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## SDLS121 – Retiming of the parameters of a dynamic model by modal analysis

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### Summarized:

This benchmark of the command validates the features of retiming in dynamics `MACR_RECAL`. They is in particular factor key word `DYNAMIQUE` but also the new algorithms of optimization: the algorithm évolutionnaire as well as the hybrid technique based on a combination enters the algorithm évolutionnaire and that of Levenberg-Marquardt.

One considers a plate with a discrete mass placed above and one readjusts, by three different methods, two parameters of the model: the thickness of the plate and the value of the discrete mass. The experimental results are the modal eigenfrequencies and the deformed of the eigen modes identified by the measurement and which one stored in a file in format unv.

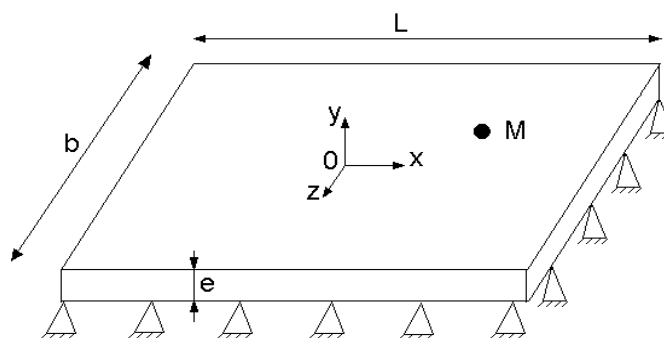
## 1 Problem of reference

### 1.1 Geometry

the structure is a plate with following dimensions (see [Figure 1.1 - has]):

- length  $L=10\text{ m}$  ;
- width  $b=10$  ;
- thickness  $e=0.5\text{ m}$  .

The origin of the reference system is located at the center of the plate and a discrete mass  $M=5\text{E}4\text{ kg}$  is placed at  $X=2\text{ m}$   $Y=3\text{ m}$  .



Appear 1.1-a : Geometry of the plate

### 1.2 Properties of the material

Modulus Young:  $E=2\text{E}11\text{ Pa}$

Poisson's ratio:  $\nu=0.3$

Density:  $\rho=7800\text{ kg/m}^3$

### 1.3 Boundary conditions and loadings

the plate is embedded on its edges. (see Figure1.1-a).

## 2 Reference solution

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### 2.1 Méthode de calcul

This computation is a validation of option `DYNAMIQUE` of the macro `MACR_RECAL`. With this intention, the approach is the following one:

- one does a calculation known as “experimental” to obtain the modal base exported in format `unv` as if it would have been provided by measurement, while considering for the parameters of the model to readjust the expected values optimal,
- one supposes now that the values to be identified preceding are unknown for us. The only information which one has it is the modal base which we will thus regard as an experimental measurement,
- one then launches optimization on this pseudonym measures experimental by taking for each parameter an arbitrary value,
- one checks that the values identified by the algorithm are well the values to be identified.

This approach is very classical in optimization where it makes it possible to validate the algorithms.

### 2.2 Quantities and results of reference

the reference variables are the values of the parameters with convergence is:

- $e = 0.5 m$
- $M = 5E4 kg$

## 3 Modelization A

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### 3.1 Characteristic of the modelization

In this modelization, of plate type `DST`, one considers method "HYBRIDE" to carry out the retiming of the discrete mass and the thickness of the plate. The initial values and the acceptable fields of the parameters are:

- mass : 30000 in [20000.,70000.]
- thickness : 0.15 into [0.1,1.]

the discrete mass is introduced using an element `DIS_T`.

### 3.2 Characteristics of the mesh

the structure is modelled by a regular mesh composed of  $20 \times 20$  `QUAD4`, respectively along the axes  $x, y$  (see [Figure 3.2 - has]).

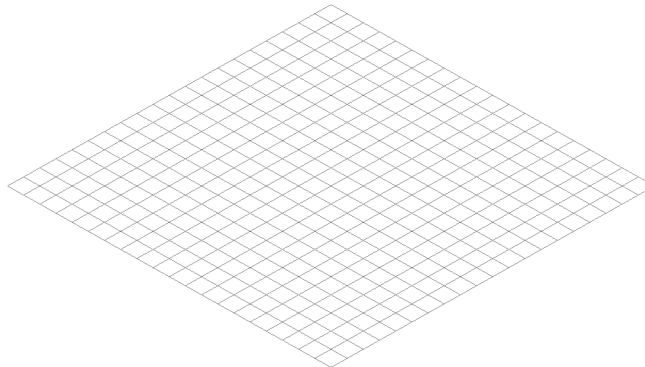


Figure 3.2 - a: Mesh for modelization A.

### 3.3 Grandeurs testées et résultats

Identification	Reference
Thickness	0.5
discrete Mass	50000

## 4 Modelization B

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### 4.1 Characteristic of the modelization

In this modelization, of plate type `DST`, one considers method "LEVENBERG" to carry out the retiming of the discrete mass and the thickness of the plate. The initial values and the acceptable fields of the parameters are:

- mass : 30000 in [20000.,70000.]
- thickness : 0.25 into [0.1,1.]

the discrete mass is introduced using an element `DIS_T`.

### 4.2 Characteristics of the mesh

the structure is modelled by a regular mesh composed of  $20 \times 20$  `QUAD4`, respectively along the axes  $x, y$  (see [Figure 3.2 - has]).

### 4.3 Quantities tested and results

Identification	Reference
Thickness	0.5
discrete Mass	50000

## 5 Modelization C

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### 5.1 Characteristic of the modelization

In this modelization, of plate type `DST`, one considers method "GENETIQUE" to carry out the retiming of the thickness of the plate. The initial value and the acceptable field are:

- thickness : 0.35 in  $[0.3, 0.7]$

the value of the discrete mass is considered known and fixed at 50000 kg .

### 5.2 Characteristics of the mesh

the structure is modelled by a regular mesh composed of  $20 \times 20$  `QUAD4`, respectively along the axes  $x, y$  (see [Figure 3.2 - has]).

### 5.3 Quantities tested and results

Identification	Reference
Thickness	0.5

## 6 Modelization D

### 6.1 Characteristic of the modelization

One uses the same initial characteristics as the modelization A or B.

For this modelization D, the technique of modal retiming used consists with diagonalizing the generalized stiffness matrixes and of mass obtained with the identified modal deformed shapes extended on the model numerical. One also tries to minimize the difference between the eigenfrequencies identified and the eigenfrequencies estimated by carrying out the relationship between the generalized stiffness and the generalized mass of each mode.

The expansion of the identified eigen modes "in experiments" is carried out as a preliminary in the master file. The generalized matrixes are calculated by the operator `MAC_MODES` in slave file.

One does not use option `DYNAMIQUE` of the macro `MACR_RECAL`. The mode of launching of computation slave is of type `INCLUSION`.

In this modelization, of plate type `DST`, one considers method "LEVENBERG" to carry out the retiming of the discrete mass and the thickness of the plate. The initial values and the acceptable fields of the parameters are:

- mass : 30000 in [20000.,70000.]
- thickness : 0.25 in [0.1,1.]

the discrete mass is introduced using an element `DIS_T`.

### 6.2 Characteristics of the mesh

the structure is modelled by a regular mesh composed of  $20 \times 20$  `QUAD4`, respectively along the axes  $x, y$  (see [Figure 3.2 - has]).

### 6.3 Quantities tested and results

Identification	Reference
Thickness	0.5
discrete Mass	50000

## 7 Summary of the results

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This benchmark allowed the validation of the features of retiming in dynamics with command `MACR_RECAL` by means of the experimental data resulting from the modal analysis. Four methods were tested and that which gives the best results is method `HYBRIDE` than one advises with the use to readjust the parameters of nature different from a dynamic model.