Journal of Management & Entrepreneurship
ISSN 2229-5348

UGC Care Group I Journal

Vol-11 Issue-01 April 2022

A Review of Methods for Categorizing Satellite Images

Mr ABHISHEK GAJULA[1], POSIMSETTI T CHIRANJEEVI SWAMY[2], Mr S VARA VINOD UNGARALA[3]

Asst. Professor[1,2,3]

Dept. of Computer Science and Engineeering,

Bhimavaram Institute of Engineering and Technology, Bhimavaram, Andhra Predesh, India.
E.mail id:abhishek.gajula@gmail.com, chiranjeevi.pt@gmail.com , satyamtech12@gmail.com

ABSTRACT

In order to classify a satellite picture, the pixel values inside the image must be clustered into meaningful groups. There are a variety of approaches to classifying satellite images. There are three main types of techniques used to classify satellite images. 1) mechanically Two more options are to go the manual route or use a hybrid system. There are benefits and drawbacks to using any of the three approaches. Most satellite image categorization techniques are first-generation approaches. Selecting the most suitable classification approach for satellite image categorization is essential. This study investigates several approaches of classifying satellite images. The study also evaluates the performance of different researchers' approaches to classifying satellite images.

Keywords

Satellite Image, Classification, Summary of reviews

1. INTRODUCTION

The geographical information provided by satellite photographs is extensive and invaluable [1]. The quantitative and qualitative information provided by satellite and remote sensing imagery simplifies field work and study time [2]. Data and photos are periodically gathered using satellite remote sensing technology. As both time and data quantities have been expanding at an exponential pace, the data received at datacenters has become enormous and is increasing at a dizzying rate [3]. Mechanisms that can efficiently and accurately glean useful information from large satellite photos are urgently needed. Classifying satellite pictures is an effective method for mining a large database of satellite photos for useful insights.

Classifying satellite images involves sorting their pixels into meaningful categories [4]. There are several steps involved. Information extraction from satellite pictures is another name for satellite image categorization. While the process of satellite image categorization is not very complicated, it does need the analyst to make a number of important judgments and choices. Classifying satellite pictures requires the analysis of remote sensing images, spatial data mining, research into different forms of vegetation (urban, agricultural, forested, etc.), and the determination of different land uses [5].

This study is a literature assessment of several approaches to classifying satellite images. It gives the analyst a detailed description of many approaches for classifying satellite images. The focus of this literature review is on existing approaches for automatically classifying satellite images.

The remaining parts of the paper are structured as follows. The importance of satellite image classification is introduced in Section 3, followed by examples of relevant classification methods in Section 4, a discussion of several cutting-edge classification approaches in Section 5, and finally, a summary in Section 6.

NEED OF SATELLITE IMAGECLASSIFICATION

Satellite image classification plays a major role in extract and interpretation of valuable information from massive satellite images. Satellite image classification is required for:

- Spatial data mining [6]
- Extract information for an application
- Thematic map creation
- Visual and digital satellite image interpretation
- Field surveys
- Effective decision making
- Disaster management

2. SATELLITE IMAGE TECHNIQUES

- Satellite image categorization may be accomplished using a variety of approaches. The categorization algorithms for satellite images are shown in a hierarchical form in Figure 1. There are three main types of satellite image categorization techniques [7]:

3.2 Supervised

- Automated
- Manual
- Hybrid

3.1 Automated

In order to classify satellite images automatically, algorithms are applied to the full picture and used to sort the pixels into meaningful groups. The vast majority of categorization strategies are included here. Two subcategories have been established for automated satellite image categorization techniques. categorization techniques that 1) need human oversight and 2) do not.

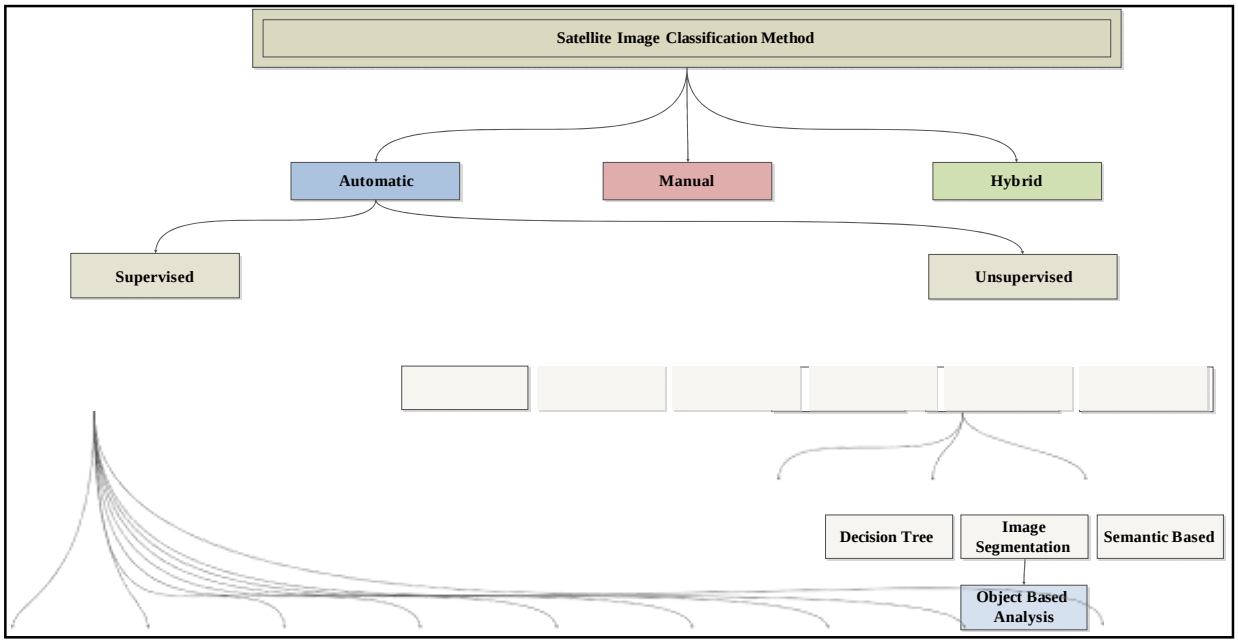

Figure 1 Shows supervised satellite image classification

Supervised classification methods require input from an analyst. The input from analyst is known as training set. Training sample is the most important factor in the supervisedsatellite image classification methods. Accuracy of themethods highly depends on the samples taken for training. Training samples are two types, one used for classificationand another for supervising classification accuracy. process. Training set is provided before classification is run. Major supervised classification methods uses the following statistical techniques:

- Artificial Neural Network (ANN)
- Binary Decision Tree (BDT)
- Image Segmentation

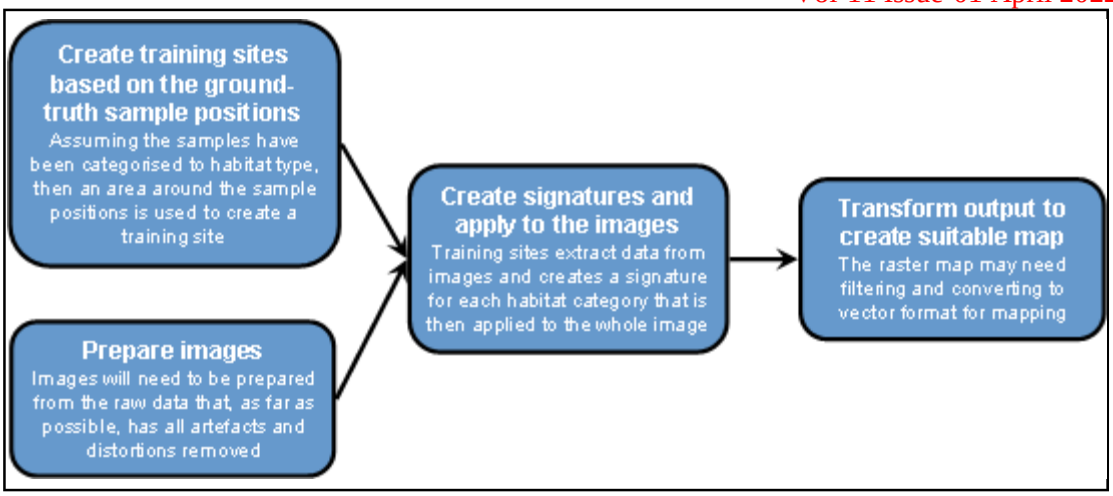

Figure. 2. Supervised satellite image classification process.

Different types of similarity matching algorithms are the focus of various categorization strategies. Some of the extra features of supervised classification include the analysis of input data, the generation of training samples and signature files, and the evaluation of their quality.

The algorithms that make up an Artificial Neural Network (ANN) mimic the way a human brain learns so that it can correctly assign labels to picture pixels. The use of artificial neural networks (ANNs) in satellite image classification algorithms has the advantage of improving classification accuracy via the simple incorporation of more data into the classification process.

Satellite image classification methods based on the Binary Decision Tree (BDT) are a kind of machine learning. In the decision tree method, each pixel is assigned a class according to a set of binary rules. There are a variety of decision tree programs that may be used to produce binary rules. The program utilizes both the training set and other data to choose the most appropriate rules to apply.
Satellite image processing, analysis, and pattern identification all benefit greatly from segmentation [8, 9]. The methods and algorithms used to segment satellite images have nothing to do with the categorization of images. Image

By definition, segmentation creates groups of visually similar pixels. Algorithms for segmenting images often include variables that allow the analyst to choose the size and form of the segments. Classification of segmented images is performed at the segmentation level rather than the pixel level. Algorithms for classifying satellite images at the segmentation level are far quicker than pixel-level classification techniques.

3.3 Unsupervised

Grouping satellite image pixels into unlabeled classes/clusters is the goal of the unsupervised classification approach. A well-classified satellite picture is then generated when an analyst provides relevant labels to the clusters. ISODATA [9], Support Vector Machine (SVM), and K-Means [10] are the most widely used unsupervised methods for classifying satellite images.

3.4 Manual

Manual techniques of satellite picture categorization are reliable, accurate, and productive. Manual processes, however, are slower. For manual processes to work, the analyst has to be well-versed on the region imaged by the satellite. The classification's efficacy and precision are both reliant on the analyst's level of expertise and familiarity with the subject matter.

3.5 Hybrid Hybrid techniques for classifying satellite images combine the best features of automated and human-led approaches. The first categorization of satellite images is performed automatically using a hybrid technique; however, the classification is refined and mistakes are corrected using human approaches.

3. METHODS FOR CLASSIFYING SATELLITE IMAGES

Some modern techniques for classifying satellite images are shown here.

The categorization of extremely high resolution satellite pictures into specified classifications using fuzzy logic was first described by J. Shabnam et al., [11]. Using this strategy, satellite photos may be broken down into the following five categories: shadow, vegetation, road, building, and barren ground. This strategy for classifying satellite images employs picture segmentation and fuzzy approaches. Shadow, vegetation, and the road are all identified and categorized by the first level of segmentation. Segmentation at the second level is used to recognize structures. Additionally, it performs a contextual check to assign classes to previously unlabeled areas and segments. Improved border categorization accuracy is achieved by the use of fuzzy approaches.

[12] Introduces a supervised technique for identifying water, urban, and undeveloped terrain in satellite photos. This strategy uses a k-means and LDA [13] threshold computation based on a training set for each class. This technique uses the k-means algorithm to cluster satellite pictures into unlabeled subsets by extracting low-level characteristics. By comparing threshold values with retrieved characteristics, meaningful labels are given to the unlabeled classes.

[14] Provides details on a supervised ontology-based approach to classifying ocean satellite images. This technique demonstrates the efficacy of ontology in classifying ocean satellite images. The technique uses owl files to represent low-level characteristics extracted from satellite photos of the ocean. Domain ontologies and tagging guidelines are included with this owl file. The SWRL [15] language is used to express a variety of rule types, including labeling rules, training rules, binary decision tree rules, and expert rules. Method generates

Using training, a human expert, decision support, and labeling rules, classify a satellite picture of the ocean. [14] Complements the protégé ontology editor with a plug-in tool. With the help of domain ontologies, the tool can work with satellite photos of the ocean.

The decision tree methodology was suggested for supervised categorization of satellite images by S. Muhammad et al. [1].

Features are derived from a satellite picture using the color and intensity of individual pixels. The location of objects in satellite photos may be determined with the use of extracted characteristics. The technique uses a decision tree to categorize satellite photos based on the presence or absence of previously recognized items.

[16] Explains how to divide up satellite pictures into several types of terrain. This training-set-supported, automated approach classifies segments at the segment level. The contextual aspects of established multiple classes are used into the classification procedures to boost classification precision.

In [17], A. Selim introduced a Bayesian technique-based classification approach. High-resolution satellite photos may be classified with the use of spatial information. The process of categorization occurs in two stages. First, we extract spectral and textural information from each pixel to use in training Bayesian classifiers based on discrete non-parametric density models. In the second step, the pixel-level classification maps are turned into continuous areas using an iterative split-and-merge process.

The ISODATA [9] method is the most often used unsupervised approach to satellite classification. It divides a satellite picture into a set number of unlabeled groups. The clusters are not initially labeled with anything significant. Multiple ISODATA parameters are required to set the desired number of clusters and iterations. Rarely, a cluster may include pixels from many classes. ISODATA employs the cluster-busting [18] method to assign labels to such convoluted categories.

K-Means [10] is widely used in statistical analysis and data mining. Based on their average Euclidean distance, n observations are divided into k groups. The K-Means method has the benefits of being easy to understand and quick to implement. This technique has the drawback that the analyst has to know the whole number of classes ahead of time.

Non-parametric unsupervised statistical categorization using support vector machines (SVM) [19]. A land-use map may be extracted using this technique. SVM assumes that there is no knowledge about the optimal data distribution. SVM expedites the process, boosts precision, and decreases the price of satellite categorization.

The minimum distance [20] method determines which group a given pixel is closest to spectrally and places it in that group. It's straightforward in both application and comprehension. However, the minimal distance approach looks at simply the average. Comparing the Mahalanobis distance technique [21] to the minimal distance approach reveals several similarities. For satellite picture categorization, it employs the covariance matrix approach of statistics.

Boxes with a parallelepiped form are used in the execution of Parallelepiped [20]. The limits of each category's parallelepiped are fixed in advance. Pixels in test pictures are checked against a set of boundaries to establish their classification. The parallelepiped approach runs quickly and easily, however the overlap might lead to inaccurate outcomes.

The maximum likelihood [22] method is a supervised statistical technique for pattern recognition. It allots picture elements to

classifications that make sense given the pixels' probability values. To efficiently categorize satellite picture pixels, maximum likelihood is a useful technique. However, gathering enough ground-truth data takes time and might lead to inaccurate predictions.

4. A CLASSIFICATION OF SATELLITE IMAGES COMPARISONIOTN Approaches

Researchers have compared unsupervised and supervised methods for classifying satellite images.

approaches, as well as a hybrid of the two, in terms of classification precision and kappa coefficient. Different researchers' findings are summarized and compared here. The results of several studies are summarized in Table 1. Based on the comparative summary, there is no consensus among researchers as to which approach is superior for classifying satellite images. The effectiveness of approaches for classifying weather satellite images should also be investigated, since this will vary from dataset to dataset.

Table 1. Comparison of various researchers satellite image classification comparative statements

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 Datasets	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

3. CONCLUSION

This study provides an overview of automatic techniques for classifying satellite images and analyzes multiple studies written by different academics. The two main categories for automated satellite image categorization techniques are 1) supervised, and 2) unsupervised. The manner that pixels are organized into meaningful categories is where supervised and unsupervised satellite image categorization approaches diverge. Satellite image classification algorithms have been surveyed in the literature, and their efficacy measured against a variety of datasets. This study provides a concise overview of the literature concerning satellite image categorization techniques. methods, and tools. Researchers may use the summary to choose which approach or strategy for classifying satellite images best fits their needs.

4. REFERENCES

[1] "Classification by Object Recognition in SatelliteImages by using Data Mining" [1] Muhammad, S., Aziz, G., Aneela, N., & Muhammad, S., 2012. London, United Kingdom, July 4–6, 2012: Proceedings of the World Congress on Engineering (WCE 2012), Volume I.

[2]

[3] [2] "A Normalized Difference Vegetation Index (NDVI) Time-Series of Idle Agriculture Lands: A Preliminary Study," Chaichoke, V., Supawee, P., Tanasak, V., and Andrew, K. S. 2011. Engineering Journal. Vol. 15, Issue 1. pp. 9-16.

[4]

[5]

[6] In 2013, Zheng, X., Sun, X., Fu, K., and Hongqi Wang published "Automatic Annotation of Satellite Images via Multifeature Joint Sparse Coding With Spatial Relation Constraint" in IEEE Geoscience and Remote Sensing Letters, Volume 10, Issue 4, July 2013, Pages 652-656.

[7]

[8] Read "Classification of high resolution satellite images" by Anders Karlsson from August 2003 at http://infoscience.epfl.ch/record/63248/files/TPD_Karlsson.pdf.

[9]

[10] According to [5] "An Overview of Remote Sensing" by Amanda Briney (published on May 16, 2014). http://geography.about.com/od/geographictechnology/a/remotesensing.htm is where you can find this article online.

[11]

[12] For example, see "A classification system for remote sensing satellite images using support vector machine with non-linear kernel functions" by O. S. Soliman and A. S. Mahmoud (2012) in the proceedings of the 8th IEEE International Conference on Informatics and Systems (INFOS), held in Cairo from May 14-16, 2012 (pp.BIO-181,BIO-187).

[13]

[14] For example: [7] Horning, N. 2004. "Land cover classification methods", Version 1.0. Center for Biodiversity and Conservation, American Museum of Natural History. Extracted from the website, "biodiversityinformatics.amnh.org."

[15]

[16] In 2012, P. Murugeswari and D. Manimegalai published "Color Textured Image Segmentation Using ICICM - Interval Type-2 Fuzzy C-means Clustering Hybrid Approach" in the Engineering Journal, Volume 16, Issue 5 (pp. 115-126).

[17]

[18] Journal of King Abdulaziz University-Earth Sciences, Vol. 20, No. 1, pp. 167-191, 2009, "Comparison of Four Classification Methods to Extract Land Use and Land Cover from Raw Satellite Images for Some Remote Arid Areas, Kingdom of Saudi Arabia" [9].

[19]

[20] In 2009, Ahmed et al. published "An Optimal Unsupervised Satellite image Segmentation Approach Based on the Pearson System and k- Means Clustering Algorithm Initialization" in International Science Index: Volume 3, Issue 11 (948-955).

[21]

[22] In 2013, Algorithms published "Very High Resolution Satellite Image Classification Using Fuzzy Rule-Based Systems," written by Shabnam Jabari and Yun Zhang, on pages 762-781.

[23]

[24] According to [12] Chandrakala, M., and Amsaveni, R., "Classification of Remote Sensing Image Areas Using Surf Features and Latent Dirichlet Allocation", International Journal of

[25]

[26] Pages 178–182 in Volume 3 Number 9 of Advanced Research in Computer Science and Software Engineering.

[27]

[28] [13] "Latent dirichlet allocation," The Journal of Machine Learning Research, ACM, Volume 3, Pages

993-1022, 2003, David M. Blei, Andrew Y. and Michael I, J.

[29]

[30] Jesus (M.), Almendros-Jiménez (L.), Domene (J.), and Piedra-Fernández (José A.) (2013). IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Volume 6, Issue 2, April 2013, Pages 1048-1063, "A framework for Ocean Satellite Image Classification based on Ontologies."

[31]

[32] [15] See Martin Kuba's "OWL 2 and SWRL Tutorial" at http://dior.ics.muni.cz/makub/owl/ for a comprehensive introduction to both OWL and SWRL.

[33]

[34] Christiane Schmullius, Joachim Denzler, Soren Hese, Irene Walde, Bjorn Frohlich, and Eric Bach are the authors of the following referenced work. ISPRS Annals of the Photogrammetry, Remote Sensing, and Spatial Information Sciences, Volume II-3/W1, Pages 1–6, 2013. "Land Cover Classification of Satellite Images using Contextual Information."

[35]

[36] Selim Aksoy. 2006. "Spatial Techniques for Image Classification," in C. H. Chen (ed.), Signal and Image Processing for Remote Sensing, CRC Press, pp.491-513.

[37]

[38] Prisloe, L., Gilmore, M., Wilson, E., and Civco, D.L. (2006). "An integrated pixel-based and object-based classification approach for identifying tidal wetlands in Landsat imagery." 2006 Annual Meeting of the ASPRS, Reno. Proceedings.

[39]

[40] [19] Jensen, J. R. 2005. "Introductory Digital Image Processing: A Remote Sensing Perspective", 3rd Edition, Up-per Saddle River: Prentice-Hall, 526 pages.

[41]

[42] The following is a direct quote from page 2-3 of the second edition of "Classification Methods for Remotely Sensed Data" by Tso, B., and Mather, P., M., published in 2009 by the Taylor and Francis Group in the United States.

[43]

[44] [21] Richards, J. A., "Remote Sensing Digital Image Analysis", Springer-Verlag, Berlin, 5th Edition, 2013. 496 pages.

[45]

[46] [22] Munyati, C. H. "Use of Principal Component Analysis (PCA) of Remote Sensing Images in Wetland Change Detection on the Kafue Flats, Zambia", Geocarto Int. Vol.19, No.3, pp.11-22.

[47]

[48] In 2013, Kanika, Anil, and Rhythm published "A Comparative Study of Supervised Image Classification Algorithms for Satellite Images" in the International Journal of Electrical, Electronics, and Data Communication, Volume 1, Issue 10, pages 10–16.

[49]

[50] According to Offer (2011) and Arnon (2011) ("Comparison of Methods for Land-Use Classification Incorporating Remote Sensing and GIS Inputs"), published in EARSeL eProceedings Volume 10 Issue 1 Pages 27-45.

[51]

[52] Reference: [25] Aykut, A., A. H. Eronat, and T. A. Necdet. 2004. In Proc. XXth ISPRS Congress Technical Commission, ISPRS, Vol. XXXV Part B4, July 12-23, Istanbul, Turkey, we compare and contrast several satellite image classification techniques with an application in the Ayvalik District.

[53]

[54] In 2013, "Satellite Image Classification Methods and Landsat 5tm Bands" was published in the Cornell University Library by T. Jamshid, L. Nasser, and F. Mina.

[55]

[56] Journal of Environmental Research and Development, Vol. 5, No. 2, Pages 279-293, 2010. Shila, H. N., and Ali, R. S. "Comparison of Land Covers Classification Methods in Etm+ Satellite Images (Case Study: Ghamishloo Wildlife Refuge)."

[57]

[58] According to [28] "Comparing different classifications of satellite imagery in forest mapping (Case study: Zagros forests in Iran)", International Research Journal of Applied and Basic Sciences, Vol. 8, No. 7, pp. 1407-1415, Maryam N., Vahid M.Z., and Mehdi H. 2014.

[59]

[60] "Comparison of Different Methods for

[61]

[62] Using Satellite Data Classification Methods, International Journal of Scientific and Engineering Research, Volume 4, Number 2, Pages 1–6.

[63] For example, in 2012, Subhash, Akhilesh, and Seema published "Comparison of Different Image Classification Techniques for Land Use Land Cover Classification: An Application in Jabalpur District of Central India" in the International Journal of Remote Sensing and Geographic Information Systems.

[64] In the proceedings of the International Scientific Conference on Sustainable Development and Ecological Footprint, held March 26-27, 2012 in Sopron, Hungary, the authors Malgorzata V. W., Anikó K., and rzsébet V. compare several image classification techniques in an urban setting.