Therefore, k times training data are repeated, the finishing classification ratio be the normal for the entire k time Classification ratios and k-fold's cross-acceptance fitness (ie:F) is getting through:

$$F = 1/K \sum U_i \text{ ratio} \tag{12}$$

Wherever ratio U_i be the characterization ratio of U_i utilizing the rest of the k-1 subsets as preparing set. [2]

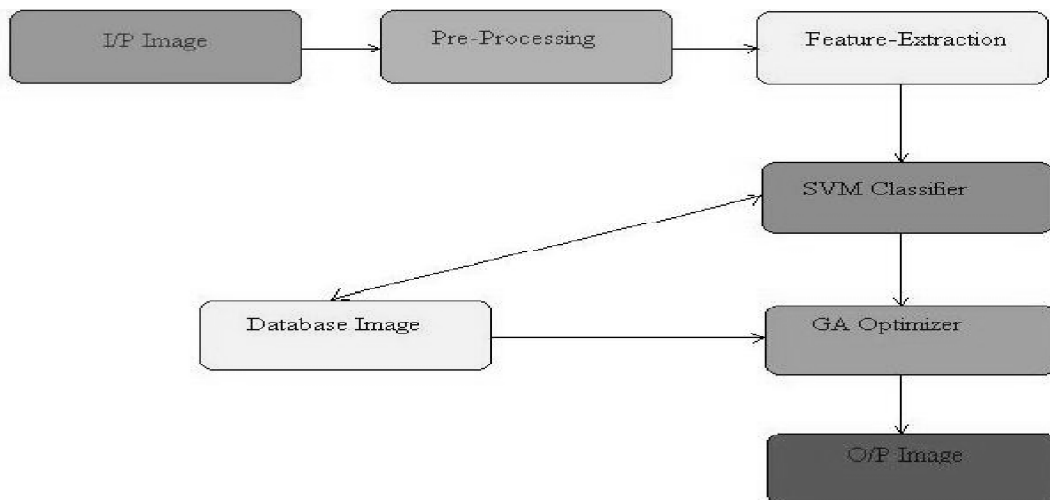


Figure 1: Genetic Algorithm –Support Vector Machine Classifier Engine

(B) Investigational setup

Our initiative within project be to set the specified set of data into a few classifications, for example, Barren Land, Sea Water, Building, Dry Cultivated fields, green cultivated fields, Upputeru river, Vegetation, etc. A high determination image is in use a contribution for SVM-GA Classifier Engine as given away in figure 1.

(C) Preprocessing method

For enhancing the identification rate of the image, pre-processing of the image is executed like 5 X 5 nonlinear digital Histogram & filtering equalization. [4, 8]

(D) Features-Extraction method

Data regarding an image are obtained with characteristics. The Characteristics be the attributes that are associated with a particular class. Pixel level characteristics, Global level characteristics, Local level characteristics be able to obtain. [4]

(E) SVM Classifier

Among entire machine learning algorithms, SVM is the advanced classifier. Support Vector Machine utilizes a processing algorithm to find the ideal limits among classes. The finest limits ought to be summed up to inconspicuous patterns with minimum errors between all conceivable limits isolating all classes, accordingly minimal the befuddling among classes. [5]

Therefore, with depreciating the uncertainty we can boost precision of classification.

(F) Genetic Algorithms

The approach of image classification which is ranging against the high probability to neural network relies upon highlight edges shaped by the strength values in each ghastrly strait for every picture element. Yet, the spectral data is not only adequate to precisely recognize a picture element. The elements of its region, similar to surface, or the normal estimation of close-by pixels are important to get great unearthly data. The various types of spatial substance data might likewise be included in the picture element highlight vector as extra element measurements. [6]

As a result, there are countless for extra component vectors that could improve the arrangement than now acquiring the rare spectral value like feature vectors. Therefore, to select these components naturally another transformative uses hybrid's genetic algorithm

(G) Database

It has every class data, which represents like a database. Our features of input image's are related to the database and subsequently ultimate classification is done. At last we acquire the output image which is classified.

5. METHODOLOGY

The implementation of Support Vector Machine-Genetic Algorithm parameters optimization progression can be compiled as below:

- A. Pre-processing of Data:** To evade characteristics within the larger numeral range domineering individuals in a lesser range, usually, every feature must be linearly scaled to array [0, 1] or [-1, 1].

- B. Population Initialization** In this process, C and _, the parameters, are distorted to chromosomes, that are defined by the bit string by the binary code method. Also produce a populace of N chromosomes randomly m where C (m=1,...,N).
- C. Decoding:** Alter genotype into phenotype: A contrary procedure of encoding, that alter binary chromosomes to numeric values.
- D. Cross-validation of K-fold:** In this article, k-fold cross validation is required to assess the ability of the generalization of the Support Vector Machine classifier for a training data which is known.
- E. Support Vector Machine model Training:** The Support Vector Machine classification model will accessed by training data, also According to GA decoding results the model parameters are set. [7]
- F. Classification rate Calculation:** The trained SVM model is used to calculate the classification rate on test data which can be achieved by previous execution.
- G. Evaluation of Fitness:** For a Genetic Algorithm fitness function the cross-verification exactness is used. To create the next generation, the advanced condition chromosomes are obvious to choose.
- H. Termination:** While a termination state is fulfilled, a progression concludes, or else In next operations the process executes.
- I. Genetic operations:** Here at, one procedure of development, After a sequence of genetic aberrations the novel populace is formed, like mutation, selection and crossover.

6. RESULTS

One at a time to assess the viability of the intended way for high motion remote sensing imagery object base classification, a test is passed out on a image of pixels with 2858×3805 resolution. On the way to develop the identification rate of the subset image, a preprocessing of the image is executed alike as Pan-sharpening fusion, histogram equalization and 5X5 pixel mean filtering. Within the initial pace, the image objects are developed by mean of Fractal Net Evolution Approach segmentation. In the literature, it has determined that image characteristics alike pattern, texture and shape are useful for the high motion satellite images.



Figure 2: Study area with 23.5 Spatial data

Interpretation: Secondly, object features, engages shape, spectral and textural be intended after the segmentation. During the study, we mine the usually used object features with: 1) features of specter : maximum difference, standard deviation , brightness and layer means; 2)features of texture based on GLSDM: standard deviation, mean, dissimilarity, contrast, homogeneity, angular second moment and entropy; 3)character features: length/width and shape index; 4) The Normalized Difference Vegetation Index and The Normalized Difference Water Index



Figure 3: Training area of each class

**Table 1
Colors reserved for each class**

<i>Class</i>	<i>Color</i>
Sea Water	Black
Dry Cultivated Fields	Thick Green
Barren Lands	Light Violet
Green Cultivated Fields	Light Green
Upputeru river	Brown
Vegetation	Dark Green

In support of the disjointed 250 image objects, 80 objects as samples are selected from 250 image objects, that arbitrarily is separated as two different parts: 50 objects be served for Support Vector Machine training data, whereas the left over used as verification data, the work of future Genetic Algorithm based approach is evaluated. And also, we categorized the objects to six groups: dry cultivated fields, barren land, sea water, Green Cultivated Fields, vegetation and Upputeru. The study was performed on MATLAB7.7 version development settings by means of the Support Vector Machine toolbox (LIBSVM).

7. CONCLUSION

Image objectives are significant to be measured as the imagery are fetched based on mentioned features. The mining of appropriate feature of the image be the essential process by means of the database image and the query images will be analyzed. The well-known feature of a image are texture, shape, color. Usually, in object-based high motion satellite image classification, several object feature, like shape, texture, contextual, spectral be analyzed after image segmentation. Though, purpose of the majority suitable feature subsets are not lone lowers the computational difficulty, In addition we can attain a advanced classification rate. Utilizing Support Vector Machine classifier we are able to classify the objects further perfectly while applying a Non-parametric classifier.

The final conclusion is that, when the confusion appear from the edge, the genetic parameters used for image classifier is finest

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