National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Deep-Learning based Damage Detection of Structures
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Venue	: Civil Engineering Department seminar Hall
Date and Time	: 21 May 2024 (4.00 PM)

Abstract : Health monitoring of structures is very important for early detection of any changes that occur in the structure which may hamper its overall safety and serviceability. The present study shows a detailed comparison of different Deep learning (DL) algorithms for damage detection of continuous beam using time-domain acceleration data. Gated Recurrent Unit (GRU) and Long Short-Term Memory (LSTM) based DL networks clearly outperform other DL algorithms in this comparison. Different LSTM-GRU based combined algorithms are then analysed and compared in terms of validation and prediction accuracy. Finally, a novel DL-based damage detection method has been proposed for the localization and quantification of damage using a combined GRU-LSTM (P) neural network. Parameter optimization is performed to optimize different parameters of the proposed algorithm. Simulated acceleration data of a two-span continuous steel beam, generated from finite-element based software ABAQUS, is used in this research to detect the location and severity of damage. Varying percentages of Gaussian random noise are added to the acceleration data to generate noisy simulated data that resemble the practical scenario. Finally, the algorithm is validated by detecting different damage scenarios from real-life raw acceleration data of the Z24 bridge to check the robustness of the model. The investigation concludes that the proposed damage detection method using GRU-LSTM (P) based combined neural network is highly effective in localizing and quantifying damages of structures from the time domain acceleration dataset.

Keywords: structural health monitoring, structural damage detection, gated recurrent unit, long short-term memory, deep learning