SHIP DETECTION FROM SATELLITE IMAGERY USING SVM+HOG AND DEEP LEARNING

MOTIVATION

Fishing boats, cargo ships, oil tankers, navy vessels, and transshipments may all be monitored remotely even in the absence of AIS signals using satellite imagery. It aids in the tracking of illegal fishing, drug trafficking, and human trafficking vessels.

Monitoring ship traffic within strategic interest regions could aid in port design and administration. Satellite photographs aid in the detection of spills and pollution in open waters, which can be utilised to safeguard Marine Conservation Areas. Large regions of ocean can be patrolled remotely using satellite images.

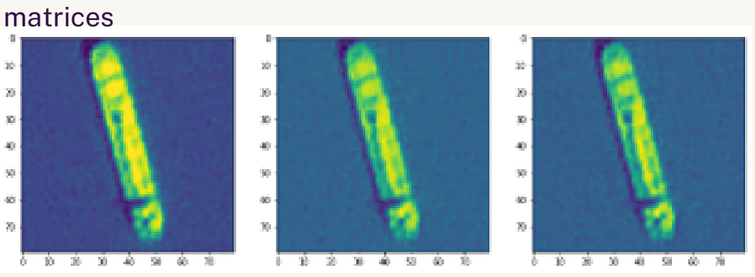
SCOPE OF THE PROJECT

To ensure safe and legal maritime passage while optimizing resource usage, reducing fatalities and costs. To reduce the time taken to accurately detect ships.

SVM with HOG and Deep learning models are used to detect ships in satellite imagery to achieve better performance and accuracy.

METHODOLOGY FOR PCA & FCNN

Load necessary packages/libraries
Download dataset from json object
Images are transposed to change RGB layers to last dimension.
Each R,G,B layer is displayed. RGB images are displayed. Dataset is split into test, train and validation
Dimensions of each array are permuted via transpose
No. of principal components in dataset are chosen(PCA) and graph is plotted
n_components are set to 80 and test, train and validation datasets are reshaped
Label vectors are converted from integers to binary class matrices



A Fully Convolutional Neural Network model with l2 weight regularizers and dropout is compiled and fit with the PCA transformed data. Images are predicted and displayed. The accuracy is 97.57%.

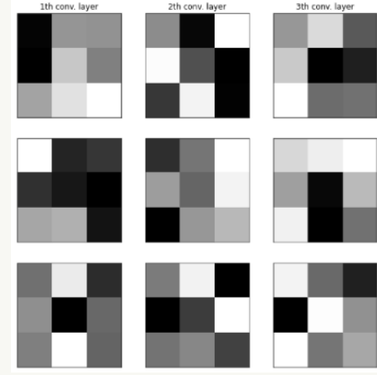
METHODOLOGY FOR SVM WITH HOG

.json data is loaded and data is converted to numpy arrays. Label data is extracted and data is reshaped using transpose. All images are converted from RGB to grayscale and output is a list. Training data is converted from 3D to 2D matrix. Dataset is split into test and train. SVM classifier is implemented with rbf kernel and standard scaler. Classification accuracy is 94.875%. LinearSVC with hinge loss has an accuracy of 83.125%. SGDClassifier() trains model to give an accuracy of 84.375%.

Get_hog(image) function applies a bilateralFilter() to remove the noise and uses Sobel() to calculate gx and gy gradients for edge detection. The gradient magnitude and direction angle are converted from Cartesian to polar and histogram and edges are returned.

HOG and SVM are applied
The model is GridSearchCV and trains svc

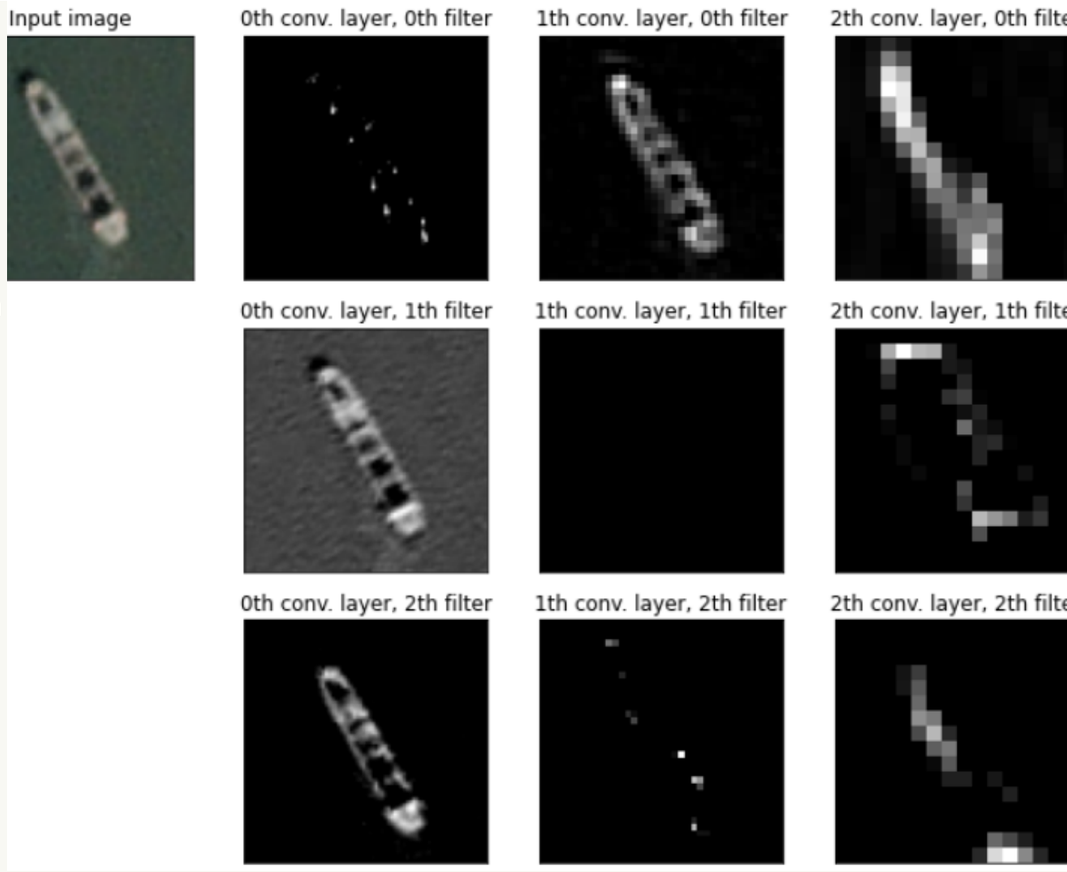
METHODOLOGY FOR DEEP LEARNING



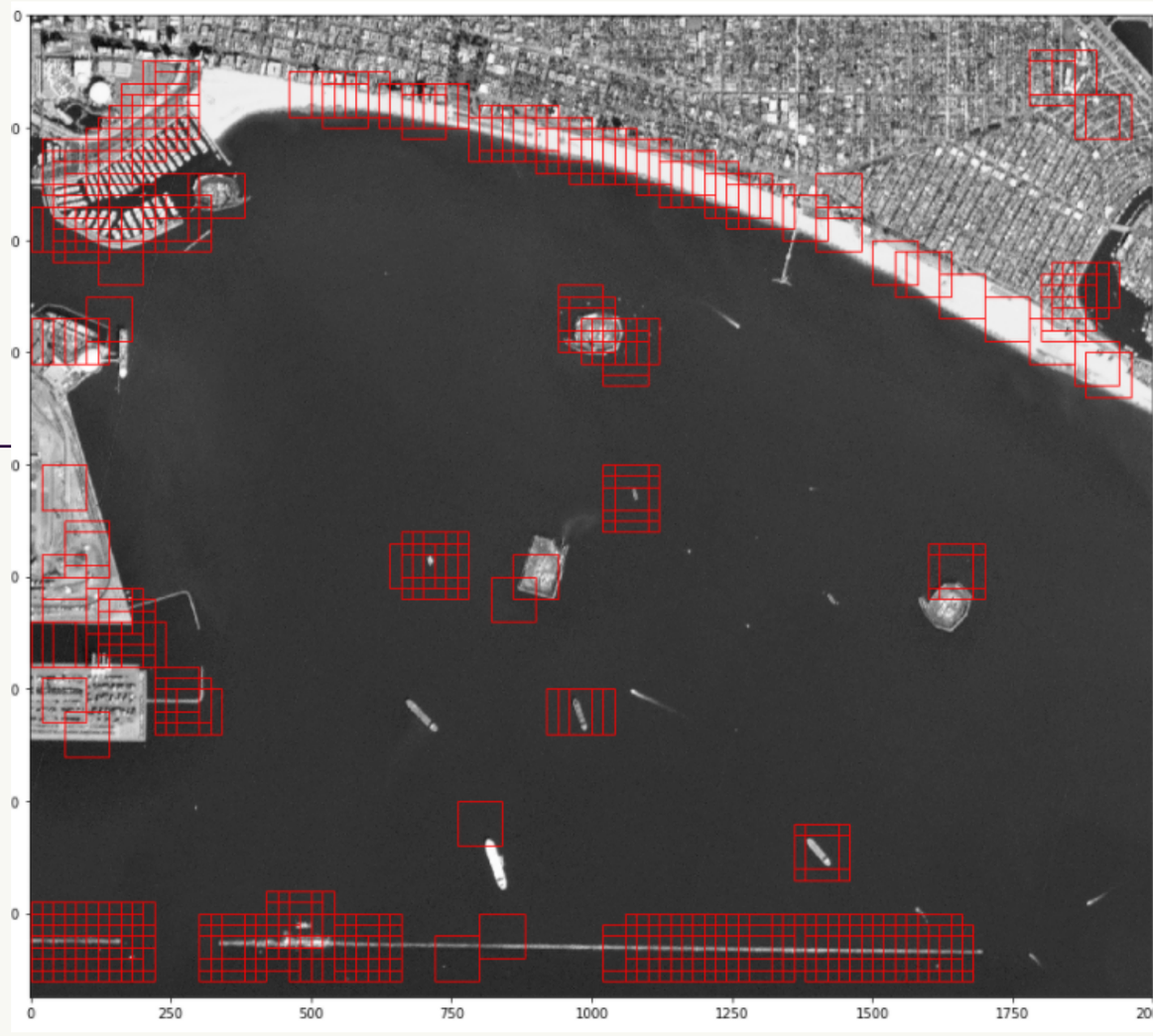
.json file is loaded as dataframe
Normalize RGB data so it ranges between 0 and 1
Reshape and apply transpose on RGB array
Split test and train dataset
Ensure numpy arrays are of type float for Keras
A Sequential model is used. It contains

- Convolutional layer. This layer applies 32 3x3 convolutions to the input 80x80 images in Red Green Blue colours.
- Max pooling layer. This layer gets the maximum of each 2x2 square. It reduces the amount of pixels and simplifies the whole process.
- More convolution and max pooling layers are added. Each new convolutional layer will output a less detailed picture and will capture the essential features of the image, so following layers will have it easier to identify patterns and decide if the image has a ship or not.
- A flatten layer converts the 3D tensor to a 1D tensor.
- Then, a dense layer works just as a regular ANN layer: the input is transformed with some weights to give an output of 64 nodes.
- Finally, a dense layer of just 1 node will give the final outcome of the model: between 0 and 1 to decide if the image contains a ship or not.

The model is compiled using binary cross entropy as the loss function.
After training the model is used to predict x_test. The accuracy is 98.63%. Convolutional layers' filters are plotted by accessing the layers attribute of the model and the get_weights method.



RESULTS



CONCLUSION

Support Vector Machine(SVM) and Histogram of Oriented Gradients
(HOG) offers a decent accuracy when dataset is small. But deep learning offers better results especially after data augmentation.

REFERENCE

Ship detection from optical satellite images based on visual search mechanism | IEEE Conference Publication | IEEE Xplore