Classification of maritime objects in TerraSAR-X imagery

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For an adequate security of the maritime domain is necessary to be aware of the objects location and their activities, e.g. ship traffic, in relevant areas of the sea. TerraSAR-X, a satellite radar imager operating at X-band, is a powerful tool to detect maritime objects, e.g. ships, oil platforms, icebergs etc., which can raise potential risk for maritime traffic and environment. The use of satellite radar to create such awareness has the benefits, among many, that can detect also no self-reporting objects; it operates almost independently of cloud cover and beyond coastal ranges. However, radar images are less easy to interpret and carry no direct objects identification information, like it happens in optical images or messaging report systems such as Automatic Identification System (AIS) and Long Range Identification and Tracking (LRIT). Therefore, the challenge is to classify the different types of maritime objects based on the radar signal only. Different machine learning techniques are here investigated to this end.

In this paper the problem at hand is restricted to the classification of 5 common type of maritime object in Synthetic Aperture Radar (SAR) images, i.e. tanker ship, cargo ship, windmill turbine, offshore platform and harbour structure. Cargo and tanker represent ~~are~~ the most correlated in terms of size and mechanical structure, so the most challenging to discriminate. Indeed windmill and platform are yet static object but with the increasing offshore energy production the amount and geographical location is not always available, i.e. new structure being built, removed or moved. Land masking process in high resolution SAR ship detection might suffer from false alarms of harbour structure not included in medium resolution landmask database and therefore being able to identify this class gives the opportunity to reduce this risk.

The Multi Layer Perceptron (MLP) and Convolutional Neural Network (CNN) models are the two feature extractors and classifiers used to accomplish this task. The performance of the two models are evaluated depending on the depth of the network layers and resolution of the input image using a relatively large classification dataset composed of real SAR samples extracted from TerraSA-X images.