ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Spanning Tree Based Clustering Technique Combined With Morphological Operations for Unsupervised Multi-Spectral Satellite Image Segmentation

P. Sujith
M.Tech Student,
Dept. of CSSE,
Andhra University,
Visakhapatnam, AP, India.

K. Venkata Ramana
Assistant Professor,
Dept. of CSSE,
Andhra University,
Visakhapatnam, AP, India.

Abstract:
An unsupervised protest based division, joining an adjusted mean-move (MS) and a novel least spreading over tree (MST) based bunching methodology of remotely detected satellite pictures has been proposed in this correspondence. Morphological operations are used to get the enhanced image. The picture is first pre-prepared by a changed rendition of the standard MS based division which safeguards the attractive discontinuities introduce in the picture and ensures over segmentation in the yield. Considering the divided districts as hubs in a low level highlight space, a MST is developed. An unsupervised system to group a given MST has likewise been conceived here. Morphological operation has been performed on the final region which is obtained after clustering.

This sort of half and half division system which bunches the areas rather than picture pixels lessens extraordinarily the affectability to commotion and improves the general division execution. The prevalence of the proposed strategy has been probed an expansive set of multi-unearthly pictures and contrasted and some outstanding half and half division models.

Keywords: ***Graph based clustering, image segmentation, mean-shift, minimum spanning tree, Morphological operations***

1. Introduction:

Picture division is one of the fundamental and principal steps required for abnormal state picture understanding. It connects the semantic hole between low level picture preparing and abnormal state keen picture investigation. Object recognition and tracking [2], land cover and land utilization classification [3] and so on are a portion of the applications where division is one of the indispensable parts. Information bunching [4] is one of the entrenched closeness based techniques which has generally been connected in the area of picture division. The principle idea of bunching based division is to gathering picture highlights into various clusters so that the intra bunch varieties are minimized and bury group varieties are expanded to the conceivable degree. A few distributions report the fruitful use of different traditional grouping methods (k-implies, fluffy c-implies, thickness based grouping [5]) for division of satellite pictures [6], [7]. In any case, the greater part of them are parametric and require the surmised starting number of groups to continue assist. Mean-move [8] grouping method has been investigated in late writing as a promising picture division system [9]. In spite of the fact that the

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

bunching based division methodologies are effective in finding hidden picture highlights, they force a few genuine downsides as well. The spatial structure and the edge data of the picture are not saved and pixels from various areas are hard to recognize if there should arise an occurrence of covering highlight spaces. Spatial division systems have been investigated in late writing as an option division procedure to save picture irregularity and spatial relationship between pixels. In any case, the fundamental disservice with these calculations is that they undesirably create an expansive number of little semi homogeneous locales, i.e. as on account of watershed change. The structure proposed in [12] has been implemented here in this paper in general form. MS calculation is generally connected to perform brokenness protecting smoothing took after by picture division. Due to its edge saving sifting property the striking elements of the general picture are held. This property is vital for sectioning remotely detected pictures in which a few unmistakable districts are utilized to speak to the entire scene. In any case, it is troublesome to segment a remotely detected picture into various land covers exclusively in view of the MS calculations. Henceforth, MS based technique is a decent decision to perform the underlying over division. The picture is first over portioned by the proposed MS based bunching took after by a consolidating methodology utilizing another MST based bunching calculation. The MST clustering algorithm is known to be capable of detecting clusters with irregular boundaries . Unlike traditional clustering algorithms, the MST clustering algorithm does not assume a spherical shaped clustering structure of the underlying data.

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. According to Wikipedia, morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to greyscale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest. Morphological operation is performed for the final region which is obtained after the MS based clustering. The morphological operations performed are IMCLOSE, IMOPEN, IMERODE, IMDILATE.

2. Existing Segmentation Algorithm:

Fig. 1 delineates the flowchart of the proposed division technique. Extensively, it is a three-stage handle.

- Apply the adjusted MS based grouping calculation to bunch the pixels of the information satellite picture in the ghostly space.
- A component extraction step is completed to figure a few low level components from each of the items found in the past state.
- Considering every district as a hub in the recently characterized include space, the MST based non-parametric grouping strategy is connected for definite area consolidating.

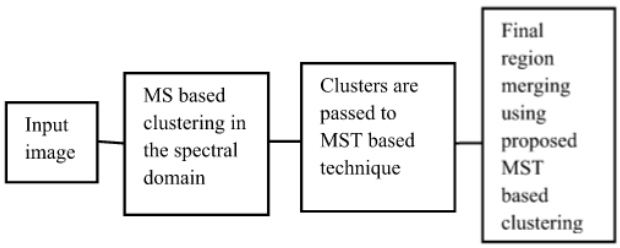


Fig 1. Flowchart of the existing segmentation algorithm.

3. Proposed Segmentation algorithm:

This section describes the proposed data clustering technique using minimum spanning tree. MST based clustering [14] technique is known to be capable of detecting clusters with irregular boundaries and the morphological operation performed.

A. Mean Shift Technique:

The mathematical details of the standard mean-shift technique can be obtained in [7]. Though mean shift does not require the initial number of clusters actually present in the data space, the width of the Parzen window is to be mentioned beforehand. If the window

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

size is larger, there is possibility of over merging whereas smaller window leads to the generation of several small sub-clusters in the output. Here a k-dist based method for estimating the bandwidth has been proposed. The traditional mean-shift process stops when the density gradient attains a value close to zero. It is an iterative process and may generate unnecessary larger number of clusters. Here an adaptive termination criterion has been developed which has been demonstrated to accelerate the clustering process. This terminating condition detects the sub-clusters present in a given cluster first and then a post processing step combines them together into a single group.

B. MST Based Clustering Algorithm

Given a set of points $x_1, \ldots \ldots x_N (x_i \in R^{p+4})$ with unknown underlying probability distribution, a graph G(V,E) is constructed with vertex set 'V' and edge set 'E' where each of the x_i is represented by a node in the graph. The edge between a given pair of vertices x_i and x_j is weighted by the Euclidean distance:

$$w(x_i, x_j) = 1 - \exp\left(-\frac{\|x_i - x_j\|^2}{2\sigma^2}\right)$$

σ has been fixed by grid search [15] technique using 50% of the total data for cross-validation. The value of w will be smaller if x_i and x_j are similar to each other in some sense whereas will get increased in case the data points differ. A minimum spanning tree $T(V, E_T)$ of G is constructed henceforth using the Kruskal's approach [15]. The proposed clustering method checks iteratively whether a given edge of the tree can be deleted to form two compact sub-clusters. The edges are considered in the descending order of the corresponding edge weights because it has been assumed that edges with larger weights are the ones which span different clusters. Algorithm 2 [1] describes the proposed clustering process. A is a measure of the cluster compactness. If a given edge $E_{w(i)}$ has drastically larger weight value than the component edge weights of its two adjoining connected components (CC's), then it can be presumed that $E_{w(i)}$ spans two different clusters and hence can be deleted. Given a CC, the corresponding α controls the gap allowed in the feature space between this CC and any other CC.

C. Morphological Operation:

After the segmentation and clustering procedure, we expected to clarify all satellite image, comprising of different types of images. Consequently, we connected morphological administrators, for example, enlargement, filling, and diminishing operation with various cycles. Since it can be utilized to mean and portray a locale of shape, the scientific morphology was utilized here to separate the pictures and the picture limits additionally follow them delicately. The morphology used to control the question and the limit state of the picture is subject to the information picture A and cover B, called an organizing component. The organizing component was made to track the picture shape grouping by the MS calculation. The yield of this progression is an over segmented adaptation of the first picture. An element extraction is performed to concentrate shading and surface elements from every question along these lines separated. The items are bunched in the component space utilizing a non-parametric least spreading over tree based bunching technique. This MST based bunching does not require the quantity of bunches to be said from the earlier. The calculation saves the idea of question based picture investigation and is equivalent to other question based division systems. The tests performed demonstrate that, the strategy shows preferable arrangement exactness over strategies like Watershed + MS based division or MS + Normalized cut based division techniques. In addition, it can take any shape based on the input image and the operation used.

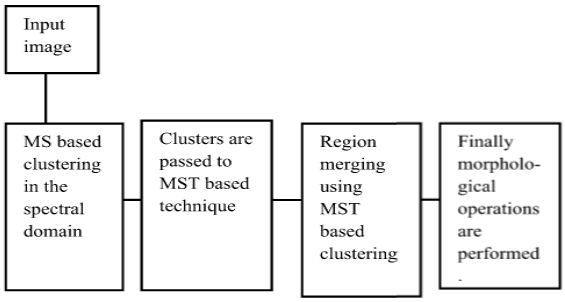


Fig 2. Flowchart of the proposed segmentation algorithm

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

This division can be utilized further to concentrate particular items like streets, structures from the picture and does some specific operations, for instance, dilation, filling, and thinning operations.

1. Dilation

The dilation process is the meaning of extending the image boundary or the object of the image itself by adding a number of pixels based on the structuring element design. This operation was applied to a binary image s^2 . For example, if the input image is A and the structuring element B, then[13] :

$$A \times B = s\{(B)_s \cap A \neq \emptyset\}$$

Where $\emptyset$ is the empty pixel that is similar to a background pixel, however, this pixel was originally related to the foreground pixels. Based on the previous equation, our approach is, if the origin value of the structuring element window is equivalent to the corresponding input pixel and not equal $\emptyset$ then the dilation takes place regarding the mask size of the structuring element. In this operation, the size of the mask was 9 by 9. In order to close the opening gaps along the images, we applied this operation repeatedly with this combined algorithm extracting from dilation and filling operations.

2. Thinning

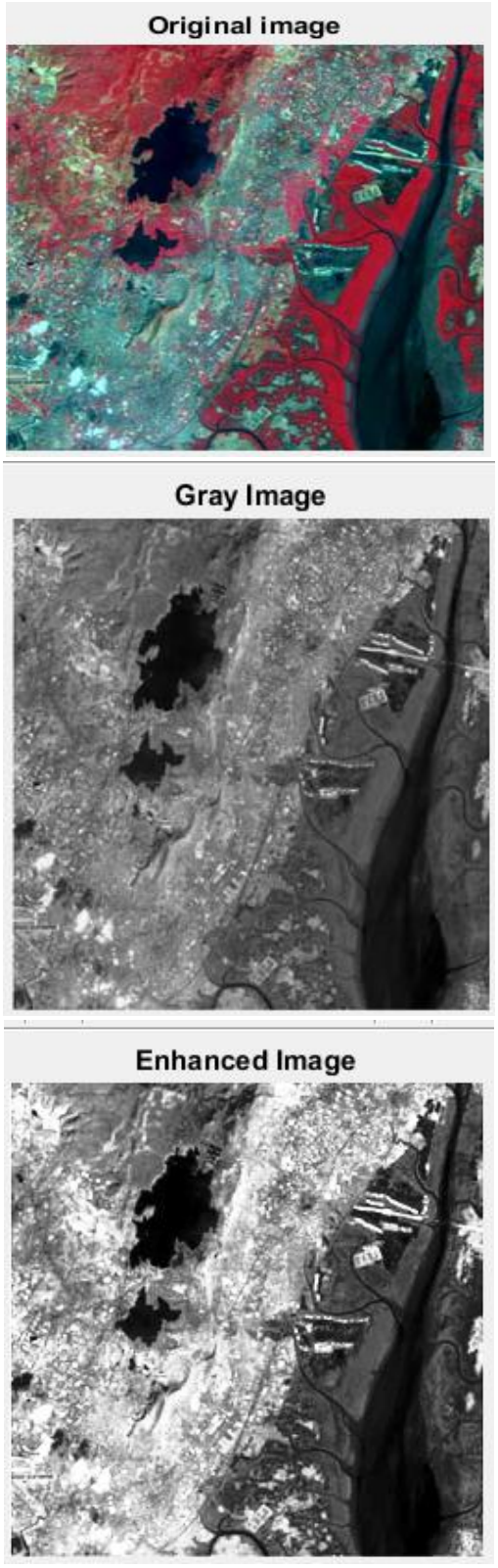
This operation was utilized to eradicate some of the extension part of the images due to the dilation process. Typically, the thinning approach was designed based on the algorithm in which, if the foreground and background pixels of a structuring element are correspondingly identical to the beneath pixels of the input image, then the origin pixel of the structuring element is set to zero, otherwise the input image remains the same. This method was applied to all of the images in tracking way.

$$A \times B = A_s \cap B_s$$

Where A_s is a set of binary image pixels and B_s is the structuring element.

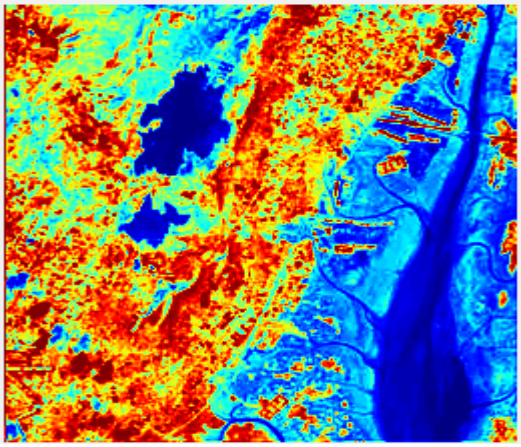
5. Results:

The below figures shows the implementation of existing and proposed algorithm. The original image is the Satellite image which is used for segmentation process.

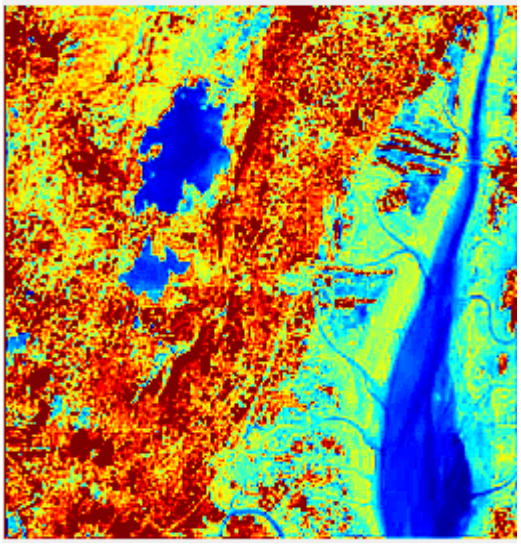


ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

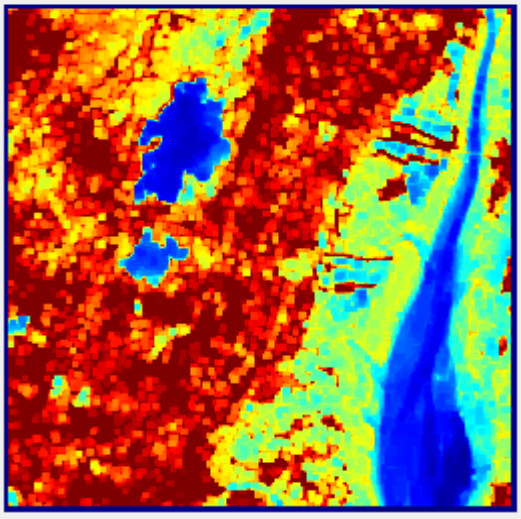
Output of Mean shift technique



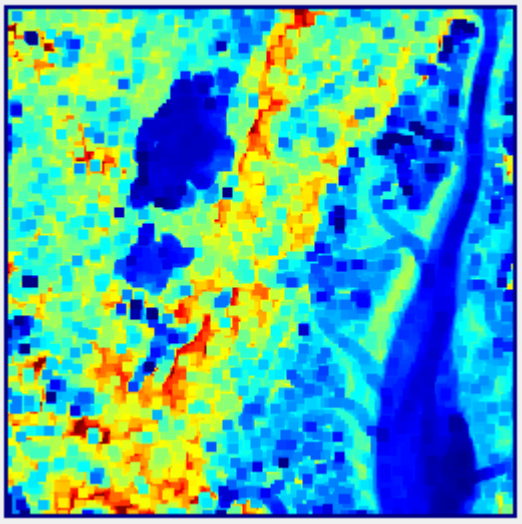
Output of MST Technique



opening of image



Closing of image



6. Conclusion:

A novel unsupervised satellite picture division calculation has been proposed here. It comprises of two sections. Initially the picture is divided in the otherworldly space by a changed mean-move based clustering strategy. A novel ending criteria and a novel technique for evaluating the Parzen window width have been added to the customary MS grouping calculation which ensures quick joining while performing close ideal bunching by the MS calculation. The yield of this progression is an over segmented adaptation of the first picture. An element extraction is performed to concentrate shading and surface components from every protest along these lines separated. The items are clustered in the element space utilizing a non-parametric least spreading over tree based grouping technique.

This MST based clustering does not require the quantity of clusters to be specified from the earlier. A morphological operation on a binary image creates a new binary image in which the pixel has a non-zero value only if the test is successful at that location in the input image.The morphological operation is performed for the final region after clustering. The tests performed demonstrate that, the strategy shows preferable arrangement exactness over strategies like existing division techniques. This division can be

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

utilized further to concentrate particular articles like streets, structures from the image.

References:

[1] Biplab Banerjee, Surender Varma, Krishna Mohan Buddhiraju, and Laxmi Narayana Eeti," Unsupervised Multi-Spectral Satellite Image Segmentation Combining Modified Mean-Shift and a New Minimum Spanning Tree Based Clustering Technique", ieee journal of selected topics in applied earth observations and remote sensing, vol. 7, no. 3, july 2015

[2] Q.Hao, R. Cai, Z.Li,L.Zhang,Y. Pang, and F.Wu, "3D visual phrases for landmark recognition," in Proc. 2012 IEEE Conf. Computer Vision and Pattern Recognition (CVPR), 2012, pp. 3594–3601.

[3] W. Long, III and S. Srihann, "Land cover classification of SSC image: Unsupervised and supervised classification using Erdas Imagine," in Proc. 2004 IEEE Geoscience and Remote Sensing Symp., 2004, vol. 4, pp. 2707–2712.

[4] A. K. Jain, M. N.Murty, and P. J. Flynn, "Data clustering: A review," ACM Computing Surveys (CSUR), vol. 31, no. 3, pp. 264–323, 1999.

[5] J.-F. Yang, S.-S. Hao, and P.-C. Chung, "Color image segmentation using fuzzy C-means and eigenspace projections," Signal Process., vol. 82, no. 3, pp. 461–472, 2002.

[6] S. Saha and S. Bandyopadhyay, "Application of a newsymmetry-based cluster validity index for satellite image segmentation," IEEE Geosci. Remote Sens. Lett., vol. 5, no. 2, pp. 166–170, 2008.

[7] C. Wemmert, A. Puissant, G. Forestier, and P. Gancarski, "Multiresolution remote sensing image clustering," IEEE Geosci. Remote Sens. Lett., vol. 6, no. 3, pp. 533–537, 2009.

[8] D. Comaniciu and P. Meer, "Mean shift: A robust approach toward feature space analysis," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 24, no. 5, pp. 603–619, 2002.

[9] W. Tao, H. Jin, and Y. Zhang, "Color image segmentation based on mean shift and normalized cuts," IEEE Trans. Syst., Man, Cybern., B: Cybernetics, vol. 37, no. 5, pp. 1382–1389, 2007.

[10] Z. Li, X.-M. Wu, and S.-F. Chang, "Segmentation using superpixels: A bipartite graph partitioning approach," in Proc. 2012 IEEE Conf. computer Vision and Pattern Recognition (CVPR), 2012, pp. 789–796.

[11] B. Banerjee, V. Surender, and K. Buddhiraju, "Satellite image segmentation: A novel adaptive mean-shift clustering based approach," in Proc. 2012 IEEE Geoscience and Remote Sensing Symp. (IGARSS), Jul. 2012, pp. 4319–4322.

[12] B. Georgescu, I. Shimshoni, and P.Meer, "Mean shift based clustering in high dimensions: A texture classification example," in Proc. 9th IEEE Int. Conf. Computer Vision, 2003, pp. 456–463.

[13] R.C. Gonzalez, R.E Woods," Digital Image Processing," Pearson Educatio,Inc. 2008,pp 122-827.

[14] O. Grygorash, Y. Zhou, and Z. Jorgensen, "Minimum spanning tree based clustering algorithms," in Proc. 18th IEEE Int. Conf. Tools Wit Artificial Intelligence, ICTAI'06, 2006, pp. 73–81.

[15] J. B. Kruskal, "On the shortest spanning subtree of a graph and the travelling salesman problem," Proc. American Mathematical Society, vol. 7, no. 1, pp. 48–50, 1956.

Author Details

P.Sujith pursuing his M.Tech in the department of Computer Science and Systems Engineering, Andhra University, Visakhapatnam, A.P., India. He obtained his B.Tech(CSE) from JNTU Vizainagaram.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

K . Venkata Ramana, M.Tech, working as Assistant Professor in the department of Computer Science and Systems Engineering, Andhra University, Visakhapatnam. His area of interest is in web technologies and data mining.