

Road Pole Detection Using Template Matching

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Objectives

The road commission is tasked with maintaining road poles along the Danish roads, sometimes these may have fallen over, disappeared or they might never have been placed.

The road commission knows where there *should* be poles. They have a set of GPS coordinates describing their alleged position.

The goal of this project is to identify, (given a set of GPS coordinates) whether or not a road pole is present in close vicinity.

Ascend XYZ product is aerial photography, these photographs together with the GPS coordinates is what is used to find the probability of a pole in a given place. A GPS coordinate is given to the system and a patch of land is cropped and analyzed for road poles, by the presented method

Flight Height

Aerial photography is expensive. The first part of the project was to determine which flight height was necessary for the method to work. The higher the plane, the more ground covered which equals less time in flight. However height also equals less image resolution.

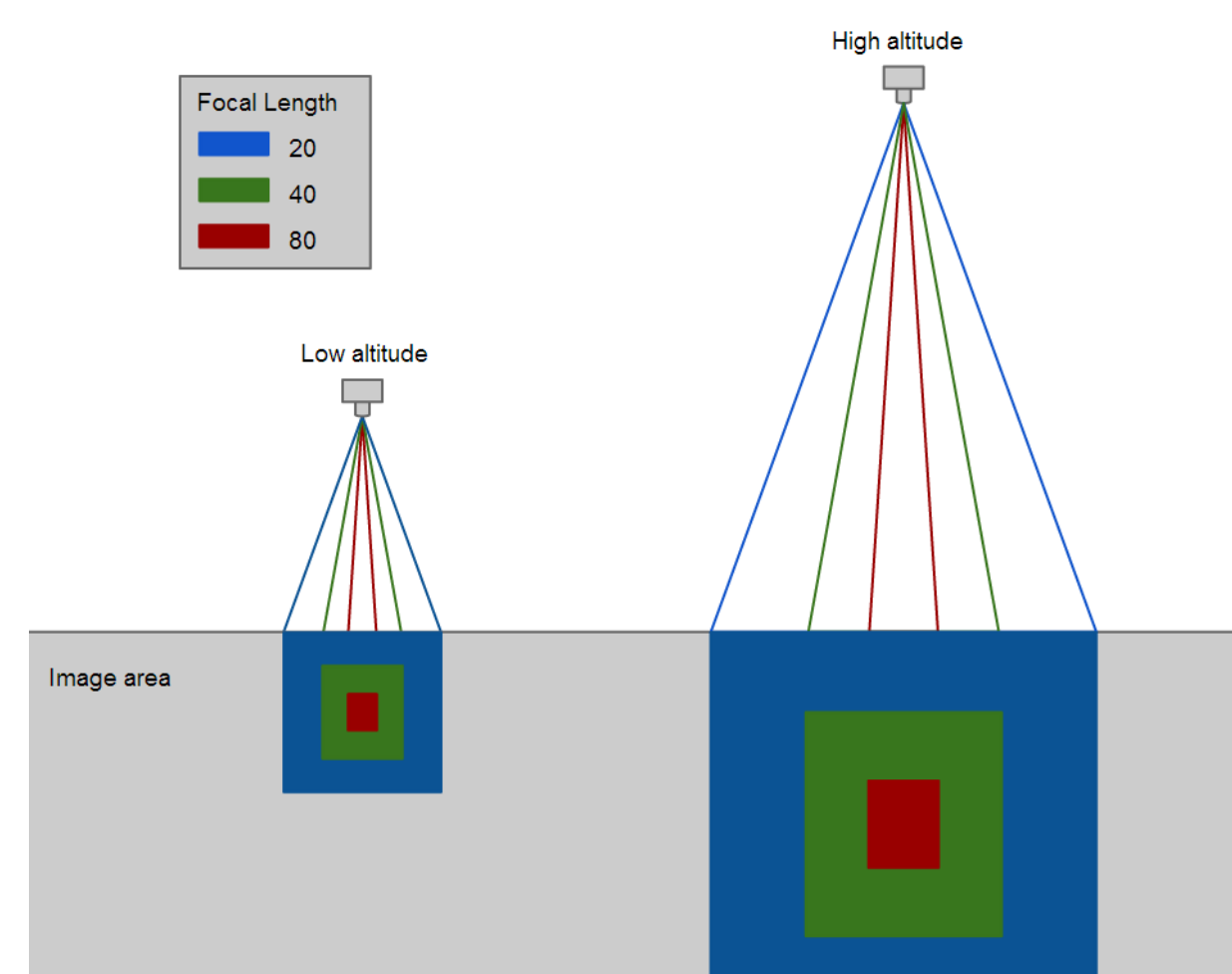


Figure 1: Area covered from different altitudes

Here are some samples of road poles from different heights(4,6,8,10):



Figure 2: Positive Patches

Algorithm

To identify what flight height is best suited for detecting road poles. The algorithm was tested on 4 data sets all taken from different altitudes(2,4,6,8) the algorithm consists of:

- 1 Gathering 10 templates.
- 2 Grouping datasets into negative and positive patches.
- 3 Running template matching on negative and positive patches
- 4 Extracting maximum score and save it in a Gaussian mixture model

The proposed algorithm will always find a match, it takes the match that resembles the pixel values of the templates the most.

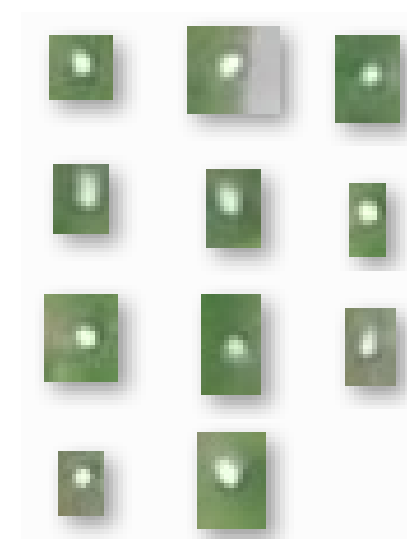


Figure 3: Road Pole Templates

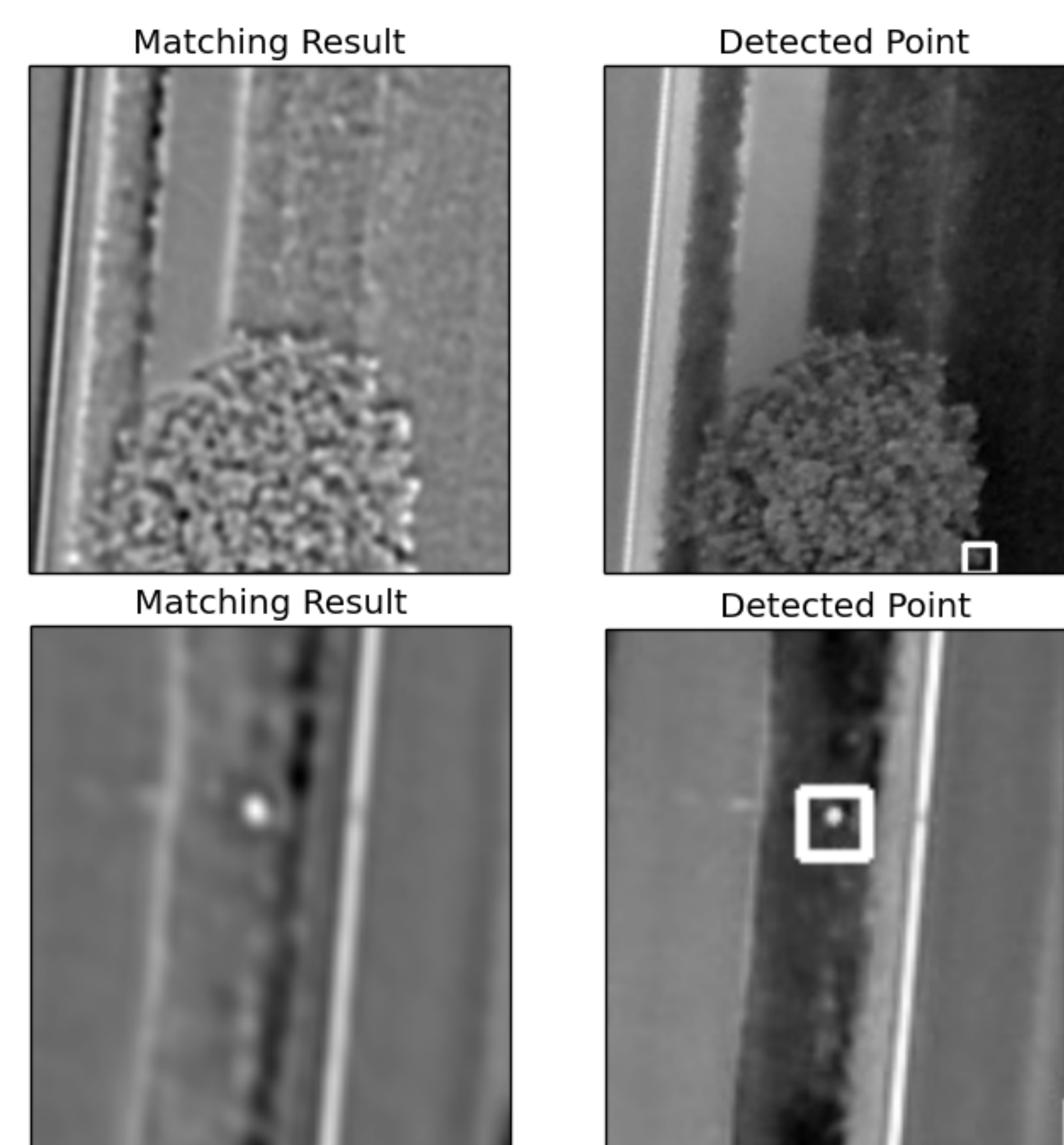


Figure 4: Template matching on negative and positive patch

The template matching algorithm used returns a single value for how closely the best detected point in the picture resembles the templates.

Histograms

This value is saved as a bin value in a histogram and fed to the Gaussian Mixture model.

Underneath the histograms of different flight heights is shown. To the left the image was matched with one template, to the right the image was matched with 10 templates and the average score is taken. The blue bins are from the positive patches, the green bins are from the negative patches.

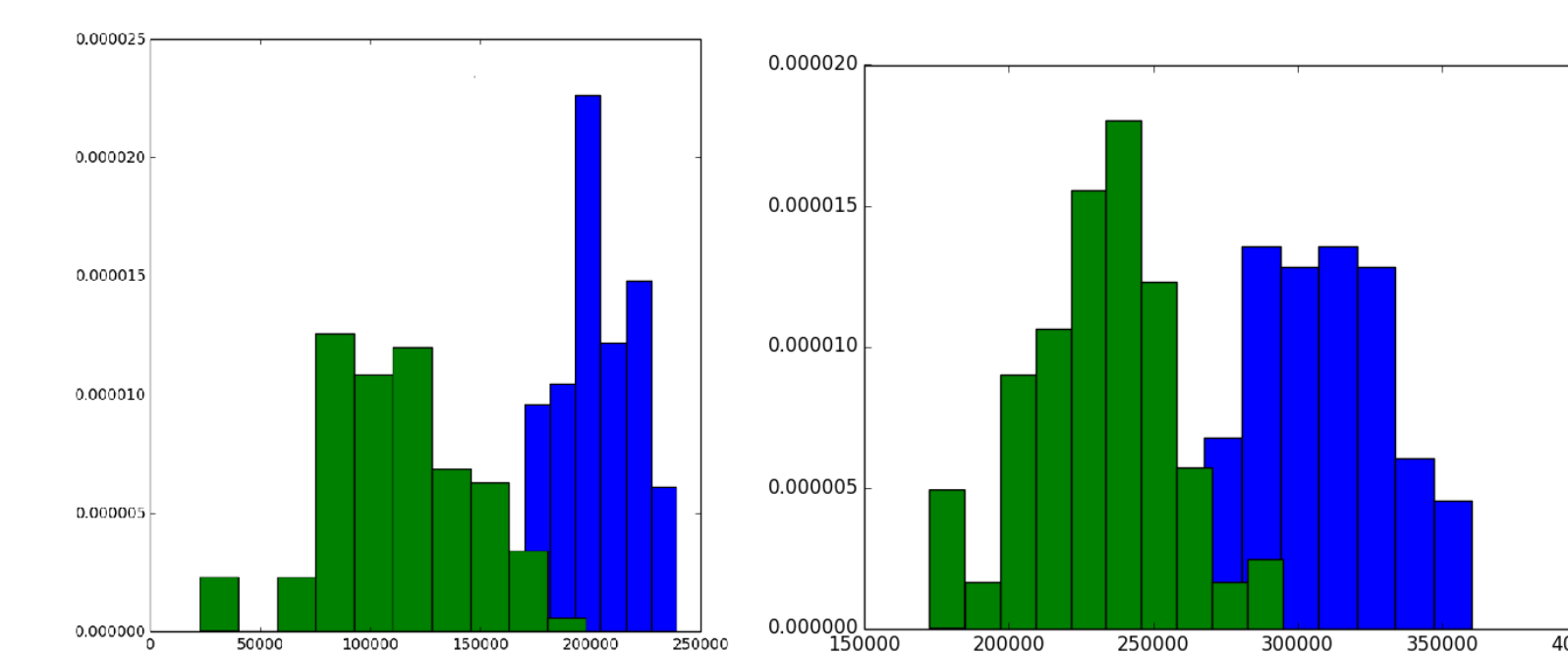


Figure 5: Flight height 4

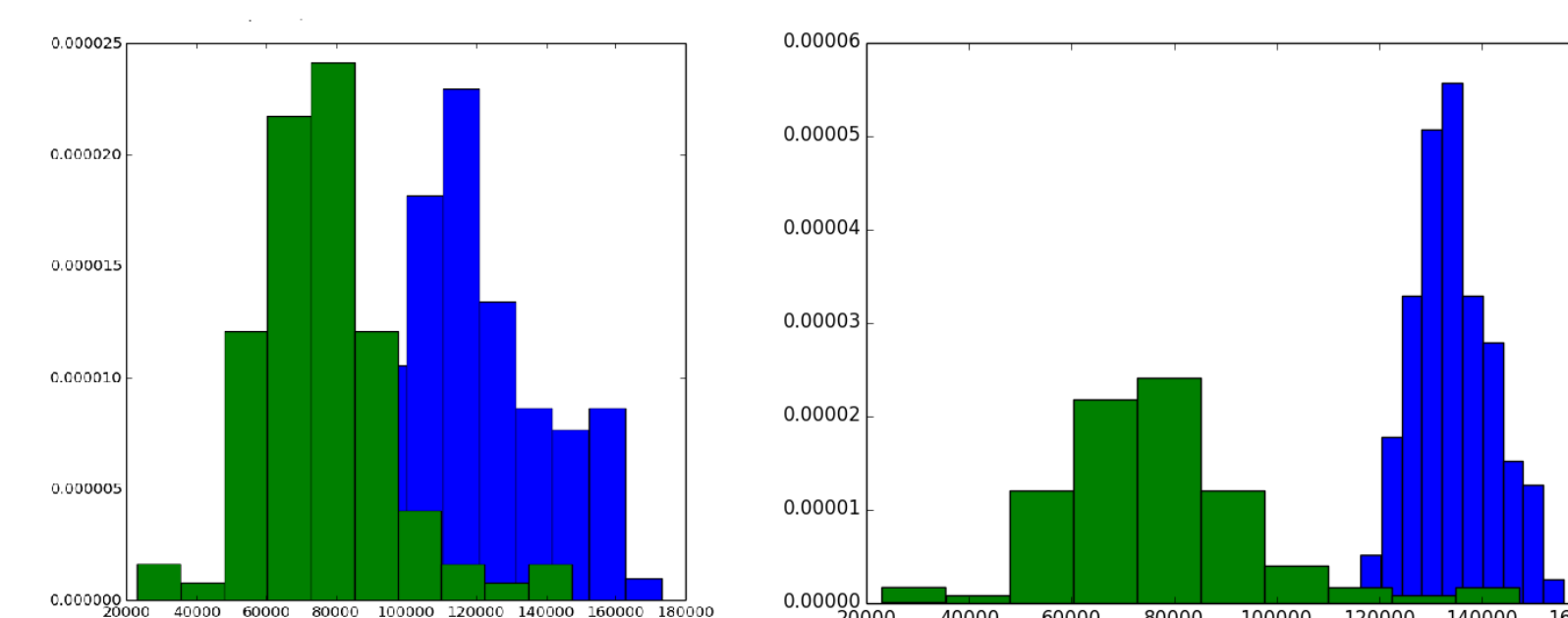


Figure 6: Flight height 6

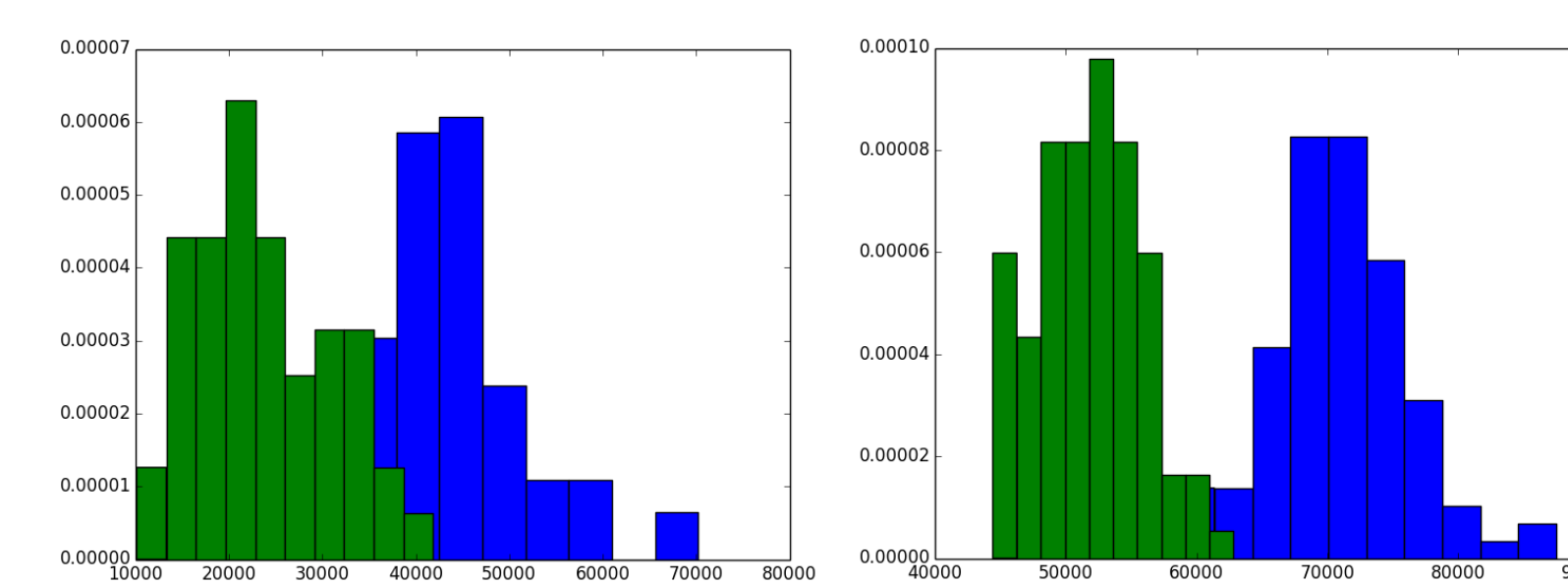


Figure 7: Flight height 8

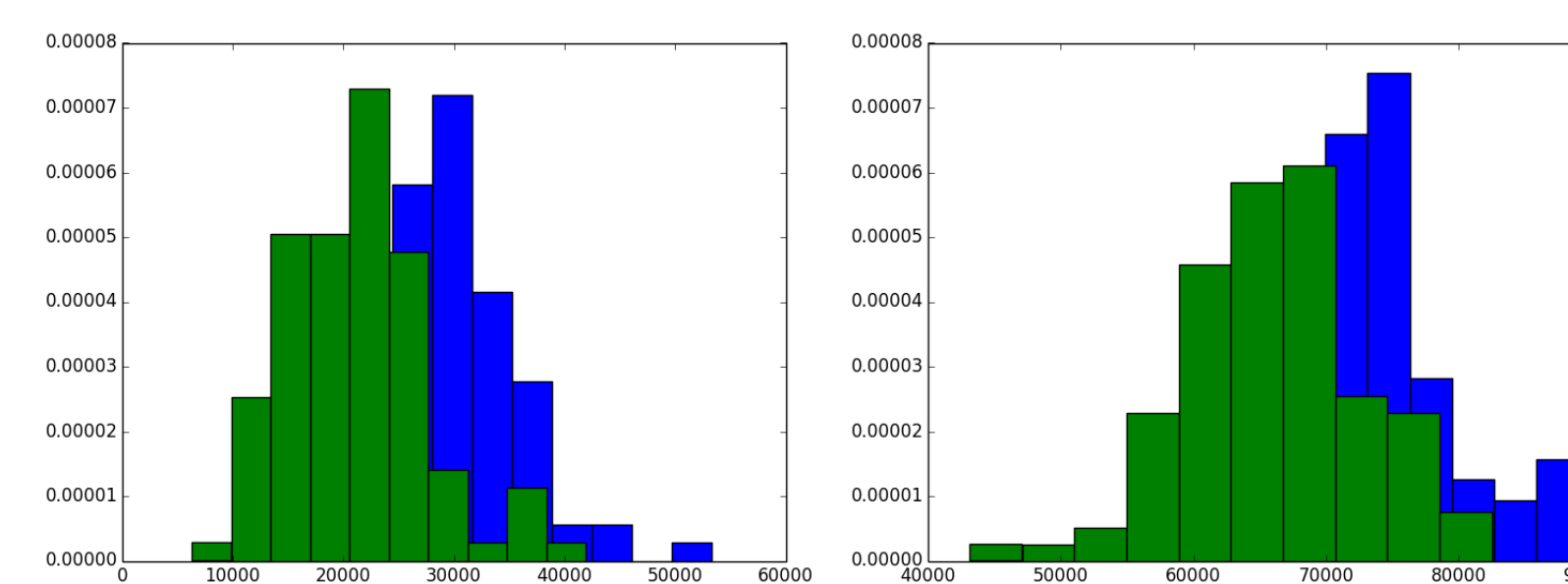


Figure 8: Flight height 10

Flight height 6 and 8 proved to have the best results(most distinction between negative and positive patches) The reason why height 4 is not doing well is due to blur from the planes relative ground speed.

Results

The results look promising for flight height 6 and 8, with the training done for the mixture model, the method can now be fed with GPS coordinates a patch of land can be cropped and template matching applied to the cropped patch, the value can then be checked with the mixture model and it will return a value in percentage of the likelihood that the patch belongs to the blue cluster. If the likelihood is too low, then the road commission might need to check up on this location and place a new pole.

Additional Information

This project was done through the summer vacation 2014, as a student job for Ascend XYZ, I currently study Naturvidenskab og IT with specialization in mathematics at the University Of Copenhagen. I am currently writing my bachelor project in image analysis. I hope to continue my masters next semester here at DTU.

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