World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:16, No:12, 2022

An Integrated Label Propagation Network for Structural Condition Assessment

Authors : Qingsong Xiong, Cheng Yuan, Qingzhao Kong, Haibei Xiong

Abstract : Deep-learning-driven approaches based on vibration responses have attracted larger attention in rapid structural condition assessment while obtaining sufficient measured training data with corresponding labels is relevantly costly and even inaccessible in practical engineering. This study proposes an integrated label propagation network for structural condition assessment, which is able to diffuse the labels from continuously-generating measurements by intact structure to those of missing labels of damage scenarios. The integrated network is embedded with damage-sensitive features extraction by deep autoencoder and pseudo-labels propagation by optimized fuzzy clustering, the architecture and mechanism which are elaborated. With a sophisticated network design and specified strategies for improving performance, the present network achieves to extends the superiority of self-supervised representation learning, unsupervised fuzzy clustering and supervised classification algorithms into an integration aiming at assessing damage conditions. Both numerical simulations and full-scale laboratory shaking table tests of a two-story building structure were conducted to validate its capability of detecting post-earthquake damage. The identifying accuracy of a present network was 0.95 in numerical validations and an average 0.86 in laboratory case studies, respectively. It should be noted that the whole training procedure of all involved models in the network stringently doesn't rely upon any labeled data of damage scenarios but only several samples of intact structure, which indicates a significant superiority in model adaptability and feasible applicability in practice.

Keywords : autoencoder, condition assessment, fuzzy clustering, label propagation
Conference Title : ICCCBE 2022 : International Conference on Computing in Civil and Building Engineering
Conference Location : Auckland, New Zealand
Conference Dates : December 02-03, 2022