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COMPARISON OF DIFFERENT APPROACHES TO ANALYZE RESPONSES OF STACKED SOLAR ARRAYS IN A REVERBERANT ACOUSTIC FIELD

Abstract

The analysis of the structural response for stacked solar arrays exposed to a reverberant acoustic excitation has been a hot research topic in the field of spacecraft structural dynamics for years, since solar arrays are very sensitive to the acoustic field which could bring about severe damage to the structure. This type of analysis is very difficult, partially because the peculiar random excitation is hard to simulate accurately, and partially because the system is hard to model, such as the narrow cavities between the array panels. Currently, there are several different approaches to do the analysis. Since the responses cover the full frequency range from several hertz to thousands of hertz, none of these methods is proved to be universal and practical to all conditions until now. In this paper, four methods are applied to model the excitation and the solar array system, and the results are compared. Firstly, the theoretical backgrounds of FEM, coupled FEM/BEM, hybrid FE-SEA and SEA are briefly introduced. Then, the modeling details for solar arrays are presented for each method and their results are compared at important positions and frequency points. It is found that FEM is efficient to model the narrow acoustic cavity, BEM or Semi-infinite Field (SIF) is effective to model the outside acoustic field, and FEM or SEA could be easily applied to model the structures such as the panels, according to different frequency bands. Finally, based on the comparison between the numerical results and ground vibration test results, an appropriate solution is recommended. It is concluded that the above methods should be combined for different frequency bands in order to obtain the reliable and efficient response prediction of solar arrays in a full-frequency acoustic field, while it becomes a key issue in the engineering view to set the “boundries” between each method.