IAC-06-C2.3.8

DYNAMIC ANALYSIS WITH VARYING PARAMETER USING THE FACTORIAL DESIGN METHOD

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ABSTRACT

For varying parameter (e.g. stiffness, damping, or masses in case of different filling level of propellant tanks) in structural dynamic analysis there is the method of factorial design, which allows with a minimum of evaluations based on large and complex simulation models (in general FE-Element models) to establish analytical approximation models covering a range of parameter. These approximation models take into account interactions of the different parameter and can be used for quick and systematic investigations, e.g. optimization. The benefit of the method is demonstrated on different realistic examples for Ariane 5 dynamic analyses.

INTRODUCTION

Dynamic responses are depending sensitively on the knowledge of the model parameter (masses, stiffness, damping). These parameter can vary or change due to different reasons, e.g.:

- Various payload models have to be considered in the launcher/payload coupled analysis leading to different responses
- A model parameter is non-stationary, it changes over the time (e.g. propellant loading or a compensator stiffness due to different pressurization)
- There are uncertainties in a model parameter and a range around the estimated parameter shall be considered
- Due to the customer requirement a design parameter shall be kept variable in a certain range and the design verification shall consider this flexibility (e.g. a tank family with different cylindrical length)

Presently the above mentioned problems are dealt by a huge amount of parametric investigations, usually using large FE models and resulting in a time consuming effort.

An efficient way to deal with these problems is the Factorial Design Method. This method allows