
SDLV401 - Full sphere free-free

Abstract:

This three-dimensional test of modal analysis consists in calculating the eigenfrequencies of a full sphere into free-free.

The interest of this test is to evaluate the robustness and the performance of *Code_Aster* in the detection of the rigid modes and the multiple frequencies, during the use of voluminal elements.

The reference solution is numerical and is obtained using the computation software of structures by finite elements the SAMCEF software.

In this test, one compares the results got with two types D "elements:

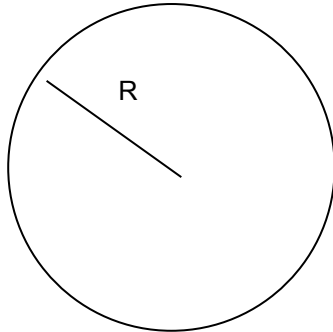
- 1) L" element HEXA8 (modelization A)
- 2) element HEXA20 (modelization B).

In order to determine the clean elements of this system, the method known as of SORENSEN is used.

1 Problem of reference

1.1 Geometry

full Sphere:



interior Radius $R=0.01\text{ m}$

1.2 Material properties

the linear presumedly elastic material has the following characteristics:

$$E = 1.E8\text{ Pa}$$

$$\nu = 0.3$$

$$\rho = 10000\text{ kg/m}^3$$

1.3 Boundary conditions and loadings

the studied structure is free in space.

2 Reference solution

2.1 Method of calculating used for the reference solution

the reference solution is numerical: it is obtained with the computation software of structures by finite elements the SAMCEF software.

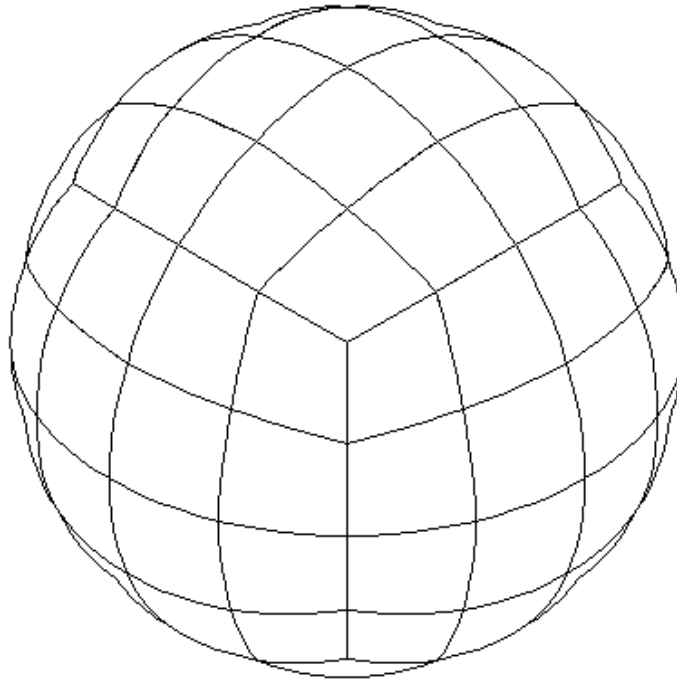
The méthode de calcul of the eigenfrequencies is the method known as of SORENSEN (method by default in operator `MODE_ITER_SIMULT`).

2.2 Results of reference

the structure presenting six rigid modes, one is interested in the first 10 non-zero eigenfrequencies. The following table shows the values of the frequencies obtained (in Hz) according to the degree of the voluminal elements.

Mode	Degree 1	Degree 2
1	2.54231 E3	2.47035 E3
2	2.54231 E3	2.47035 E3
3	2.60747 E3	2.47101 E3
4	2.60747 E3	2.47101 E3
5	2.60747 E3	2.47101 E3
6	2.74095 E3	2.61296 E3
7	2.74095 E3	2.61296 E3
8	2.74095 E3	2.61430 E3
9	2.76313 E3	2.61430 E3
10	2.76313 E3	2.61430 E3

3 Modélisation A



3.1 Characteristic of the modelization A

Mesh made up of elements `HEXA8`

3.2 Characteristic of the mesh

Many nodes: 417

Number of meshes and type: 160 `HEXA8`

3.3 Quantities tested and results

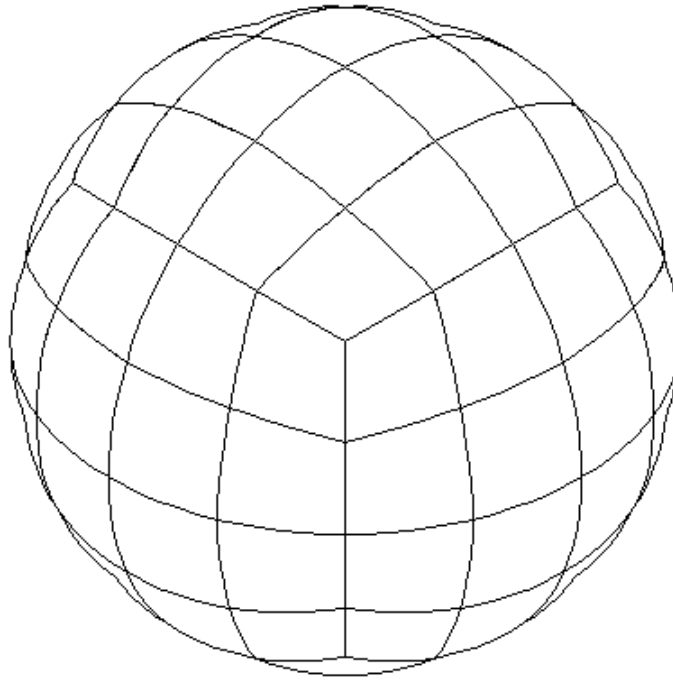
(Frequencies in Hertz)

Identification n° mode	Reference	Code_Aster	% difference
1	2.54231 E3	2.54231 E3	1 E -6
2	2.54231 E3	2.54231 E3	1 E -6
3	2.60747 E3	2.60747 E3	1 E -6
4	2.60747 E3	2.60747 E3	1 E -6
5	2.60747 E3	2.60747 E3	1 E -6
6	2.74095 E3	2.74095 E3	1 E -6
7	2.74095 E3	2.74095 E3	1 E -6
8	2.74095 E3	2.74095 E3	1 E -6
9	2.76313 E3	2.76313 E3	1 E -6
10	2.76313 E3	2.76313 E3	1 E -6

3.4 Remarks

Code_Aster detects well the 6 modes of rigid body.

4 Modelization B



4.1 Characteristic of the modelization B

Mesh made up of elements `HEXA20`

4.2 Characteristics of the mesh

Many nodes: 815

Number of meshes and type: 160 `HEXA20`

4.3 Quantities tested and results

(Frequencies in Hertz)

Identification n° mode	Reference	Code_Aster	% difference
1	2.47035 E3	2.46964	-0.029
2	2.47035 E3	2.46964	-0.029
3	2.47101 E3	2.47084	-0.007
4	2.47101 E3	2.47084	-0.007
5	2.47101 E3	2.47084	-0.007
6	2.61296 E3	2.61344	0.019
7	2.61296 E3	2.61344	0.019
8	2.61430 E3	2.61345	-0.033
9	2.61430 E3	2.61364	-0.025
10	2.61430 E3	2.61364	-0.025

4.4 Remarks

Code_Aster detects well the 6 modes of rigid body.

5 Summary of the results

the got results are excellent since the instantaneous frequency deviations with the reference solution are lower than 0.03% . Moreover, *Code_Aster* detects well the 6 modes of rigid body, which one did not ask to calculate.

To compute: indeed the rigid modes, two possibilities exist. With the option "BANDAGES" on the bande de fréquence (0,3000 Hz) , one can employ either the method of "SORENSEN", or the method of LANCZOS ("TRI_DIAG") by specifying option "MODE_RIGIDE".