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A virtual shaker testing experience: Modeling, computational methodology and preliminary results

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Abstract. This work illustrates the progress of a TAS activity at exploring the challenges and the benefits of the Virtual Shaker Testing (VST) approach. The definition and the validation of new computational methodologies with respect to the state of the art were encouraged throughout this activity.

The shaker Finite Element (FE) model in lateral configuration was built for the purpose and it was merged with the SpaceCraft (S/C) FE model, together with the S/C-Shaker adapter. FE matrices were reduced through the Craig-Bampton method. The VST transient analysis was performed in MATLAB® numerical computing environment. The closed-loop vibration control is accounted for and the solution is obtained through the fourth-order Runge Kutta method.

The use of pre-existing built-in functions was limited by authors with the aim of tracing the impact of all the problems' parameters in the solution. Assumptions and limitations of the proposed methodology are detailed throughout this paper. Some preliminary results pertaining to the current progress of the activity are thus illustrated before the conclusions.

Keywords: virtual shaker testing; vibration tests; structural dynamics; S/C mechanical testing

1. Introduction

In the aerospace industry the base-shake sine testing is a well-known technique employed to ensure that the structure will survive the low frequency environment. Ideally, the input accelerations on the tested structure during the vibration test would be the same as the ones stated in the test specification. However, this ideal situation is not practical for several reasons. Among the others, one of the most important causes of discrepancies is given by the dynamic coupling between shaker and test article, which grows as the effective masses of the article increases. Since the numerical sine test-prediction is commonly obtained by imposing the ideal acceleration of the test specification to the base of the S/C, the numerically predicted structural responses of the tested structure are typically not in good agreement with the ones from the test.

The VST approach is a promising way to include the dynamic coupling between shaker and test article in the numerical sine test prediction. Basically, VST consists of a refined modeling

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