Malik, H.M, Arif, A. F. M., ANN Prediction Model for Composite Plates against Low Velocity Impact Loads Using Finite Element Analysis, Journal of Composite Structures, Accepted for publication, 2013.

ABSTRACT

In this paper, the use of Artificial Neural Networks to predict the absorbed energy in the composite plates impacted with low velocity is described. The impact response of a composite laminate depends upon various factors such as thickness, stacking sequence and number of layers. These factors are identified in an earlier study using the sensitivity analysis. These factors have the most prominent effect on the impact resistance of the composite plates. These are studied here with the help of design of experiments so that a suitable data set is obtained. The ability to solve a large number of simulations using FEA gives an advantage in the design optimization with the help of DOE (Design of Experiments). During the study different variations of these factors were tried and the response in terms of the absorbed energy was estimated. The simulation results were then used along with the ANN (Artificial Neural Networks) to fit a function to estimate the amount of absorbed energy. The results from the DOE follow the intuition that the increase of thickness and number of layers increase the performance of the composite plates. The ANN model is trained such that it is able to predict with an acceptable accuracy range the amount of absorbed energy for different configurations of input variables. The paper discusses the codification of input variables so that they can be used to train ANN model. Also, the use of differential evolution algorithm is discussed which is used to select the best possible ANN model based on the maximum error and root mean square error of the ANN models.

Keywords:Composite plates, Impact Resistance, Design of Experiments, Finite Element Analysis, Artificial Neural Networks, Carbon/Epoxy plates, Glass/Epoxy plates