PREDICTING OPEN-AIR BLAT-INDUCED POSITIVE PHASE PEAK IMPULSE USING DEEP LEARNING

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Abstract: This research uses a deep learning-based model to predict open-air blast-induced peak impulse caused by high explosives. Positive peak impulse, a key blast parameter used to evaluate the blast-induced damage in the environment was predicted via a feed-forward artificial neural network (ANN) for two types of commonly used high explosives; trinitrotoluene (TNT) and Composition B. The supervised learning method was followed when training the ANN. Hence, in order to provide example data to train the ANN model, a broad tabular dataset consisting of the explosive type, explosive mass, standoff distance, and the respective peak impulse as variables was generated using a validated finite element-based numerical model. The dataset used to train the ANN model has standoff distances ranging between 1 m to 20 m and explosives masses ranging from 0.5 kg to 25 kg. The peak impulse, which is the blast parameter to be predicted, is the dependent variable for the dataset while the remaining variables are the independent variables. Part of the dataset was randomly selected and used in training the model and the rest was retained without exposing to the model during the training stage so that it could be used to evaluate the performance of the trained model as unseen data. The hyperparameters of the model were tuned to identify the optimum model architecture and the tuned model was used to predict peak impulse values for the retained data set. The predicted and the actual peak impulse values of the test set were used to evaluate the performance level of the model by employing error metrics including adjusted coefficient of determination, root mean square error and mean absolute error. It was found that the ANN-based models provided extreme fast and highly reliable predictions when compared with the retained data set prediction. Thus, this demonstrated the possibility of replacing the conventional time consuming and computationally expensive physics-based numerical modelling approach for blast parameter prediction by deep learning approach in practical engineering applications.