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Pattern recognition-based unmeasured structural response estimation for bridges using LSTM

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ABSTRACT

This study proposes an innovative structural response estimation method for structural health monitoring. Because the structures have their own mechanical characteristics directly affected by the material, geometric properties, and boundary conditions, they show structural behavioral patterns. It means that if the structural pattern can be effectively recognized, the structural responses which could not be easily detected by sensors can be estimated. Based on the fundamental structural engineering concept, we reify the behavioral pattern recognition-based structural response estimation method using the LSTM algorithm, which is widely used for dealing with time-series data. The target structure is the Chung-Dam bridge located in Seoul, South Korea. For the feasibility study, the finite element (FE) model of the target bridge was used to generate the data for training and validation. First, the LSTM algorithm for structural behavioral pattern recognition is trained by using the prepared data. Then, the trained algorithm is used to estimate the unmeasured structural responses of the target bridge. The validation study well shows that the proposed method can effectively estimate the structural responses. Using the proposed approach, many structural responses could be precisely estimated. Therefore, the structural state could be evaluated using the essential responses. Also, the long-term structural condition change could be effectively recognized using this approach.

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