Acoustic Characterization and Modeling of the Thickness of a Submerged Tube by ANFIS and the Artificial Neural Network

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Abstract

Several theoretical and experimental studies have shown that the characterization of a target (tube,...) can be made from the cut-off frequencies of the anti-symmetric circumferential waves A1 propagating around the tube of various radius ratio b/a (a: outer radius and b: inner radius). This work investigates the abilities of Adaptive Neuro-fuzzy Inference System ANFIS and Artificial Neural Networks ANN to predict the thickness of a tube immersed in water for various cut-frequency of anti-symmetric circumferential wave A1. The useful data determined from calculated trajectories of natural modes of resonances, were used to develop and to test the performances of these models. The ANN model was trained using Levenberg-Marquardt (LM) algorithm, and the ANFIS model was trained using hybrid algorithm learning that is a combination of Last Square Estimate and the gradient descent back-propagation algorithm. Several configurations are evaluated during the development of these networks. The Mean Absolute Error (MAE), Mean Relative Error (MRE), Standard Error (SE), Root Mans Square Error (RMSE) and Correlation Coefficient (R) were the statistical performance indices that were used to evaluate the accuracy of the various models. Based on the comparison between ANN
and ANFIS, it was found, that the ANFIS model can be applied successfully in the in the modeling of the thickness of a Submerged Tube.

References


Index Terms

Computer Science
Fuzzy Systems

Keywords

Fuzzy logic; ANFIS; Artificial Neural Network; Acoustic response; Submerged elastic shell; Scattering waves; Circumferential waves.