The 2022 World Congress on
The 2022 Structures Congress (Structures22)
16-19, August, 2022, GECE, Seoul, Korea

Physics-informed neural network for dynamic responses of structures based on monitoring data

*Jaehwan Jeon[1] and Junho Song[2]

[1),2)] *Department of Civil and Environmental Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, S. Korea*
[1)] *dudesup123@snu.ac.kr*
[2)] *junhosong@snu.ac.kr*

ABSTRACT

Structures under dynamic loads are inevitably subject to the risks of serviceability problems and even structural failures. Various methods have been developed in civil engineering fields to predict dynamic responses based on monitoring data. However, for multi-degree-of-freedom (MDOF) structures, such predictions require large computational costs and become challenging with even modest nonlinearities. This paper develops a physics-informed neural network that accommodates monitoring data into the linear model of an MDOF structure through a neural network. The method uses modal properties of the given linear model to reduce the dimension of the system and augments the equation of motion by the neural network trained by monitoring data. The numerical example of a bridge structure subject to wind loads demonstrates that the proposed method can predict the nonlinear responses of MDOF structures successfully.

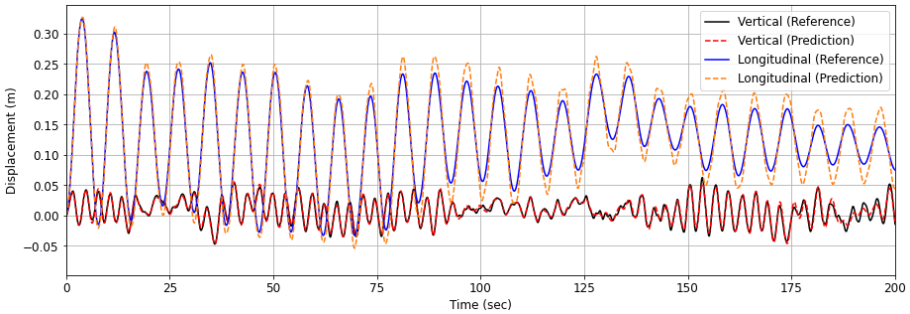

Fig. 1 Predictions by neural network augmented physics model for the Lysefjord bridge

REFERENCE

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[1)] Graduate Student
[2)] Professor

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