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Pod-Based Identification of Modal Parameters from Wind-Induced Structural Response

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Summary

The identification techniques for modal parameters such as natural frequencies, mode shapes, and modal damping ratios are frequently used for design and maintenance of struc-tures.

Conventional modal identification techniques extract such parameters based on the in-formation of both input loadings and output responses, which are called input-output meas-urement approach. The data for input and output can be obtained by exciting the structure with a shaker or by imparting an impact load on the structure. However it is not easy or prac-tical to vibrate a real structure to extract modal parameters, especially when the structure is large in size. To overcome this problem the output-only measurement approach is studied to identify modal parameters based on dynamic responses caused by natural external loads such as wind or earthquakes.

In this paper, the Proper Orthogonal Decomposition (POD) method, which is a statistical analysis technique to find the modal characteristics of a structure, is adapted to identify the modal parameters of a tall chimney structure. As an applied load, a time history of wind force is obtained from a wind tunnel test of a scaled model. The POD method is applied on the wind-induced structural responses to predict the modal parameters of the structure. The analysis results shows that the modal parameters including natural frequencies, mode shape vectors, and modal damping ratios of the structure can be estimated accurately using the POD method. Based on the analysis results, it is concluded that the POD can be used as an output mode identifier which can complement the shortcomings of conventional input/output mode identifiers.

keywords: Proper Orthogonal Decomposition, Modal Identification, Tall Chimney Structure, Wind Tunnel Test.

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