Seabed Recognition Using Neural Networks

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Side Scan Sonar (SSS) imaging is one of the advanced methods for data acquisition about the sea floor. A skilled technician can interpret the images of the area surveyed and produce a base map showing the distribution different classes of seabed materials. Continued monitoring of the seabed by SSS enables the detection of changes in the seafloor. The possibilities of intelligence-based approaches in the analysis of sonar images and classification of seabed material have been explored in this study.

The only available type of measurement for classification SSS images is the grey level of the pixels corresponding to the acoustic reflectance. It is difficult to recognise and classify objects based on a single feature. However, the spatial order of the grey level transitions gives 'texture' characteristics to the image and it is these that act as an important aid in human interpretation. Image texture can be characterised by the Spatial Grey Level Dependence Method (SGLDM) based on the cooccurrence matrix of pairs of grey levels.

Artificial neural networks (ANNs) are powerful tool for classification problems. An ANN can learn the classification task from a set of examples known as training set. Multi Layer Perceptron (MLP) is one of the most popular supervised learning ANN models which is frequently used for classification problems. However, when the prior knowledge about the classes in the data is limited, it is difficult to prepare a data set for training the neural network classifier. Only practical alternative in such situations is to use a data exploration tool that can detect the groups in the data based on their prominent features.

The Self Organising Feature Maps (SOM) is one of the neural network models offering great potential in data exploration. The SOM algorithm is based on unsupervised competitive learning, which means that the training is entirely data driven. The various benefits of SOM include topology-preserving projection of the higher dimensional data space on a regular two-dimensional grid and clustering.

In this study, data exploration of sonar image segments has been carried out using SOM. The developed seabed recognition system consists of a tool for feature extraction from sonar images and two neural network classifiers, the labeled SOM feature map and SOM_MLP classifier. The system identifies the seabed materials like clay/mud, sand, eel grass and gravel from images using five selected features of the image segments; median, 3rd quartile, energy, entropy and momentum.

Both SOM and MLP were developed using NeuroSolutions 3.01