Tree Counting in different Scenarios using Satellite Remote Sensing

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AGENDA

- INTRODUCTION
  - METHODOLOGY
    - DIFFERENT APPROACHES OF TREE COUNTING.
      - CASE STUDIES OF TWO DIFFERENT AREA
      - CONCLUSION

WHY WE ARE DOING TREE COUNTING USING SATELLITE REMOTE SENSING ?

INTRODUCTION:

Forests and trees play a crucial role in maintaining the planet's ecological balance, contributing to carbon storage, the preservation of biodiversity, and the overall health of ecosystems. To effectively manage and conserve these vital resources, it is imperative to have accurate information about tree populations. Satellite remote sensing has swiftly emerged as a potent tool for tree counting over vast areas, revolutionizing our capacity to collect essential data for environmental monitoring and management. The use of this technology, combined with the availability of resources such as Google Earth photos, has widened the scope of our environmental study efforts. Google Images is a convenient and accessible source of satellite imagery. Here we carried out the study of carrying out tree counting using satellite remote sensing .

METHODOLOGY

- In this study, we use two satellite images from Google Earth to evaluate our tree counting algorithm. The first image is from Lindale, United States. The second image is from the IITK campus near OAT .

- In this study, MATLAB served as the pivotal tool for conducting the image processing tasks. MATLAB's extensive suite of image processing functions.

- Procedure used in two different study area is below:

Algorithm:

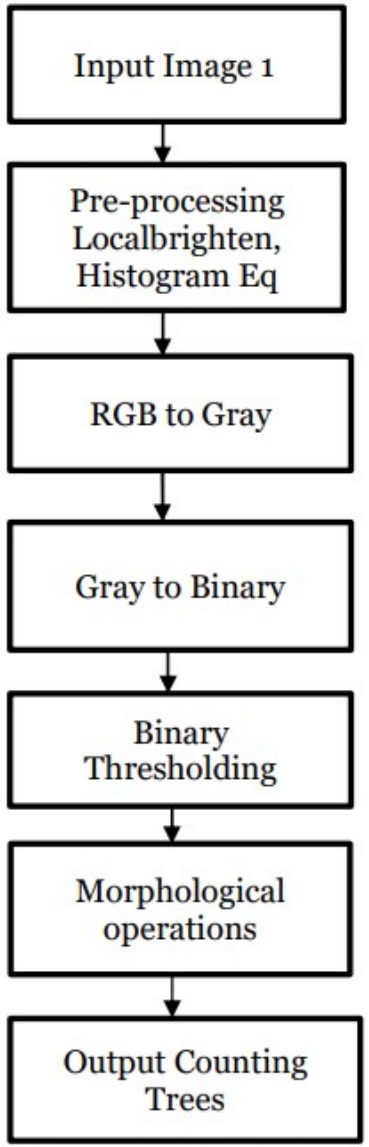

Figure 30: Block Diagram 1

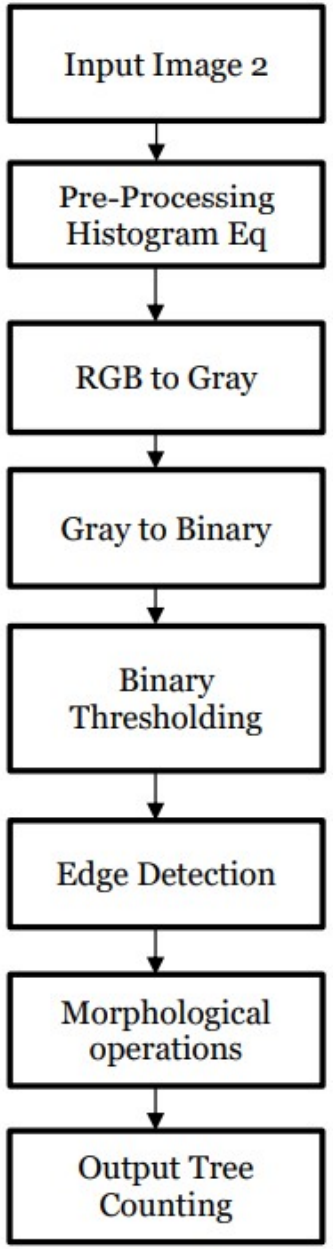

Figure 32: Block Diagram 2

Different Approaches of Tree Counting

- By manual method.
- By using satellite remote sensing.
- By using UAV's.
- By using Deep Learning.

STUDY AREA –I (IIT KANPUR-near OAT campus area)

Figure 1: Google Earth view of IITK, area near OAT(11-5-2022)

IMAGE RESOLUTION-1485*829 pixels.

IMAGE QUALITY –POOR.


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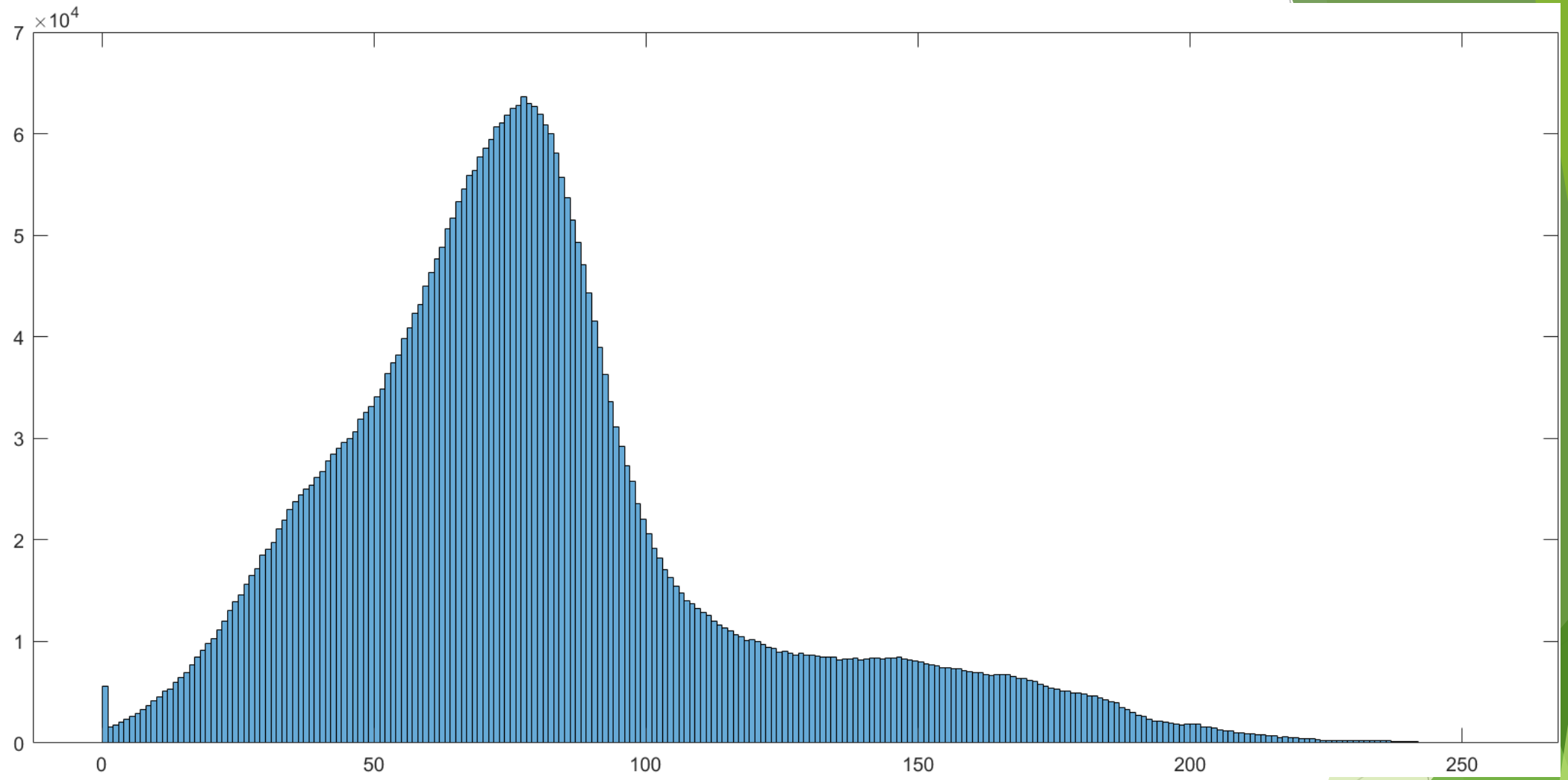
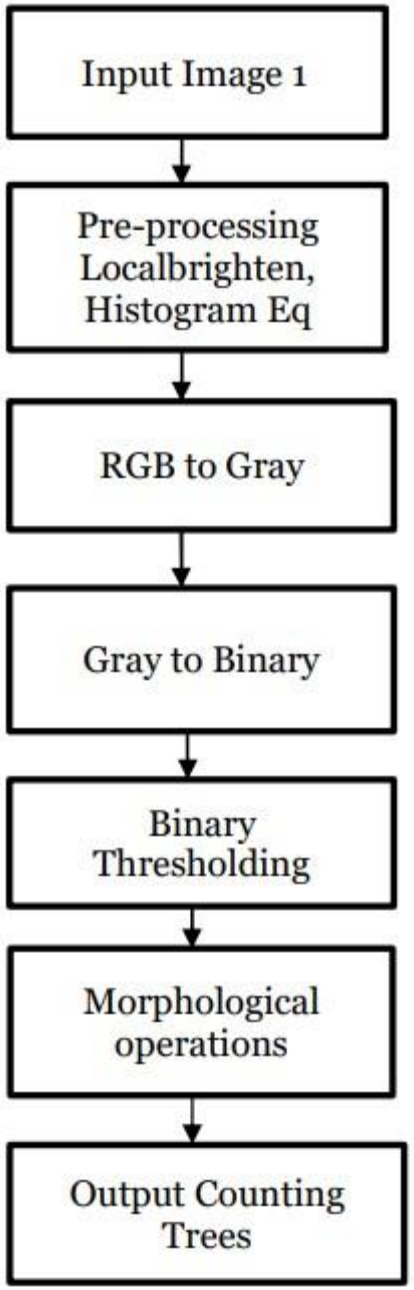


Figure 2: Histogram of the original image



Block Diagram representing process of tree counting for IIT K (OAT image).

Pre-Processing: image enhancement techniques

A. Local-brighten

Imlocalbrighten () function

Original image

Enhanced image

B. Histogram equalization

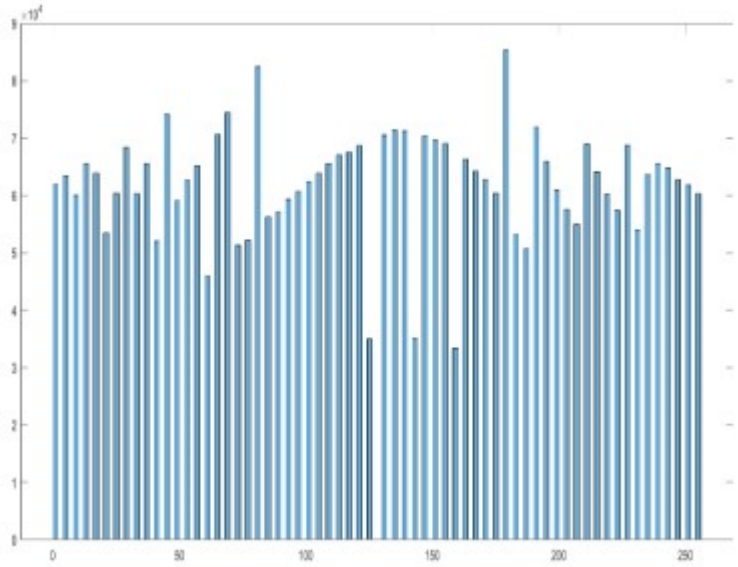
histeq() function

image after histeq

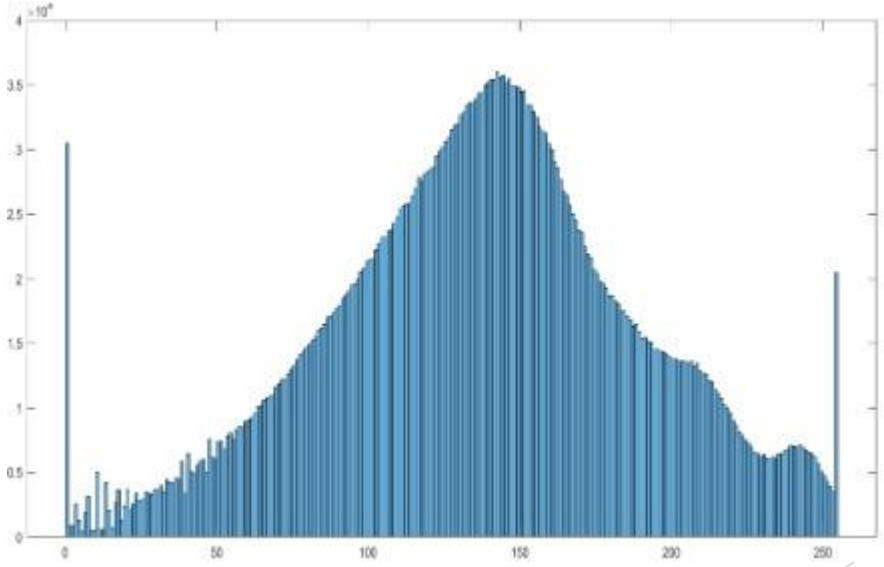
Image after localbrighten

B. Histogram equalization

Original image histogram



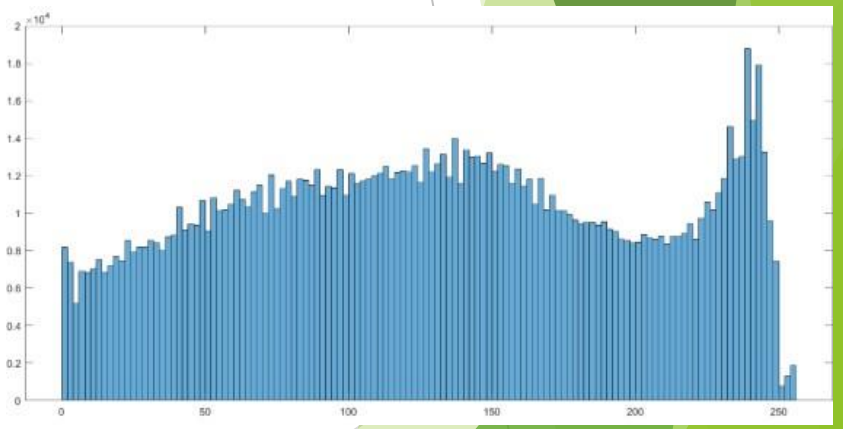
Enhanced image histogram



RGB to Gray conversion

Gray image

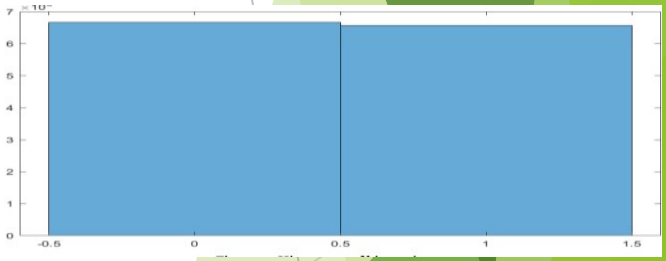
Histogram of gray image



Gray to Binary conversion

Binarized image after thresholding values lesser than 65

Histogram of binary image

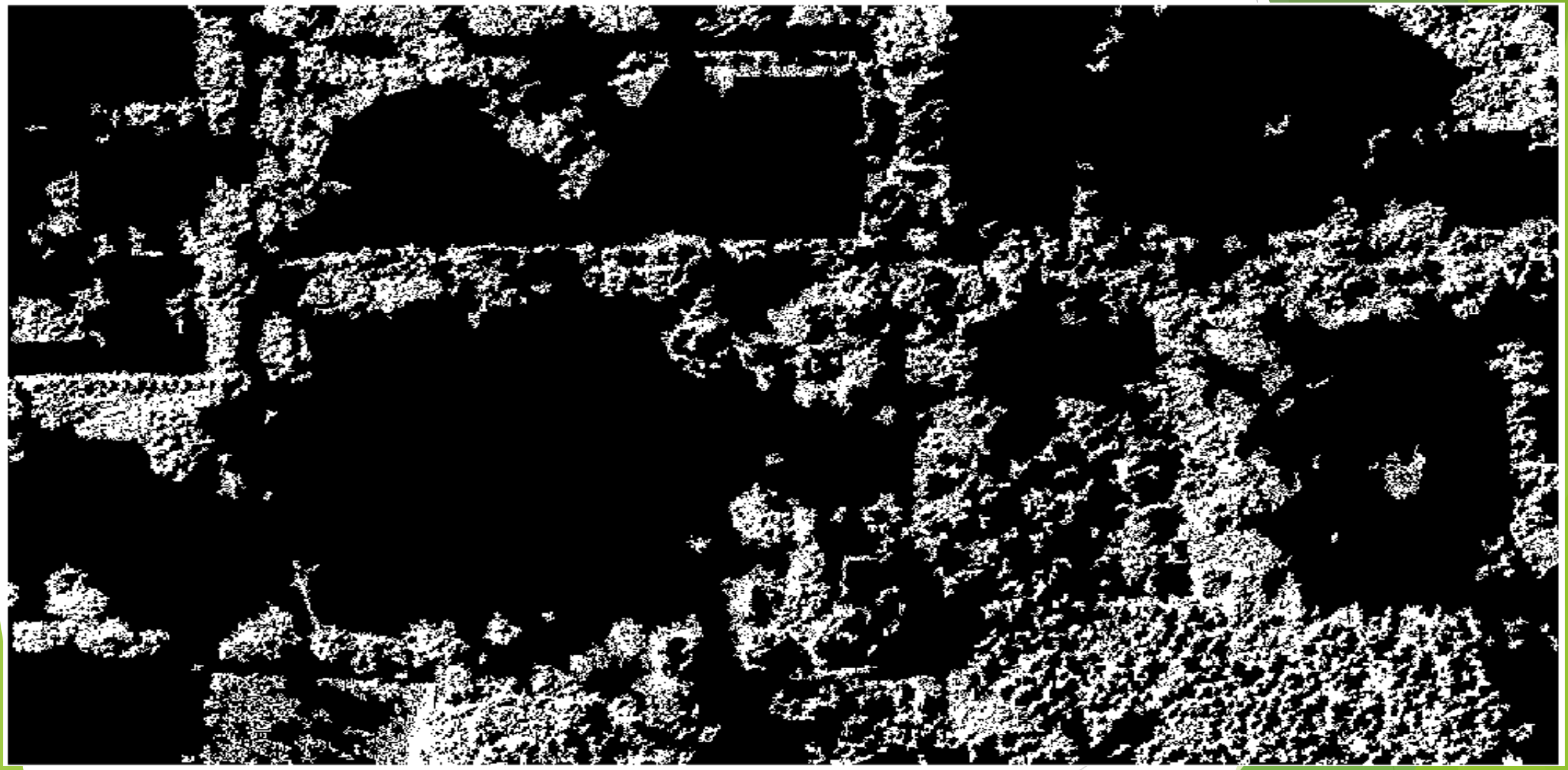


Gray to Binary conversion

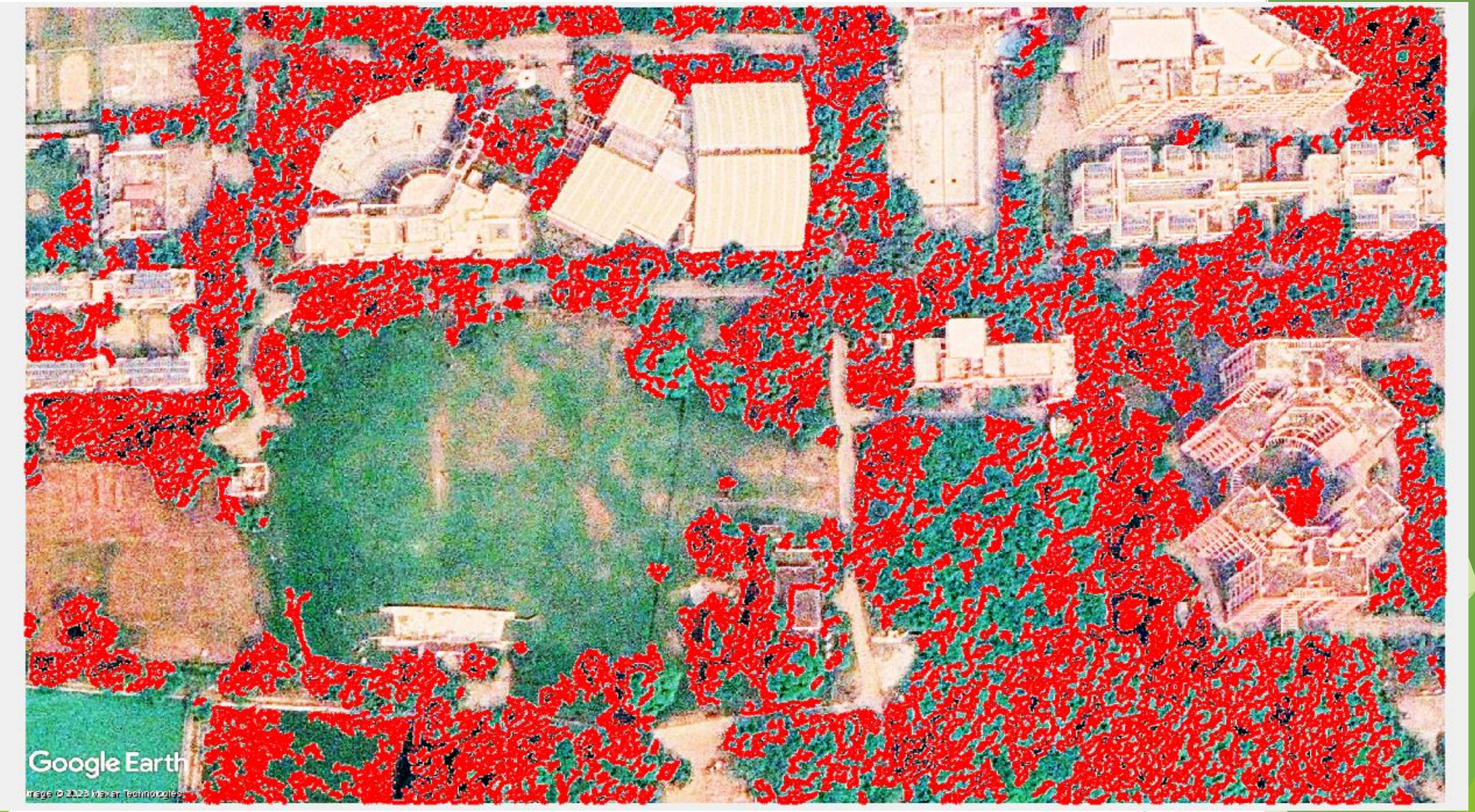
Binarized image after thresholding values lesser than 65


Google Earth

Improving Segmentation: Cleaning Binary Masks (Morphological Operations)



Masked image after applying bwareaopen

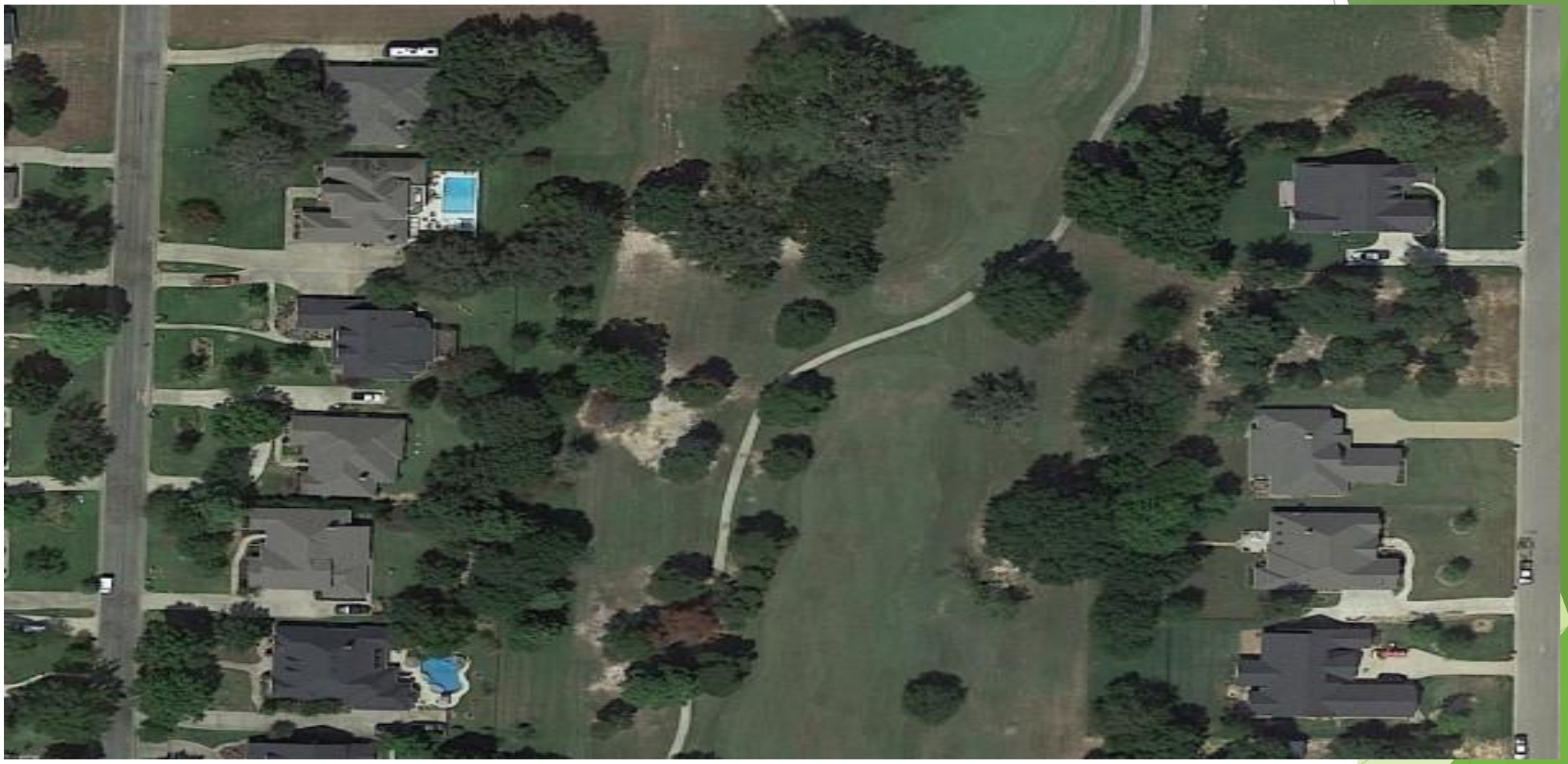


Overlay region boundaries on image (bwboundaries)

Finding and analyzing objects

- We use the **bwconncomp()** function to calculate the number of trees in the image.
- In 8-connected pixel tree counting, each pixel in the image is considered to be connected to its 8 nearest neighbors.
- Numer of trees found to be 550.

STUDY AREA –II (USA –LINDALE IMAGE)

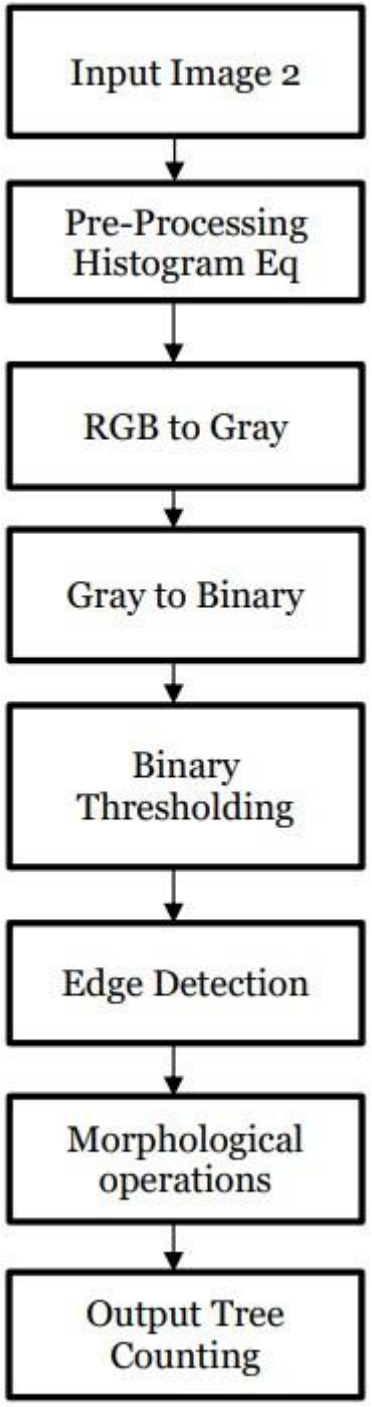


Satellite View of Lindale, United States - Aerial Image from Google Earth(9-10-2021)

IMAGE RESOLUTION-6447*4920 PIXELS

IMAGE QUALITY-BETTER.

GROUND RESOLUTION-80 METRES

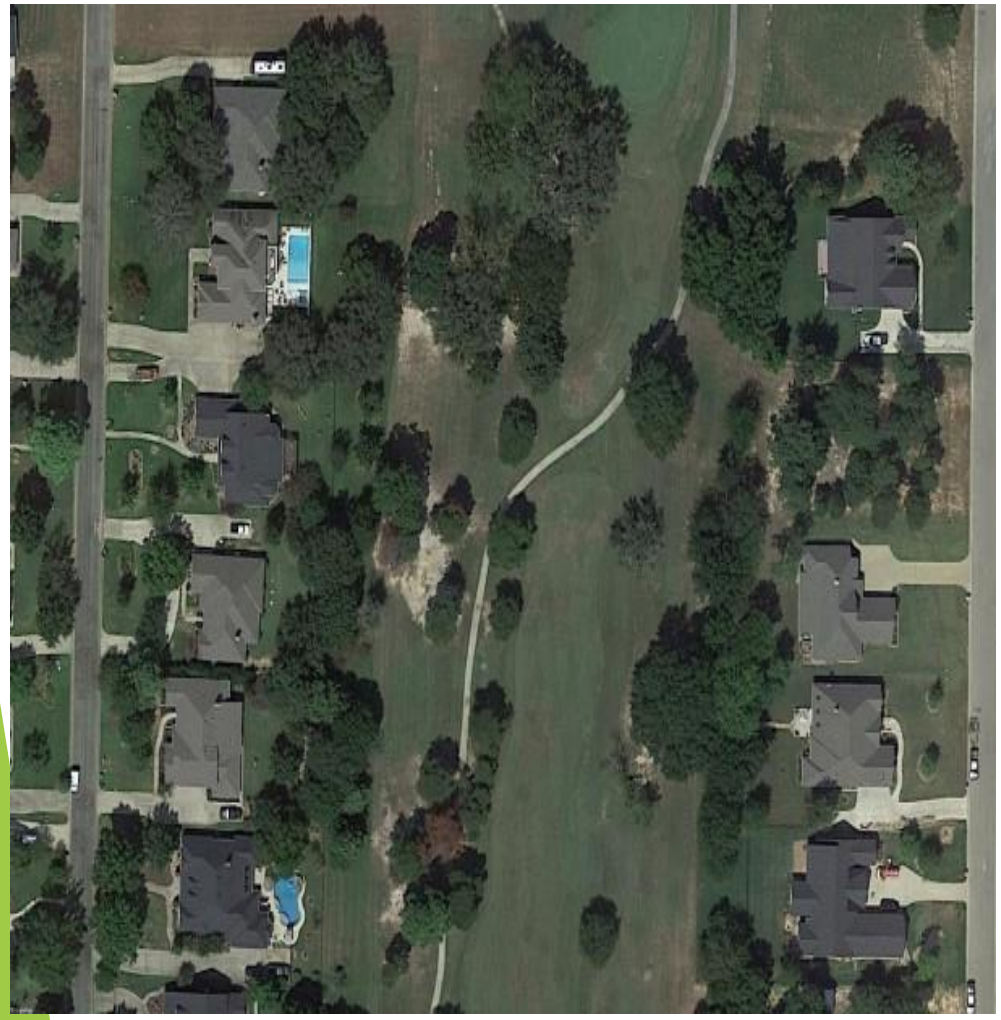


Block Diagram representing process of tree counting in USA –Lindale image.

Pre-Processing: image enhancement techniques

Histeq () function

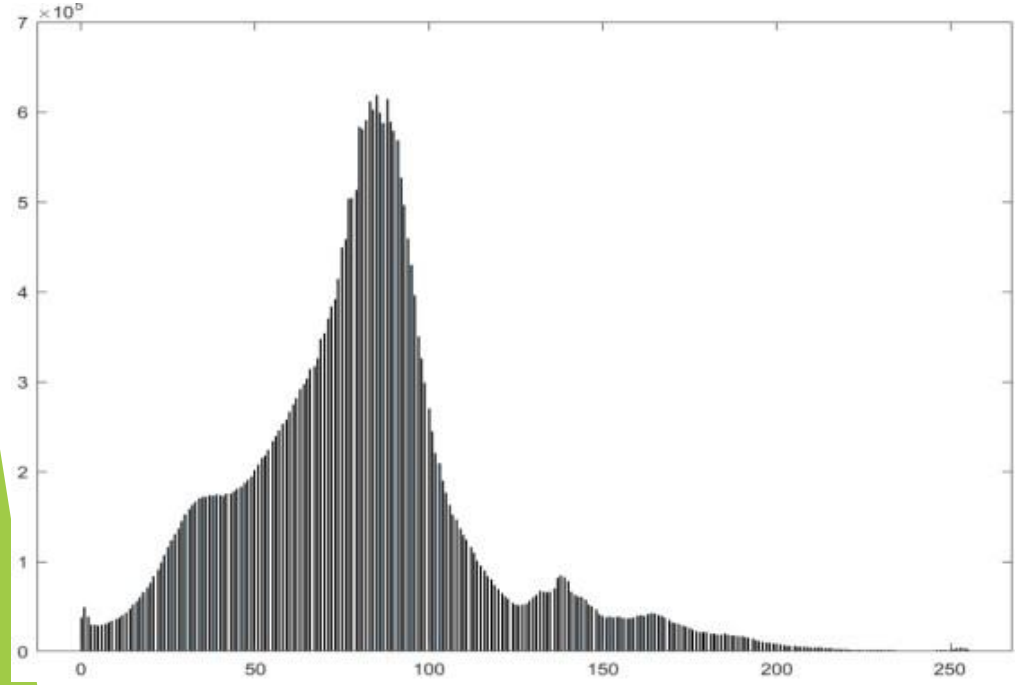
Original image before histeq



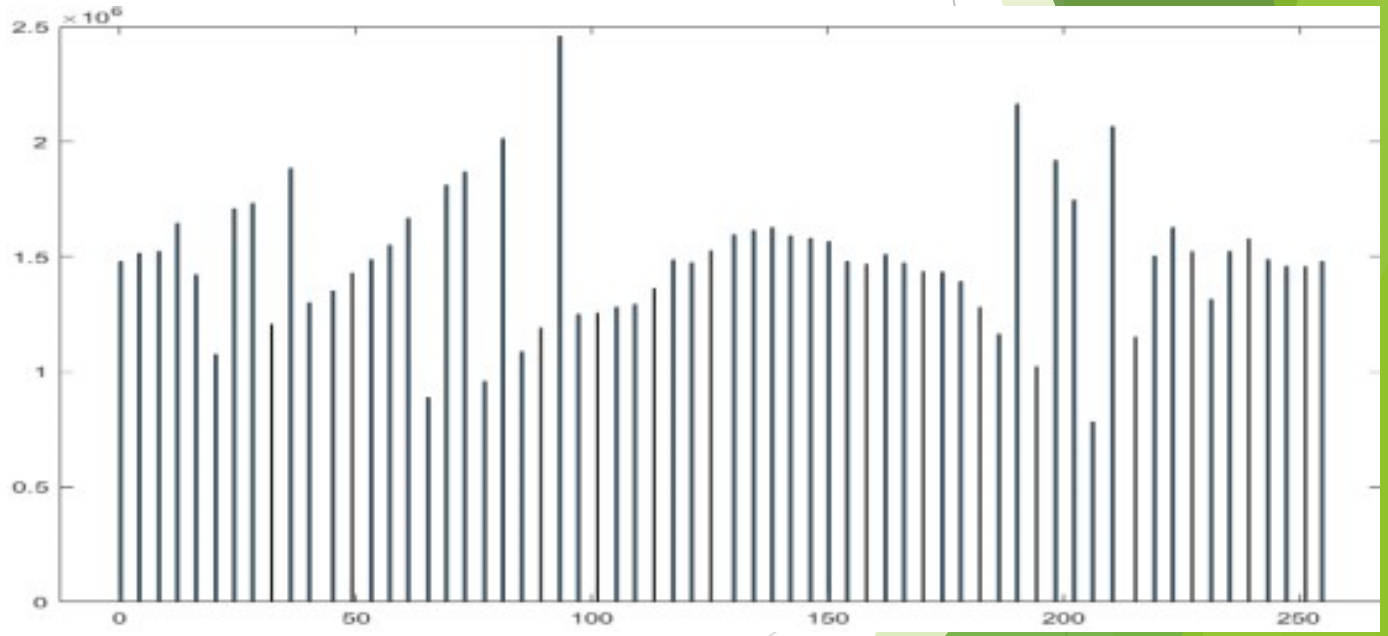
Enhanced image after histeq

Histogram equalization

Original image histogram



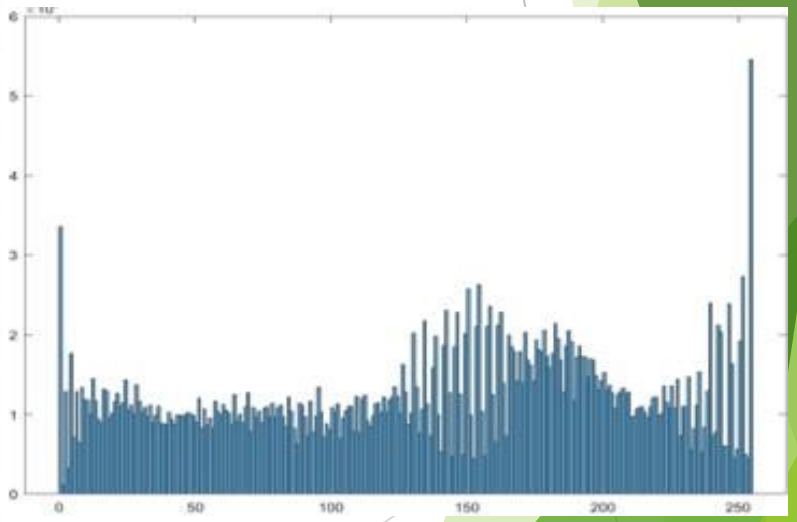
Enhanced image histogram



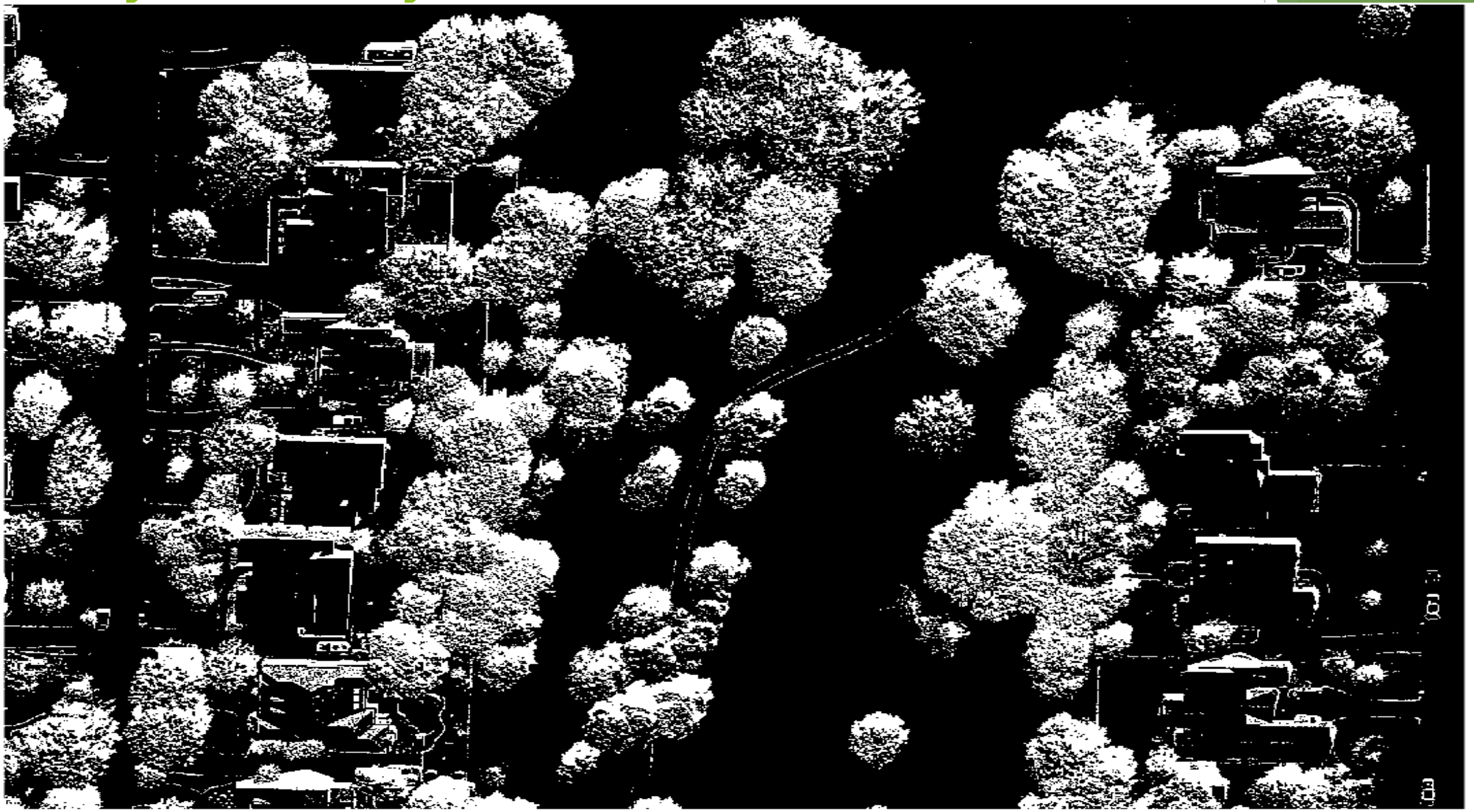
RGB to gray conversion

Gray image

Histogram of gray image

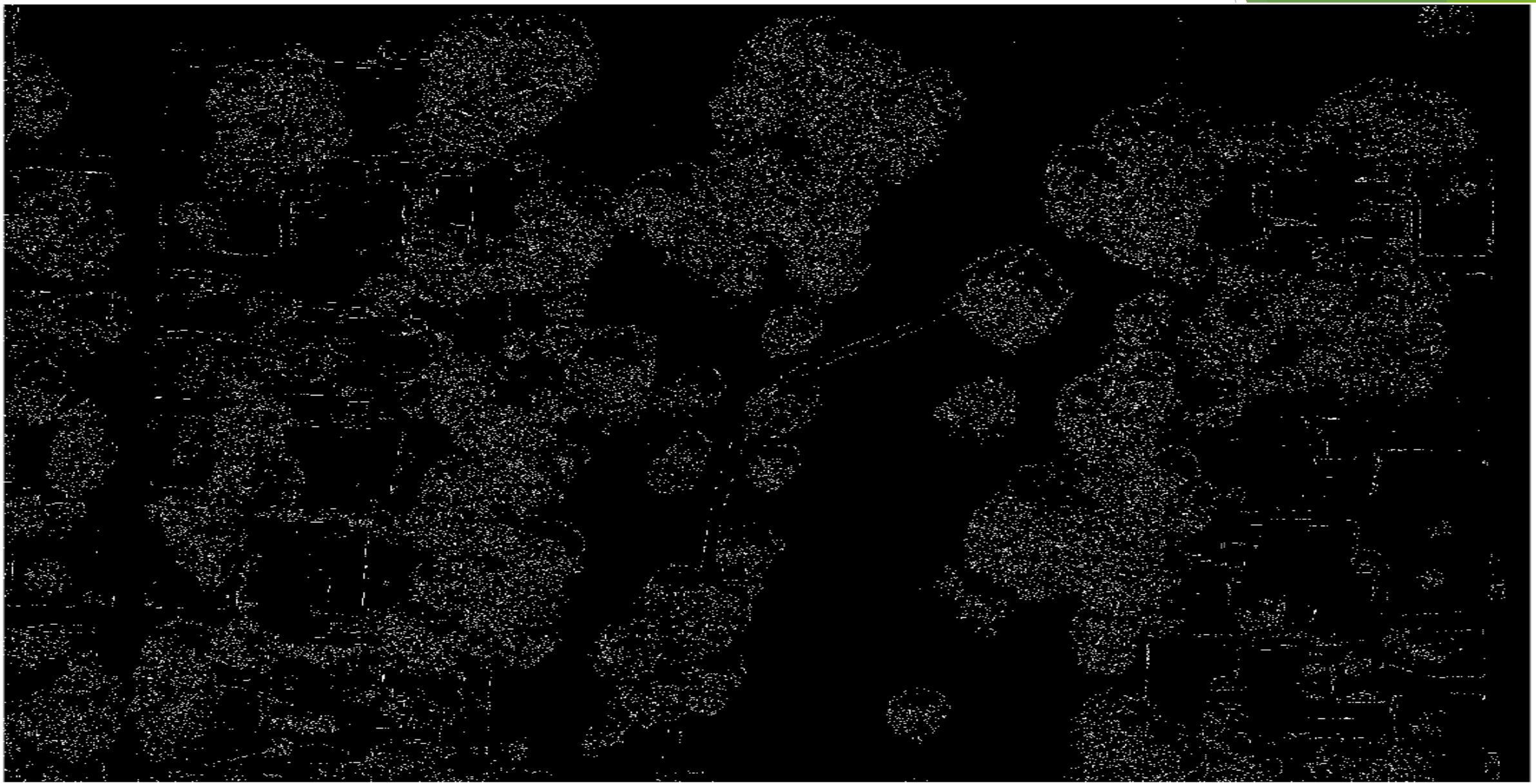


Gray to Binary conversion

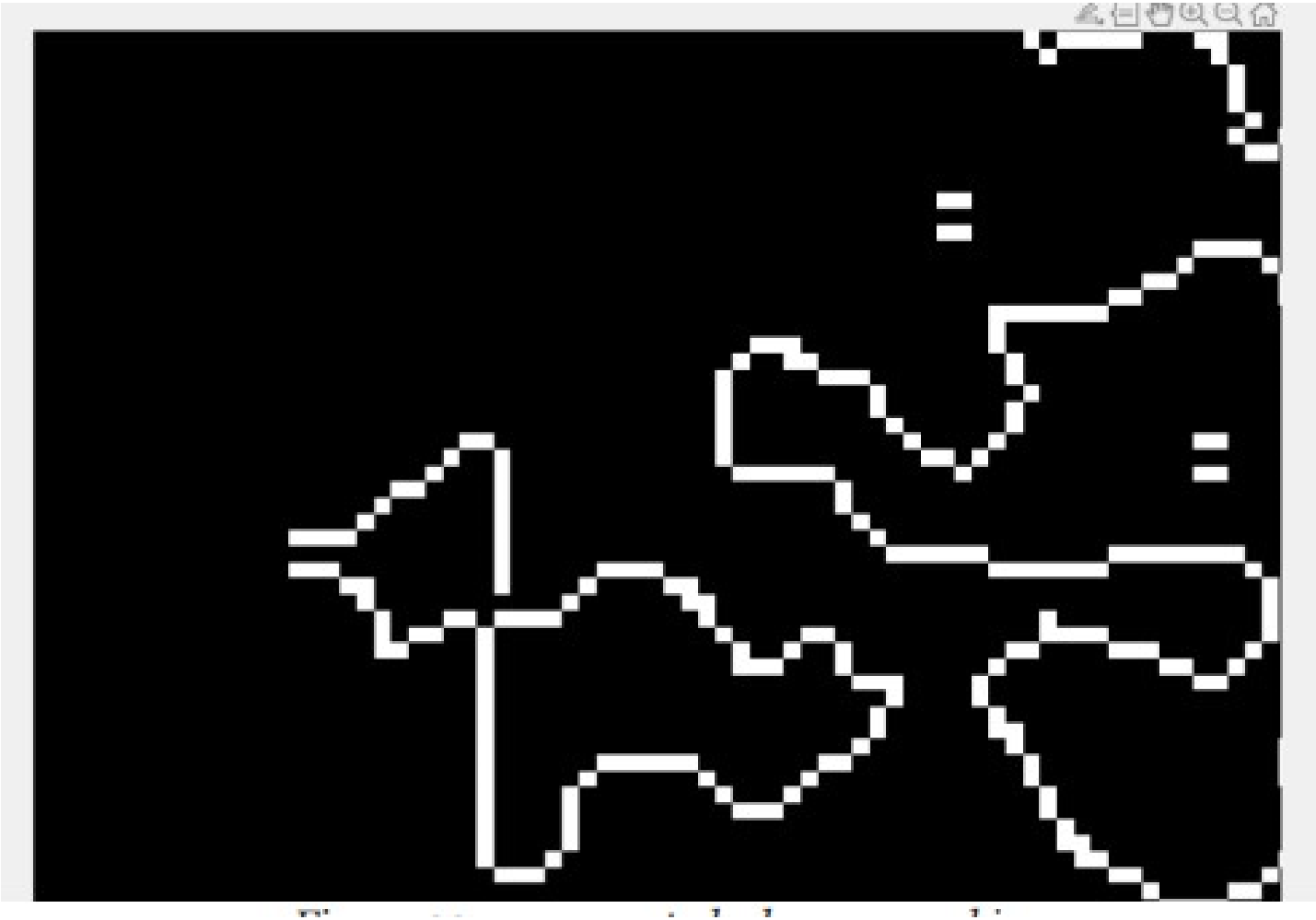


Binarized image after thresholding values lesser than 65

Edge detection (Post-Processing)- sobel edge detector

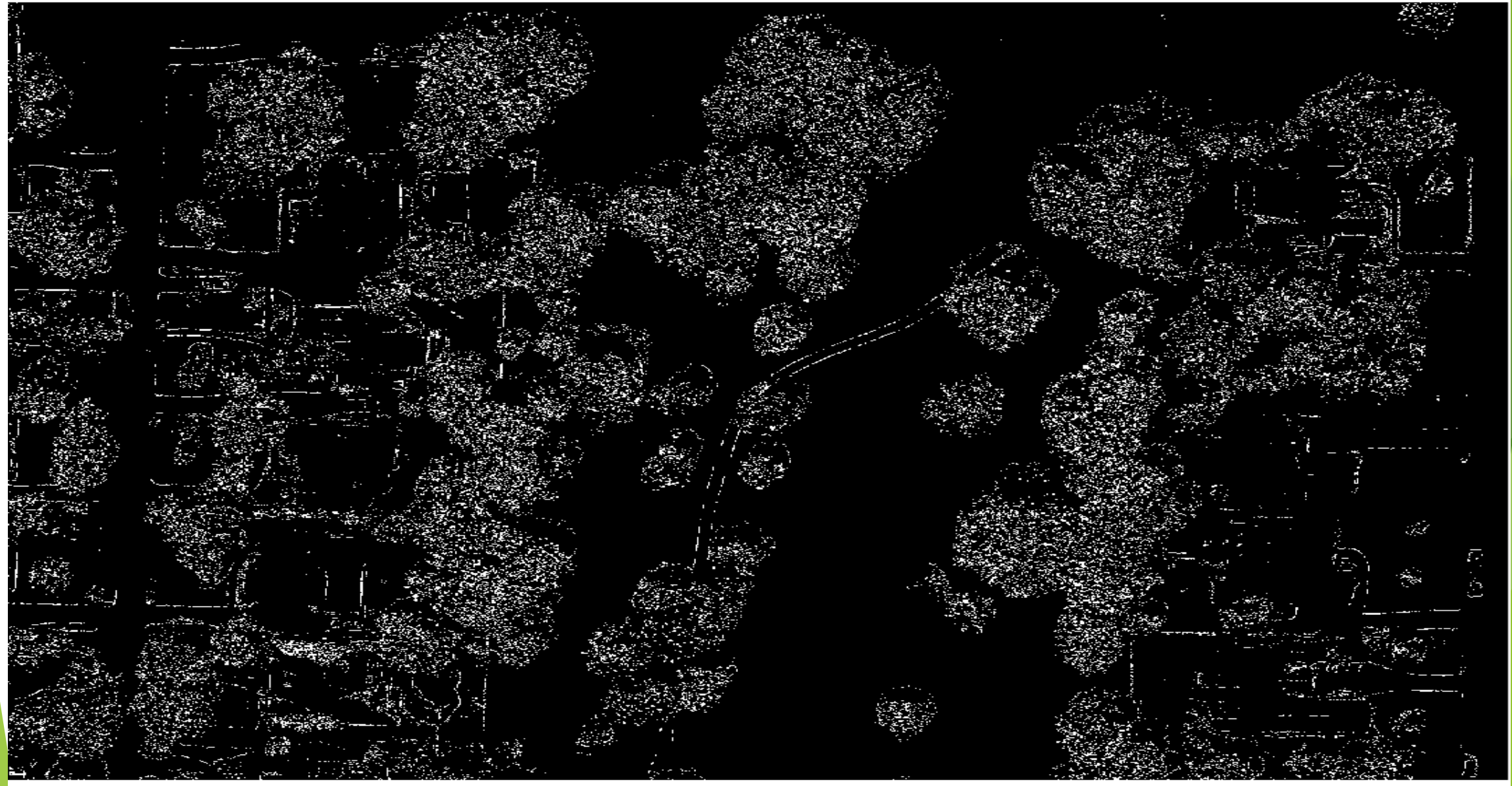


Edge detected image



unconnected edges zoomed in

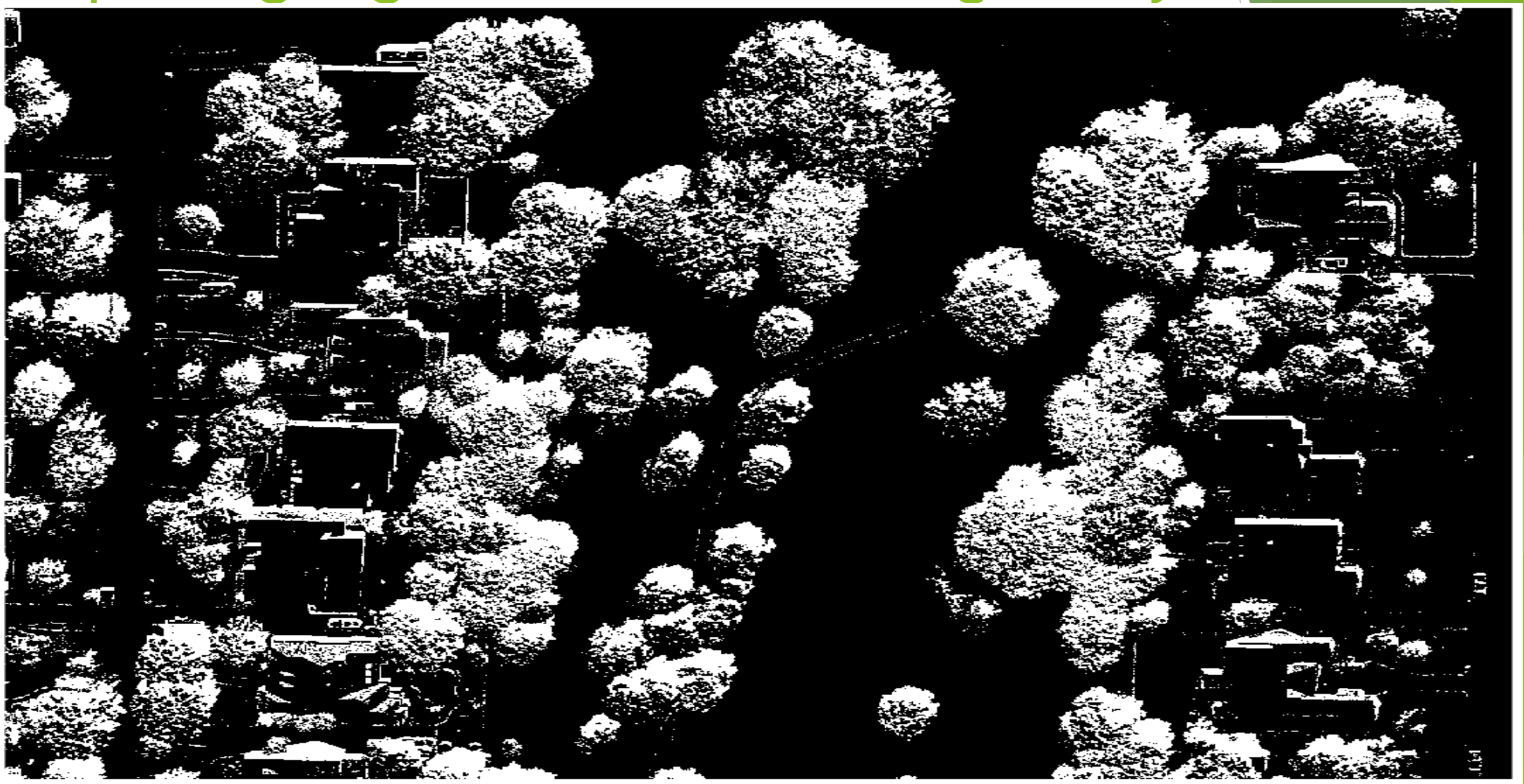
Edge closing (Morphological Operations)



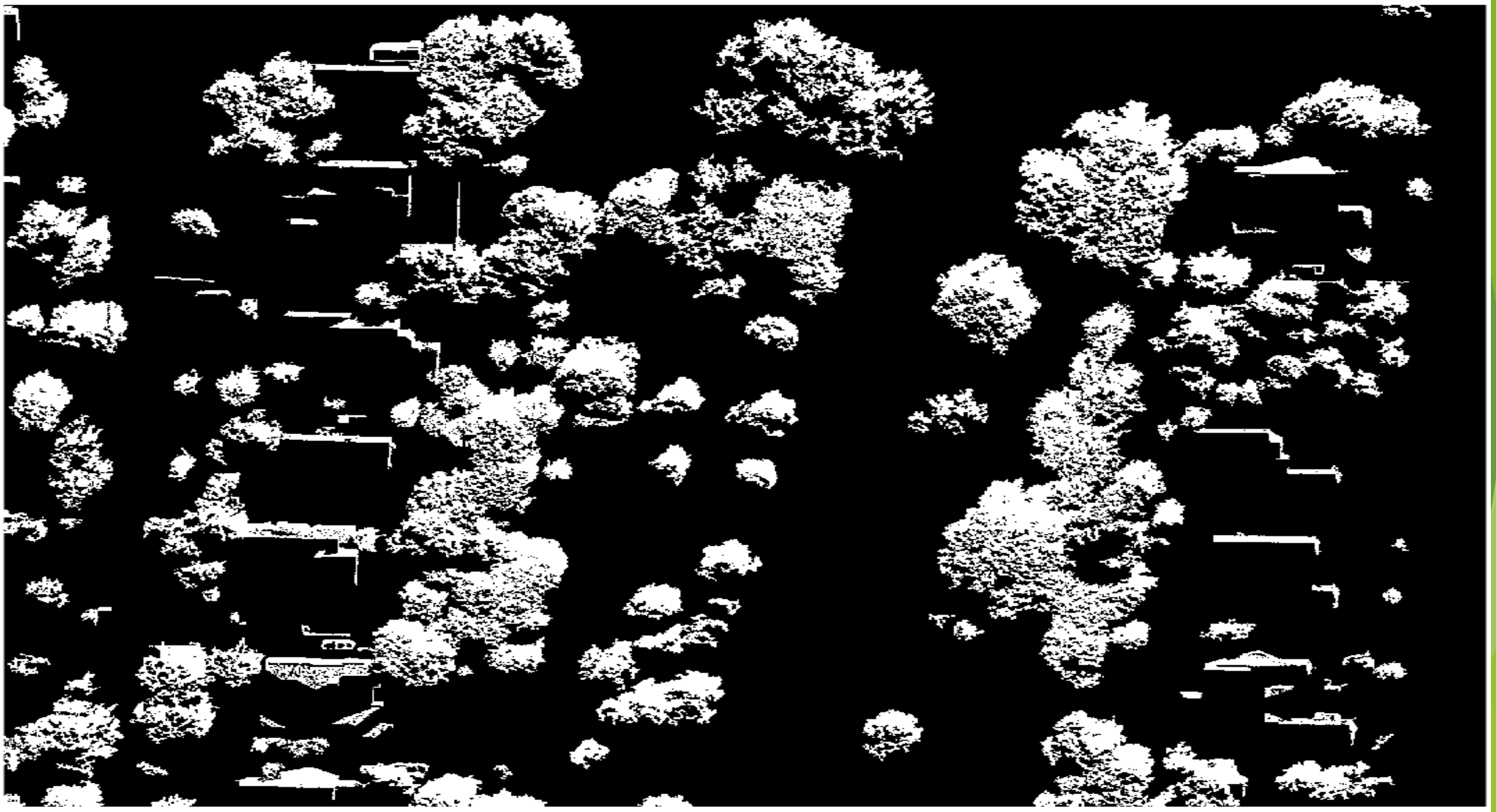
Closed edges of a binary image

closed edges of the binary image zoomed in

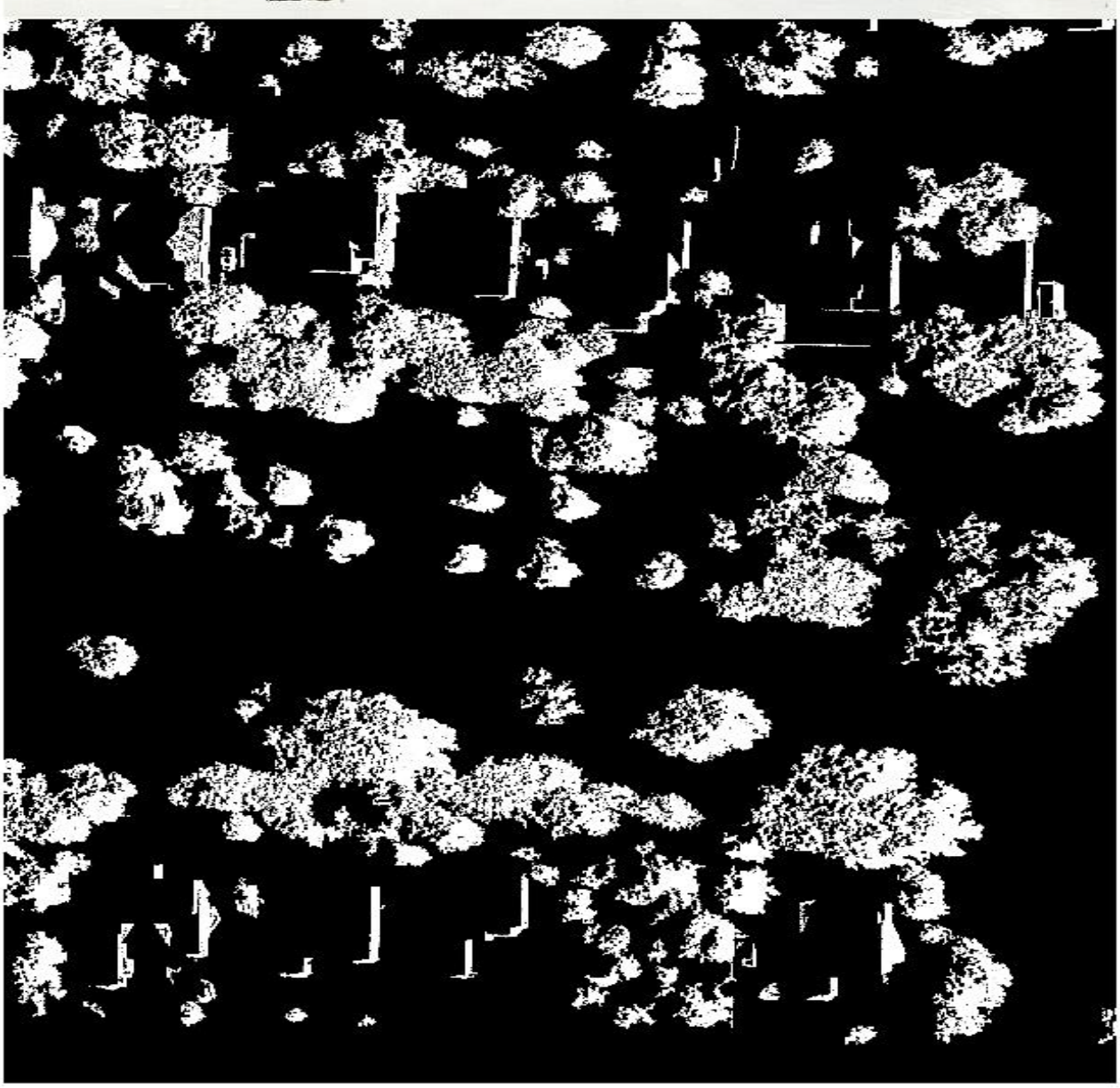
Improving Segmentations: Cleaning binary Masks



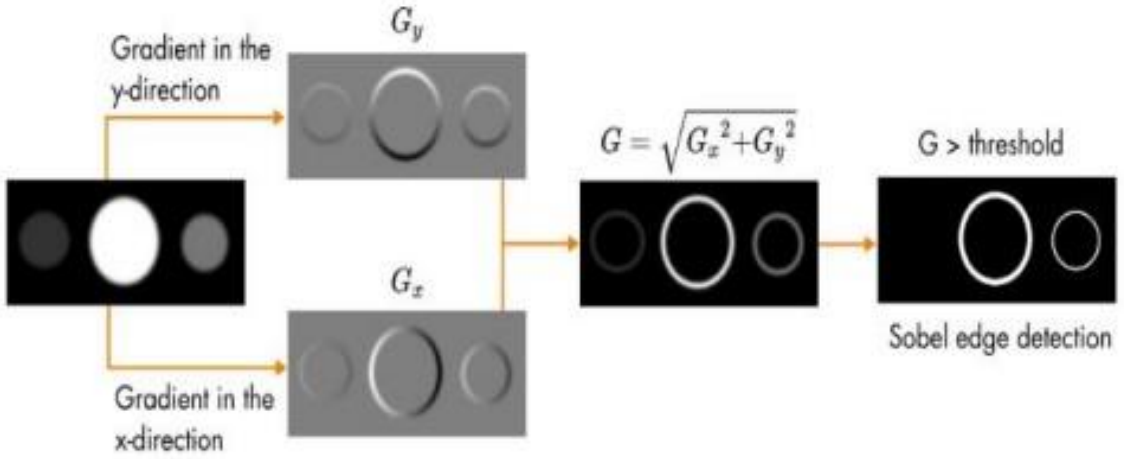
Segmented image using bixtor



Segmented image using bwareaopen



Edge Detection



Algorithm of SOBEL filter

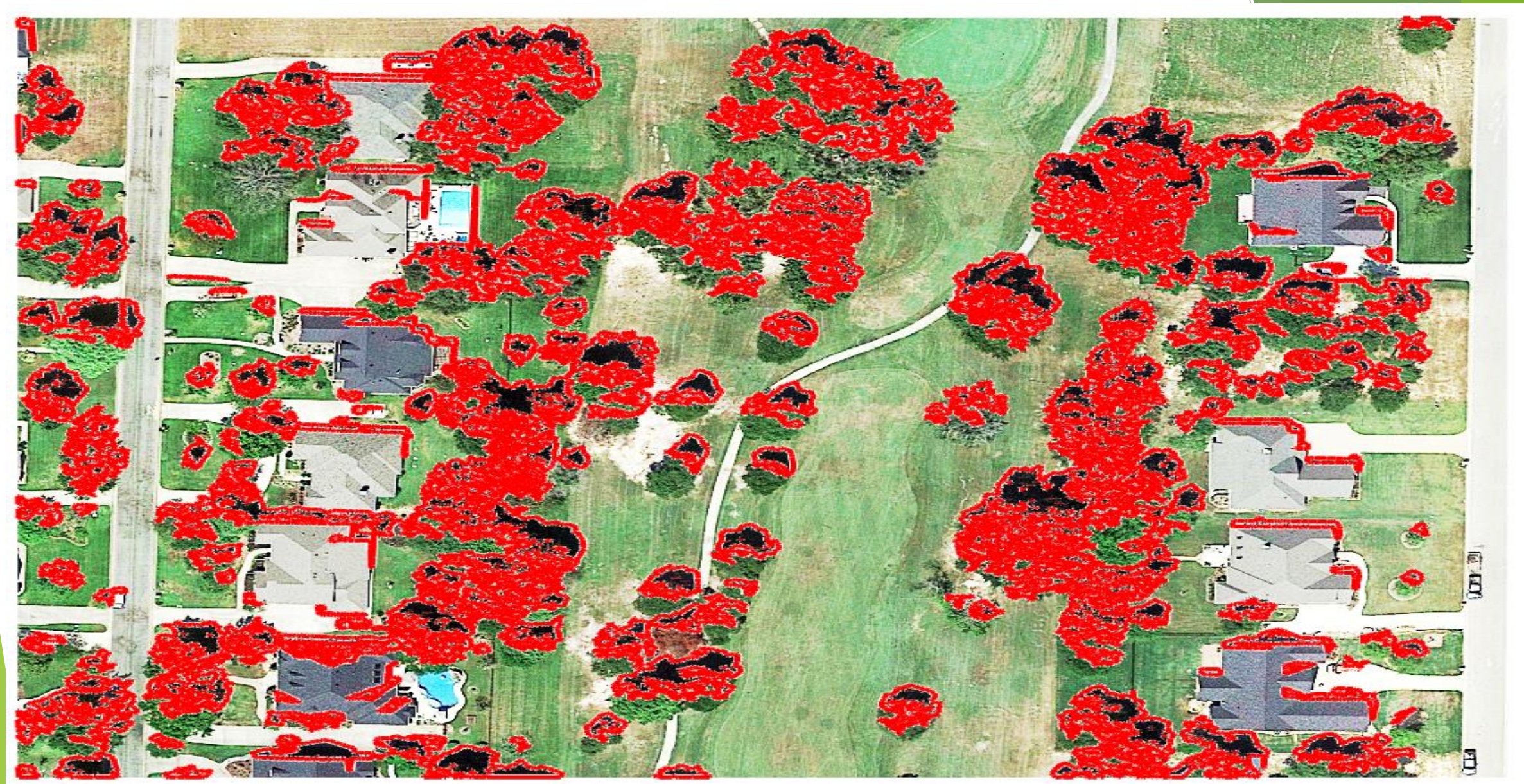
-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

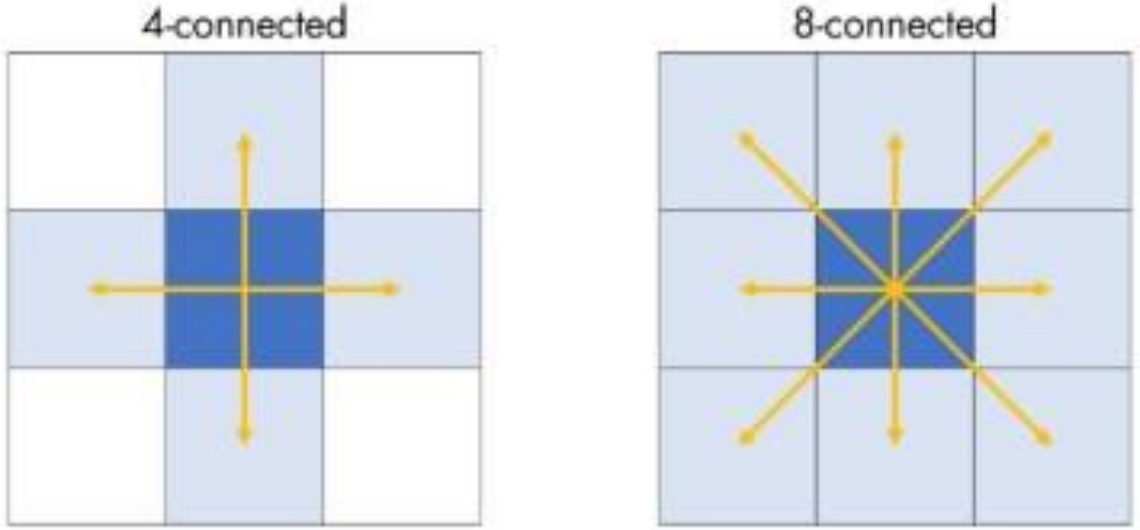
SOBEL –convolution kernels



Overlay region boundaries on image (bwboundaries)

Finding and analyzing objects

- bwconncomp function was used for counting the number of trees
- Use of 8 connectivity reduces the risk of overcounting trees.
- 4- connectivity could result in counting multiple trees as separate entities



RESULTS

	Sample 1	Sample 2
Actual Trees	650	200
Detected Trees	550	198
Composition	RGB	RGB
Percentage Accuracy	84.6%	99%

CONCLUSION

- Filling in the holes in a masked image of trees can reduce the number of trees counted, especially if the trees are very close to each other.
- Cost effective method for monitoring large forested area.
- Higher spatial resolution imagery easier image detection and more accurate responses.
- When the image cannot be detected due to poor quality , we can go for other methods like deep learning and UAV.
- Even with high-resolution imagery, some scenes may be too complex to accurately count trees using traditional methods. In these cases, different morphological methods can be used to improve the accuracy of tree counts.

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MATLAB


THANK
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