SDLV125 – Identification of loading starting from the answer interspectrale

Summary:

This case test validates the identification part the effort of the operator CALC_ESSAI. Measurement was simulated by using the operator OBSERVATION.
The operator is normally used in mode **INTERACTIVE**. When it is not the case, as in this CAS-test, the execution is done in the command file, which carries out, instead of the user, the functions of identification.

1 Problem of reference

1.1 Geometry

One considers a hollow roll embedded at his base and cover on his higher face. The made cylinder $2\,m$ of length and $1\,m$ of diameter.

1.2 Properties of material

The material is elastic isotropic whose properties are:

- $E=7.110^{10}\,Pa$
- $\nu=0.3$
- $\rho=2820\,kg/m^3$

1.3 Boundary conditions and loadings

The cylinder is embedded on its lower board.
One applies simultaneously a vertical effort to the center of the lid and a horizontal effort in a point of the circumference of the lid. The loading is described in the form of matrix interspectrale.

1.4 Initial conditions

Nothing

2 Reference solution

2.1 Method of calculating

One seeks to find the loading applied starting from the answers measured in some points of observation.

The identification of the efforts supposes that one can break up the movement of the structure studied on a modal basis Φ . The assumption is also made that the efforts to be identified are localised on degrees of freedom declared a priori by the user.

The answer of the structure, at the frequency ω , is written in the following way:

$$y(\omega)=[C\,\Phi].[Z(\omega)]^{-1}.[\Phi^T B].f(\omega)$$

The matrix C is the matrix of observation allowing to pass from the degrees of freedom of the digital model to the degrees of freedom observed.

The matrix B is the matrix of localization allowing to pass from the degrees of freedom of the digital model to the degrees of freedom where the efforts are applied.

Dynamic impedance Z is written: $Z(\omega)=[\Phi^T K\,\Phi-\omega^2\Phi^T M\,\Phi]$

To identify the efforts amounts reversing the system above:

That is to say: $f(\omega)=[\Phi^T B]^{-1}.[Z(\omega)].[C\,\Phi]^{-1}.y(\omega)$

2.2 Sizes and results of reference

It is considered that the identification occurred well, if the relative error on the resynthetized answer is worthless.
One calculates this relative error by carrying out the relationship between value RMS of the difference between the autospectres of measured displacement and resynthetized displacement, and value RMS of the autospectre of measured displacement.

2.3 Uncertainties on the solution

The reference variable suggested makes it possible to check the good progress of the inversion. One can regard it as an analytical solution.

3 Modeling A

3.1 Characteristics of modeling

A modeling is used DKT.

One simulates measurement by using the operator OBSERVATION. One considers three points of observation on the lid and six points of observation on the side face.

The answer is projected on a basis made up of the first ten clean modes of the cylinder with a modal damping of 0.01.

The efforts are applied to three ddl (vertical effort in the center of the lid and effort in the plan of the lid in a point of its circumference). One identifies the interspectres of the efforts starting from the interspectres of the answers measured on the points of observation.

3.2 Characteristics of the grid

The grid contains 2934 elements of the type QUAD4.

3.3 Sizes tested and results

One tests the relative errors on the resyntethized answers.

Identification	Type of reference	Value of reference	Tolerance
Degrees of freedom observed (name of the node and direction of observation): N5, N8, N15, N17, N20, N27 on DX and DZ N24 , N28 , N30 on DY	'ANALYTICAL'	0	0.2

4 Summary of the results

This case test makes it possible to validate the identification part of the efforts of the operator CALC_ESSAI.
The identification of the efforts passes by an inversion of a matrix which can be almost singular close to the frequency of resonance of the system. In spite of this singularity, one can consider that the got results are correct in the studied waveband.