ZZZZ175 - Coupling Aster-Lobster on a calculation STAT_NON_LINE

Summary:

This series of CAS-tests validates by means of computer the adaptation of grid with LOBSTER with use of STAT_NON_LINE. On a simple grid, either in 2D, or in 3D, a calculation of nonlinear mechanics is launched, with production of an indicator of errors. From there, a call to the software LOBSTER will involve a modification of the grid. On this new grid, a new calculation is activated, corresponding to the same physical problem.

These CAS-tests are not examples of the interest of the adaptation of grid and do not have any physical meaning. They are used only as tests of not-regression of the functionality in the various possible configurations.

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1 General information

1.1 Context

The objective is only to test the not-regression of the future evolutions of *Code_Aster* and LOBSTER. Even if the CAS-tests are realistic from the physical point of view for representing real studies well, one should not attach importance to the value of the results.
In particular, one should not anything deduce some as for the performance indicating couple from adaptation error from grid.

These CAS-tests validate the operation of the two macro-orders `MACR_INFO_MAIL` and `MACR_ADAP_MAIL` who control the whole of the process.

More precisely, the features tested are the following ones:

- readings and writings of grid and fields to the format `MED`. They are the orders `IMPR_RESU`, `LIRE_CHAMP` and `LIRE_MAILLAGE` with the keyword `MED` like format,
- writing of the data file for LOBSTER,
- launching of the procedure managing the LOBSTER execution. It is the order `EXEC_LOGICIEL` ; it calls a script with a variable number of arguments,
- piloting of the whole of the process by the python: `macr_adap_mail_ops.py`.

The process is a priori insensitive with modeling considered. The important points which cause different treatments in the data exchange between LOBSTER and *Code_Aster* are the types of elements, the piloting of the adaptation and the update of fields on the new grid.

The not-regression is tested on the value of the field of displacement, constraint or temperature in a free node. The test takes place for several resolutions, those with the grids resulting from the first and at least another adaptation. Indeed, the LOBSTER data transmissions and piloting are not the same ones for the first adaptation and the following ones. At least two passages thus should be tested.

1.2 Method of calculating used for the reference solution

These CAS-tests are CAS-tests of nonregression. The reference solution is that obtained with a calculation *Code_Aster*.

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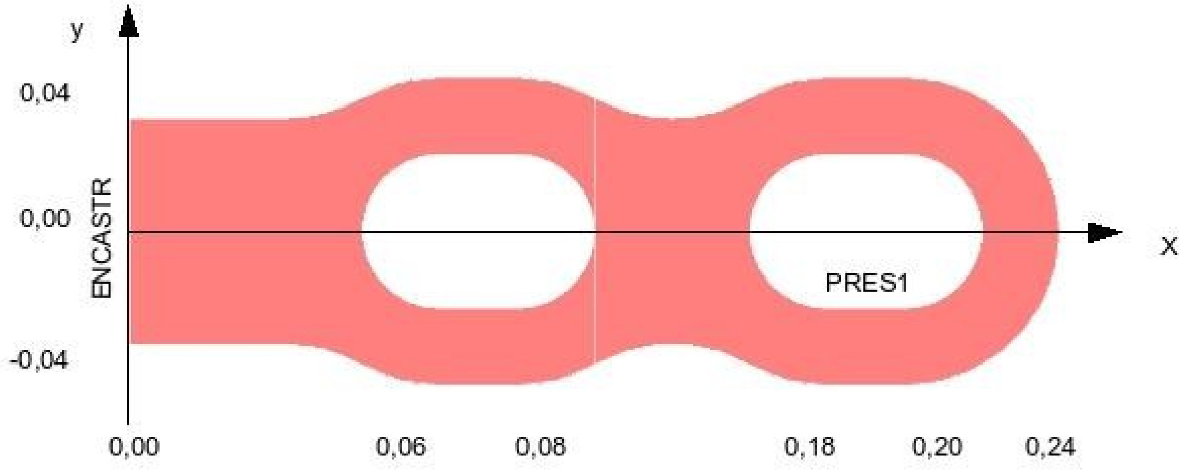
2 Modeling A

2.1 Geometry



2.2 Properties of material

Material with elastoplastic behaviour with a linear work hardening:

Elasticity:

- $E = 2.1\,x\,10^5\,Pa$ Young modulus
- $\nu = 0.3$ Poisson's ratio

Plasticity:

- Slope of the traction diagram in the plastic range $\frac{\partial\sigma}{\partial\varepsilon} = 2.\times 10^3\ Pa$
- Yield stress $\sigma_e = 235.\,Pa$

2.3 Boundary conditions and loadings

Calculation is in nonlinear mechanics. The part is embedded on its left face. Pressure is put on the low horizontal part of the second hole (zone $PRES1$ on the sketch). This pressure varies in time. One will look at the evolution of displacement on a node of the base.

Edge *ENCASTR* : blocking of displacements by blocking of the degrees of freedom: `DX = DY = 0`.

Edge *PRES1* loading

- pressure imposed according to the moments:

Moment (*S*)	Pressure (*Pa*)
0.	0.
60.	15.
120.	20.
180.	20.

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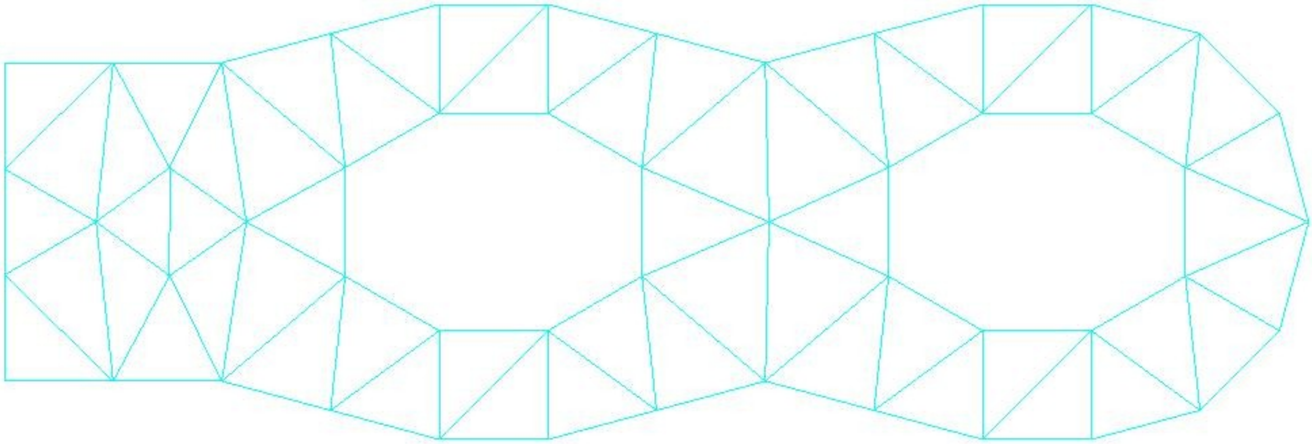
240.	30.
300.	30.
360.	20.
420.	15.
480.	10.

The other edges are with worthless constraint.

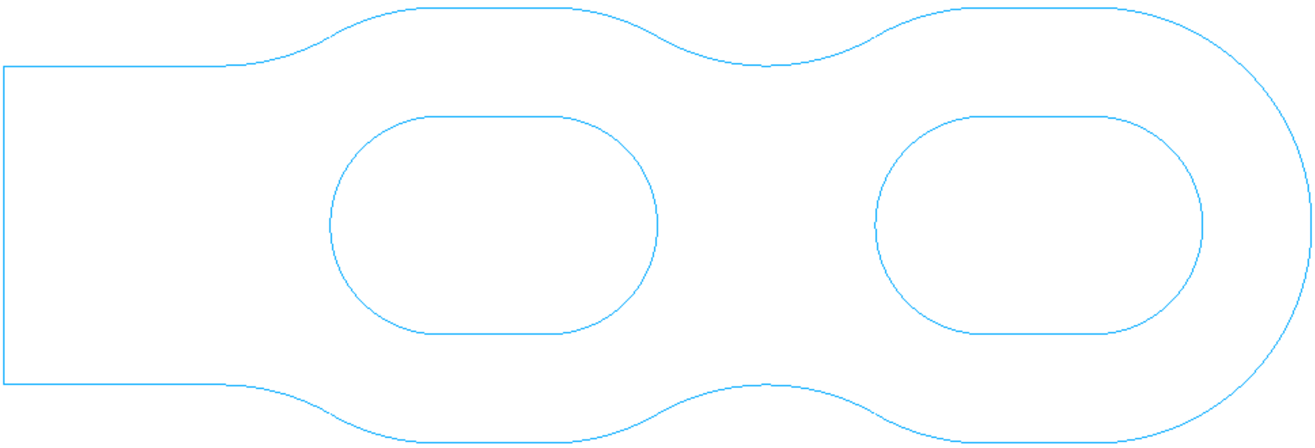
2.4 Characteristics of the grid

Initial grid before refinement.

Nodes: 158
SEG3 : 45
TRIA6 : 57



The discrete border is made of 4643 nodes and as many segments.



2.5 Results of reference

Displacements DX and DY for the group of node A1, constituted of only one node, after the 3ème adaptation:

DX = $-3{,}897029 \times 10^{-5}$

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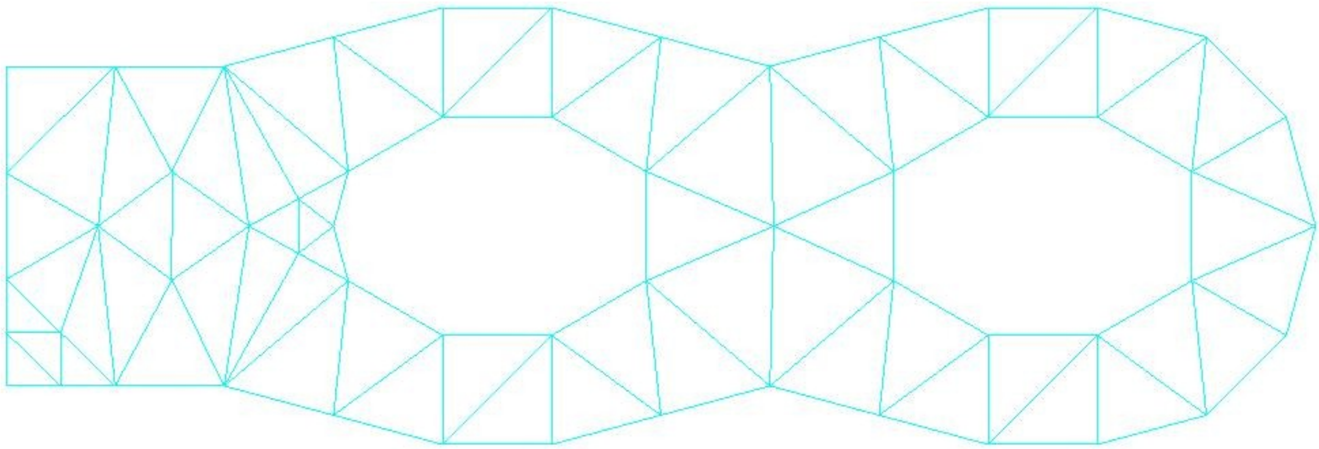
DY = $-1{,}395493 \times 10^{-4}$

2.6 Adapted grids

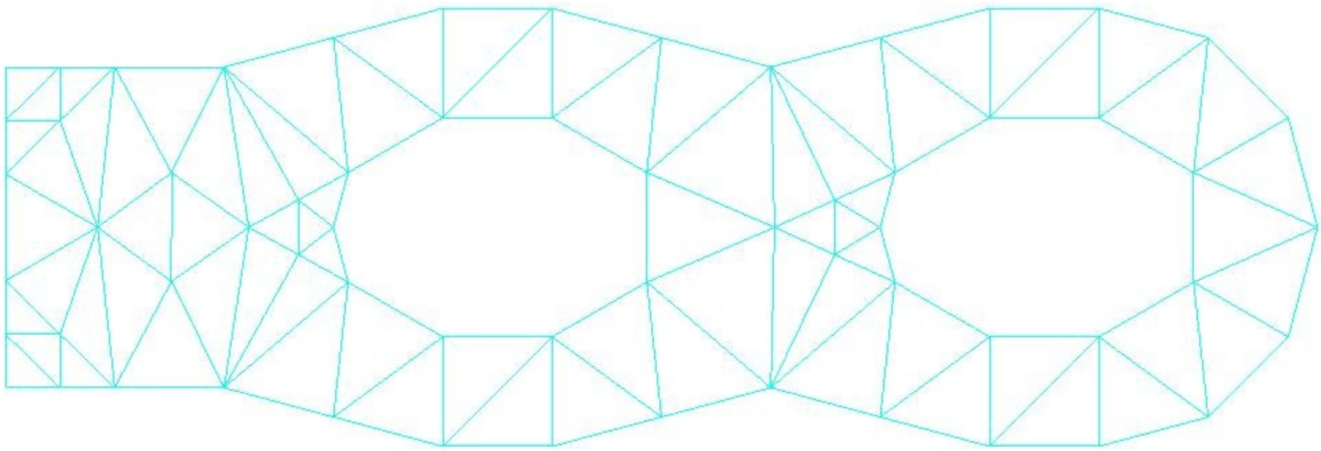
The loop python of refinement of grid comprises 3 iterations starting from the indicator of error (ERME_ELEM) . For each iteration, one describes the characteristics of each grid produced by the macro-order MACR_ADAP_MAIL.

2.6.1 Refined grid: iteration 1



Nodes: 179
SEG3 : 48
TRIA6 : 66

2.6.2 Refined grid: iteration 2



Nodes: 200
SEG3 : 51
TRIA6 : 75

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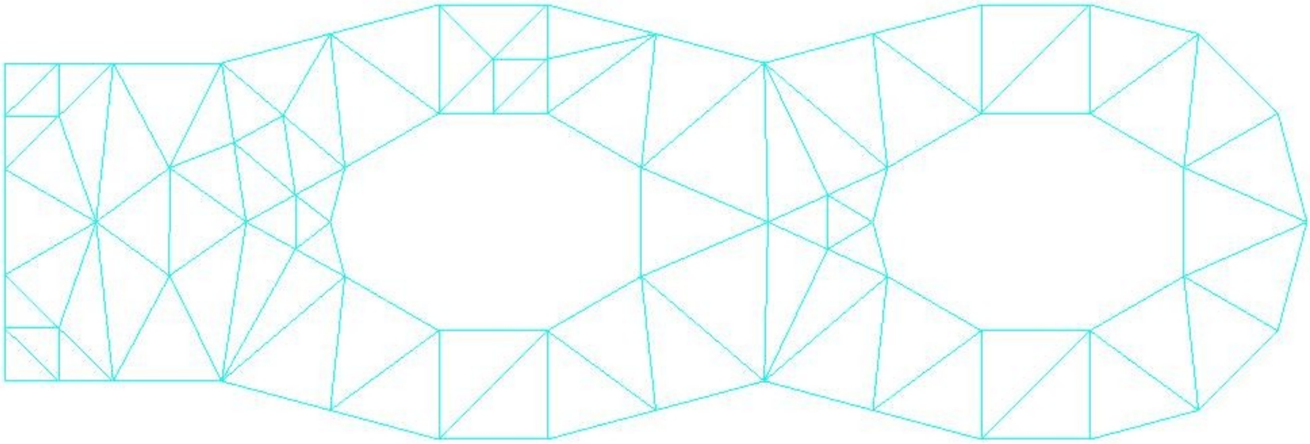
2.6.3 Refined grid: iteration 3



Nodes: 219
`SEG3` : 52
`TRIA6` : 84

2.7 Remarks

One can note that the nodes resulting from the segment divisions on the border will be placed on the fine description of the border.

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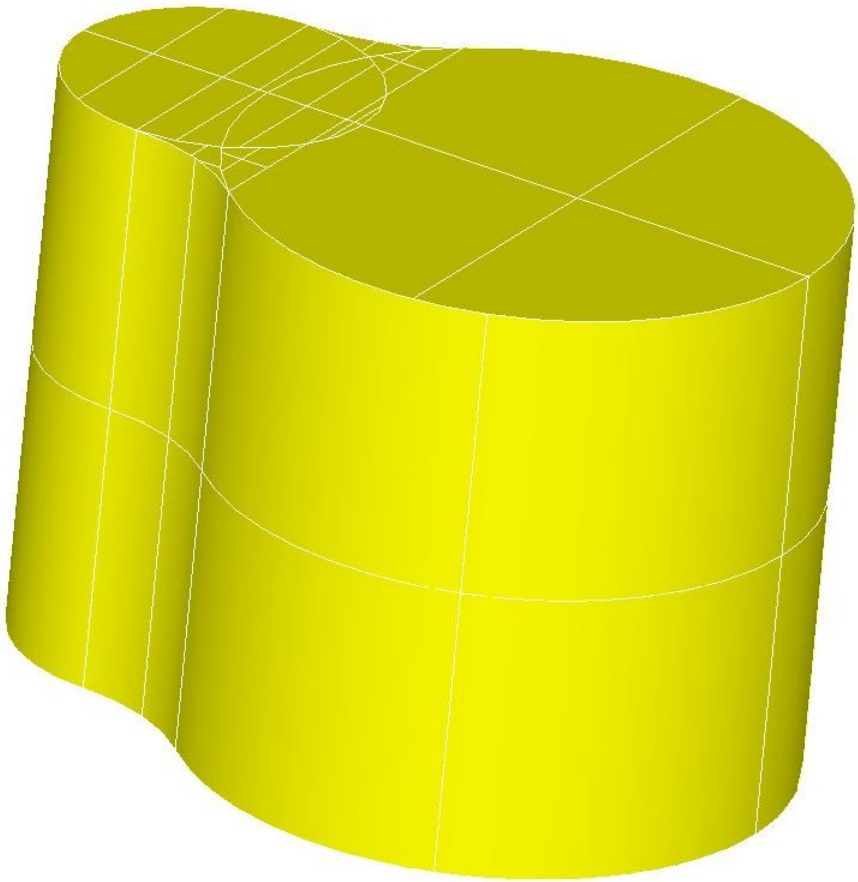
3 Modeling B

3.1 Geometry



3.2 Properties of material

The material is that definite for the CAS-test of THM `wtnl100a`

3.3 Boundary conditions and loadings

Calculation is in saturated hydro-mechanical nonlinear mechanics. After each adaptation, calculation is initialized by the results of preceding calculation, interpolated on the new grid. One will look at the evolution of displacement on a node of the upper surface.

Face	Mechanics	Hydraulics
Higher	Imposed constraint	Null flow
Lower	Null displacement	Null flow
Side	Worthless constraint	Imposed pressure

Mechanical problem:

The part is blocked on the lower face:
Face `Z_MIN` : `DX = DY = DZ = 0`

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One applies a pressure to the higher face:
Face Z_MAX : CLOSE = 1.0 10^5

The other edges are with worthless constraint.

Hydraulic problem:

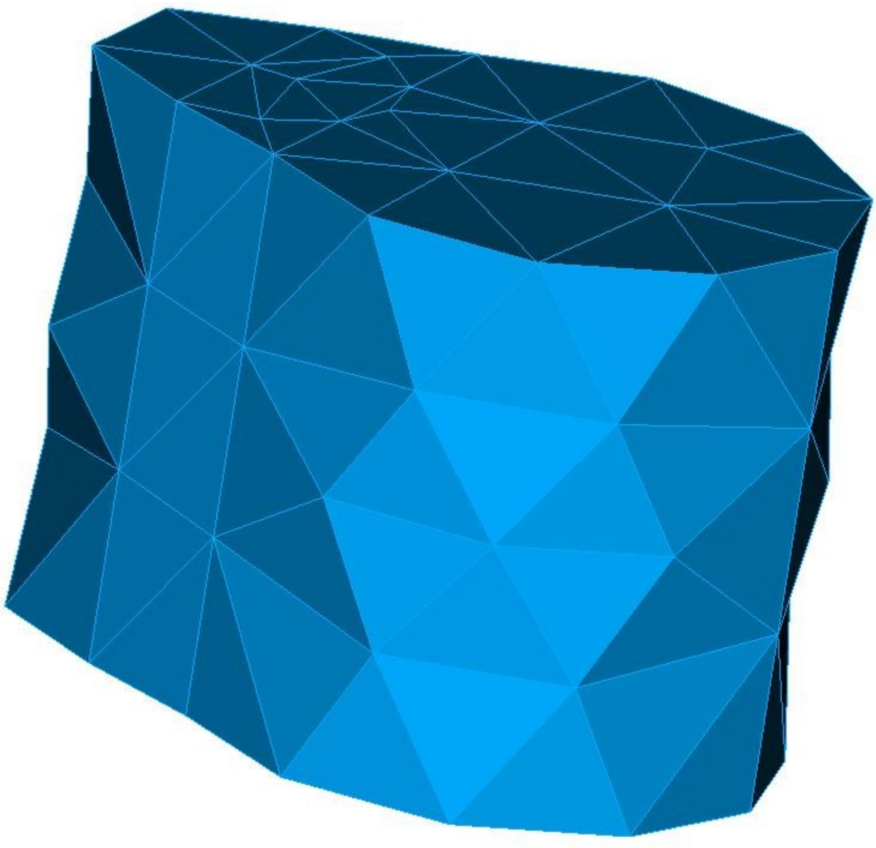
One applies a pressure to the side faces:
Faces *COTE_0*, *COTE_1*, *COTE_2*, *COTE_3* : PRE1 = 1.0 10^5

The other edges are with null flow.

3.4 Characteristics of the grid

Initial grid before refinement.

Nodes: 622
TRIA6 : 148
TET10 : 339



3.5 Results of reference

Displacement DZ for the group of node *With,* constituted of only one node, after the 3ème adaptation:

DZ = $-6{,}23819060503 \times 10^{-2}$

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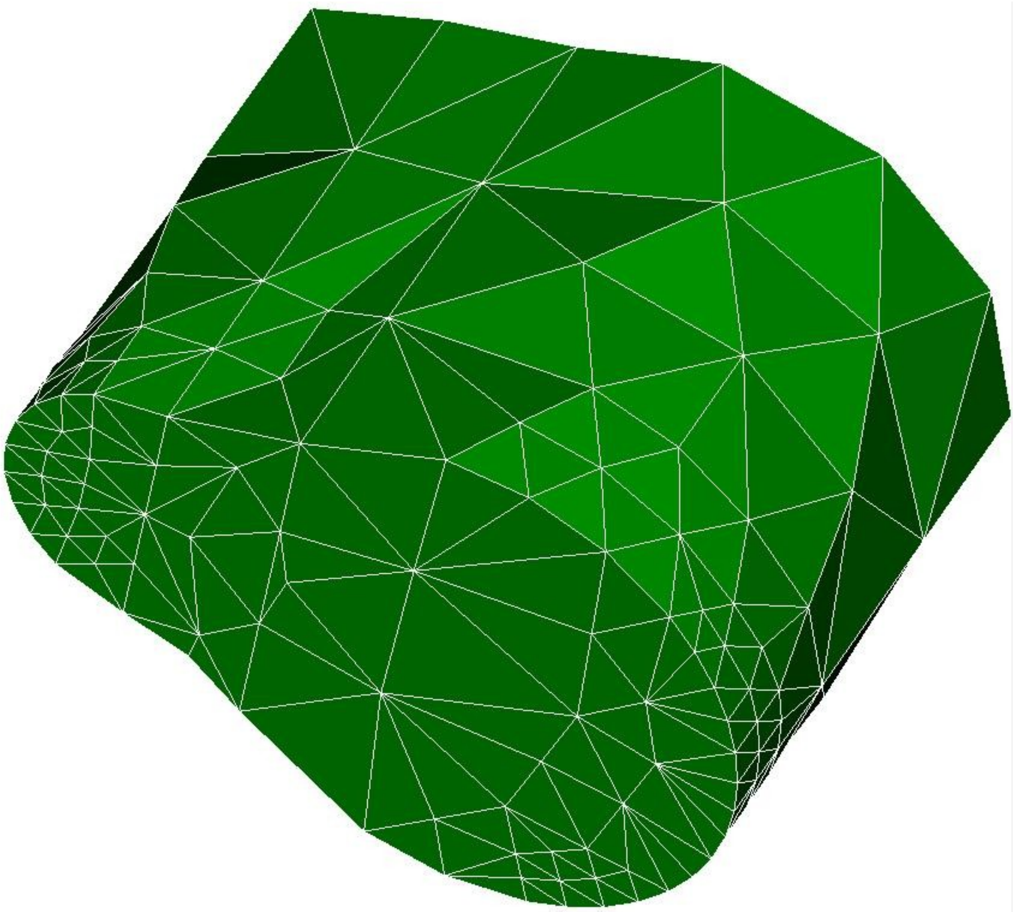
3.6 Adapted grids

The loop python of refinement of grid comprises 3 iterations starting from the jump of the mechanical field of displacement of a node to its neighbor. For each iteration, one describes the characteristics of each grid produced by the macro-order MACR_ADAP_MAIL.

Nodes: 1611
TRIA6 : 362
TET10 : 901



3.7 Remarks

One can note that the nodes resulting from the segment divisions on the border will be placed on the analytical description of the border.
One will look with attention the mechanism used to read again the fields at the points of Gauss.

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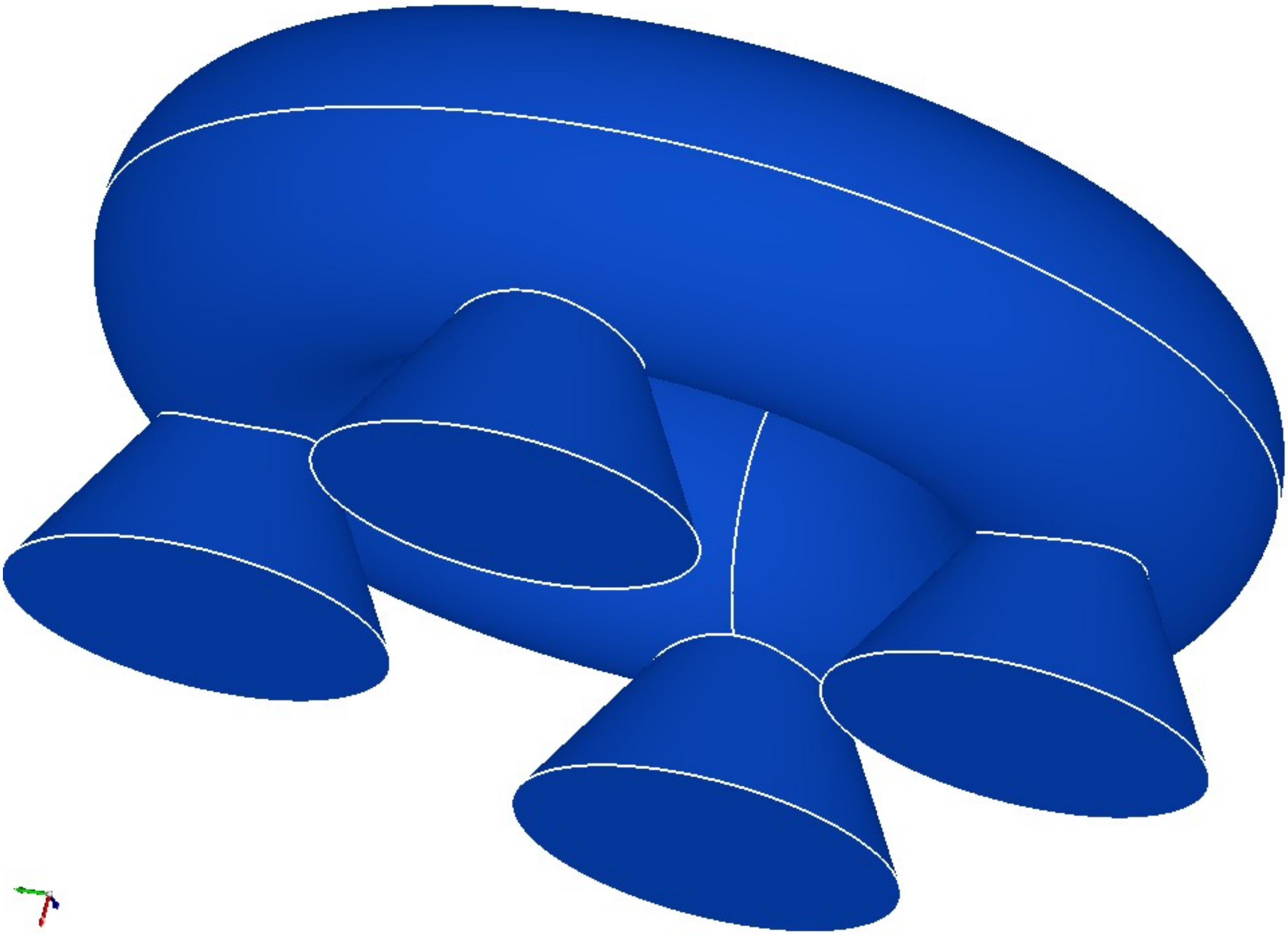
4 Modeling C

4.1 Geometry



The structure is a torus centered on the origin and of axis OX. Its ray of revolution is of 400 and the ray of the disc which turns around the axis is of 160. The feet are cones of axis OX and angle 30 degrees.

4.2 Properties of material

The material with a Young modulus E = 180,000 Pa is an elastic material and a Poisson's ratio N = 0.3 S.I.

4.3 Boundary conditions and loadings

Calculation is in nonlinear mechanics. One will look at the evolution of displacement on two nodes located on the basis of two foot.

The part is blocked on the basis of foot first:
Face `C_1_base` : `DX = DY = DZ = 0`

One applies a pressure on the basis of foot third:
Face `C_3_base` : `CLOSE = 1.0` 10^3

The other edges are with worthless constraint.

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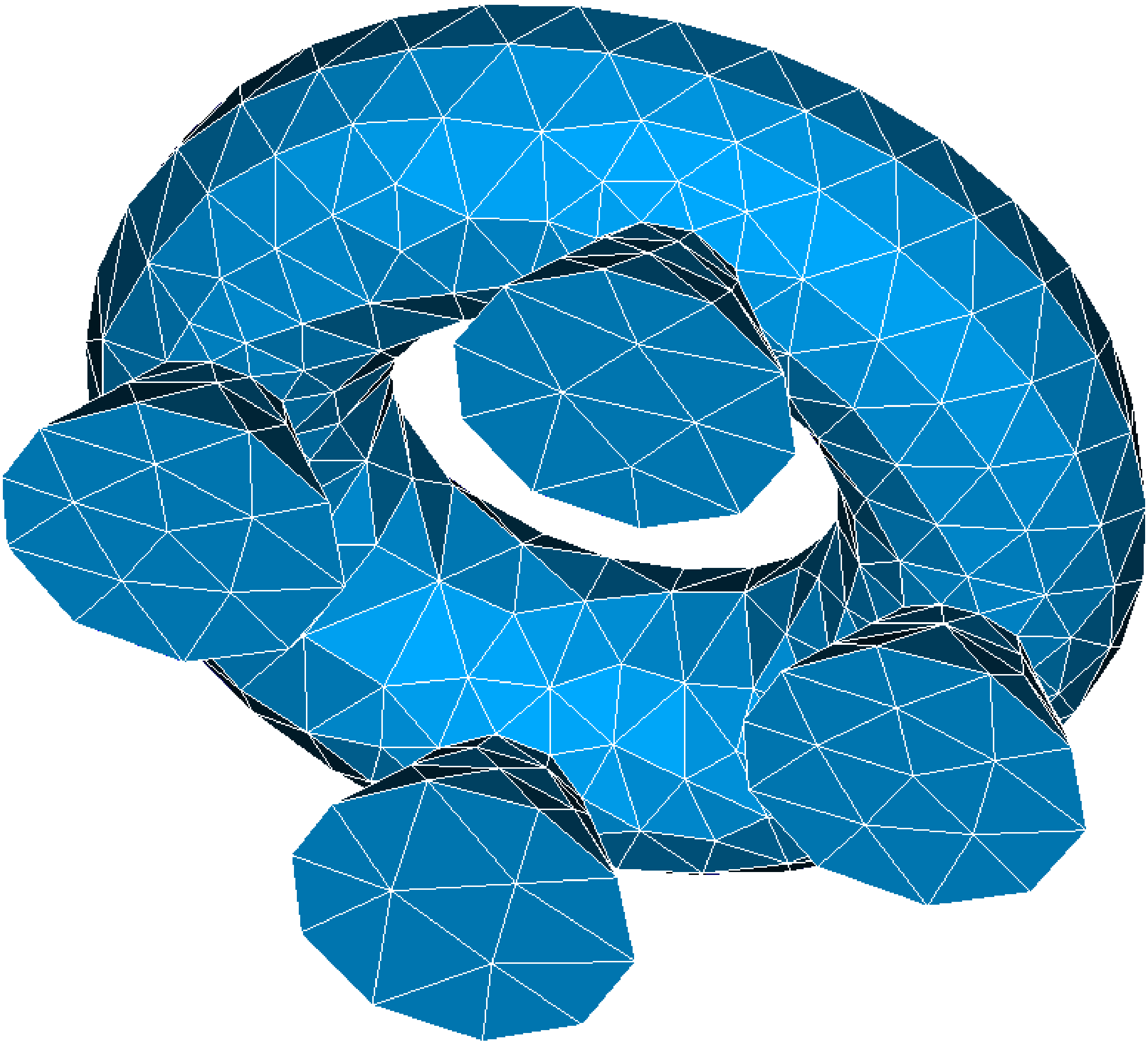
4.4 Characteristics of the initial grid



Nodes: 3,323
SEG3 : 133
TRIA6 : 932
TET10 : 1,723

The intersections between the cones and the torus are with a grid finely by segments,

4.5 Adapted grids

first adaptation is a total uniform refinement. The number of tetrahedrons is thus multiplied by 8: 13,784.

The second adaptation is a uniform refinement of the faces of feet:

Nodes: 29,500
SEG3 : 448
TRIA6 : 6,336
TET10 : 17,078

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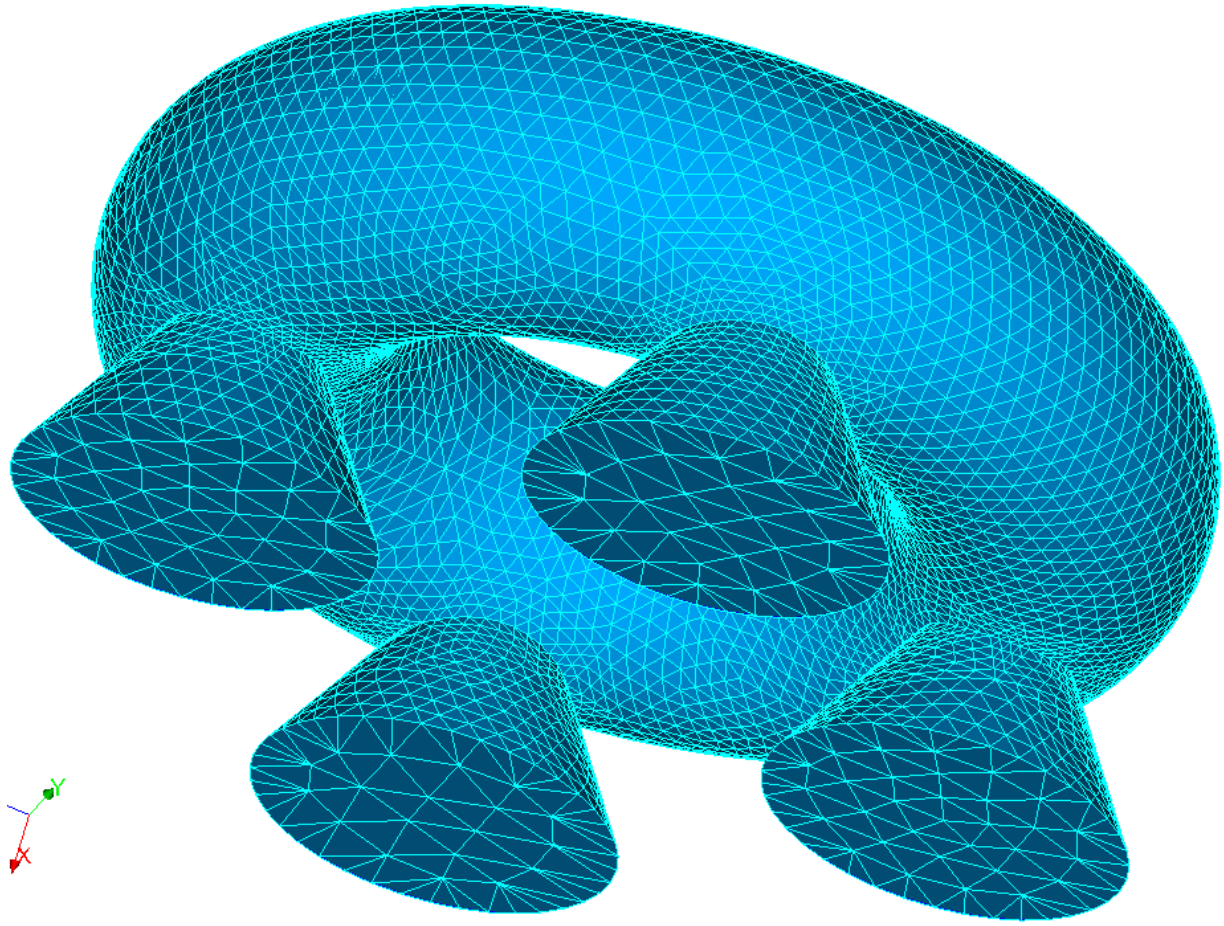
The third adaptation is a uniform refinement of the face of the torus:

Nodes: 51,130
SEG3 : 532
TRIA6 : 14,152
TET10 : 26,976



4.6 Results of reference

Displacement DX for the groups of node S_2 and S_4, constituted of only one node at the base of the feet n° 2 and 4:

	After adaptation 2	After adaptation 2
S_2	-627.975420185	-628.773696974
S_4	-152.344709784	-152.436880132

4.7 Remarks

One can note that the nodes resulting from the segment divisions on the border svont to place itself on the analytical description of the border.
One will look with attention the mechanism used to file and read again the histories of the adaptation.

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5 Summary of the results

This series of CAS-tests shows the good performance of the macro-order MACR_ADAP_MAIL to refine a grid with LOBSTER with follow-up of a border 1D or 2D curves.

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