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Author: Dr. Domenico Velotto
German Aerospace Center (DLR), Bremen, Germany, Germany, domenico.velotto@dlr.de

Mr. Björn Tings
German Aerospace Center (DLR), Germany, bjoern.tings@dlr.de
Mr. Carlos Bentes
Technische Universität München, Germany, carlos.bentes@tum.de
Dr. Anja Frost
DLR (German Aerospace Center), Germany, anja.frost@dlr.de
Dr. James Imber
DLR (German Aerospace Center), Germany, james.imber@dlr.de

MACHINE LEARNING APPROACHES TO CLASSIFY MARITIME OBJECTS FROM SPACE RADAR

Abstract

For an adequate security of the maritime domain is necessary to be aware of the locations of maritime objects and their activities, e.g. ship traffic. TerraSAR-X, a satellite which operates an X-band radar imager, is a powerful tool to detect maritime objects that can raise potential risk for maritime traffic and environment, e.g. ships, oil platforms, icebergs etc. The use of satellite radar to create such awareness has the benefits, among many others, that also non self-reporting objects can be detected almost independently of cloud cover and beyond coastal ranges. However, radar images are less easy to interpret and carry no direct object 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, i.e. the backscatter signatures. Different supervised machine learning techniques investigated in literature are based on the prior extraction of meaningful object's features that are then fed to a classifier. In the deep learning approach, the job of finding and extracting meaningful object's features is left to a complex neural network. In this paper the State-of-Art of two problems is reviewed: 1) the classification of 5 common types of maritime objects, i.e. tanker ship, cargo ship, windmill turbine, offshore platform and harbour structure; 2) ship-type versus iceberg differentiation. Cargo and tanker represent the most correlated in terms of size and mechanical structure, so the most challenging to discriminate. Indeed windmills and platforms are yet static objects but with the increasing offshore energy production the amount and geographical location is not always available, i.e. new structures are built, removed or moved. The continuing economic development of harbour activities during the last years has pushed the building of new constructions in the coastal areas, which are not mapped or included in navigational sea charts and hence identifying such structures is important for the ship safety on sea. Ship-iceberg differentiation is of paramount importance due to the recent steady trend of high latitude navigation.