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RDNN for classification and prediction of Rock/Mine in underwater acoustics

Jetty Bangaru Siddhartha [a], T. Jaya [a], V. Rajendran [a]

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Abstract

The detection of minerals (mines) or rocks would have been extremely difficult without the expansion of the Sound Navigation Ranging methodology, which uses specific parameters to determine if a barrier or a surface is a mine or rock. Hence, this proposed work is concerned with the progression of distinctive among metal cylinder which is named as mines and cylindrical shape material which is named as rocks using deep learning based algorithms. Moreover, this work introduced novel technique as Rock or mine Detection Neural Network for performing rock/mine prediction and classification in underwater acoustics. The proposed RDNN method outperforms the outcomes by attaining high accuracy as 92.85% mean accuracy that makes better model performance.

Introduction

One of the major difficult task in sonar targets are classification of substantial properties in underwater acoustics sonar objects such as mine like objects, rocks etc. By Jetty [1] applied various machine learning algorithms for identifying rocks/mines and distinguishing the same from underground data of unmanned vehicle. Here the neural networks are trained to distinguish the sonar based datasets into metal like mine, or rocks of comparable size. Khatik et al. [2] proposed generic rock mass rating for categorizing rocks using artificial neural network. Venkataraman Padmaja et al. [3] Machine learning techniques such as KNN, decision tree, and gradient booster, as well as SVM techniques, were used to separate the objects, such as rock or mine, in order to obtain high resolution images. Using a feature set and a Gradient Boosting classifier, this model achieves an accuracy of roughly 90%. Fig. 1 demonstrates finding abnormalities such as rocks which is classified from mine like objects in underwater acoustics system.

But, this paper focused on performing extra investigation in sonar dataset for detection and distinguishing the rocks or mines like materials in underwater acoustics using deep learning based neural network approach [[32], [33]]. Moreover, comparison of network distinguishing performance of existing deep learning models along with our proposed neural network based layers by evaluating accuracy and loss measures as metrics evaluation.

Section snippets

Related work

Ravi et al. [9] introduced Online Multiple Kernel Learning (OMKL) is a combination of neural networks and online learning that tries to build a kernel-based prediction function from a pool of predefined kernels. Here, SVM and NN algorithms were applied to distinguish sonar data. Hassan et al. [4] utilize PCA and standalone architecture to integrate Back Propagation Neural Network for the categorization of two datasets (sonar and ionosphere datasets) in bagging ensemble architecture. Lee et al.

Proposed workflow

The proposed workflow describes the classification of rock or mine in underwater acoustics through sonar technology.

Step 1: Gathering dataset from the specified repository especially SONAR dataset.

Step 2: Loading the dataset for training phase.

Step 3: Apply feature extraction technique to extract the relevant features related with sonar dataset.

Step 4: Create RDNN algorithm for predicting and categorizing the sonar dataset as normal (mine) and abnormal (rock) in underwater acoustics.

Step 5:

Dataset explanation

The dataset which were utilized in this work have been taken from the resource namely UCI machine learning repository described in Table 1. This high generalization has been attained on the Neural Network based approach. To achieve greater accuracy for performance enhancement, the implementation was done in Python version 3.7 environments. The resource link is mentioned as https://datahub.io/machine-learning/sonar#resource-sonar ↗ [34], [35].

The total number of sonar data available in the source

Proposed architecture

The architecture elucidates about how we are predicting the metal like mine objects, rocks etc and distinguishing the sonar abnormal data into rocks or mines using RDNN classifier model. The proposed framework is depicted in Fig. 5.

The sonar abnormal dataset have been collected from Kaggle website as a source for this work. When the features in the data have diverse ranges, normalization is a strategy used during data preparation to adjust the values of numeric columns in a dataset to use a

Metrics evaluation

A. Central tendency measures

Each layer's activation may result in a different data distribution. As a result, we must normalize the data input to each layer by subtracting the mean and dividing by the standard deviation to improve the stability of deep neural networks. In this method we are estimating the central tendency measures such as mean and standard deviation to enhance the steadiness of neural networks for improving the overall performance. Mean and SD formula along with its description

Experimental outcomes

The layers utilized for sonar abnormal dataset using deep learning neural network based Rock/mine detection and classification. The layers maintained by models, the size of layers, input shape, activation layer and which optimizers are utilized by various existing models and comparing with proposed approach depicted in Table 3.

Conclusion

In this proposed work, RDNN classifier model have been applied for metal classifying namely rock or mine in underwater acoustics through statistical analysis in deep learning based neural networks using sonar datasets. Sonar technology combined with an unmanned autonomous vehicle can be used to remove signals in underwater communication. But, here Rock/mine detection neural network approach reveals enhanced outcomes by achieving mean accuracy of 100% with 0% SD using k-fold evaluation and sonar

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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