Corrosion Protection Status Survey of Submarine Pipelines Based on Bayesian Regulated Neural Networks

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ABSTRACT
Bayesian Regularization Neural Network is used in the estimating system for corrosion protection status survey of submarine pipeline. Firstly it discusses about the theory and approach to mend back-propagation (BP) neural network using Bayesian Regularization training algorithm, then using this algorithm to train and validate an actual Neural Network based on a particular simulation calculated model for the submarine pipeline cathodic protection system, and it was proved that this algorithm effectively improved the precision and generalization capability of BP Neural Network. This approach is used in the estimating software system and need further extension.

KEY WORDS: Submarine pipeline; Corrosion protection; Neural Network; Back-Propagation Algorithm; Bayesian Regularization Algorithm.

INTRODUCTION
As the exploitation of offshore oil and gas, submarine pipeline has been used extensively, and pipeline failure accidents take place frequently. Even a compound anti-corrosion means by using protection coatings and sacrificial anode jointly is generally used the submarine pipeline, according to the statistics, corrosion damnification is one of the key reasons of pipeline failure. So the accurate and effective detection of corrosion protection status of submarine pipe means a lot to the safe operation. Corrosion protection status of submarine pipe can be described by the following several parameters: the defection ratio of anti-corrosion coat, the current of sacrificial anode, the remaining weight of sacrificial anodes and etc. The traditional detection method relies on visualizing of diver which will make the result inaccurate. In order to improve the precision, we creatively bring out a detection method based on the measurement of ambient electric field, which is resulted from the cathodic protection by sacrificial anodes, and meanwhile is affected by status of the compound anti-corrosion system. The influence of negative data will also be avoided in this method. Applying the calculation software for corrosion protection system numerical simulation, the ‘Influencing Factors Database of the Submarine Pipeline Cathodic Protection System’ would be gotten.

Using the characteristic parameters of the ambient electric field as the input, the parameters which describe the anti-corrosion state of submarine pipeline as the output, artificial neural network (ANN) mapping models between these two sets of parameters are designed. In order to apply these theories to practical engineering, a set of applicable technology for practical and equipment solutions has been proposed. Operation mode of the system is shown in Fig. 1, two corrected Cathodic Protection Probes (CP Probe) are set on a Remotely Operated Vehicle (ROV), and the ROV is navigated to the top of the pipeline during the detecting operation. Potential differences of different heights above seabed mud in vertical direction will be gotten by two CP Probes. Using the non-linear mapping relationship between characteristic parameters of the ambient electric field and Corrosion protection status, the data will be related to the defection ratio of anti-corrosion coat, the current of sacrificial anode, the remaining weight of sacrificial anode and etc., and then the purpose of detecting the anti-corrosion state of submarine pipe is realized. Therefore, it is a key point of the system to obtain the accurate mapping relationship between characteristic parameters of the ambient electric field and Corrosion protection status.

Fig. 1 Operation mode of subsea pipeline cathodic protection surveys