ZZZZ259 - Adaptation of grid and follow-up of borders 2D

Summary:

This case tests the functionality of follow-up of borders during the adaptation of grid with LOBSTER. One finds there borders 2D described analytically and borders 1D described by a fine grid.

1 Problem of reference

1.1 Geometry

The studied field is a pricking: two pipes meet to form a connection. In the example chosen, one aims at the general information by taking different diameters and nonsecant axes. The geometry is built by Salomé. The groups of all the faces of edge are created. The groups of the arrises are also created.

To each adaptation of the grid, nodes will be created on the edge. If nothing is done, the geometry remains facettized. One tests the LOBSTER faculty here to replace the new nodes on the curved border.
For borders 2D, surfaces are described analytically. It is the case of the inner faces and external of the two pipes.
For borders 1D, the lines are described by a grid annexes very fine. It is the case of the complex curve which represents the intersection of the two pipes.
For the ends of the cylinders, two cases arise. For the large pipe, the plans of cut are perpendicular to the axis. It is useless to specify the form of the intersection because projection on the cylinder is made in the plan. On the other hand, the external plan of the small pipe is not perpendicular to its axis. It is thus necessary to follow the curve by a grid annexes fine.

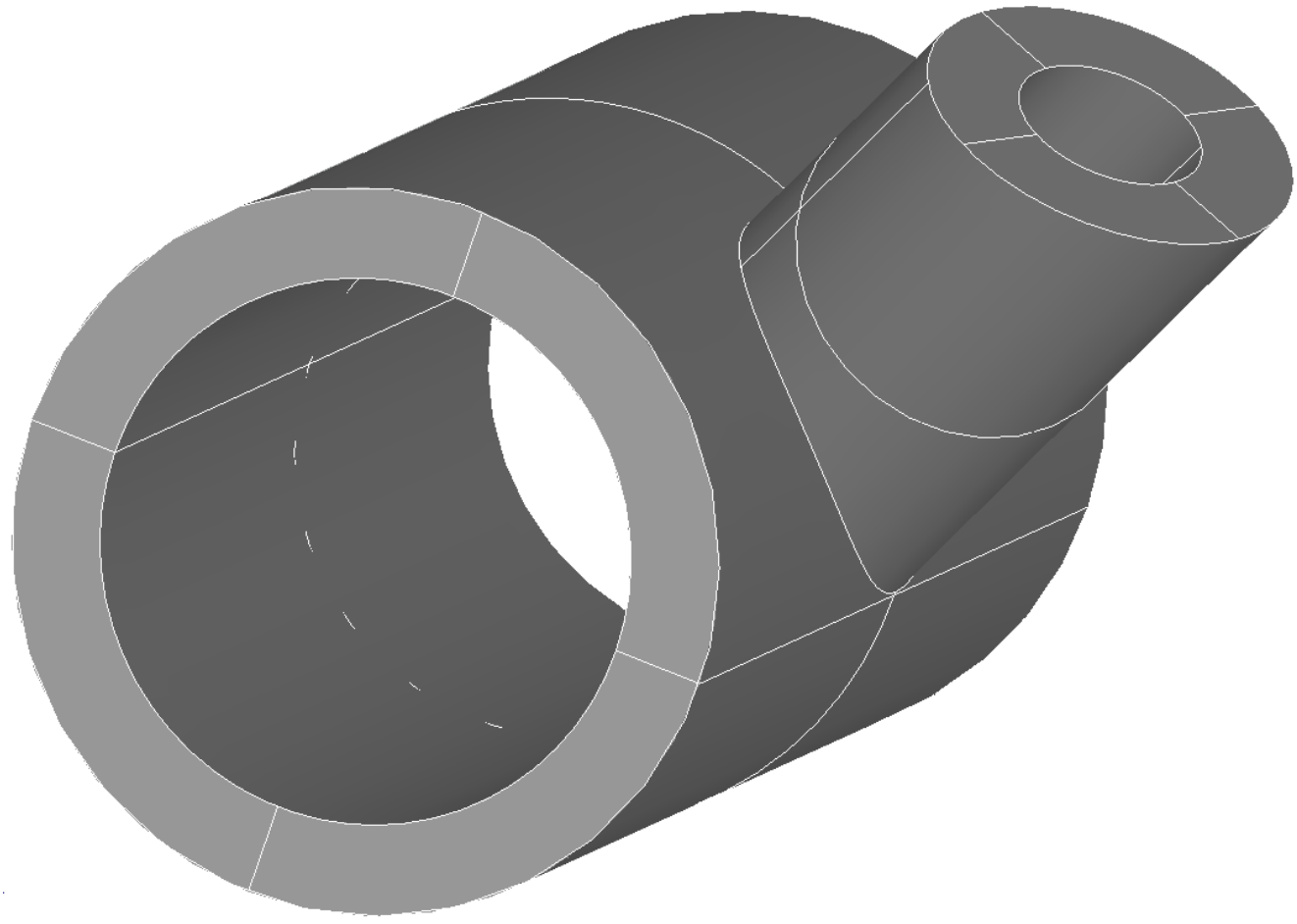

Figure 1.1-1.: Sight of the geometry

Characteristics:

	Pipe n°1	Pipe n°2
X base	0	17.5
Y base	25	-2.5
Z base	-25	-100
X axial vector	25	-100
Y axial vector	50	-75
Z axial vector	75	-25
Interior ray	75	25
External ray	100	50
Height	400	250

Table 1.1-2.: Dimensions of the pipes

1.2 Properties of material

The material is defined with:

Thermal conductivity = $40\ X.m^{-1.\mathrm{K}^{-1}}$

1.3 Boundary conditions and loadings

Calculation will simulate the thermal state of the pipes if two fluids of different temperature circulate inside. Outside is placed in the ambient air.

The interior face of the large pipe is blocked at temperature 600.
The interior face of the small pipe is blocked at temperature 400.

The external faces of the two pipes represent a heat exchange with outside. The coefficient of exchange is worth 5 and the external temperature is worth 300.

The others external faces on the sections of the pipes are free. One voluntarily imposes a normal flow on it no one, to ensure a correct calculation of the indicators of error if one wanted to extend the problem.

2 Reference solution

The reference solution is the first calculation Aster.

3 Modeling A

3.1 Characteristics of modeling

Calculation is a resolution in linear thermics.

3.2 Characteristics of the grid

3.2.1 Grid of calculation

The initial grid was created by Salomé. It is in degree 1. Before calculation, the grid placed in degree 2 by the order CREA_MAILLAGE.

Many nodes:	1106
Many SEG2:	187
Many TRIA3:	1954
Many TETRA4:	3584

The groups are defined to be able to follow the borders, to apply material and the loadings and to carry out the final test.

VOLUME	Voluminal meshs.
IN1	The face of the entry of the large pipe.
IN2	The face of the entry of the small pipe.
OUT	The face of the exit of the large pipe.
T1_INT	The inner face of the large pipe.
T2_INT	The inner face of the small pipe.
T1_EXT	The external face of the large pipe.
T2_EXT	The external face of the small pipe.
IN2_IA	The 1st half-edge interns entry of the small pipe.
IN2_IB	The 2nde half-edge interns entry of the small pipe.
IN2_EA	The 1st external half-edge of the entry of the small pipe.
IN2_EB	The 2nde external half-edge of the entry of the small pipe.
INT_EA	The 1st external half-edge of the intersection.
INT_EB	The 2nde external half-edge of the intersection.
INT_IA	The 1st half-edge interns intersection.
INT_IB	The 2nde half-edge interns intersection.
NOT	A node on the intersection of the external faces of the pipes.

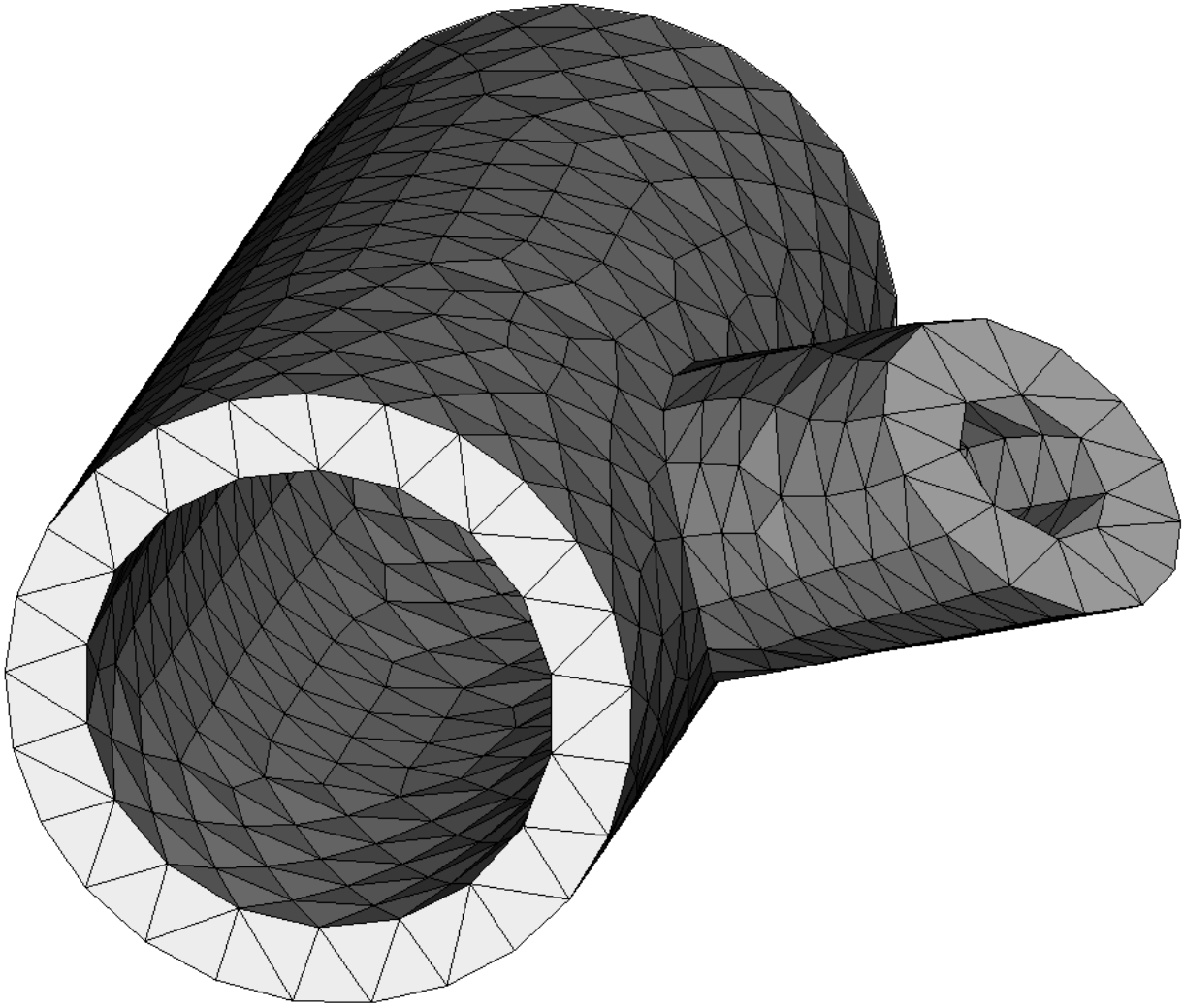

Figure 3.2.1-1.: Initial grid

3.2.2 Grid of the border

The initial grid was created by Salomé. It is in degree 1. The purpose of it is to define a border 1D numerically. Only the arrises of the geometry were with a grid, with a smoothness of an order of magnitude higher than that of the grid of calculation. One chose to discretize in 1000 segments each arris of the grid.

Many nodes:	17996
Many SEG2:	18000

One finds the same groups as in the grid of calculation, to represent the same loci. Only the groups of segments exist.

IN2_IA	The 1st half-edge interns entry of the small pipe.
IN2_IB	The 2nde half-edge interns entry of the small pipe.
IN2_EA	The 1st external half-edge of the entry of the small pipe.
IN2_EB	The 2nde external half-edge of the entry of the small pipe.
INT_EA	The 1st external half-edge of the intersection.
INT_EB	The 2nde external half-edge of the intersection.
INT_IA	The 1st half-edge interns intersection.
INT_IB	The 2nde half-edge interns intersection.

3.3 Features tested

Orders

MACR_ADAP_MAIL	OPTION	FRONTIERE_ANALYTIQUE
		MAILLAGE_FRONTIERE
		GROUP_MA_FRONT

3.4 Sizes tested and results

Nonthe regression is tested on a node of the intersection.

Field	Component	Value
TEM	*TEM*	370.861930

Table 3.4-1.: Values of reference

4 Summary of the results

4.1 Adaptation n°1

The passage of the initial grid to the grid n°1 is obtained by systematically cutting out all the triangles of the inner faces of the pipes. It is noted that the support of these inner faces remains cylindrical.

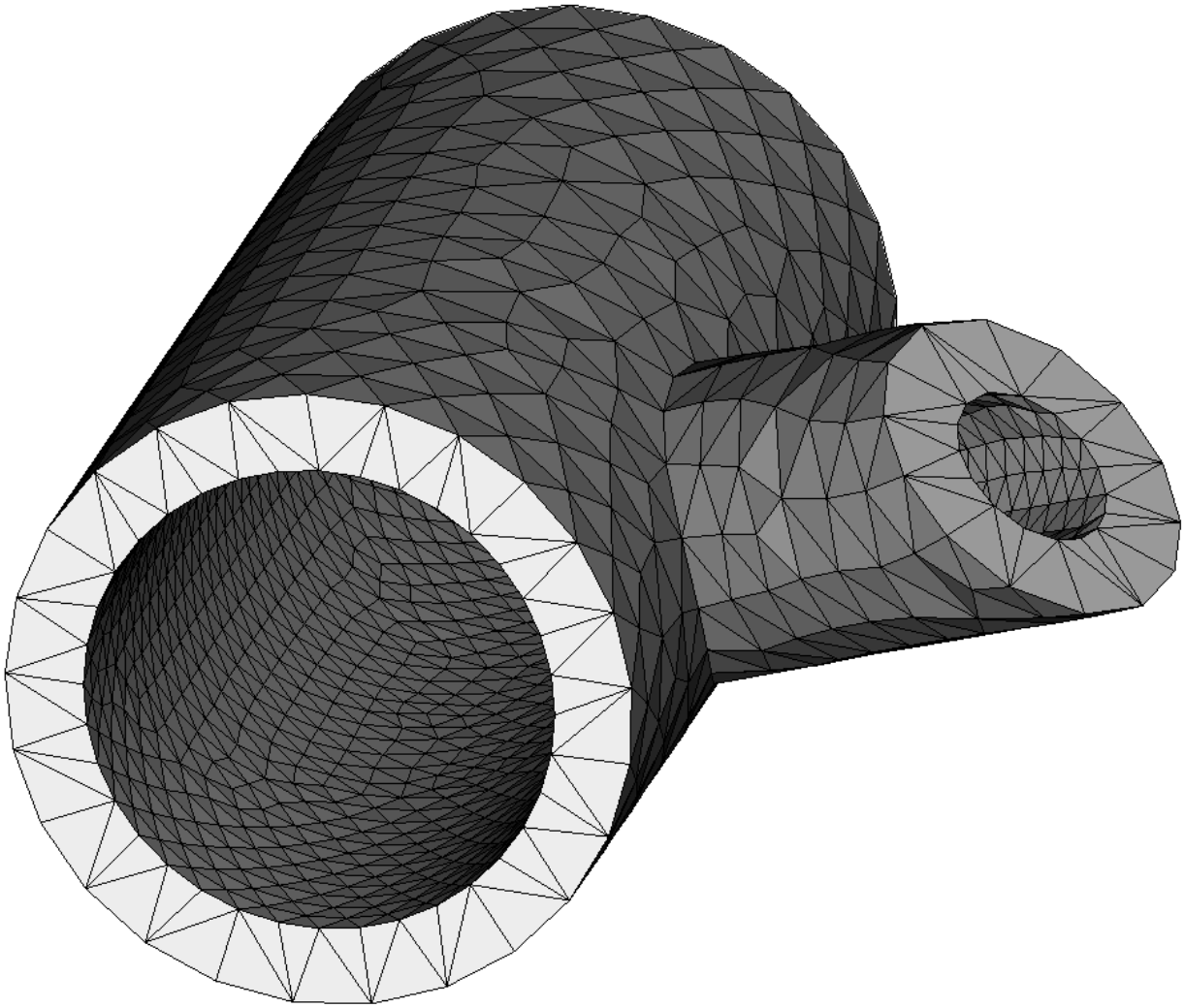

Figure 4.1-1.: Grid n°1

4.2 Adaptation n°2

The passage of the grid n°1 to the grid n°2 is obtained by systematically cutting out all the triangles of the external faces of the pipes. It is noted that the support of these external faces remains cylindrical.

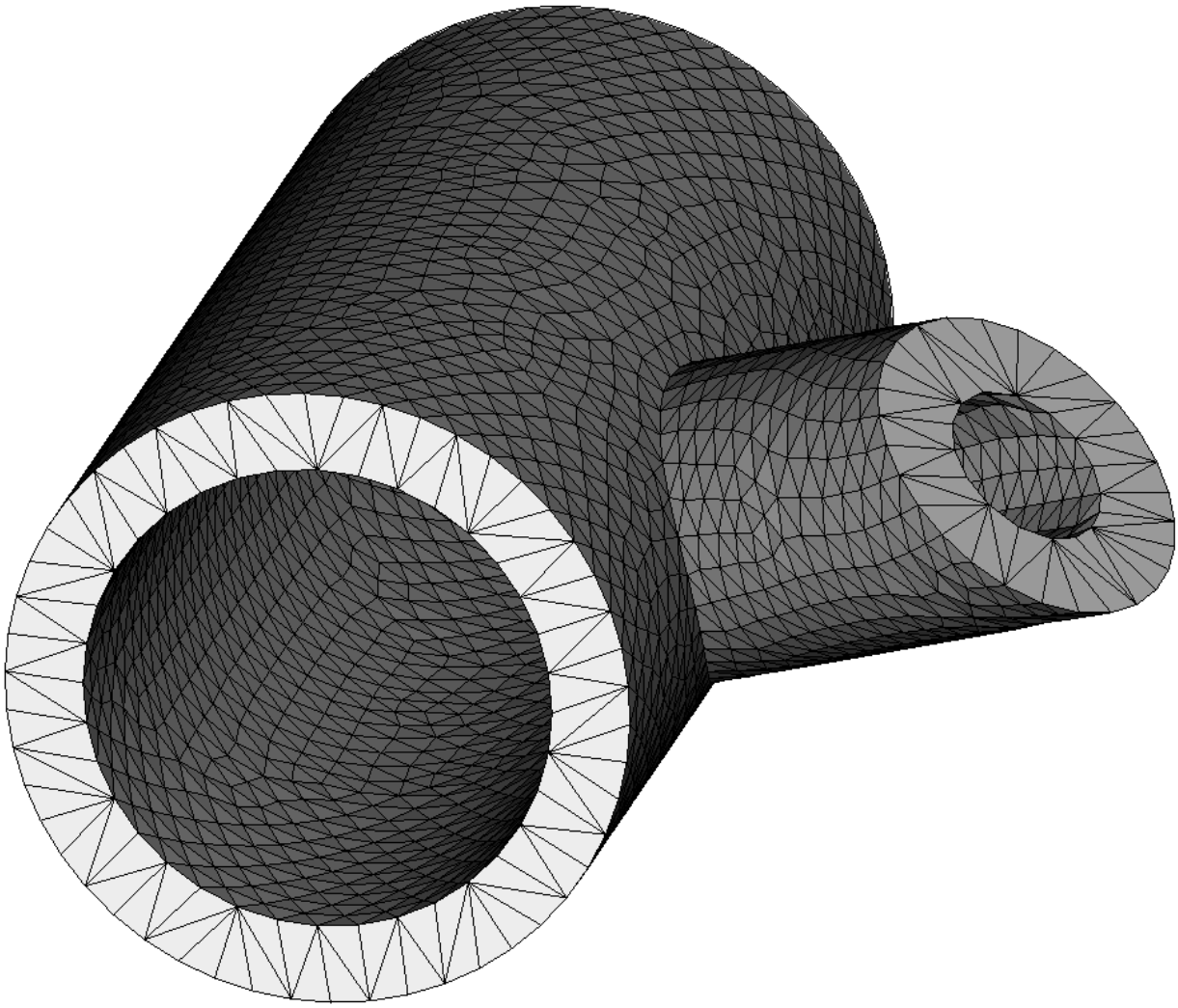

Figure 4.2-1.: Grid n°2

4.3 Adaptations n°3 and n°4

The passage of the grid n°2 to the grid n°3, then grid n3 with the grid n°4, is obtained by systematically cutting out all the segments of the intersecting lines between the 2 pipes. One sees to increase the smoothness of the description of the intersection.

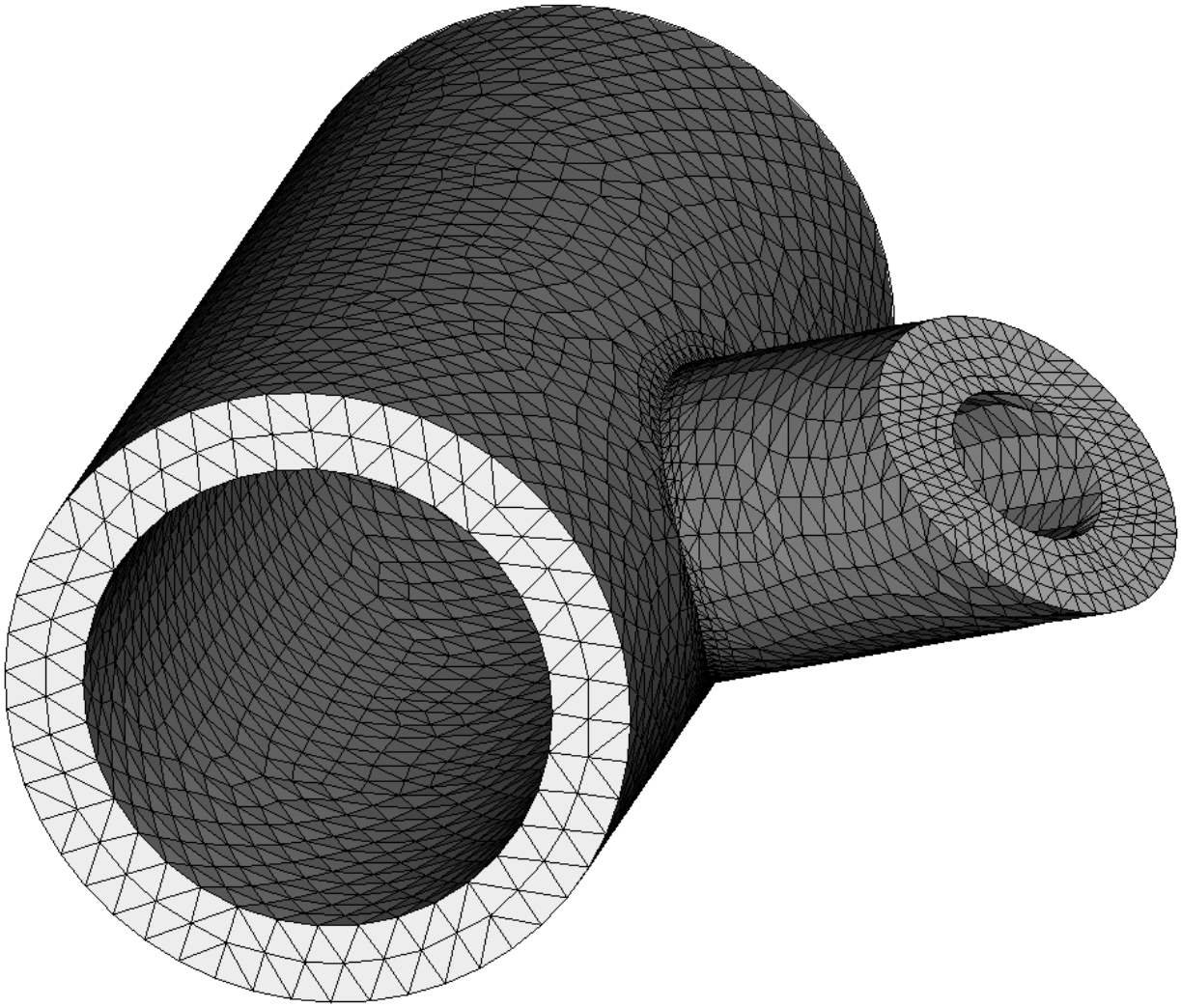

Figure 4.3-1.: Grid n°4

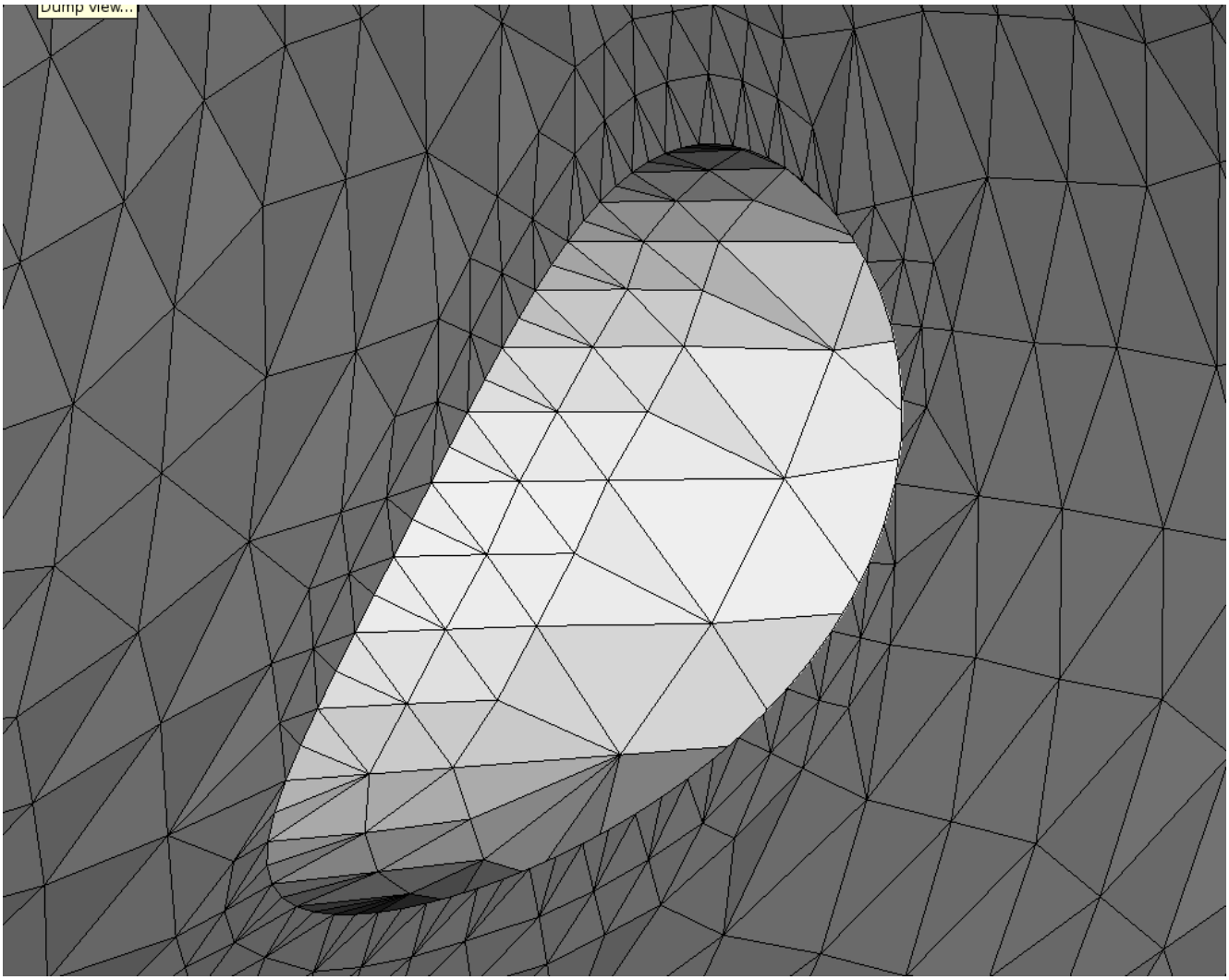

Figure 4.3-2.: Grid n°4 – interior detail