**Airbus Ship Detection - Traditional v.s. Convolutional Neural Network Approach**

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CS 229– Machine Learning Project  
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**Introduction**

The fast growing shipping traffic increases the chances of infractions at sea. Comprehensive maritime and monitoring services help to support the maritime and industry to increase knowledge, anticipate threats and improve efficiency at sea. This challenge originates partly from the Airbus Ship Detection Challenge on Kaggle. We developed classifiers to efficiently classify whether there is any ship from satellite images with machine learning and deep learning approaches. Various scenes including open water, wharf, buildings and clouds appear in the dataset.

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**Methodology**

**Traditional Machine Learning Approach**

Linear Discriminant Analysis (LDA):
The algorithm finds a linear combination of features that characterizes and separates two classes, with estimation of the mean and variance for each class.

K-Nearest Neighbors (KNN):
The algorithm classifies an object by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors.

Naïve Bayes(NB):
The algorithm is a probabilistic model based on applying Bayes’ theorem with strong (naïve) independence assumption between feature.

Random Forest (RF):
The algorithm is an ensemble learning method by constructing a multitude of decision trees and outputting the class of the individual tree. We use 70 trees in the forest.

Support Vector Machine (SVM):
The algorithm finds the maximum margin between different classes by determining the weights and bias of the separating hyperplane, with RBF kernel.

**Convolutional Neural Network (CNN) Approach**

The CNN Approach can efficiently capture relevant features from different locations of an image. It takes image as input, go through some hidden layers such as convolutional layers, pooling layers and fully connected layers, and output a prediction probability of the image containing ship.

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**Experiment**

**Dataset:**
We use a public dataset provided on Kaggle Airbus Ship Detection Challenge website. We initially implemented the methods on a dataset with 10k training images and 5k test images. All the image has been resized in 256 x 256 x 3 using the cv2 package in python.

**Feature Engineering for Traditional ML Algorithms:**
We used hand engineering features extraction methods [2] to obtain three different global features for traditional ML algorithms. The images were converted to grayscale for Hu and Ha, and to HSV color space for His before extraction, shown in Figure 4.
- Hu Moments (Hu) features were used to capture the general shape information.
- Color Histogram (His) features were applied to quantify the color information.
- Haralick Textures (Ha) features were extracted to describe the texture.

**Image Augmentation for CNN:**
To improve the robustness of our network, we augmented the training data by rotating, flipping, shifting and zooming training images.

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**Results & Discussion**

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<th>Accur.</th>
<th>His</th>
<th>Ha</th>
<th>Hu</th>
<th>His + Ha</th>
<th>Hu + Ha</th>
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**Table 1: Traditional ML Approach Comparison (w/ Featurering Engineering)**

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**Future Work**

- We plan to extract global features along with local features such as SIFT, SURF or DENSE, which could be used along with Bag of Visual Words (BOW) technique.
- For traditional methods we can apply data augmentation method.
- Implement different network (e.g., deeper network) to train the classifier.
- Come up with a smart input data sampling method that can balance images of different scenes/backgrounds.
- Apply segmentation technique to identify the locations of all ships in a image.

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**Reference**