Identification through Frequency-Domain Methods of Hysteretic Models for Bolted Joints of Assembled Structures

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Abstract

Assembled structures play an essential role in dynamic structural applications. However, the nonlinear interactions that occur in the joint interface are complex and challenging for modeling mainly due to the customarily hysteretic effect generated in these spots. Therefore, some contributions still lacking in the literature to analyze the dynamic behavior and to predict the structural properties on the joints. Hence, this article proposes to apply and to compare both the harmonic balance method and the harmonic probing technique to update parameters from experimental measurements for a beam structure with bolted joints operating under nonlinear regime of motion. The main novelty of this work lies on performing a nonlinear modal analysis of the assembled structure through frequency domain methods when the excitation assures a weak hysteretic force. An experimental setup composed of two substructures, both made of aluminum and connected by a bolted joint, is used to identify the nonlinear frequency response functions from the measurement data and then to extract the model parameters. The Bouc-Wen model is adapted to create a nonlinear mathematical model that represents the hysteretic effect in the joint interface, since the model can achieve a wide range of states of hysteresis loops analytically. The updated numerical models obtained from the two different strategies are also correlated with experimental data. The results show that the frequency domain methods provide a useful and straightforward approach for nonlinear updating of hysteretic models for assembled structures by bolted joints.

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