# ISAR ship classification using transfer learning

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In an airborne maritime radar, Inverse Synthetic Aperture Radar (ISAR) is used to image and classify non-cooperative targets. Traditional classification approaches rely on geometric features extracted from imagery of known targets to form a training dataset that is later used to classify observed targets. In recent years, deep learning-based techniques have been applied to a number of radar problems with demonstrated improvements over conventional processing schemes. There is a strong motivation to exploit deep learning-based solutions to improve the performance of automatic ship classification of ISAR imagery.

The deep learning-based approach to ISAR image classification is difficult due to small training datasets and the inability to recognise an unknown class. In this work, we focus on these two challenges that are crucial to a real world implementation. The proposed solution to the first challenge is to utilise a transfer learning approach that exploits knowledge in a pre-trained network. A number of network structures have been investigated, including VGG16, VGG19, Inceptionv3, and Xception. The second issue that is addressed is how to deal with an unknown class. This is addressed by replacing the final network layer with a new activation layer known as OpenMax. OpenMax has the capability to exclude outliers based on statistics of intermediate results within the network model. Using an ISAR dataset of small boats, the new classification results are compared with a traditional classification approach and a simple convolutional neural network. A set of experiments against a small dataset with 7 classes has been carried out to show the effectiveness of the proposed transfer learning approach and the OpenMax method.