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Tree Detection for Urban Environment Using Watershed Segmentation

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Abstract: *Devastation of trees at urban level is expanding quickly which is prompting incredible natural anxiety. This needs to be controlled to save and keep up the environmental offset of earth. Exact urban vegetation information is obliged to oversee green assets so regions can keep the track of the venture done in urban ranger service exercises. The study exhibits a methodology to gauge the tree populace by dividing the VHR information with the assistance of marker controlled watershed algorithm. It sections all the trees and different objects uniquely. Implementation on the basis of texture algorithm, color based algorithm, mean shift algorithm and threshold can also be performed.*

Keywords: Image, segmentation, erosion, dilation.

1. Introduction

Measuring rates of forest cover change is vital for improved carbon accounting and environmental change modeling, management of forestry and agricultural resources and other biodiversity monitoring. Observing woodland change is likewise essential for global climate study because of both deforestation emissions and altered land-atmosphere exchanges of energy, water and carbon. For any mountainous country, trees are essential assets and checking individual tree crown detection and delineation has become steadily important for managing the green resources. The role of remote sensing is mainly focused on the supply of data and information for the planning operation of infrastructure and other objects.

Traditional methods of studying forest structure like field inventories and aerial photo interpretation are intrinsically restricted in giving spatially continuous information over a large area. The field study on forest land is tedious and expensive. In addition, investigation of such a large mountainous area is nearly difficult and impossible. Therefore, using remote sensing techniques makes it easy and requires less time in sampling of data and information retrieved is also cost-effective.

Remote Sensing has been a great source of information over the span of few decades in mapping and monitoring the forest zone. It provides the forest mangers a cost- effective tool to understand forest characteristics, such as forest area, locations, species and how to characterize the individual trees. The very high resolution satellites have established both new opportunities and challenges in remote sensing and earth observation information extraction.

Many distinct kinds of professionals are keen in managing tree data in communities. Community leaders and administrators; Forestry land, parks, public work areas; and private tree care practitioners require precise information concerning the identification and management of green areas.

Detecting the trees from the remotely sensed data is the main objective of this paper. The classification of vegetation, especially trees, has been a piece of useful information for many studies, but it is a challenging task because remotely sensed imagery data, provides little information about the internal structures of tree canopies. In many studies, tree identification is performed by human interpretation using aerial photos which is a much difficult process.

The major goal of this work is to identify the trees and for this purpose, marker controlled watershed segmentation is implemented for detection and then based on clustering methods they can be extracted so as to detect trees and the other green vegetation through which the green resources can be evaluated and managed accurately.

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2. Background Study

Ongoing urbanization has brought a vast range of challenges across the globe, and only terms of population growth. More land is required for urban areas to provide inputs and outputs for of resources and energy, with a detrimental effect on forest vegetation and other green areas.

Especially in the developing world, where most of the emerging mega- cities are located, managing and catering for urban populations will be one of the most challenging tasks of our time. The influx of rural human population will not stop. Continuing urbanization in the developing world has led to major issues in terms of hunger; poverty; improper shelter; unemployment; pollution of water, soil, atmosphere, and so forth. Those people for managing cities are under heavy pressure to develop strategies for sustaining livelihoods.

Hence, the development of urban green structures and resources are of important contribution to sustainable urban development in terms of improving the quality of life and environment for the present urban populations, without endangering the opportunities of future populations.

3. Marker controlled watershed segmentation

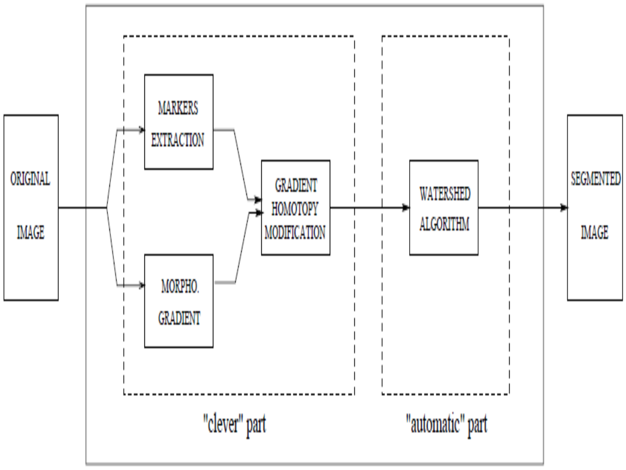


Figure1. 1

Watershed segmentation is used to separate touching objects in an image. The watershed transform is often applied to this problem where the objects sharing the boundaries need to be extracted. The watershed transform finds "catchment basins" and "watershed ridge lines" in an image by treating it as a surface where light pixels are high and dark pixels are low.

Segmentation using the watershed transforms works well if one can identify, or "mark," foreground objects and background locations. The steps to be followed are:

Step 1: Read in the Color Image and Convert it to Grayscale- Acquire the image to be processed and convert it into the gray image for further processing to take place.

Step 2: Use the Gradient Magnitude as the Segmentation Function-Use the *Sobel* edge masks, `imfilter`, and some simple arithmetic to compute the gradient magnitude. The gradient is high at the borders of the objects and low (mostly) inside the objects

Step 3: Mark the Foreground Objects-A variety of procedures could be applied here to find the foreground markers, which must be connected blobs of pixels inside each of the foreground objects. In this example you'll use morphological techniques called "opening-by-reconstruction" and "closing-by-reconstruction" to "clean" up the image. These operations will create flat maxima inside each object that can be located using `imregionalmax`.

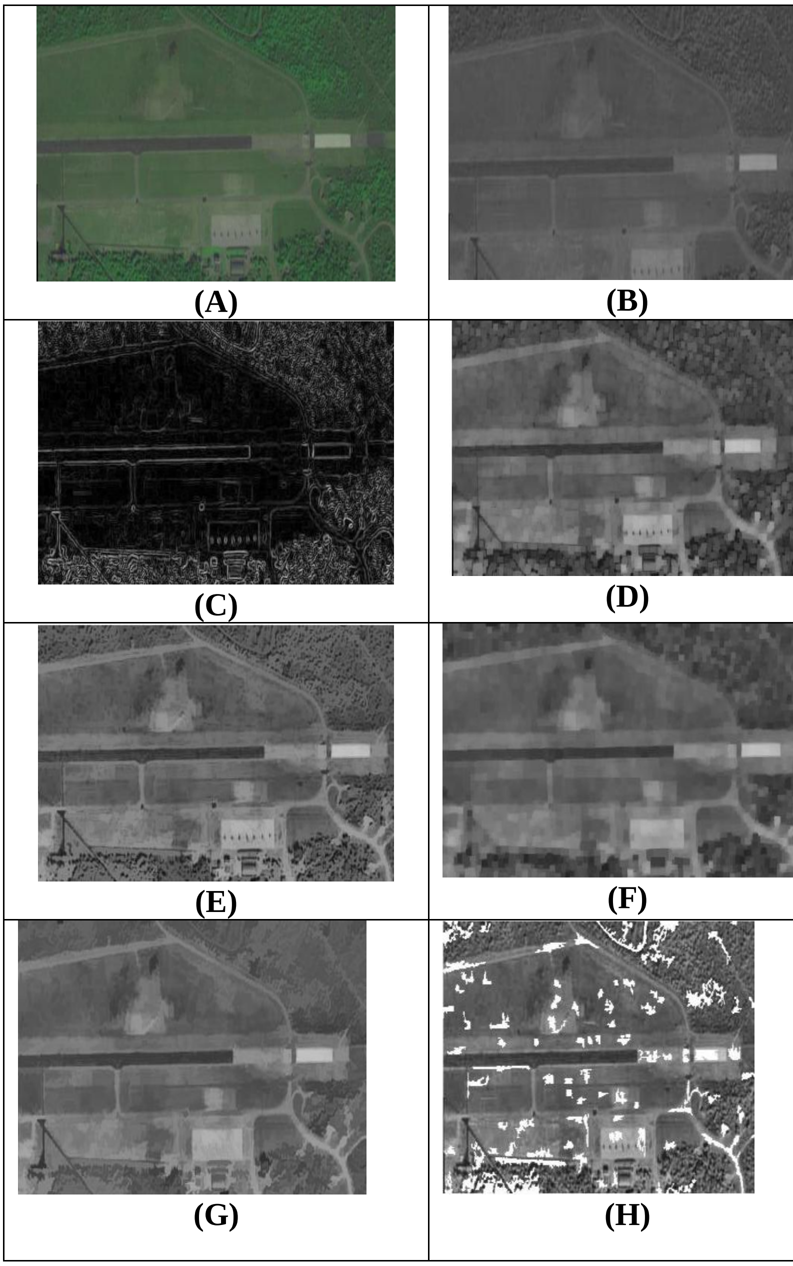
Opening is *erosion* followed by *dilation*, while opening-by-reconstruction is an erosion followed by a morphological reconstruction. Let's compare the two. First, compute the opening using `imopen`.

Step 4: Compute Background Markers-Now we need to mark the background and the dark pixels that belong to the background can be distinguished by using the thresholding operation.

Step 5: Compute the Watershed Transform of the Segmentation Function-The function `imimposemin` can be used to modify an image so that it has regional minima only in certain desired locations. Here we can *use* `imimposemin` to modify the gradient magnitude image so that its only regional minima occur at foreground and background marker pixels.

Step 6: Visualize the Result-One visualization technique is to superimpose the foreground markers, background markers, and segmented object boundaries on the original image. You can use dilation as needed to make certain aspects, such as the object boundaries, more visible. Object boundaries are located where `L == 0`.

4. Segmentation results



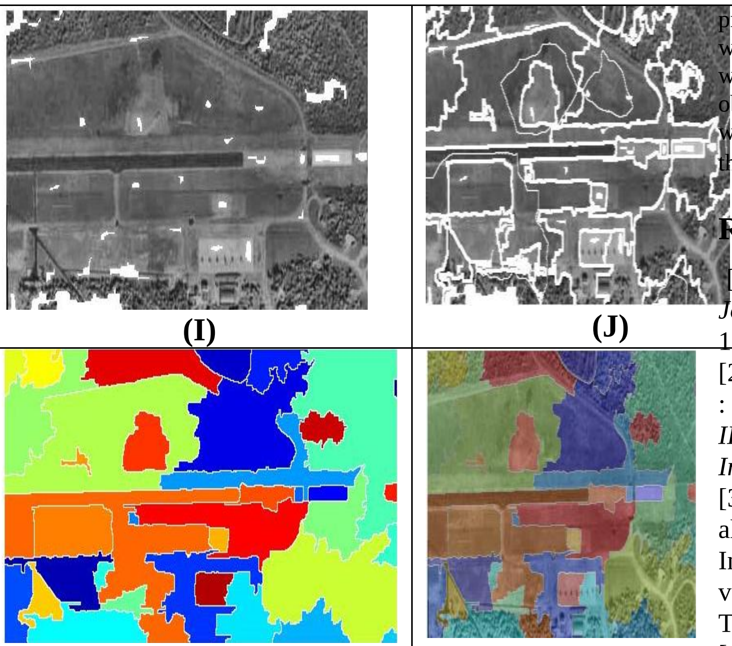


Figure1. 2

(A) Original Image (B) Gray Image (C) Gradient Image (D) Opening (E) Opening by reconstruction (F) Opening-closing (G) Opening- closing by reconstruction (H) Regional maxima superimposed on original image (I) Modified regional maxima superimposed on original image (J) Markers and boundaries superimposed on original image (K) Colored watershed matrix (L) Lrgb superimposed transparently on original image.

The tree segmentation results can be seen in above figures. It is very clear from the images that the proposed tree detection algorithm work well and help in obtaining the needed outputs. Different algorithms can be used according to the image. This segmentation based method can reliably recognize nearby trees, but sometimes it faces problems in detecting trees that are far away from the camera in the images. The other algorithms can also be used as per the use on the basis of texture, threshold, region boundaries etc. The edge detectors also help in understanding the boundaries of various objects in the image.

5. Conclusion

Tree detection and accurate vegetation estimation is a very challenging task for navigating the forest regions. The algorithm used to understand the segmentation of the vegetation of green resources has distinguished the image very well and the trees have been detected precisely. The algorithm used for this purpose has brought the outputs which can be further exercised to get more efficient results. The future work may include more accuracy and clarity of the work and the objective can be extended to get the details of the classified trees which would result in complete understanding of the green areas in the urban locations..

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Priyanka Garg received the Bachelor of Technology degree in Computer Science and Engineering in year 2011 and currently pursuing M.Tech. in the same field. She did her six months internship at IIRS,ISRO, Dehradun in Photogrammetry and Remote Sensing Department. Her area of interests include Digital Image Processing and Networking.