SDNV301 - Hertzian collision of two elastic balls

Summary:

This test models the nonlinear vibratory answer of two elastic balls returning in collision, subjected at an initial speed. The goal is to validate the order DYNA_NON_LINE with a linear elastic behavior and contact with DEFI_CONTACT .

Two modelings suggested are the following ones:

- Modeling A : linear grid with meshs QUAD4 , and a diagram of temporal integration of type HTT (implicit). One tests formulation of the contact DISCRETE with one algorithm of contact of the type CONSTRAINT as solution AUTRE_ASTER.
- Modeling B : quadratic grid with meshs QUAD8, and a diagram of temporal integration of type HTT (implicit). The formulation of the contact is tested DISCRETE with the algorithm of contact of the type CONSTRAINT as solution AUTRE_ASTER.

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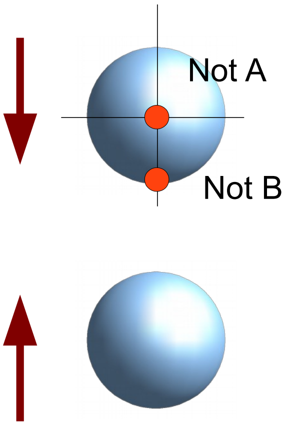
1 Problem of reference

1.1 Geometry



Ray of the balls	8.0
Speed	1.0

1.2 Properties of material

The material is elastic isotropic whose properties are:

- Young modulus $E=50000.$
- Poisson's ratio $\nu=0.3$
- Density $\rho=1.$

1.3 Boundary conditions and loadings

No boundary condition is applied.

1.4 Initial conditions

An equal in amplitude and opposite vertical uniform speed is applied to the balls.

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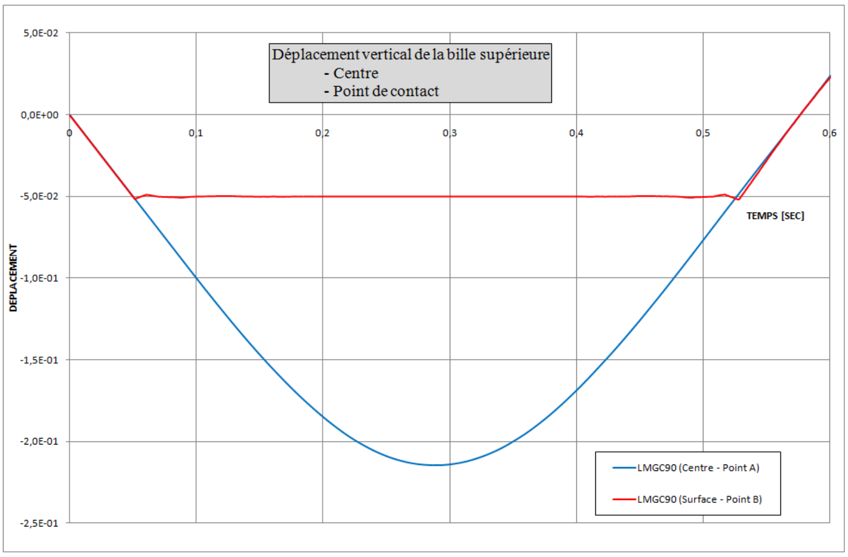
2 Reference solution

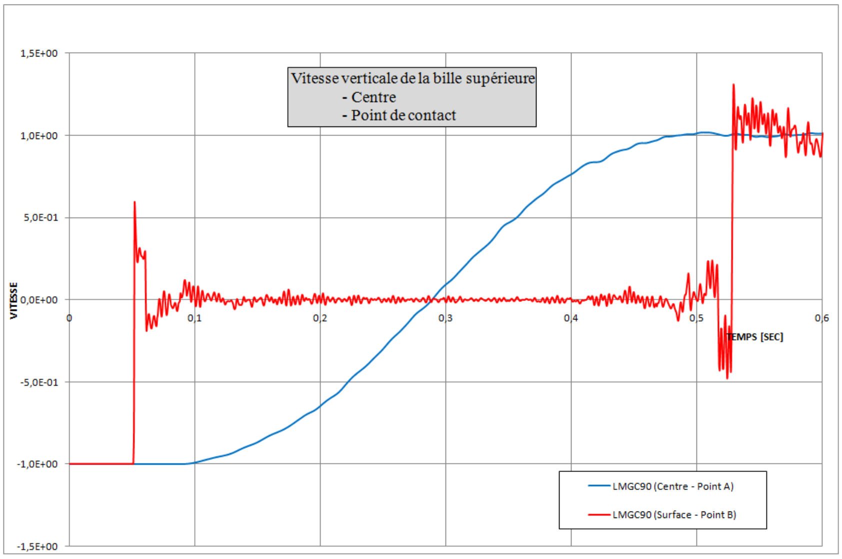
2.1 Method of calculating

The reference solution was obtained using platform LMGC90 of the university of Montpellier.

2.2 Sizes and results of reference

The selected results of reference relate to maximum displacement in the center and the top of the higher ball.





Time (S)	Not	Displacement
0.289	$A(centre)$	0.05
0.289	$B(Surface)$	0.21454

2.3 Uncertainties on the solution

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Digital solution < 5%.

2.4 Bibliographical references

[1] Plate-form LMGC90 of the university of Montpellier

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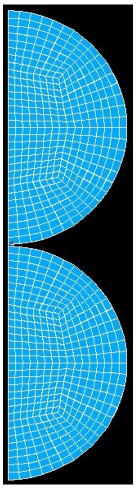
3 Modeling A

3.1 Characteristics of modeling

A modeling is used `AXIS`.

3.2 Characteristics of the grid

- Many nodes 834
- Many meshs 1024
- Group of nodes
  - `Center`
  - `Low`
- Group of meshs
  - `Bille_sup`
  - `Bille_Inf`
  - `Contact_Haut`
  - `Contact_Bas`



3.3 Characteristics of the fields tested

- Contact: Formulation `DISCRETE` with the method `CONSTRAINT`
- Dynamics: `DYNA_NON_LINE` with a diagram of temporal integration of type `HHT` (`ALPHA=-0.3` and `MODI_EQUI='NOT'`)

The step of time is selected to 0.00 05. The moment O is tested ù the displacement obtained by the reference, in the center of the ball, is maximum.

3.4 Sizes tested and results

Identification		Moment (S)	Type of reference	Value of reference	Tolerance (%)
Not	Size				
A	*DY*	0.289	'SOURCE_EXTERNE'	0.05	1.0
B	*DY*	0.289	'SOURCE_EXTERNE'	0.21454	2.0

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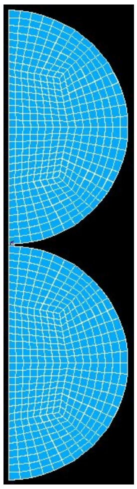
4 Modeling B

4.1 Characteristics of modeling

A modeling is used AXIS.

4.2 Characteristics of the grid

- Many nodes 2434
- Many meshs 1024
- Group of nodes
  - Center
  - Low
- Group of meshs
  - Bille_sup
  - Bille_Inf
  - Contact_Haut
  - Contact_Bas



4.3 Characteristics of the fields tested

- Contact: Formulation DISCRETE with the method CONSTRAINT
- Dynamics: DYNA_NON_LINE with a diagram of temporal integration of type HHT (ALPHA=- 0.3 and MODI_EQUI='NOT')

The step of time is selected to 0.00 05. The moment O is tested ù the displacement obtained by the reference, in the center of the ball, is maximum.

4.4 Sizes tested and results

Identification		Moment (S)	Type of reference	Value of reference	Tolerance (%)
Not	Size				
A	*DY*	0.289	'SOURCE_EXTERNE'	0.05	4.0
B	*DY*	0.289	'SOURCE_EXTERNE'	0.21454	0.1

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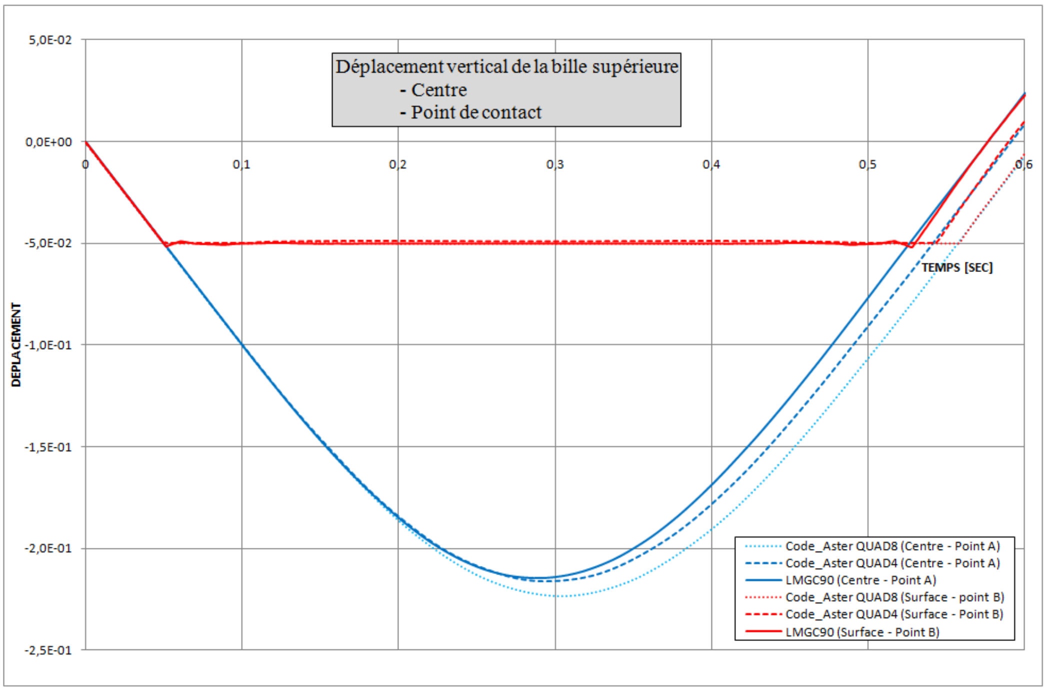
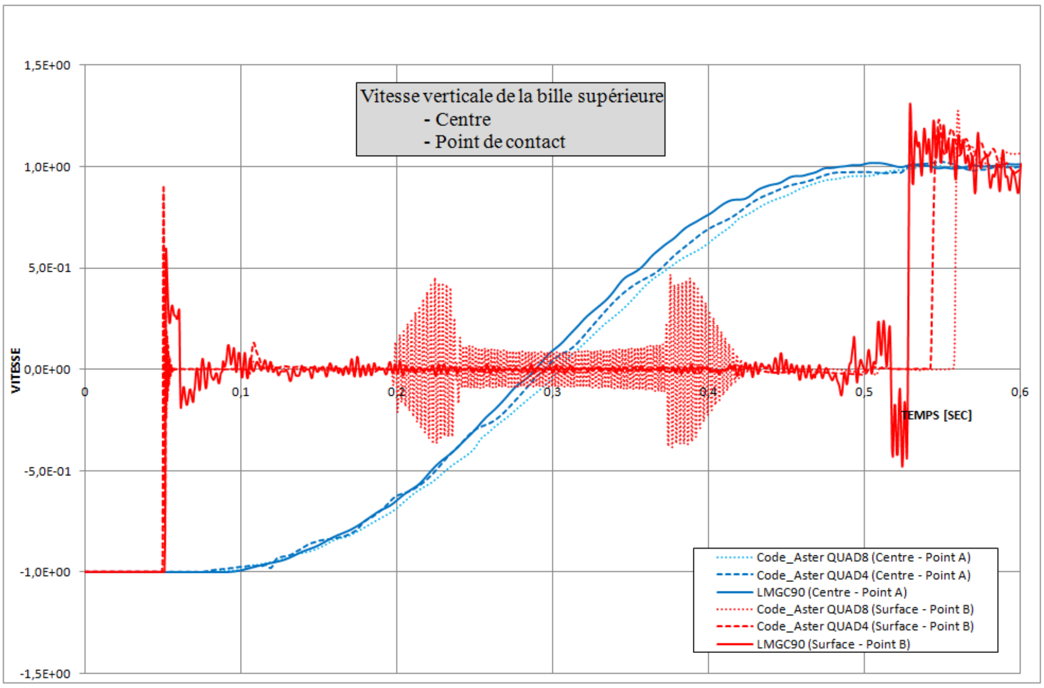
5 Summary of the results

On the figures below we represented the evolution of the displacement and speed in the center and the level of the point of contact of the higher ball compared with the results got with LGMC90.





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