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Study and comparative analysis of different optimization theory based feature extraction techniques

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Abstract
This paper has presented a study on the various feature extraction techniques. The overall objective is to explore the benefits and limitation of the earlier techniques. The feature selection technique which is based on GA (Genetic Algorithm) and PSO (Particles Swarm Optimization) is considered. The feature selection technique finds the feature in term of accuracy and CPU time without using theoretical operator. The hybrid technique is able to differentiate between road and background pixels. SVM (Support vector machine) classifiers give a best solution, since useful to classification of high-dimensional problems.

Keywords
Road detection, Feature extraction, SVM, PSO, GA.

1. Introduction

Feature extraction approach is used to detect road for multiclass. Particles swarm optimization (PSO) contains particles which moves in space to find an optimal solution. Genetic algorithm (GA) is applied on chromosomes to find better fitness value. Overall accuracy (OA) of an SVM calculated on the basis of fitness value.

1.1 Road Detection

In road detection feature extraction used for differentiate feature of road and background pixels. New technique is applied for multiclass objects. This result gives better performance and accuracy in term of comparison with other techniques [1]. Fig 1.will be used for finding the multiclass i.e. for complex images in city, urban states. Multi-hybrid used to find the roads as well as other features exists around the roads by choosing specific area. It will work for multiclass sum.

Fig 1. Specific area of urban city

1.2 Feature extraction

When data present in large amount then it converted into small features for algorithm input reason. Information of particles is encoded as 0 or 1 it may or may not be include in subset. Important information taken from data and required task performed on small amount of data not on large data. This feature selection technique is used in hybrid PSO and GA. Feature extraction divides the input data into feature space into decision region by use samples. Then reduced sets of features are produced. Feature extraction techniques are divide into two types:- unsupervised and supervised. If available samples are infinite than performance can't be improve by ignore feature. Important role of Feature selection is to determine most relevant features of road. Feature selection give results in:
Good in generalization.
Eliminate redundant image.
Give the final classified output.

1.3 Method used:-

1.3.1 Feature selection using GA

Genetic algorithm (GA) is used in fuzzy logic, Neural networks and for solving complex feature detection problems. GA contains the solution sets i.e. chromosomes or particles. Chromosomes are consists of genes. Set of chromosomes are come from population. Then fitness function is applied on chromosomes. From fitness values set of chromosomes are taken and set are selected for the output. Mutation is applied over selected sets of chromosomes to increase the randomness and minimize the probability of local optimum. GA is useful to find optimal solutions**.** Individuals contain better fitness function used for next generation production. From fitness values set of chromosomes are taken and set are selected for the output. Mutation is applied over selected sets of chromosomes to increase the randomness.

1.3.2 Feature selection using PSO

PSO is also a type of optimization algorithm based on populations. It uses both memory and time. PSO use swarm intelligence to achieve optimization. PSO used in GA and Neural network problems. GA combined with PSO to find the actual solution which gives more suitable solution in term of less CPU time. PSO contains particles in the search space with velocity. Number of particles makes swarm. It consists of memory and avoid local minima. PSO is problem solving technique based on hybridization and have ability to control coverage. Hybrid approach can give a better trade off between computational efforts.

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1.3.3 Feature selection using SVM

Overall accuracy of SVM calculated on the basis of individuals. After selection crossover is done. Tournament selection is used for the population. Selection of two individuals is done by comparing their fitness value. Particles are selected randomly on basis of their fitness. These particles are selected which give best fit values and then put into mating pool. Similarly, parent set select and put into mating pool. Crossover operation is used i.e. two point crossover. Output is generated for next population. PSO go through search space and Mutation is applied to find the exact solution. GA does not give optimal solution. In confirms that the combination of the spectral information and spatial information types can significantly improve results compared to the standard SVM method. If number trading samples available are limited for high dimensional data classification SVM provide acceptable accuracies.

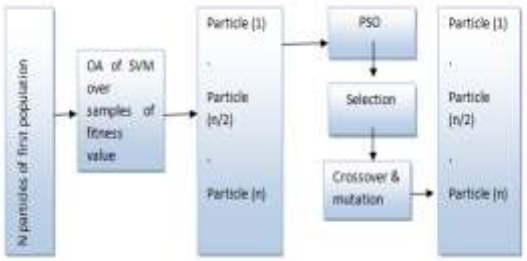

Fig 2. Methods in road detection

1.4 Metrics

Signal to noise ratio(SNR)

Signal to noise ratio is defined as the ratio of power of a signal (meaningful information) and power of background noise (unwanted noise). Where p is an average power.

$$\mathrm{SNR} = \frac{P_{\text{signal}}}{P_{\text{noise}}},$$

Mean error(ME)

It is defined as the average error of a number of observations found or encounter. Measuring the accuracy of a forecast called mean error. $\bar{X}$ is mean, $\sum$ is summation, X is the symbol for the error, N is the symbol for the number of errors.

$$\bar{X} = \frac{\Sigma X}{N}$$

Mean square error(MSE)

The MSE assesses the quality of an estimator and predictor. Predictor is a vector of predictions and vector of observed values.

$$\mathrm{MSE}(\hat{\theta}) = \mathrm{E}\left[(\hat{\theta} - \theta)^2\right].$$

I.e. the MSE is the *mean* $(\frac{1}{n}\sum_{i=1}^{n})$of the square of the errors $(\hat{Y}_i - Y_i)^2$ Estimator-The MSE of an estimator with respect to an unknown parameter is defined as

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y_i)^2$$

Maximum error

Maximum error (MAXE**)** is the difference between the point estimate of a parameter and actual value of parameter

$$E = z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

2. Literature survey

Ghamisi; P et al. (2015) [1] author proposed feature selection based on hybridization genetic algorithm and particle swarm optimization used for road detection in single and dual classes**.** It give better results in term of accuracy and performance for urban city.

Jeon; B et al. (2002) [2] proposed feature extraction for SNR images give better results to detect single track roads than GA approach. Road detection applied on highways which gives low resolution and used for wide road detection.

Alam; S et al. (2014) [3] has used swarm intelligence and PSO for data clustering. Cluster analysis, which identifies groups of similar data items in large data sets, is one of its recent beneficiaries. Swarm intelligence (SI) is one such optimization technique whose algorithms have successfully been demonstrated as solutions for different data clustering domains.

Krishna; N et al.(2014) [4] has used dual sub band frequency domain method for feature selection. Give result to improve feature extraction in term of high recognition rate. PSO give better performance for feature reduction.

Tawab. A et al. (2014) [5] has used feature extraction. Multi-feature PSO for object tracking give better result for efficiency of real time systems and better performance in the term of calculations, suitability.

Chen; Y et al. (2014) [6] has use feature extraction in classification is one of the most popular topics in hyper spectral remote sensing. The concept of deep learning is introduced into hyper spectral data classification for the first time. A new way of classifying with spatial-dominated information is proposed. The classifiers built in this deep learning-based framework provide competitive performance.

Bergh; F et al. (2004) [7] has used PSO approach for multiple swarms to optimize solution set. New PSO algorithm on benchmark optimization problems give better results in performance over the traditional PSO.

Daamouche; A et al.(2013) [8] proposed Swarm optimization applied on VHR images by using high resolution remote sensor. Its application for urban areas. It may appear theoretical referable to collect as many morphological features as one can.

Mura; M et al.(2010) [9] has used the features extracted used for the classification of two very high resolution images acquired by Quick bird on the city of Trento, Italy. The classification of result in a better description of the scene in terms of accuracy, further it will use how the

modeling of many different geometrical features can improve the analysis of multi temporal image particularly for urban areas.

Ghamisi; P et al. (2014) [10] has used Supervised feature extraction technique for hyper spectral images uses spectral and spatial information types. Gives less CPU time consumption.

Shirani; H et al.(2015) [11] proposed feature selection based on hybrid PSO. That incorporation of easily available soil properties as predictors may provide reliable frameworks for soil physical quality evaluation under different soil management, vegetation types and agricultural systems.

Perez-Jimenez; A et al. (2006) [14] proposed feature extraction based on GA. Benefit linear projection give good result in non linear projection. Limitation the number of new features is limited by the number of classes and numerical problems arise when working with high dimensional or small data sets.

Fan; S et al. (2007) [15] has used hybrid PSO solve the problems of optimization. Perform better results in manner of accuracy, efficiency and performance.

Melo; H et al. (2015) [16] has used Gaussian PSO give fast coverage, better performance by eliminating the unnecessary details. Neural network calculate size for all particles it takes more time.

Ghamisi; P et al. (2011) [17] has used SVM for detection of edges for extraction of spatial information. Both spatial and spectral information types used for better performance results.

Kaur; S et.al, (2015) [26] has shown that the fuzzy logic along with histogram based methods have quite operational results over the accessible techniques. In the proposed method, a method is prepared to augment the images excluding low-contrast images as well by balancing the stretching parameter (K) according to color-contrast. The proposed system is intended to re-store the de-graded edges caused because of contrast enhancement also.

Singh; A. et.al, (2015) [27] presents a new method for image-enhancement using fuzzy-interface system. Fuzzy techniques could accomplish the vagueness along with ambiguity efficiently (an image could be signified as fuzzy-set). Fuzzy logic is a powerful-tool to signify and process human-knowledge in form of fuzzy if-then rules. Compared to other filtering techniques, fuzzy filter gives the improved performance and it is capable to represent knowledge in a comprehensible way.

3. Gaps in literature

Following are the principle objectives which are required to successfully accomplish this dissertation:-

1) This work has used standard sum as a fitness function. Therefore, it is limited to a single or dual class of variables. Therefore inefficient for multiclass variables.
2) The use of hybrid feature extraction is ignored.
3) The use of multiple classes is also ignored in the existing literature.

4. Comparison table

Ref. No.	Technique used	Year	Technology used	Benefits	Limitations
[1]	Feature selection based on particle swarm optimization and genetic algorithm.	2015	GA,SVM	Used for single or Dual class.	Can't be used for multiclass sum.
[18]	A Cooperative approach to particle swarm optimization.	2004	PSO	Better performance in co-operative particle swarm optimization.	Not useful for solve all optimization.
[19]	Research on particle swarm optimization based clustering A systematic review of literature and techniques.	2014	PSO	Give Better performance.	Not useful for habitation of PSO.
[2]	Road detection in space borne SAR images using genetic algorithm.	2002	GA	Give best result for detect single track roads in hyper spectral images	Not used for multiclass sum.
[14]	Genetic algorithm for linear search.	2006	GA	Linear projection give good result in non linear projection.	Numerical problem occur for high dimensional data set or small data set.
[10]	Automatic Spectral Spatial Classification for Attribute Profiles and Supervised Feature Extraction	2014	GA	Decrease CPU time and give better accuracy.	Fails for more than two outputs.
[20]	An Optimal	2014	GA	Give	Lower level

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	Feature Subset Selection Using Genetic algorithm for Leaf Classification			optimal feature selection	of accuracy.
[21]	A Proximal Approach for Sparse Multiclass SVM	2015	SVM,GA	Improved accuracy.	Not used for multi-SVM.
[22]	GA for classification and feature Extraction	2013	GA	Better result in multiclass classificati on.	Not useful for classification of complex problems.
[23]	Analysis of Particle Swarm Optimization Algorithm	2010	PSO	Used for Particle analysis .	Not useful for multi road detection
[9]	Morphological Attribute Profiles for the Analysis of Very High Resolution Images	2010	GA	Useful for very high resoluti on images classific ations.	Not useful for complex urban problems..
[15]	A hybrid simplex search and particle swarm optimization for unconstrained optimization	2007	PSO	PSO used for solve continu ous optimiz ation problem s.	Multihybrid classification ignored.
[24]	An Image Enhancement by Fuzzy Logic and Artificial Neural Network using Hybrid Approach	2012	Fuzzy logic	Best results in perform ance and accurac y.	Not useful for multihybrid classes.
[8]	Swarm Optimization for Structuring Elements for Very high resolution Image Classification	2013	SVM	For collect as many morphol ogical features priori used.	It limited for training samples.
[25]	A Rough Set outlier detection	2010	PSO	Reduce computa tion	Not useful for multi-PSO.
	based on Particle Swarm Optimization			time.	

5. Conclusion

The review of various feature extraction techniques has clearly shown that no technique is effective for every case. The hybrid technique is found to be best as it can differentiate between road and background pixels. SVM classifiers give a best solution, since useful to classification of high-dimensional problems. But existing work has used standard sum as a fitness function. Therefore, it is limited to a single or dual class of variables. Therefore it is not efficient for multiclass variables. The use of hybrid feature extraction is ignored. The use of multiple classes is also ignored in the existing literature. In future work, in order to reduce the limitation of existing work, multiple sum will be use as fitness function. New Approach will be applicable for more than two classes at a same time.

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