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DEEP NEURAL NETWORKS FOR UNSUPERVISED DAMAGE DETECTION ON THE Z24 BRIDGE

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During the life-cycle, civil infrastructures are continuously prone to significant functionality losses, primarily due to material's degradation and exposure to several natural hazards. Following these concerns, many researchers have attempted to develop reliable monitoring strategies, as integration to visual inspections, to efficiently ensure bridge maintenance and early-stage damage detection. In this light, recent improvements in sensor technologies and data science have stimulated the use of machine learning algorithms for Structural Health Monitoring (SHM). Among unsupervised learning techniques, the potential of autoencoder networks has been attracting notable interest in the context of anomaly detection. Particularly promising is the Long Short-Term Memory (LSTM) autoencoder, which allows to handle long-term dependencies hidden in time-series data. In this framework, the present paper illustrates an innovative autoencoder-based damage detection technique by application to the Z24 benchmark bridge. During the training, the developed model learns how reconstructing raw acceleration sequences, acquired from a healthy structure, and how capturing the influence of environmental effects on bridge dynamics. The network is afterwards tested with unknown data, including both healthy and damaged bridge responses. In order to quantify the errors between the original and reconstructed sequence, specific indexes of reconstruction loss are selected as damage sensitive features. Results demonstrate the effectiveness of the proposed methodology to perform feature classification and real time damage detection as new sensor data is collected, resulting suitable for continuous assessment of full-scale monitored bridges.