Impact Force Identification With Pseudo-Inverse Method on a Lightweight Structure for Under-Determined, Even-Determined and Over-Determined Cases

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ABSTRACT

Force identification using inverse technique is important especially when direct measurement through force transducer is not possible. Considering the effects of impact excitation force on the integrity of a lightweight structure, impact force identification has become the subject of several studies. A methodology utilising Operating Deflection Shape (ODS) analysis, Frequency Response Function (FRF) measurement and pseudo-inverse method to evaluate the dynamic force is presented. A rectangular plate with four ground supports was used as a test rig to simulate the motions of a simple vehicle body. By using the measured responses at remote points that are away from impact locations and measured FRFs of the test rig, unknown force locations and their time histories can be recovered by the proposed method. The performance of this approach in various cases such as under-determined, even-determined and over-determined cases was experimentally demonstrated. Good and bad combinations of response locations were selected based on the condition number of FRF matrix. This force identification method was examined under different response combinations and various numbers of response locations. It shows that in the over-determined case, good combination of response locations (i.e. low average of condition number of FRF matrix) and high number of response locations give the best accuracy of force identification result compared to under-determined and even-determined cases.

KEYWORDS: Condition number; Frequency response function; Impact force identification; Pseudo-inverse method; Response combination

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