SDLS124 – Plate offset in inflection under dynamic loading

Summary:

The purpose of this test is to compare the taking into account of the offsetting of the hulls in Code_Aster and Europlexus. It is also used to provide to two cases tests of Europlexus of the results of reference for the validation of the offset hulls.

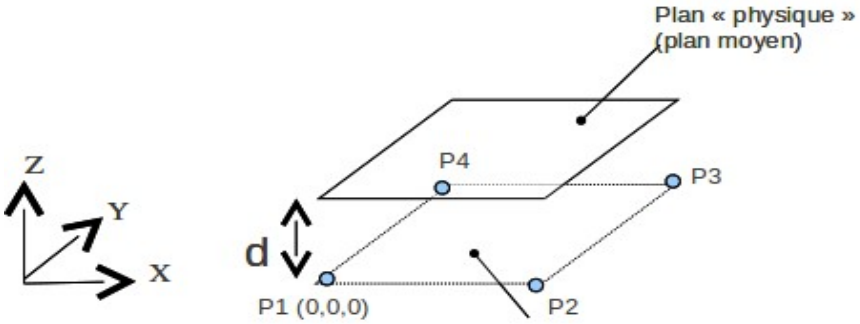
This comparison is made on an offset plate, embedded on a side, subjected to a dynamic loading inducing of the inflection. The comparisons are made for a grid in quadrangle and a grid in triangle.

The corresponding tests of Europlexus are *bm_str_q4gs_exce* for the case QUAD4 and *bm_str_t3gs_exce* for the case TRIA3 .

1 Description

1.1 Geometry

The model of study is a plate squares on side $c=1\mathrm{m}$ and thickness $ep=0.05\mathrm{m}$. This plate is offset of $d=0.05\mathrm{m}$.



1.2 Properties of materials

The properties of steel for the plate are given in the following table.

Material	Steel
Young modulus	$2\times10^{11}Pa$
Poisson's ratio	0.2
Density	$7800\,kg/m^3$

1.3 Boundary conditions and loadings

1.3.1 Boundary conditions

The side defined by segment P1P4 of the plate is blocked to 0 for the components DX, DZ and DRY, moreover the component DY is blocked in $P1$.

1.3.2 Loading:

The loading consists in applying a linear force according to Z on the segment $P2P3$, passing from 0 with $50\,000\,N/m$ in 0.01 second then maintained constant thereafter.

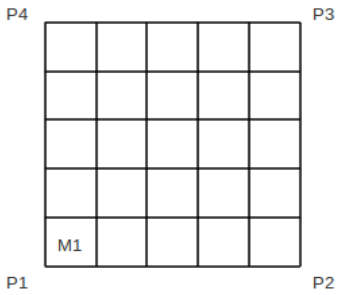
2 Reference solution

The reference solution is given by the results got for same calculation with Europlexus.
It is specified that the tests Europlexus correspondents will use the results of Code_Aster like reference.

3 Modeling A

3.1 Characteristics of modeling

The plate consists of 25 meshs of the type QUAD4 modelled in DKT.

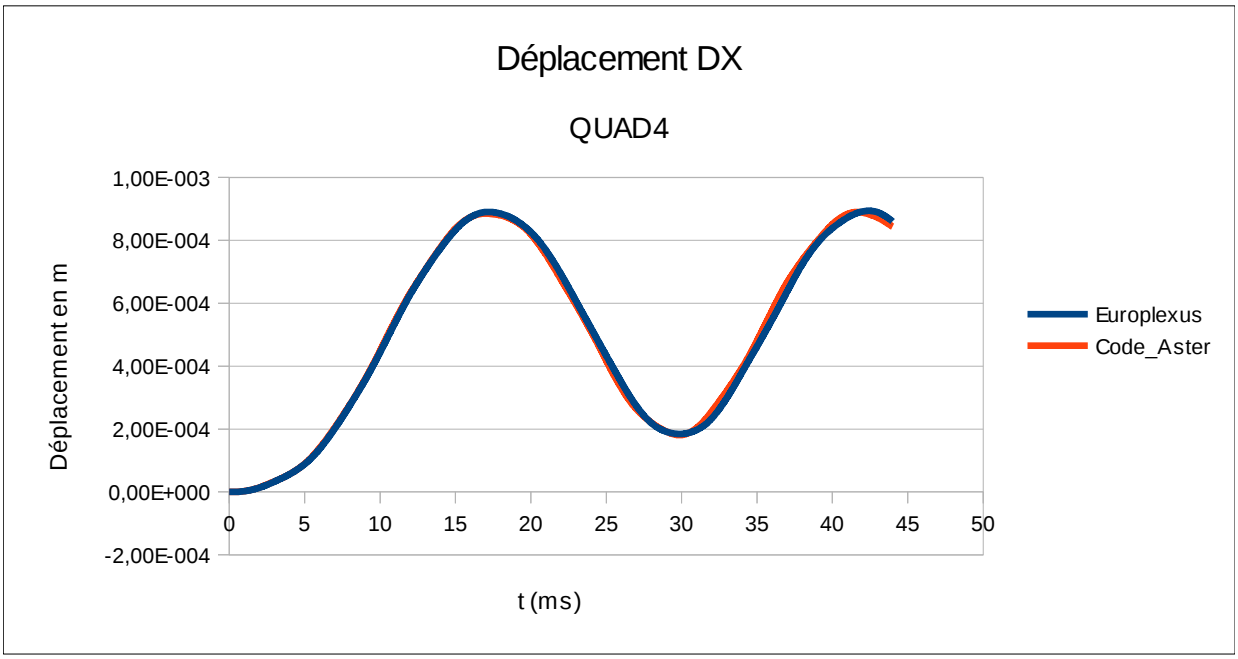


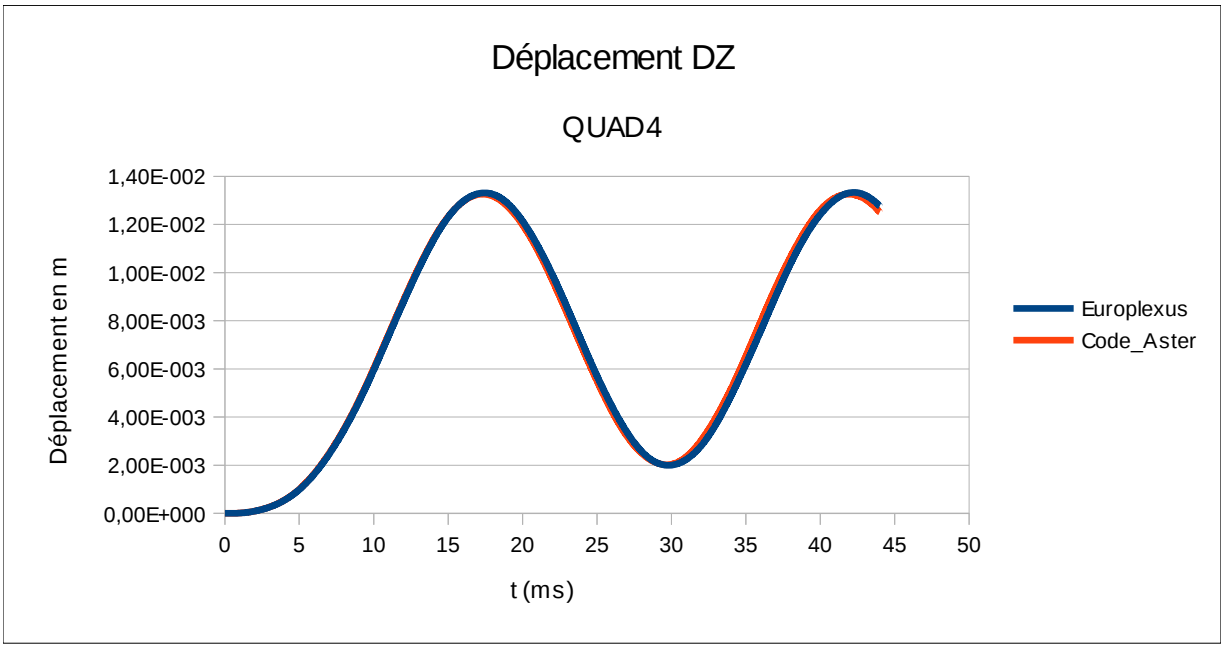
3.2 Comparisons and results

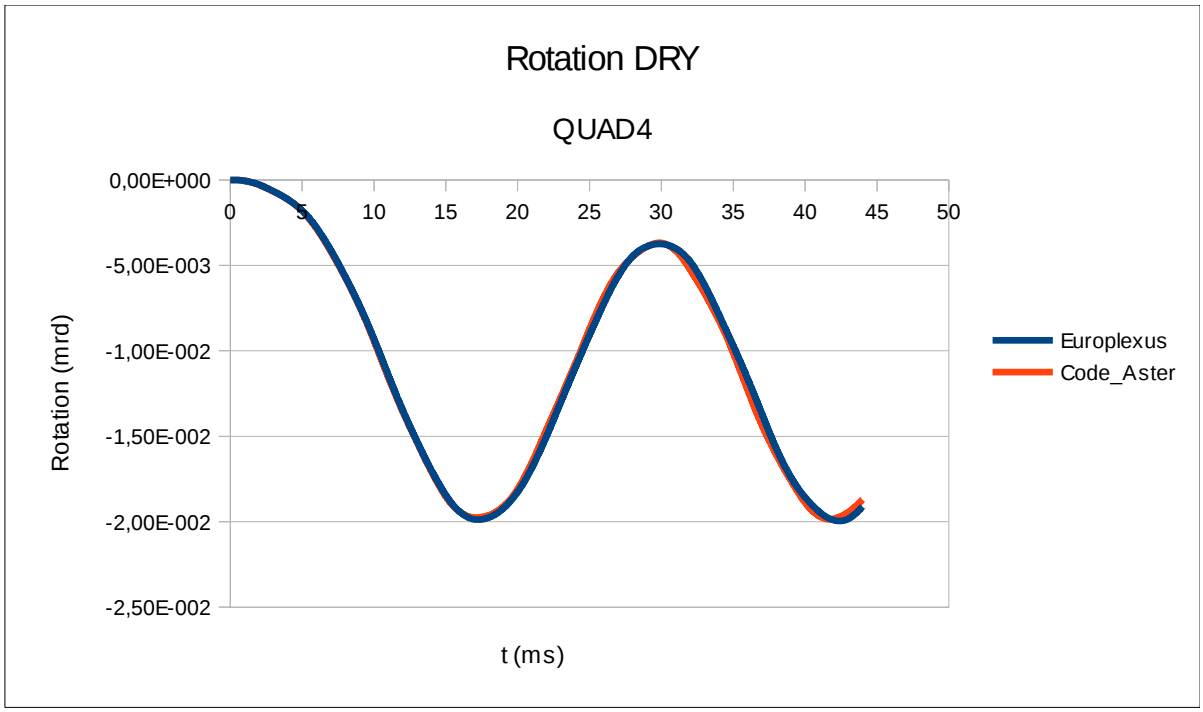
3.2.1 Comparisons

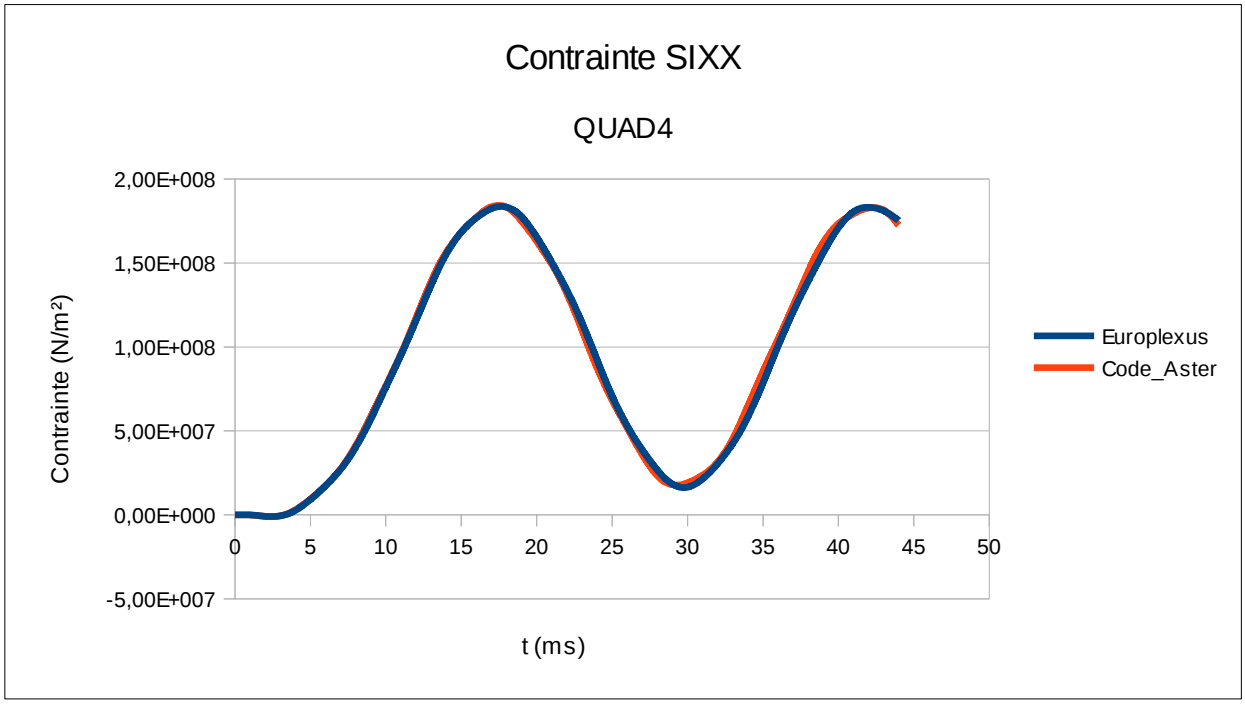
The comparisons are made on the components DX, DZ and DRY displacement of the point $P2$ like on the components $SIXX$ constraints of the mesh $M1$ (NOT 1, SOUS_POINT 1, this under-point is located at the lower end in the thickness of the hull).

The 4 following figures compare the evolutions of these values in the course of time for the two computer codes.









3.2.2 Results tested

The results tested correspond to the values compared above with the second peak, i.e. for times around $0{,}042\,ms$ (times are slightly different according to the sizes).

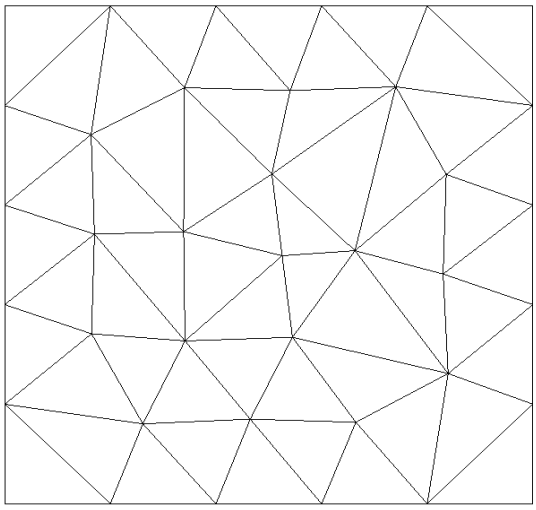
Node	Field	Component	Order	Value of ref. (m)	Precision	Reference
$P3$	DEPL	DX	5204	$8.93912E-4$	$5.0E-3$	SOURCE_EXTERNE
$P3$	DEPL	DZ	5250	$1.3327E-2$	$6.0E-3$	SOURCE_EXTERNE
$P3$	DEPL	DRY MARTINI	5210	$-1.99599E-2$	$6.0E-3$	SOURCE_EXTERNE

Mesh	Field	Comp., Not, $S-P$	Order	Value of ref. (N/m^2)	Precision	Reference
$M1$	SIEF_ELGA	SIXX, 1.1	5312	$1.8317556E+8$	$3.0E-3$	SOURCE_EXTERNE

4 Modeling B

4.1 Characteristics of modeling

The plate consists of 54 meshs of TRIA3 modelled in DKT .

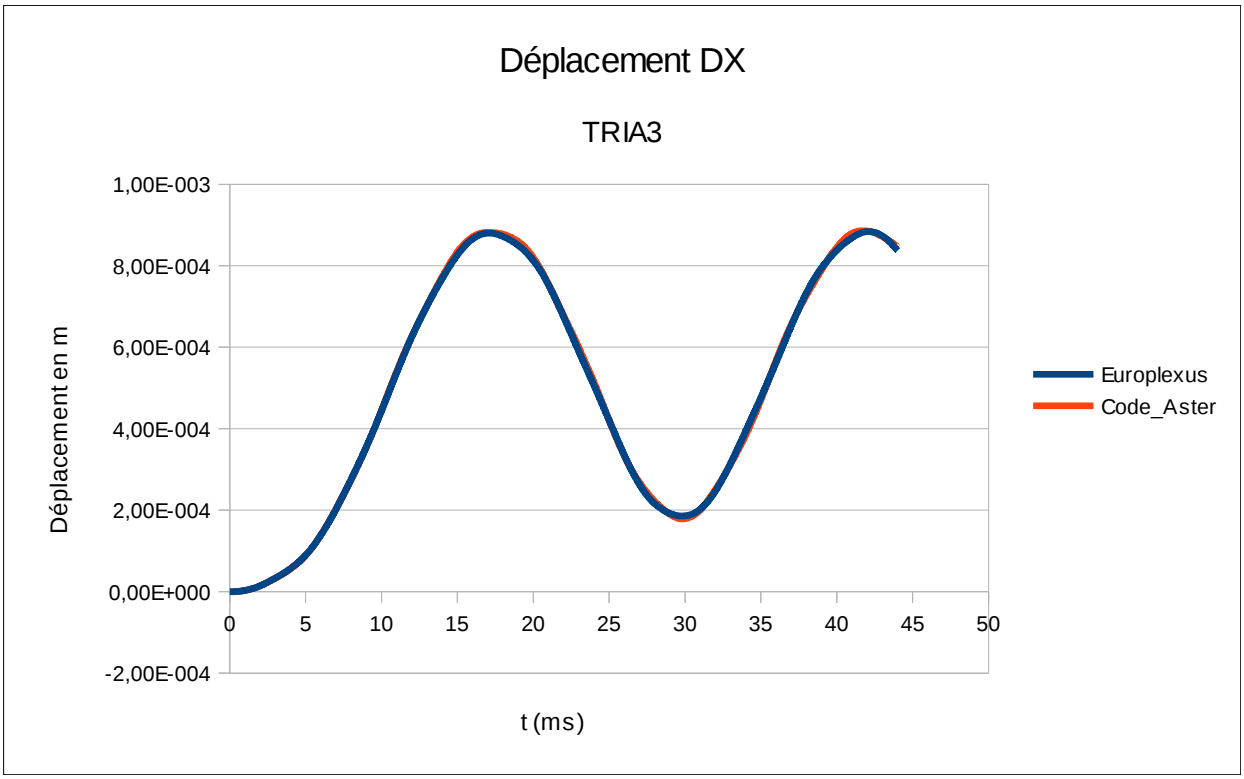


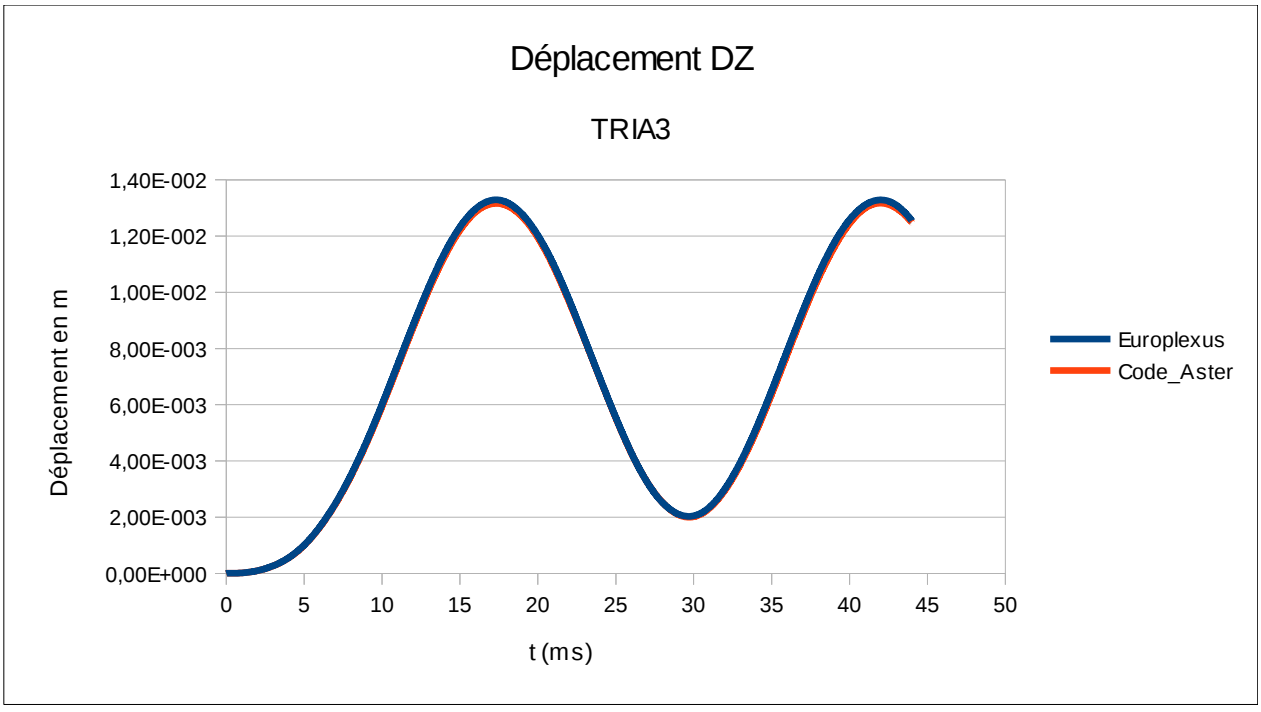
4.2 Comparisons and results

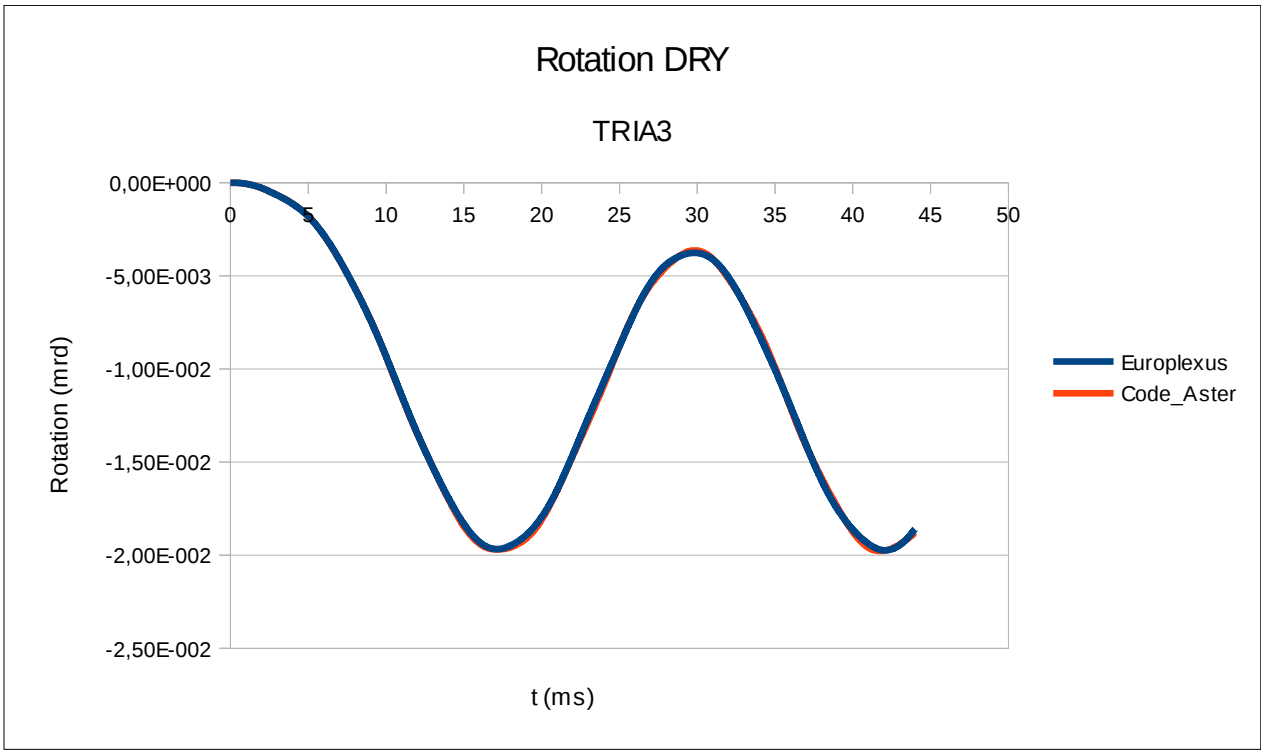
4.2.1 Comparisons

The comparisons are made on the components DX , DZ and DRY displacement of the point $P2$. Contrary to modeling A, there is no here comparison of constraints, because Europlexus does not make it possible to calculate the constraints on several layers with the triangular meshs (modeling T3GS) .

The 3 following figures compare the evolutions of these values in the course of time for the two computer codes.







4.2.2 Results tested

The results tested correspond to the values compared above with the second peak, i.e. for times around $0{,}042\,ms$ (times are slightly different according to the sizes).

Node	Field	Component	Order	Value of ref. (m)	Precision	Reference
$P3$	DEPL	DX	5214	8.83837E-4	3.0E-3	SOURCE_EXTERNE
$P3$	DEPL	DZ	5250	1.32879E-2	9.0E-3	SOURCE_EXTERNE
$P3$	DEPL	DRY MARTINI	5220	-1.97352E-2	2.0E-3	SOURCE_EXTERNE

5 Modeling C

5.1 Characteristics of modeling

The plate consists of 25 meshs of QUAD4 modelled in DKTG offset.

5.2 Comparaison of the results

Node	Field	Component	Order	Value of ref. (m)	Precision	Reference
P3	DEPL	DX	5214	8.83837E−4	3.0E−3	SOURCE_EXTERNE
P3	DEPL	DZ	5250	1.32879E−2	9.0E−3	SOURCE_EXTERNE
P3	DEPL	DRY MARTINI	5220	−1.97352E−2	2.0E−3	SOURCE_EXTERNE

6 Modeling D

6.1 Characteristics of modeling

The plate consists of 25 meshs of QUAD4 modelled in Q4GG offset.

6.2 Comparaison of the results

Node	Field	Component	Order	Value of ref. (m)	Precision	Reference
P3	DEPL	DX	5214	8.83837E−4	3.0E−3	SOURCE_EXTERNE
P3	DEPL	DZ	5250	1.32879E−2	9.0E−3	SOURCE_EXTERNE
P3	DEPL	DRY MARTINI	5220	−1.97352E−2	2.0E−3	SOURCE_EXTERNE

7 Synthesis

One notes by looking at the curves that the results of the two computer codes (code_aster and europlexus) are very close. In modeling A, one can see a light dephasing on the curves of displacement. In modeling B, there is not that dephasing but the error in DZ with the second peak 1% approach. Modelings with the homogenized plates are also in agreement.

One can conclude that the treatment of offsetting in Code_Aster corresponds to what is made in Europlexus.