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Machine Learning Based Seismic Drift Response Estimation of Buckling-restrained Braced Frames

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Abstract

Machine learning (ML) approach has the potential to predict the seismic structural responses that are aleatoric in nature. A well-trained data set using a suitable ML algorithm is essential for this goal. One 8-storey buckling-restrained braced frame (BRBF) was selected and designed as per applicable code provisions. The chosen BRBF was incorporated in OpenSees numerical frame work with pertinent nonlinearities. For the nonlinear time response history analyses, a suitable number of ground motion records were adopted and the structural responses were assessed in terms of drift responses. These drift responses were classified in to different damage states (DS) based on their magnitude and severity. The related regression fits for drift vs seismic intensity measure (IM) and the resulting fragility curves were developed to understand the vulnerability of the system. Using the obtained data ML algorithms such as K-Nearest Neighbour (KNN), Decision Tree (DT), Random Forest (RF), AdaBoost (AB), XGBoost (XGB), Light Gradient Boost (LGB) and CatBoost (CB) were utilized and the corresponding confusion matrixes were generated to obtain the best prediction model. It is found that the RF approach gave the highest accuracy among all the algorithms used.

Keywords: Buckling-restrained braced frames, Non-linear time response analyses, Drift response, Machine learning