

# MSC/NASTRAN SOLUTION 200, TIGHTLY INTEGRATED TO THE TEST ENVIRONMENT WITHIN LMS LINK: A POWERFUL APPROACH TO DYNAMIC ANALYSIS AND TEST INTEGRATION

Marc Brughmans, Katrien Wuyckaert  
LMS International, Interleuvenlaan 68, 3001 LEUVEN, BELGIUM

**ABSTRACT.** *Dynamical analysis of prototype components and assemblies is a very important step in design optimisation for noise, vibration and comfort applications. For global response predictions of assembly systems, it is important to start from individual models which one is confident with. Finite element model and test correlation are therefore important steps in this process. This supports the user to look for possible inaccuracies or inconsistencies during the modelling process.*

*An important further step in this dynamic test-analysis integration is to use this correlation information to further tune the finite element model, certainly in areas where the analyst has less confidence in the modelling parameters. In this step, optimisation strategies are very apt to improve these parameters in order to have the model better correlate with the prototype measurement values.*

*The paper discusses the process of using the MSC/Nastran solution 200 optimisation strategies for this updating and tuning process. For given target criteria, obtained from the test-analysis correlation step, like resonance frequencies, frequency response function amplitude differences, and for a selected set of physical parameters, as defined within the LMS Link environment, the necessary input data for the solution 200 process are generated. The optimisation is fully driven within the solution 200 context. The integration of solution 200 within the LMS Link context therefore offers the full advantage of the strong optimisation capabilities of MSC/Nastran, integrated with the test environment within LMS Link.*

## 1. INTRODUCTION

The objective of a finite element/test dynamic correlation, sensitivity analysis and updating step, is to finally obtain a finite element component model of which a number of more uncertain parameters are corroborated by the test model. The process of such a FE/test integration is depicted in figure 1.

In a first step, a geometrical correlation of the test and FE geometry is performed, which generates information on how the test data must be geometrically mapped on the FE data. Not always is measurement information available exactly in nodes of the FE model; typically also the number of degrees of freedom in the FE model outnumbers by far the number of degrees in the test model. Additionally, the co-ordinate systems in which test models are defined are not necessarily coincident with the co-ordinate systems of the FE models. This necessitates to implement strategies for geometrically mapping the test data onto the FE model, this both for the nodal systems, the co-ordinate systems and the resulting test data (both modal and frequency response functions).

In a second step, the FE dynamic responses are compared to the measured responses; this typically is performed with the help of a set of dedicated correlation tools, which can be both modal and frequency response function based tools. Modal based tools include a.o. MAC, CoMAC, MACCo, orthogonality and pseudo-orthogonality; frequency response function based correlation tools focus more on differences between response functions. From the correlation analysis, target criteria can be derived for the updating step.

When differences occur between the FE and the test model, it is important to select a subset of parameters in the FE model which are on the one hand the more uncertain parameters in the FE model, and on the other hand the ones that have a substantial impact and thus sensitivity on the target response. This parameter selection in the FE model is therefore guided by a sensitivity analysis, in which the derivatives of the target criteria (for instance frequency difference between test and FE model) as w.r.t. the selected parameter set are calculated via an (interrupted) solution 200 sequence. This allows to determine the most sensitive parameters before launching a computational intensive iterative optimisation.

The final step then is to launch an iterative solution 200 sequence to update the selected parameters in the FE

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