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THE FREQUENCY BASED SUBSTRUCTURING SCHEME FOR THE INVESTIGATION OF THE DYNAMIC BEHAVIOUR OF A STRUCTURE WITH BOLTED JOINTS

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ABSTRACT

There is a growing need for versatile and economic methods to accurately predict the dynamic behaviour of a large complex assembled structure which usually consists of substantial number of substructures connected together by various types of joints. Dynamic substructuring methods are the most suitable methods used by the modal analysts to predict the dynamic behaviour of the structure. One of the most preferable dynamic substructuring methods used is the frequency based substructuring (FBS) method with the capability to versatility assemble the analytically derived FRF with the experimentally derived counterparts. However, the accuracy and efficiency of the predicted dynamic behaviour of the structures using the FBS method is often found to be different from the experimental results. The discrepancies are believed to be the results of the quality of measured data and also lack of information of rotational degrees of freedom. In addition, the inappropriate coupling types used in the substructuring procedure is believed to be a significant contributor to the discrepancies. This is because the joints itself such as bolted joints are very complex to be analytically and numerically modelled. Therefore, these scenarios are the significant impetus to the chief goals of this research which are to investigate the capabilities of the FBS method in coupling the finite element model FRFs with the experimental counterparts of the substructures and to enhance the coupling scheme for bolted joints. The structure under the investigation consists of a large flat span and two simplified aircraft pylons. The pylons are connected together using a number of bolted joints. Modal tests were performed to measure the dynamic behaviour of the assembled structure and its components. The finite element method was used for constructing the numerical models of the assembled structure. The FBS method was then used for the assembly of the finite element model of the span and pylons by using different types of coupling, and also was used to predict the dynamic behaviour of the assembled structure. The predicted results were validated with the experimental counterparts. This work revealed that by implementing the proposed coupling scheme which was developed based on 3D type of element and elastic coupling has led to the improvement in the FBS predicted results.

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