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Classification techniques used in remote sensing satellite imageries: A survey

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Abstract
Satellite image classification method involves grouping the image component values into meaty classes. Several satellite image classification strategies and techniques available. Satellite image classification strategies will be broadly classified into three classes

1. Automatic
2. Manual
3. Hybrid

All three strategies have their own benefit sand disadvantages. Majority of the satellite image classification strategies fall into initial class. Satellite image classification wants choice of acceptable classification method supported the necessities. This analysis work is a study on satellite image classification strategies and techniques. The analysis work conjointly compares numerous researchers' comparative results on satellite image classification strategies. This work compares performance of conventionally recent classification techniques on satellite information. Additionally, there are many problems requiring thought in respect of the classification of remotely perceived data: 1) The way to choose the right size of coaching samples 2) The way to create the classifier parameters 3) The way to mix classifiers in an economical way. This review suggests that effective use of multiple options of remotely perceived information and also the choice of an acceptable classification methodology are crucial for rising classification accuracy. Additional analysis, however, is required to spot and cut back uncertainties within the image-processing to enhance classification accuracy.

Keywords: satellite image, remote sensing, image classification, summary of reviews

1. Introduction

Satellite pictures area unit wealthy and plays an important role in providing geographical data. Satellite and remote sensing images provides quantitative and qualitative data that reduces quality of field work and study time. Satellite remote sensing technologies collects data/images at regular intervals. The volumes quantitative and qualitative information receive at data centers is big and it is growing exponentially because the technology is growing at speedy speed as timely and information volumes are growing at associate in nursing exponential rate. There's a robust want of effective and economical mechanisms to extract and interpret valuable information from large satellite pictures. Satellite image classification could be a powerful technique to extract data from a variety of satellite pictures. Satellite image classification could be a method of grouping pixels into purposeful categories. It is a multi-step work flow. Satellite image classification can even be referred as extracting information from satellite pictures. Satellite image classification is not complicated; however the analyst has got to take several decisions. Satellite image classification involves in interpretation of remote sensing pictures, special data processing, finding out varied vegetation varieties like agriculture and foresters etc. The current analysis work could be a literature review on satellite image classification ways and techniques. It describes and provides details on varied satellite image classification methods to the analyst. The present literature review stress on automatic satellite image classification ways and techniques. The motivation behind this review is to assist the analyst, particularly people who area unit unaccustomed the sphere of remote sensing, to pick out the foremost appropriate classification approach so as to success classify a remotely perceived satellite imagery to supply a Land Use and Land Cover map. During this review, recent advances in classification algorithms area unit thought of like Artificial Neural Network (ANN), Classification Trees (CTs) and Support Vector machines (SVMs). On the opposite hand, the foremost common issues related to them are mentioned.

2. Necessitate for Satellite Image Classification

Satellite image classification acting a most important function in extorts and understanding of precious information from huge satellite Images. Satellite image classification is necessary for:

- Spatial information with drawal
- Extort information for an appliance
- Thematic map formation
- Visual and digital satellite image explanation
- Field surveys
- Efficient conclusion making
- Adversity management

3. Remote-Sensing Classification Process

The major steps of image classification could include:

- Selection of an appropriate classification system;
- Style image categories like urban, agriculture, water areas, etc;
- Conduct field surveys and collect ground information;

- Image preprocessing for the improvement of geometric and radiometric qualities of satellite imagery;
- Feature extraction and selection;
- choice of coaching samples;
- Image classification;
- Post-processing: filtering, and classification decorating;
- Accuracy assessment.

4. Satellite Image Techniques

There are many ways and techniques for satellite image classification. Figure one shows hierarchy of satellite image classification ways.

Satellite image classification ways can be broadly speaking classified into three classes

- Machine-controlled (Automatic)
- Manual
- Hybrid

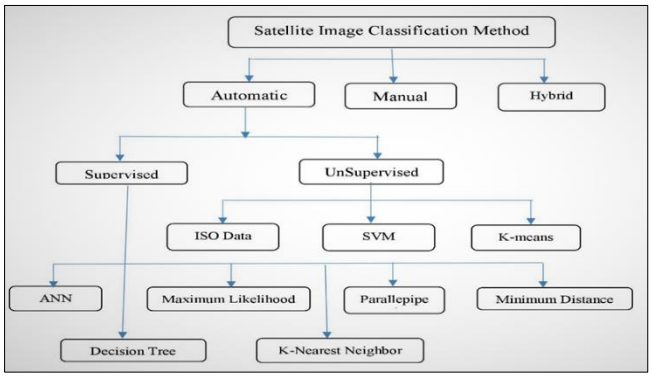

Fig 1: Satellite image classifications methods hierarchy

4.1 Machine-Controlled

Automated satellite image classification ways uses algorithms that applied consistently the complete satellite image to cluster pixels into significant classes. Majority of the classification ways constitute this class. Automated satellite image classification ways are classified into two classes 1) supervised 2) unsupervised classification methods.

4.2 Supervised

Supervised classification ways need input from associate analyst. The input from analyst is understood as coaching set. Training sample is that the most vital part for the supervised satellite image classification ways. Accuracy of the methods extremely depends on the samples taken for coaching. Training samples area is of two varieties, one used for classification and another for supervising the classification accuracy. Various classification techniques deal with totally different types of similarity matching ways. Supervised classification includes further practicality like analyzing input file, creating coaching samples and signature files, and determinant the quality of the coaching samples and signature files.

Supervised categorization could be a methodology during which the analyst defines little representative samples for every land use class referred to as a coaching sample. In supervised classification, the analyst should be accustomed to the realm lined by the satellite image and also the spectral properties of the land use categories. Accuracy of the classification results extremely depends on the samples taken for coaching. The image classification rule uses the coaching samples to spot the land use categories within the entire image

Artificial Neural Network

Algorithms make up Artificial Neural Network (ANN) simulate human learning method to associate the proper significant labels to image pixels. Advantage of ANN based mostly satellite image classification algorithms is straightforward to include supplementary knowledge within the classification method and improves classification accuracy.

Binary call Tree

Binary call Tree (BDT) satellite image classification algorithms area unit machine learning techniques. Call tree technique includes a group of binary rules that outline significant categories to be associated to individual pixels. The call tree code area unit available to come up with binary rules. The code takes coaching set and supplementary knowledge to outline effective rules.

Image Segmentation

Segmentation plays a significant role in satellite image process, analysis and pattern recognition. Satellite image segmentation techniques/algorithms are not directly associated with image classification. Image segmentationteams pixels that are comparatively consistent into segments. Image segmentation algorithms give variables that support analyst to specify relative size and shape of the segments. Divided image will be classified at segmentation level, rather than pixel level. Segmentation level satellite image classification algorithms are much lot quicker than pixel level classification strategies.

4.3 Unsupervised

Unsupervised classification technique uses bunch mechanisms to cluster satellite image pixels into unlabeled classes/clusters. Later analyst assigns meaty labels to the clusters and produces well classified satellite image. Most common unsupervised satellite image classification is ISODATA, Support Vector Machine (SVM) and K-Means.

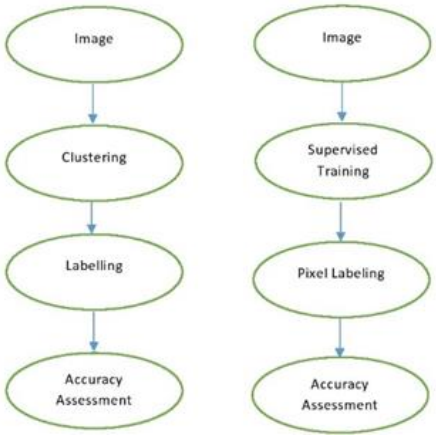

Fig 2: The major steps of unsupervised and supervised image classification

The analyst identifies the quantity of classes/clusters to come up with and that bands to use for supporting this data, the image classification rule generates classes/clusters so as to provide well classified satellite image, the analyst manually identifies every cluster labels a land use category. It is

typically the case that multiple clusters represent one land use category. The analyst merges clusters into one land use category. The unattended classification technique is often used once no coaching sample sites exist. There exist some most frequent bunch strategies used for unattended classification, namely, K-means and repetitive Self-Organizing information, analysis technique (ISODATA). These strategies believe strictly on pixel-based statistics and incorporate no previous data of the characteristics of the themes beneath investigation.

4.4 Manual

Manual satellite image classification strategies are sturdy, effective and economical strategies. However manual strategies consume more time. In manual strategies the analyst should be acquainted with the realm coated by the satellite image. Potency and accuracy of the classification, depends on analyst information and familiarity towards the sphere of study.

4.5 Hybrid

Hybrid satellite image classification strategies combines the advantages of machine-controlled and manual strategies. Hybrid approach uses machine-controlled satellite image classification methods to try to initial classification, any manual strategies are wont to refine classification and proper errors.

5. Satellite Image Classification Methods

This part demonstrates a few modern satellite image classification methods and the detailed description of various techniques studied through literature survey.

Supervised satellite image classification methodology is to classify terribly high resolution satellite images into specific categories victimization mathematical logic. This methodology classifies satellite pictures into five major classes: shadow vegetation, road, building and blank land. This methodology uses image segmentation and fuzzy techniques for satellite image classification. It applies two levels of segmentation. In level 1 the process involved is that the segmentation identifies and classifies shadow, vegetation and road. In level 2 the segmentation identifies building, further it uses discourse check to classify unclassified segments and regions. Fuzzy techniques are accustomed to improve the classification accuracy at the borders of objects. Again in another study, supervised satellite image classification method is used to work out water, urban and inexperienced land on satellite images. This methodology takes coaching set for each category and computes threshold worth victimization k-means and LDA techniques. The tactic extracts low-level options from satellite pictures and applies k-means algorithmic program to cluster into unlabeled clusters. Purposeful labels are allotted to the unlabeled categories by scrutiny threshold values with extracted options. Some describes metaphysics based mostly supervised ocean satellite image classification methodology. This methodology illustrates power of ontology in ocean satellite image classification. The method extracts low level options from ocean satellite pictures and represent in hooter file format. This hooter file is incorporated with domain anthologies and labeling rules. Labeling rules, training rules, binary call tree rules and knowledgeable rules are represent using SWRL language. The tactic produces classification results of given ocean satellite image with the support of coaching, human knowledgeable, call support and labeling rules. It conjointly provides a tool as plug-in for recipient ontology editor. The tool supports ocean satellite pictures with the support of domain anthologies. In victimization call tree technique the method extracts options from satellite image supported constituent color and intensity. Extracted options assist to work out objects reside within the satellite pictures. The strategies classifies satellite pictures victimization call tree with the support of identified objects. Another technique for the classification of satellite images into multiple predefined land use categories. This method is machine-driven and uses section level classification with the support of coaching set. The classification strategies include discourse properties of predefined multiple categories to improve the classification accuracy. The Bayesian technique uses special data for classification of high-resolution satellite pictures. The method performs classification in 2 phases. Part 1: spectral and textural options are extracted for every constituent to coach Bayesian classifiers with distinct non-parametric density models. Phase 2: split-and merge algorithmic program is employed to convert the pixel level classification maps into contiguous regions. ISODATA technique is the common unsupervised satellite classification methodology. It creates predefined variety of unlabeled clusters/classes in a very satellite image. Later meaningful labels are allotted to the clusters. ISODATA parameters desires many parameters that manage the variety of clusters and iterations to be run. In few cases clusters could contain pixels of various categories. In such things ISODATA uses cluster-busting technique to label the complex categories. K-means may be a fashionable statistics and data processing technique. It partitions the observations into k clusters supported Euclidean average. The K-means technique are straightforward method for quick execution. Limitation with this methodology is analyst ought to grasp prior variety of classes. Support Vector Machine (SVM) may be a non-constant unsupervised applied math classification methodology. This methodology can be accustomed extract land-use map. SVM works on the assumption that there is no data on the way to distribute the overall information. SVM reduces satellite classification value, increases speed and improves accuracy. Minimum distance approach calculates mean spectra of each predefined category and assigns the constituent to a group that has the least distance to mean. It simple to execute and easy to process. However minimum distance methodology considers solely mean value. Another distance methodology is extremely the same a minimum distance methodology. It uses information technique covariance prevailing conditions for satellite image classification. Parallelepiped executes supported parallelepiped-shaped boxes for every category. Prism boundaries for every category are pre-determined. Pre-determined boundaries identify checks constituents of take a look at pictures and confirm category of the pixel. Parallelepiped methodology is quick and simple to run, however overlap could produce false results. Maximum probability methodology may be applied math supervised approach for recognizing the patterns. It allocates pixels to acceptable categories supported likelihood values of the pixels. Maximum chances are economical methodology to classify pixels of satellite image. However it is time overwhelming and insufficient ground truth information produces poor results.

6. Comparison of Satellite Image Classification Methods

Various researchers are performed comparison on unsupervised, supervised satellite image classification methods and on the mixture of each with reference to classification accuracy and alphabetic character constant. This section compares comparison outline of varied researchers. In Table 1, the various methods used for classification are discussed with its advantages and disadvantages.

In Table 2 the comparison outline ofvarious researcher sare compared. From the comparison outline, researcher's opinion on higher satellite image classification technique is not consistent. Additionally there is a requirement to review the methods performance depends on the data set used for classification. The study on variousdataset gives the better method to be consider for the accuracy assessment for image classification

Table 1: Comparison of modern classification techniques

Method	Advantages	Disadvantages
AN	- Non-parametric classifiers. - High computation rate of very large datasets - Efficiently handles noisy inputs	- It is difficult to understand how the result was achieved. - The training process is slow. - Problem of over fitting. - Difficult to select the type network architecture. - Dependent on user-defined parameters.
CTs	- Non-parametric classifiers - Does not require an extensive design and training. - Easy to understand the classification process. - Accurate and computational efficiency is good. - Easy to integrate multi-source data.	- Calculation becomes complex when various outcomes are correlated.
SVMs	- Non-parametric classifiers - Provides a good generalization. - The problem of over fitting is controlled. - Computational efficiency is good. - perform well with minimum training set size and high-dimensional data - Often outperform other classifiers.	- Training is time consuming. e - Difficult to understand its structure. - Dependent on user-defined parameters. - Determination of optimal parameters is not easy.
Fuzzy Classifiers	- Efficiently handle overlapping data. - Minimize computation time and reduces memory requirements.	- Without prior knowledge output is not good

Table 2: Comparison of various satellite image classification methods

Researcher	Classification Methods Taken for Comparison	Test Data	Better Method from the Researcher Study
K. Kanika *et al*.. [23]	K-Nearest Neighbour Minimum Distance Maximum Likelihood	IRIS Plants Dataset	K-Nearest Neighbour
R. Offer *et al*., [24]	ISODATA Maximum Likelihood Hybrid Method	Desert Outlay Darasets	Hybrid Method
A. Aykut *et al*., [25]	Maximum Likelihood Minimum Distance Parellelpiped	Landsat 7 ETM+ Images	Maximum Likelihood
T. Jamshid *et al*., [26]	Parallelepiped Minimum Distance Chain Method	Landsat 5TM images	Chain Method
H. N. Shila *et al*., [27]	Unsupervised Supervised Hybrid Method	Landsat7 ETM+ data	Hybrid Method
N. Maryam *et al*., [28]	Support Vector Machine Maximum Likelihood Mahalanobis Distance Minimum Distance. Spectral Information Divergence Binary Codes Parallelepiped	Landsat7 ETM+ data	Support Vector Machine
Manoj Pandya *et al*.. [29]	K-Means ISODATA Minimum Distance Maximum Likelihood Parallelpiped Seeded region Growing Enhanced Seeded region Growing	Landsat, SPOT and IRS Datasets	Enhanced Seeded Region Growing
T. Subhash *et al*., [30]	Maximum Likelihood Minimum Distance Mahalanobis Distance	Landsat7 ETM+ data	Maximum Likelihood
W. Malgorzata *et al*., [31]	Pixel-based Classification Object-Oriented Classification	Multi-Spectral Satellite Images	Object-Oriented Classification

7. Conclusion

Image classification has created good progress over the past few decades within the development and use of advanced classification algorithms. This review offers a quick guide regarding completely different classification techniques and lists the benefits and drawbacks. It is targeted extensively on recent classification algorithms like ANN, SVMs and CTs. These classification approaches have considerably improved the accuracy in the case of our satellite imagination. This paper helps researchers in choosing an acceptable classification algorithmic rule for a selected task, optimization of the classifiers and choosing the best classifiers to enhance the classification accuracy, however the performances arescattered with various factors like the chosen base classifiers and the combination strategy. Diversity measures will play an important role out choosing the bottom classifier and this paper offers an outline for machine-driven satellite image classification strategies and compares many reviews done by various researchers. Machine-driven satellite image classification methods are

often classified into 1) supervised 2) unsupervised. Supervised and unsupervised satellite image classification methods disagree within the manner of grouping pixels into substantive categories. Within this literature, researchers have given survey on satellite image classification strategies and evaluated the performance against completely different data sets. This paper summarizes the various reviews on satellite image classification strategies and techniques. The outline helps researchers to pick appropriate satellite image classification technique or technique based on the requirements.

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