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A Survey of Image Classification Based Techniques

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Abstract

Classification of image is fundamental step of the remote sensing applications which is to extract useful geographic information from raw image data. Many new methods for remote sensed classification have been developed such as machine learning support vector machine (SVM) neural network, fuzzy set, genetic algorithm and Artificial intelligence. Though these method may have higher accuracies than conventional classifiers. However, there is still a vast scope for further increases in classification accuracies so that the results can satisfy most of the applications.

1. Introduction

Remote sensing image classification is a prerequisite for remote sensing applications, like thematic mapping, forest management, urban planning, disaster warning and assessment, military target recognition, environment monitoring,. Classification of image is fundamental process of remote sensed classification. Conventional classifiers include Mahalanobis distance, utmost likelihood, least distance, the neural network classifier, a decision tree classifier etc. Many new methods for remote sensed classification have been developed such as machine learning support vector machine (SVM ,)neural network, fuzzy set, genetic algorithm and Artificial intelligence. This paper reviews the relatively newer approaches in remote sensed classification which include SVM, fuzzy sets and Artificial Intelligence.

Image Classification: Uses the spectral information represented by the digital numbers in one or more spectral bands, and tries to find each individual pixel based on this spectral knowledge. The objective is to allocate every pixel in the image to particular classes or themes (e.g. water, coniferous forest, deciduous forest, corn, wheat, etc.). The ensuing classified figure is comprised of a mosaic of pixels, every of which fit in to a fussy theme, and is fundamentally a thematic "map" of the original image.

Procedures of Classification:

Classification can be done in three types

(a) Supervised: Requires "training pixels", pixels where together the spectral principles and the class is known.

(b) Unsupervised: No extraneous data is used: classes are determined purely on difference in spectral values.

(c) Hybrid: Use unsupervised and supervised classification together.

Support vector machines (SVMs) are a supervised non-parametric statistical learning technique made on the underlying data distribution. In its original formulation [1] the method is presented with a set of labeled data instances and the SVM training algorithm aims to find a hyper plane that separates the dataset into a discrete predefined number of classes in a fashion consistent with the training examples. The term optimal separation hyper plane is used to refer to the decision boundary that minimizes misclassifications, acquired in the training phase. Learning means to the iterative process of finding a classifier with optimal decision boundary to separate the training patterns (in potentially high-dimensional space) and then to separate simulation data under the same configurations (dimensions) [2].

Artificial Intelligence (AI) techniques have been increasingly incorporated in the classification of remote sensing images. As a bottom-up approach, Swarm Intelligence (SI) is actually a complex multi-agents system, consisting of numerous simple individuals (e.g., ants, birds, etc.), which exhibit their swarm intelligence through cooperation and competition among the individuals. Although there is typically no centralized control dictating the behavior of the individuals, the accumulation of local interactions in time often gives rise to a global pattern, SI has currently become a hot topic in artificial intelligence research, and it has succeeded in solving problems such as traveling salesman problems, data clustering, combination optimization, network routing, rule induction, and pattern recognition. However, using SI in remote sensing classification is a fairly new research area and needs much more work to do.

2. BACKGROUND

In the last few years, attention has been drawn to the support vector machine (SVM) for remotely sensed data classification. Huang and Dixon applied the SVM classification to the Landsat Thematic Mapper (TM) image classification and compared the results with the maximum likelihood classifier (MLC), the neural network classifier, and the decision tree classifier. In SVM classification, the accuracy is affected by whether the training data can provide a representative description of each class or not, etc. In general, the more the number of "pure" training pixels, the higher the classification accuracy which can be obtained. However, due to low image resolution, complexity of ground substances, diversity of disturbance, etc., many mixed pixels exist in a remotely sensed image [3].

3. RELATED WORK

Hua Zhang, Wenzhong Shi, and Kimfung Liu, [3] present a novel fuzzy-topology integrated support vector machine (SVM) (FTSVM) classification method for remotely sensed images based on the standard SVM. Induced threshold fuzzy protocol is included into the standard SVM. Two different experiments were performed to evaluate the performance of the FTSVM technique, in assessment with standard SVM, maximum likelihood classifier (MLC), and fuzzy-topology-integrated MLC. The FTSVM method performs better than the standard SVM and other methods in terms of classification exactness, thus providing a successful classification method for remotely sensed images. FTSVM when compared with the standard SVM, MLC, and FTMLC, the FTSVM obtains a comparatively high accuracy. These evince that the FTSVM is a very effective classifier for multispectral remotely sensed images. With this, the misclassified pixels are reclassified; consequently, the problem of misclassification in the traditional SVM methods is thus solved to a certain extent, particularly for those pixels located at the boundary of between classes.

Junfei Chen, Jiameng Zhong, State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University [4] proposed a new integrated model is put forward for selecting 3PL providers based on support vector machine (SVM) and fuzzy analytic hierarchy process (FAHP). In the first stage, the support vector machine (SVM) is used to classify the primary 3PL provider samples into four types which are admirable, good, medium and bad correspondingly. Then we can find the outstanding samples which are the candidates for the second stage selection. In the next phase, the FAHP is used to evaluate the selected excellent samples in the primary phase, so we can obtain the sorting results for the excellent samples and the optimal samples. The method separates 3PL provider selection into two stages. SVM is used in the first stage to classify all the enterprises to be elected. Then fuzzy AHP is adopted to estimate the excellent enterprises which were selected in the first stage. Compared with the traditional method, the model based on SVM-FAHP can improve the selection efficiency and reduce the computational cost during decision-making process and the cost of information collection. The FAHP model can solve the uncertainty problem effectively when converting the qualitative case to quantitative ones. The example study shows that the SVM-FAHP model is feasible and effective. The research can provide decision-making for enterprises to select 3PL providers.

Giorgos Mountrakis, Jungho Im, Caesar Ogole [5] studied a wide range of methods for analysis of airborne- and satellite-derived imagery continues to be proposed and assessed. SVMs are particularly appealing in the remote sensing field due to their ability to generalize well even with limited training samples, a frequent restriction for remote sensing applications. Though, they also experience from parameter assignment problem that can significantly affect obtained results. SVM classifiers, characterized by selfmalleability, swift learning pace and limited needs on training size have proven a fairly reliable methodology in intelligent processing of data acquired through remote sensing. Past applications of the technique on equally real-world data and simulated environments have shown that SVMs exhibit superiority over most of the alternative algorithms.

Zhibin Liu, Haifen Yang, Shaomei Yang, North China Electric Power University, Baoding City, China[6] overcame the shortcoming of traditional linear SCDA assessment method, proposes an enhanced support vector machine (SVM) evaluating method based on the multistage dynamic fuzzy decision, takes the multistage lively fuzzy judgment as the sampling establishment, uses the SVM principle to begin evaluation model. This technique not only can exert the single advantages of multi-layer SVM classifier, but also trounce the difficulty of looking for the high grade training sample data. The accuracy and generalization ability of SVM is excellent relatively, because the model is based on the principle of structural risk minimization, It solves the problem of "more learning" and "less learning", gains the overall optimum solution, and overcomes the deficiency of neural network can only get partial optimal solution.

Yan LI, Li YAN, Jin LIU [7] explained the changes in remote sensing classification from two aspects: basic thought and new categorization algorithms. The basic consideration of remote sensing classification has changed from per-pixel multispectral-based approaches to multiscale object-based approaches. New categorization algorithms contain support vector machine, fuzzy clustering, algorithm evolutionary algorithm, as well as Artificial Neural Networks. This is lead to the development in remote sensing image classification in the past decade, including the multi scale object-based approaches and some new categorization algorithms like, SVM, fuzzy clustering algorithm, EA, ANNs. The truth that the data types and contractors are far more than the past made us understands the real world improved. However, the immense challenge is how to use these multisource imagery (multispectral, hyper spectral, radar, LIDAR to optical infrared sensors) to improve the classification accuracy in order to boost the remote sensing application.

Qiu Zhen Ge, Zhang Chun Ling ,Li. Qiong, Xin Xian Hui, Guo Zhang [8] presented the image categorization problem as an image texture learning problem by viewing an image as a collection of regions, each obtained from image segmentation. An approach performs an helpful quality mapping through a chosen metric distance function. Thus the segmentation problem becomes solvable by a regular categorization algorithm. Sparse SVM is adopted to radically decrease the regions that are needed to classify images. The chosen regions by a sparse SVM estimated to the target concepts in the traditional diverse density framework. Thus, the SVM classification approach was found very promising for Image Analysis. It has been shown that it can produce comparable or even better results than the Nearest Neighbour for supervised classification. A very good feature of SVMs is that only a small training set is needed to provide very good results, because only the support vectors are of importance during training.

Farid Melgani, Lorenzo Bruzzone [9] considered the problem of the classification of hyper spectral remote sensing images by support vector machines (SVMs). First, we suggest a hypothetical conversation and experimental analysis aimed at understanding and assessing the potentialities of SVM classifiers in hyper dimensional feature spaces. Thus, the considered dataset allow to identify the following three properties: 1) SVMs are much more effective than other conventional nonparametric classifiers (i.e., the RBF neural networks and the K-nun classifier) in terms of categorization accurateness, computational time, and constancy to parameter setting; 2) SVMs seem more effective than the traditional pattern recognition method that is based on the blend of a feature extraction/selection procedure and a conventional classifier.

Osama Abu Abbas et al. [10] are intended to study and compare different data clustering algorithms. The algorithms underneath investigation are: hierarchical clustering algorithm, k-means algorithm, expectation maximization clustering algorithm and self-organizing maps algorithm. All these algorithms are evaluated as per the following factors: number of clusters, size of dataset, type of dataset and type of software used.

FSVM is used to enhance the SVM in reducing the effect of outliers and noises in data points and is suitable for applications, in which data points have unmodeled characteristics [11]. Combing the advantages of statistical learning framework and the fuzzy basis function inference system, Chiang and Hao [11] proposed an SVM-based fuzzy inference system which provides reliable performance in the cases of classification and prediction. Tsujinishi and Abe [12] discuss unclassifiable regions for multiclass problems which were resolved using fuzzy LS-SVMs. Fuzzy topology is generalized from ordinary topology by introducing the concept of membership value in a fuzzy set.

Lin and Wang offered Fuzzy support vector machines. The FSVM that imposes a fuzzy membership to each input point such that different input points can make different contributions to the learning of decision surface. By setting different types of fuzzy membership, they can easily apply FSVM to solve different kinds of problems. This extends the application horizon of the SVM [13]. SVM is a powerful tool for solving classification difficulties; however there are still some limits of this theory. For each class, they can easily check that all training points of this class are treated uniformly in the theory of SVM. In many real-world applications, the consequences of the training points are unusual. It is frequently that a few training points are more important than others in the classification problem. It would require that the meaningful training points must be classified correctly and would not care about some training points like noises whether or not they are misclassified.

SVMs with Fuzzy

Support vector machine (SVM) is a learning machine that seeks the best compromise between the complexities of the model and learning ability according to the limited sample information, it is suitable for the machine learning in small samples circumstances, and overcomes the insufficient problem of typical negative type data [14][15]. Various fuzzy set theories have been used to deal with fuzzy classification problems in remote sensing and image processing as well as land-cover classification. Many researchers had used the fuzzy approaches together with SVM. FSVM is used to enhance the SVM in reducing the effect of outliers and noises in data points and is suitable for applications, in which data points have unmodeled characteristics. Combing the advantages of statistical learning framework and the fuzzy basis function inference system, Chiang and Hao [11] proposed an SVM-based fuzzy inference system which provides reliable performance in the cases of classification and prediction. Tsujinishi and Abe [12] discuss unclassifiable regions for multiclass problems which were resolved using fuzzy LS-SVMs. Fuzzy topology is generalized from ordinary topology by introducing the concept of membership value in a fuzzy set. The fuzzy-topology has been developed, which provides an elementary tool for the development of fuzzy classification. The evaluation method that unifies the multi-layer SVM classifier and the expert fuzzy judgment divides into 3 stages. First, they use the expert fuzzy judgment to evaluate, and obtain the massive samples; then establish the SVM model through the training samples; finally, use the multi-layer SVM classifier system to carry on the evaluation.

PSO in remote sensing

Recently, Artificial Intelligence (AI) techniques have been increasingly incorporated in the classification of remote sensing images [16]. As a bottom-up approach, Swarm Intelligence (SI) is actually a complex multi-agents system, consisting of numerous simple individuals (e.g., ants, birds, etc.), which exhibit their swarm intelligence through cooperation and competition among the individuals. Although there is typically no centralized control dictating the behavior of the individuals, the accumulation of local interactions in time often gives rise to a global pattern, SI has currently become a hot topic in artificial intelligence research, and it has succeeded in solving problems such as traveling salesman problems, data clustering, combination optimization, network routing, rule induction, and pattern recognition [17], [18], [19], [20], [21] and [22]. However, using SI in remote sensing classification is a fairly new research area and needs much more work to do.

4. CONCLUSION

Here in this paper a review of all the papers based on image classification is given. Fuzzy topology based integrated support machine is given in the paper along with the optimization of SVM using particle swarm optimization. Fuzzy topology based integrated support machine is an efficient technique but with the optimization of SVM the algorithm performs better and accuracy of classification rate increases.

5. REFERENCES

[1]Vapnik, V., "Estimation of Dependences Based on Empirical Data", 2nd edition, Information Science & Statistics, pp. 5165–5184, (English translation: Springer Verlag, New York, 1982).

[2] Zhu, G., and Blumberg, D.G. "Classification using ASTER data and SVM algorithms;: The case study of Beer Sheva, Israel", Remote Sensing of Environment, vol.80, issue 2, pp. 233–240, 2002.

[3] Hua Zhang, Wenzhong Shi, and Kimfung Liu "Fuzzy-Topology-Integrated Support Vector Machine for Remotely Sensed Image Classification", IEEE Transactions on Geosciences And Remote Sensing, Vol. 50, No. 3, March 2012.

[4] Junfei Chen, Jiameng Zhong "An Integrated SVM and Fuzzy AHP Approach for Selecting Third Party Logistics Providers", Electrotechnical Review (Electrical Review), ISSN 0033-2097, R. 88 NR 9b/2012.

[5] Giorgos Mountrakis, Jungho Im, Caesar Ogole "Support vector machines in remote sensing: A Review", ISPRS Journal of Photogrammetry and Remote Sensing, vol. 66, issue 2, pp. 247-259, 2011.

[6] Zhibin Liu, Haifen Yang, Shaomei Yang "Integration of Multi-layer SVM Classifier and Multistage Dynamic Fuzzy Judgment and Its Application in SCDA Measurement", Journal of Computers, Vol. 4, No. 11, November 2009.

[7] Yan LI, Li YAN, Jin LIU "Remote Sensing Image Classification Development in the Past Decade", Proceedings *of* SPIE Vol.7494 74941D-1, pp. 338-343, 2009.

[8] Qiu Zhen Ge, Zhang Chun Ling ,Li. Qiong, Xin Xian Hui , Guo Zhang "High Efficient Classification on Remote Sensing Images Based on SVM", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B2. Beijing 2008.

[9] Farid Melgani, Lorenzo Bruzzone "Classification of Hyper spectral Remote Sensing Images With Support Vector Machines", IEEE Transactions on Geosciences And Remote Sensing, Vol. 42, No. 8, August 2004.

[10] C. F. Lin and S. D. Wang, "Fuzzy support vector machines," IEEE Transaction Neural Network, vol. 13, no. 2, pp. 464–471, Mar. 2002.

[11] J. H. Chiang and P. Y. Hao, "Support vector learning mechanism for fuzzy rule-based modelling: A new approach," IEEE Transaction on Fuzzy System, vol. 12, issue 1, pp. 1–12, Feb. 2004.

[12] D. Tsujinishi and S. Abe, "Fuzzy least squares support vector machines for multiclass problems," Neural Network., vol. 16, no. 5/6, pp. 785–792, Jun. / Jul. 2003.

[13] C. Warrender, and S. Forrest, "Detecting intrusions using system calls: alternative data models," Proceedings of the IEEE Computer Society Symposium on Research in Security and Privacy, vol. 6, no. 5, pp. 133-145, 1999.

[14] C.J.C. Burges, "A tutorial on support vector machines for pattern recognition," Data Mining and Knowledge Discovery, vol. 2, no. 2, pp. 121-127, 1998.

[15] F. Wang, "Fuzzy supervised classification of remote sensing images," IEEE Transaction on. Geoscience and Remote Sensing, vol. 28, issue 2, pp. 194-201, Mar. 1990.

[16] Stathakis D, and Vasilakos A. "Comparison of computational intelligence based classification techniques for remotely sensed optical image classification", IEEE Transaction on. Geoscience and Remote Sensing, vol. 44, issue 8, pp. 2305—2318, 2006.

[17] Machado Th R, and Lopes H S. "A Hybrid Particle Swarm Optimization Model for the Traveling Salesman Problem", Proceedings of the International Conference in Coimbra, pp. 255—258Portugal: Springer, 2005.

[18] Kennedy J. "Stereotyping: improving particle swarm performance with cluster analysis", In

Proceedings of the 2000 Congress on Evolutionary Computing, vol. 2, pp. 1507 – 1512, 2000.

[19] Ting T O, Rao M V C, Loo C K, Ngu S.S. "Solving unit commitment problem using hybrid particle swarm optimization", Journal of Heuristics, vol. 9, issue 6, pp. 507—520, 2003.

[20] Kwang M S and Weng H S. "Multiple ant-colony optimization for network routing", In Proceedings of the First International Symposium on

Cyber Worlds, pp. 277—281, 2002.

[21] Liu X P, Li X, Yeh A G O, et al. "Discovery of transition rules for geographical cellular automata by using ant colony optimization. Science in China Series D-Earth Sciences, vol. 50, issue 10, pp. 1578—1588, 2007.

[22] Omran M. "Particle Swarm Optimization methods for pattern Recognition and Image Processing, Dissertation for the Doctoral Degree. University of Pretoria, 2005.j