ZZZZ259 - Mesh adaptation and followed by borders 2D

Summarized:

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

1 Problem of reference

1.1 Geometry

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

A each adaptation of the mesh, from the nodes will be created on edge. If nothing is done, the geometry remains facettized. One tests the HOMARD 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 mesh 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 planes 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 plane. 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 mesh annexes fine.

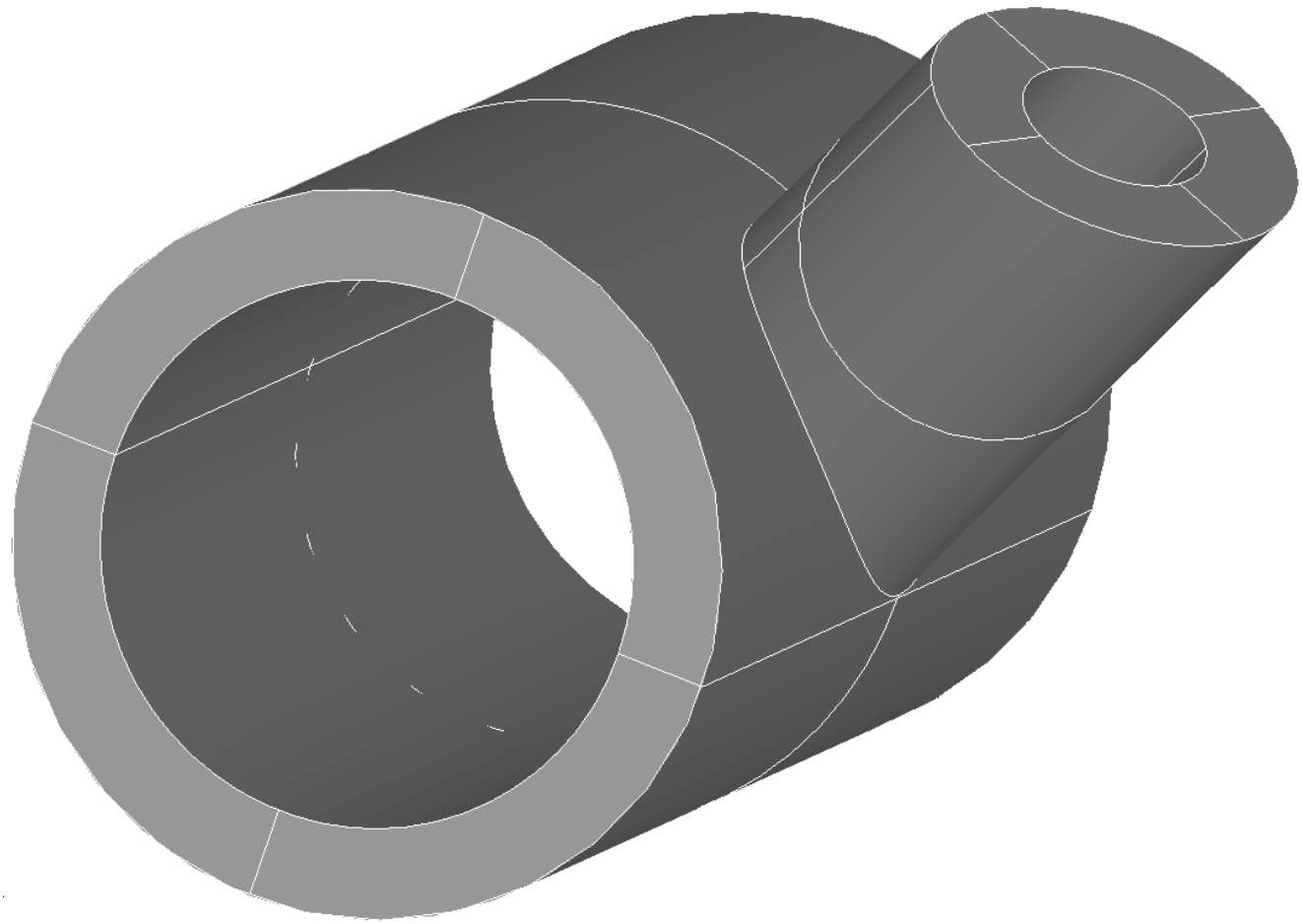

Figure 1.1-1.: Sight of the geometry

Characteristics:

	Pipe n°1	Pipe n°2
X of the base	0	17,5
Y of the base	25	-2,5
Z of the base	-25	-100
X of the axial vector	25	-100
Y of the axial vector	50.-75	
Z of the axial vector	75.-25	
interior Radius	75	25
external Radius	100	50
Height	400.250	

Table 1.1-2.: Dimensions of the pipes

1.2 Properties of the material

the material is defined with:

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

1.3 Boundary conditions and loadings

The computation 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 with temperature 600.
The interior face of the small pipe is blocked with temperature 400.

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

The other external sides on the sections of the pipes are free. One voluntarily imposes a normal flux on it no one, to ensure a correct computation of the error indicators if one wanted to extend the problem.

2 Reference solution

the reference solution is the first Aster computation.

3 Modelization A

3.1 Characteristic of the modelization

The computation is a resolution in linear thermal.

3.2 Characteristics of the mesh

3.2.1 The mesh of computation

The mesh initial was created by Salome. It is in degree 1. Before computation, the mesh passed in degree 2 by the command CREA_MAILLAGE.

Many nodes:	1106
Many SEG2:	187
Many TRIA3:	1954
Number of TETRA4:	The 3584

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

VOLUME	the meshes voluminal ones.
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 output 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.
POINT	a node on the intersection of the external sides of the pipes.

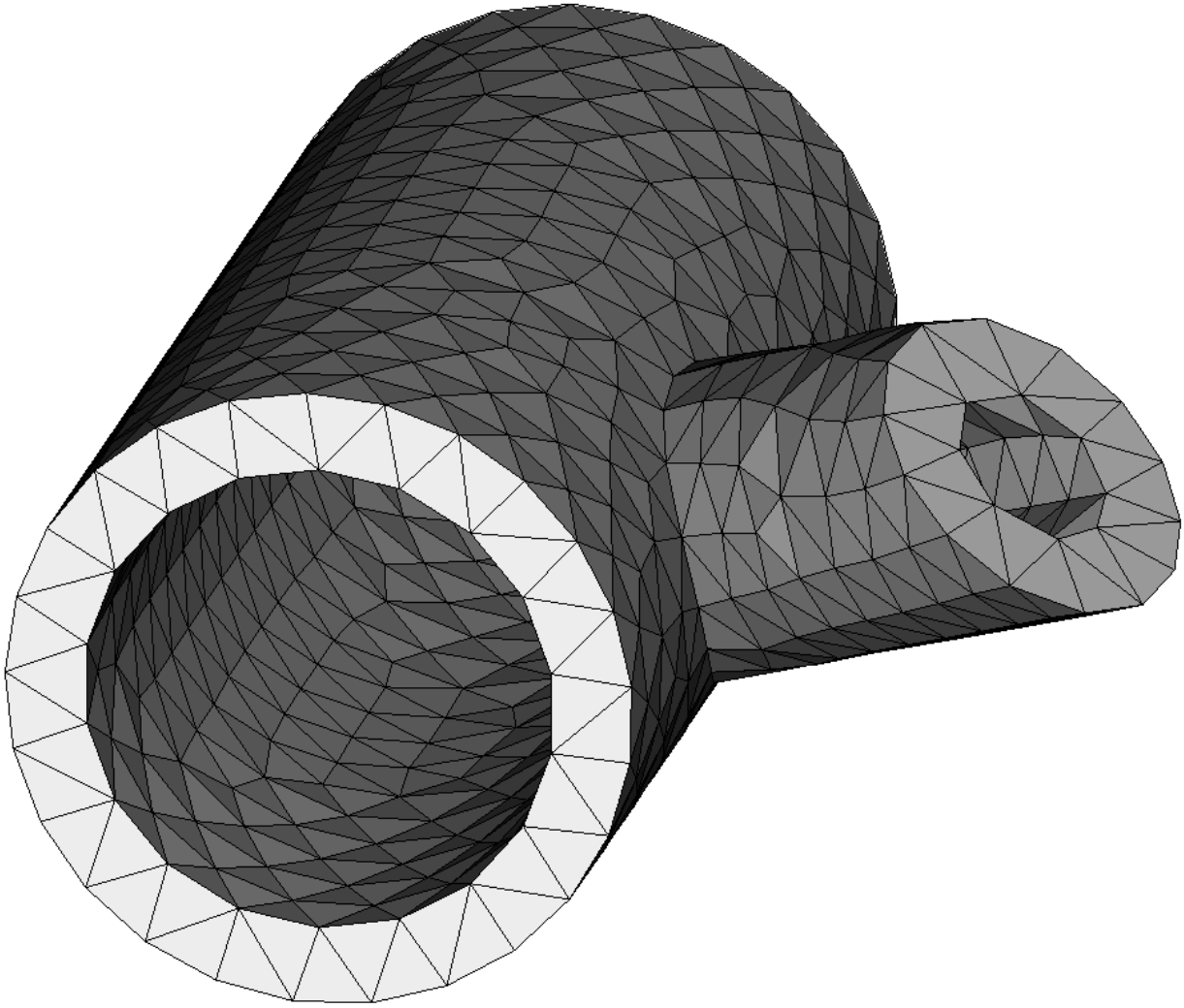

Figure 3.2.1-1.: Initial mesh

3.2.2 The mesh of the border

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

Many nodes:	17996
Many SEG2:	18000

One finds the same groups as in the mesh of computation, 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 Functionalities tested

Commands

MACR_ADAP_MAIL	OPTION	FRONTIERE_ANALYTIQUE
		MAILLAGE_FRONTIERE
		GROUP_MA_FRONT

3.4 Quantities tested and results

the non regression one 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 transition of the initial mesh to the mesh 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.

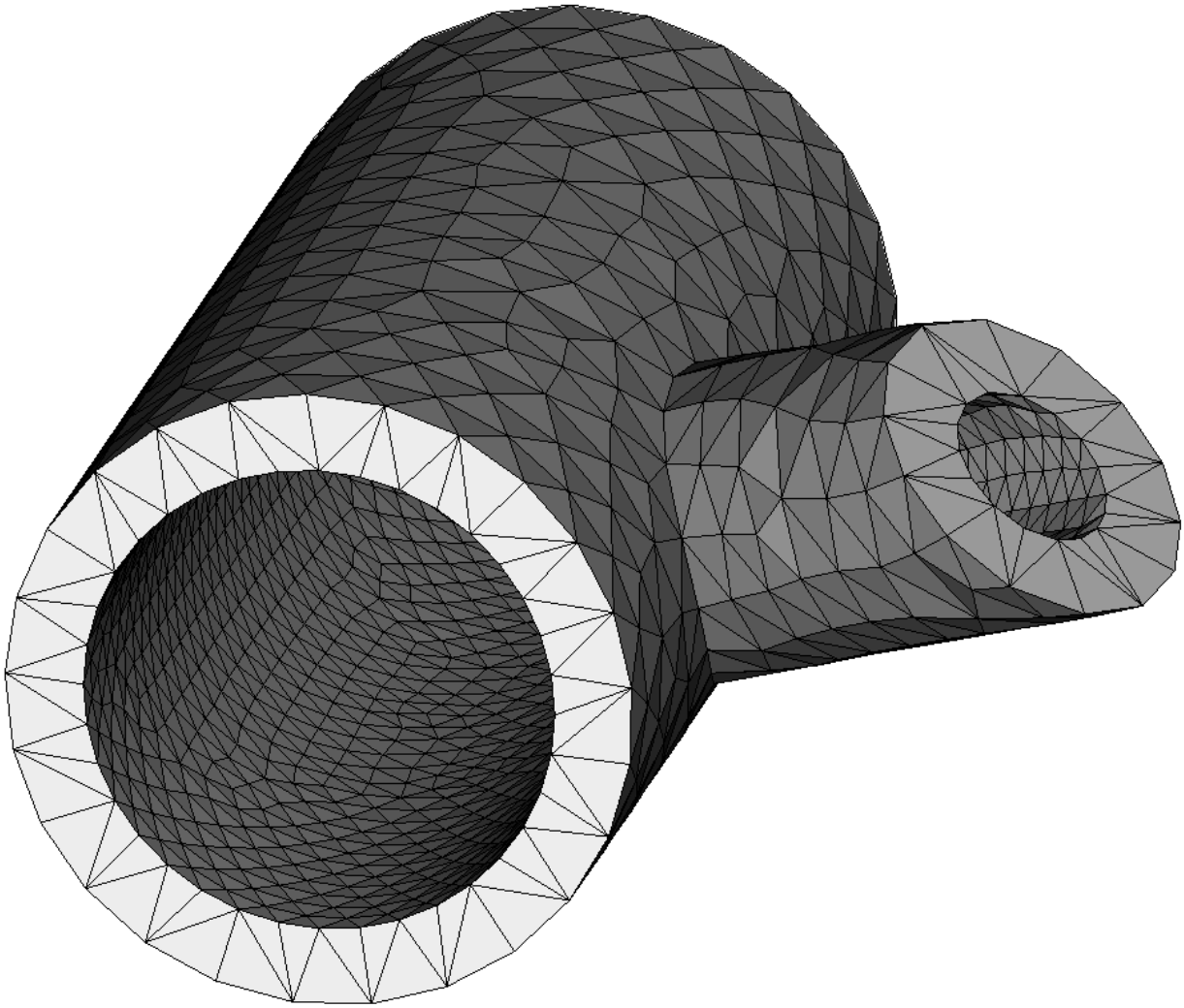

Figure 4.1-1.: Mesh n°1

4.2 Adaptation n°2

the transition of the mesh n°1 with the mesh n°2 is obtained by systematically cutting out all the triangles of the external sides of the pipes. It is noted that the support of these external sides remains cylindrical.

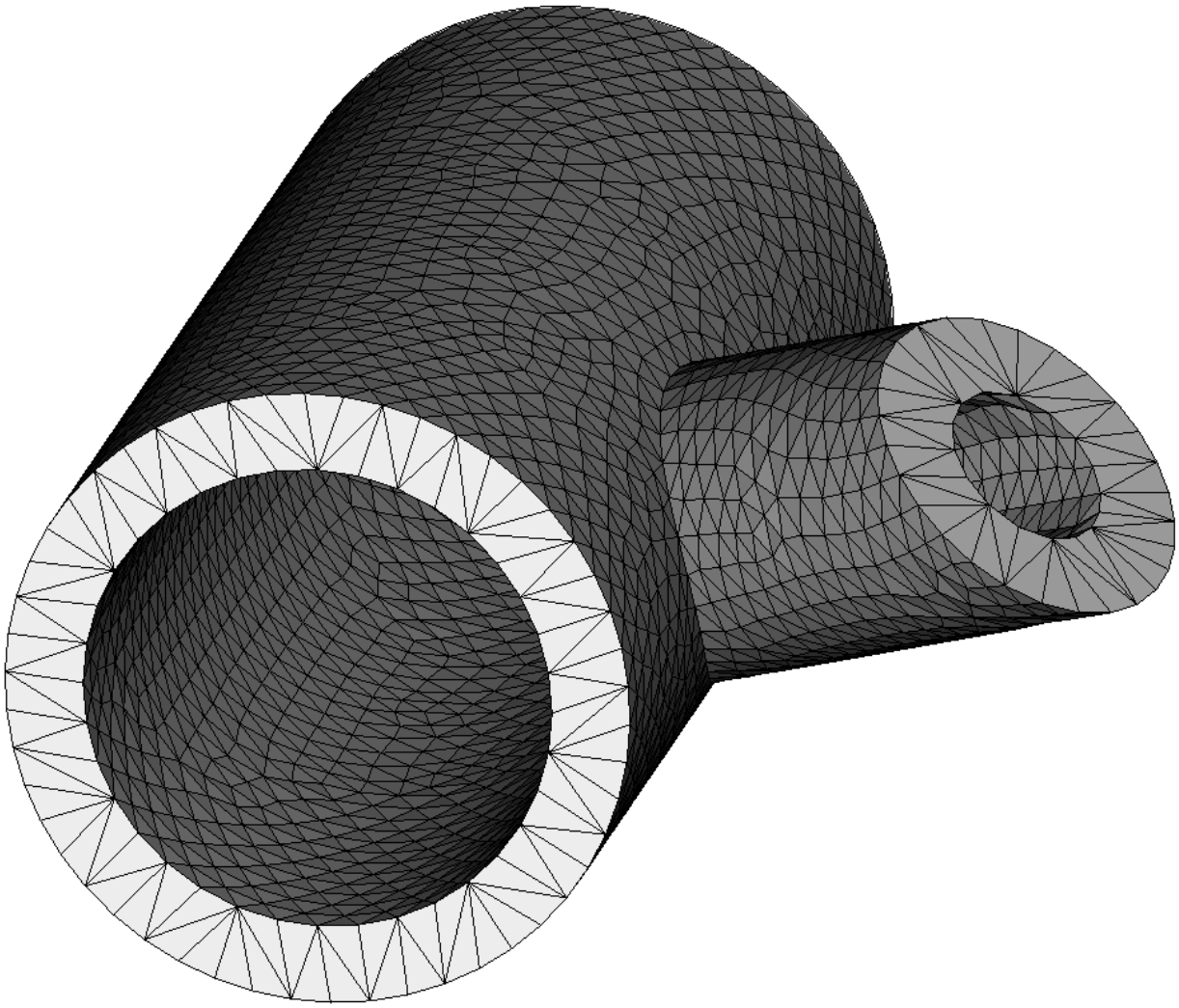

Figure 4.2-1.: Mesh n°2

4.3 Adaptations n°3 and n°4

the transition of the mesh n°2 with the mesh n°3, then mesh n3 with the mesh 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.

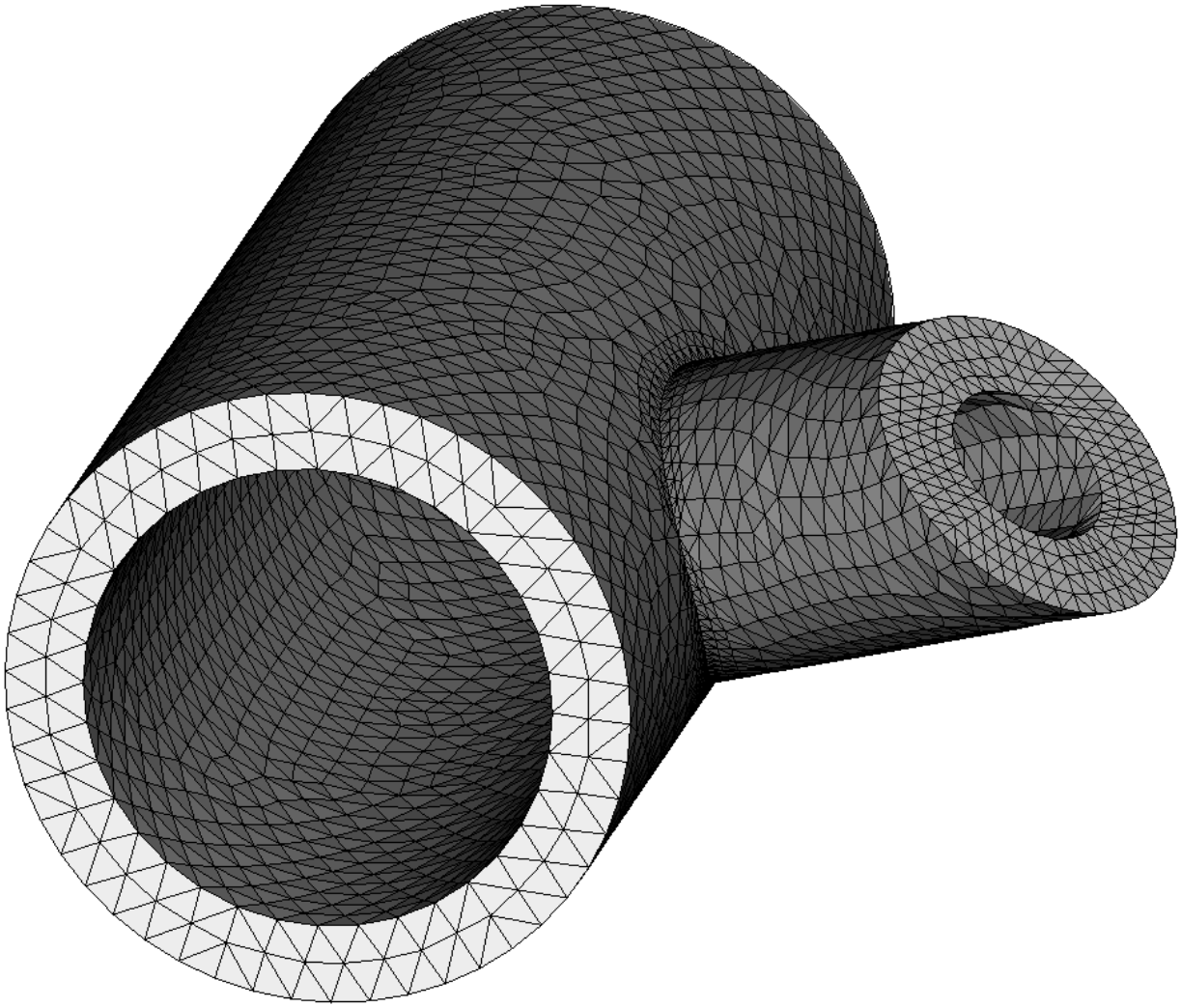

Figure 4.3-1.: Mesh n°4

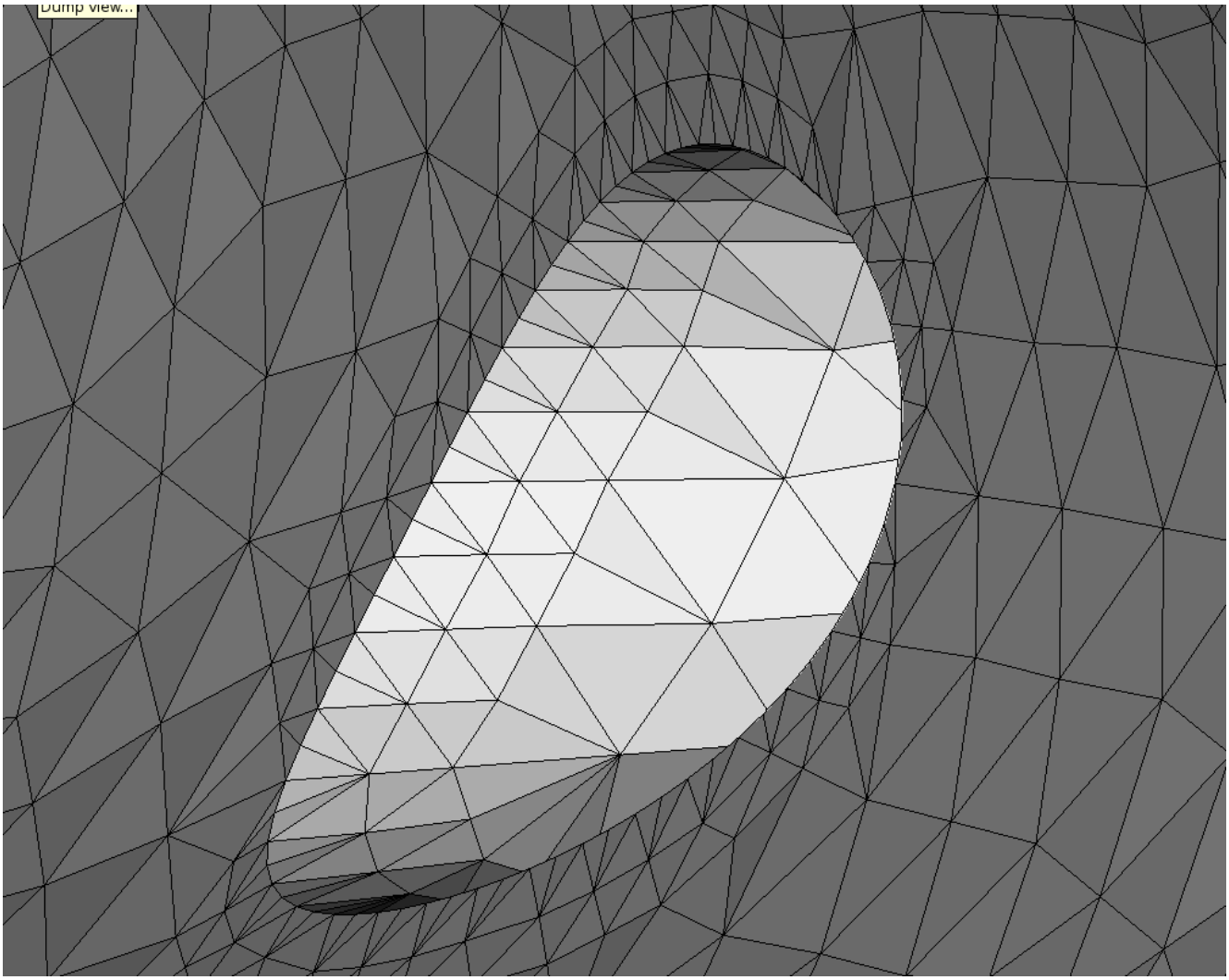

Figure 4.3-2.: Mesh n°4 – interior detail