On the Robustness of Neural Network Algorithms for Oil Spill Detection

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In this paper we present the potentialities of Neural Network algorithms for detection of oil spill. Previous works have demonstrated how neural networks are a valid instrument for this type of analysis. In fact, an artificial neural network (NN) may be viewed as a mathematical model composed of many nonlinear computational elements, named neurons, operating in parallel and massively connected by links characterized by different weights. This particular structure makes neural networks very stable and robust when there are sensible input variations. For this study, multilayer perceptrons (MPL) have been considered, which have been found to have a suited topology for classification and inversion problems. The network input is a vector containing the values of a set of features characterizing an oil spill candidate. The output is a value, included between 0 and 1, representing the probability that the candidate is an oil slick. The classification performance has been evaluated on a data set of ERS-SAR and Envisat-ASAR images containing examples of oil spills and look-alikes. To test the robustness of the algorithm, we have grouped all the collected examples into different subsets considering two main factors: the different SAR instrument (ERS-SAR or Envisat-ASAR) and the natural noise characterizing the image. For this latter case the standard deviation of the backscattering values of the sea surface has been considered as a general noise index. Several nets have been designed using in turn different subsets for the training phase and the performance of each net has been tested on different subsets, either similar or dissimilar to those used in the training. The neural algorithm gives generally satisfactory results, however the performance is clearly affected by the type of examples included in the training set. This effect has been investigated throughout a systematic analysis.