Project #1: Binary image processing

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Problem Description

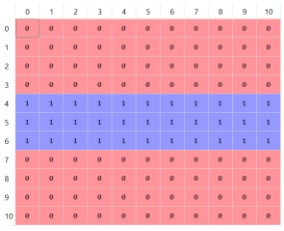
NSA needs a solution to analyze aerial photograph which can automatically count the number and the size of aircraft. In this project, binary image processing was used to achieve this goal.

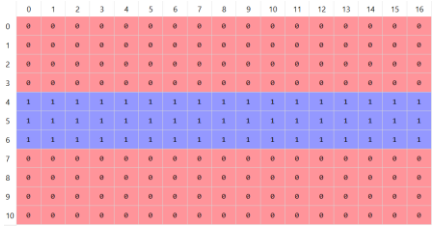
Code Design

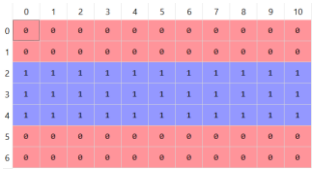
Function	Description
thresholding(img,threshold=[180,245])	Take in a set of values to threshold grayscale image to binary image
erosion(bi_img,mask)	Erode binary image with mask
dilation(bi_img,mask)	Dilate binary image with mask
morpho_operator(bi_img,mask,similarity=0.9)	Perform erosion or dilation by changing the value of similarity
connect8(bi_img)	Sequentially connecting components (take in binary image)
object_detection(con_img)	Use connected components to detect objects

Assumptions

There are three masks with different sizes used in this project. Masks were created by assuming airplane simply has "___" shape. This design highlights the backbone of airplane as object of interest.







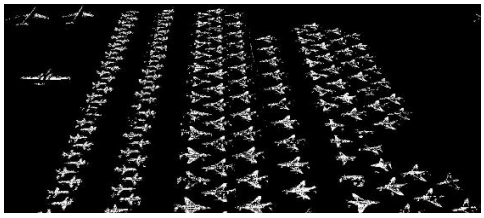
Running Code

Implementation is written in ECE574_Project2.py. All functions are kept in binary_processing.py and can be loaded for direct use.

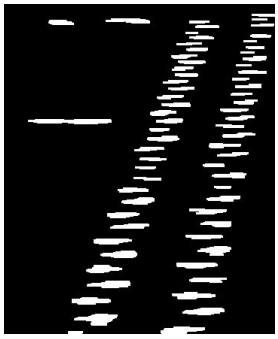
Example Results

Original image

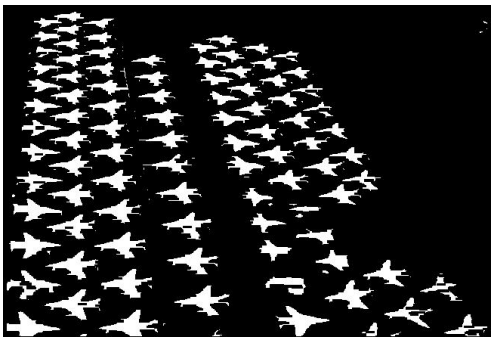
Binary image



Left sub-image (Erosion followed by Dilation)

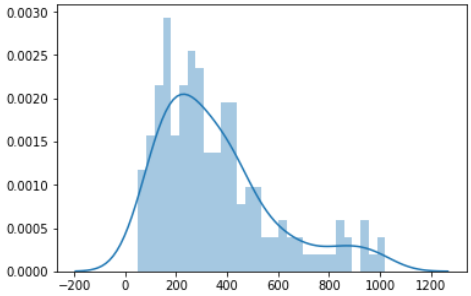


Right sub-image (Dilation followed by erosion)



Number and size of aircraft

In this project, I fount **69** airplanes in the left sub-image and **90** airplanes in the right. The distribution of aircraft size is presented below.



Conclusion

1. Preprocessing image might be necessary to smooth image before binary processing. Though I didn't perform any image preprocessing, smoothing the image by gaussian filter might help denoise.
2. Creation of mask is the critical step in this project. A finer mask that describes the object of interest with good estimation on size and shape may greatly improve accuracy of this task, assumingly. In this project, "__" shape mask also works well and leads to satisfactory accuracy.
3. However, there are two problems remained. 1) some aircrafts can't escape from erosion; 2) small aircrafts are connected as a mega airplane after dilation. This suggests a more sophisticate way to perform erosion and dilation as well as screening a good mask.