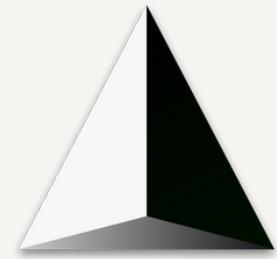


UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
ESCOLA DE ENGENHARIA
PROGRAMA DE PÓS GRADUAÇÃO EM ENGENHARIA CIVIL



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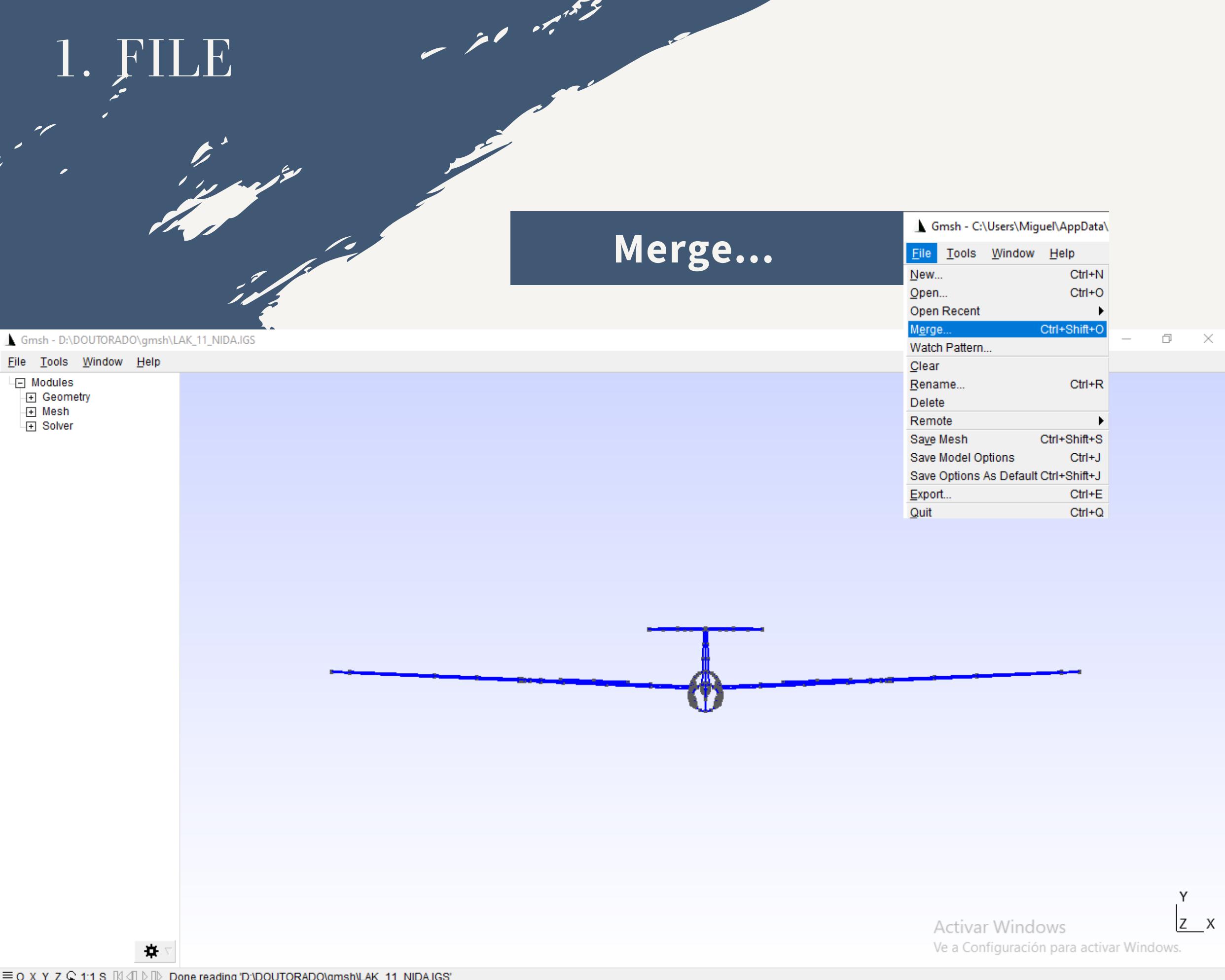


MINICURSO GMSH

GABRIELA PENNA BIANCHIN
MIGUEL ANGEL AGUIRRE

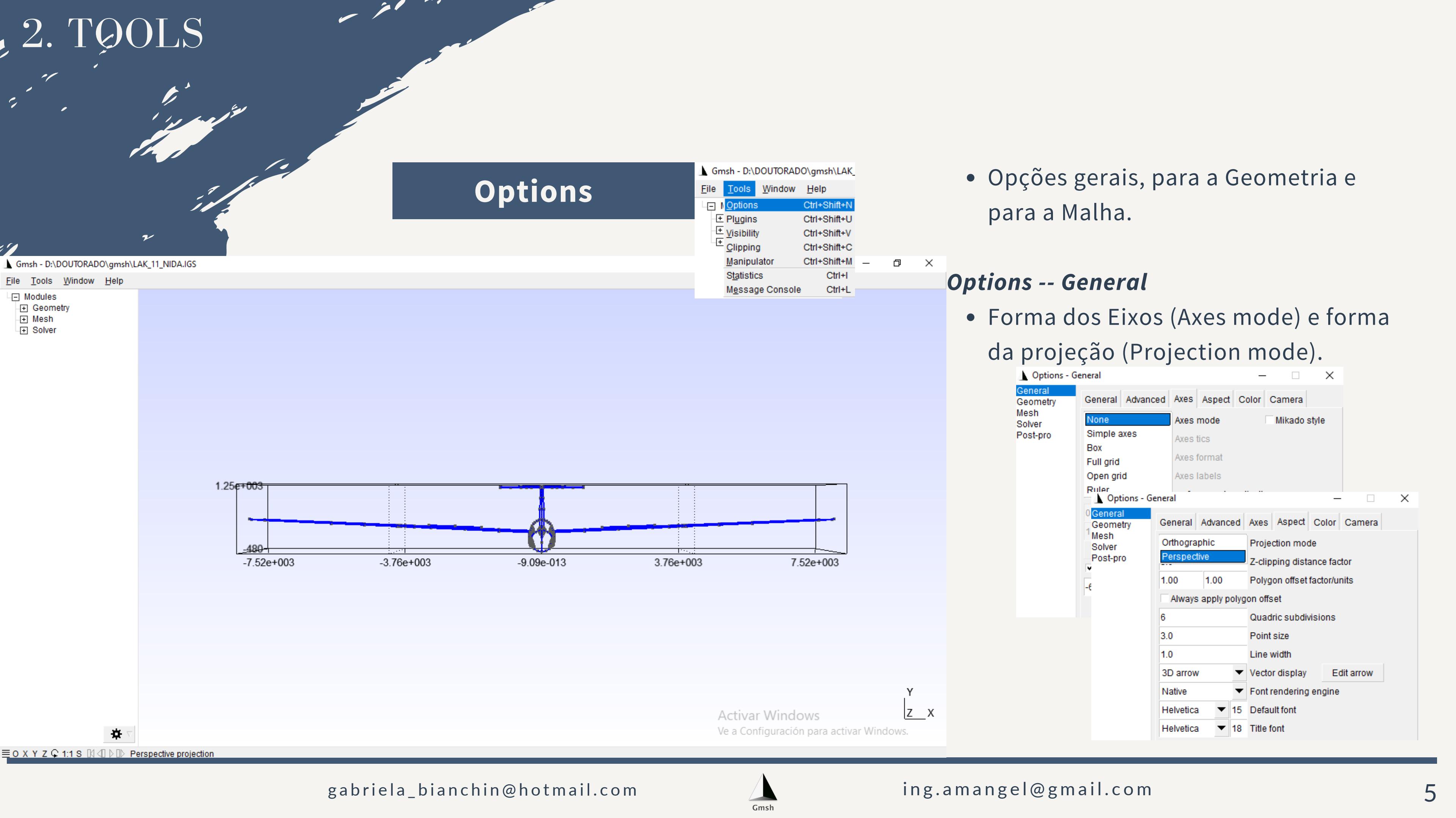
PORTO ALEGRE
NOVEMBRO DE 2020

1. FILE



- Importa uma geometria.
- Formatos mais usados: Step (.stp); Igés (.igs).
- Sites para baixar geometrias: GrabCAD.com; Free3D.com; TurboSquid.com

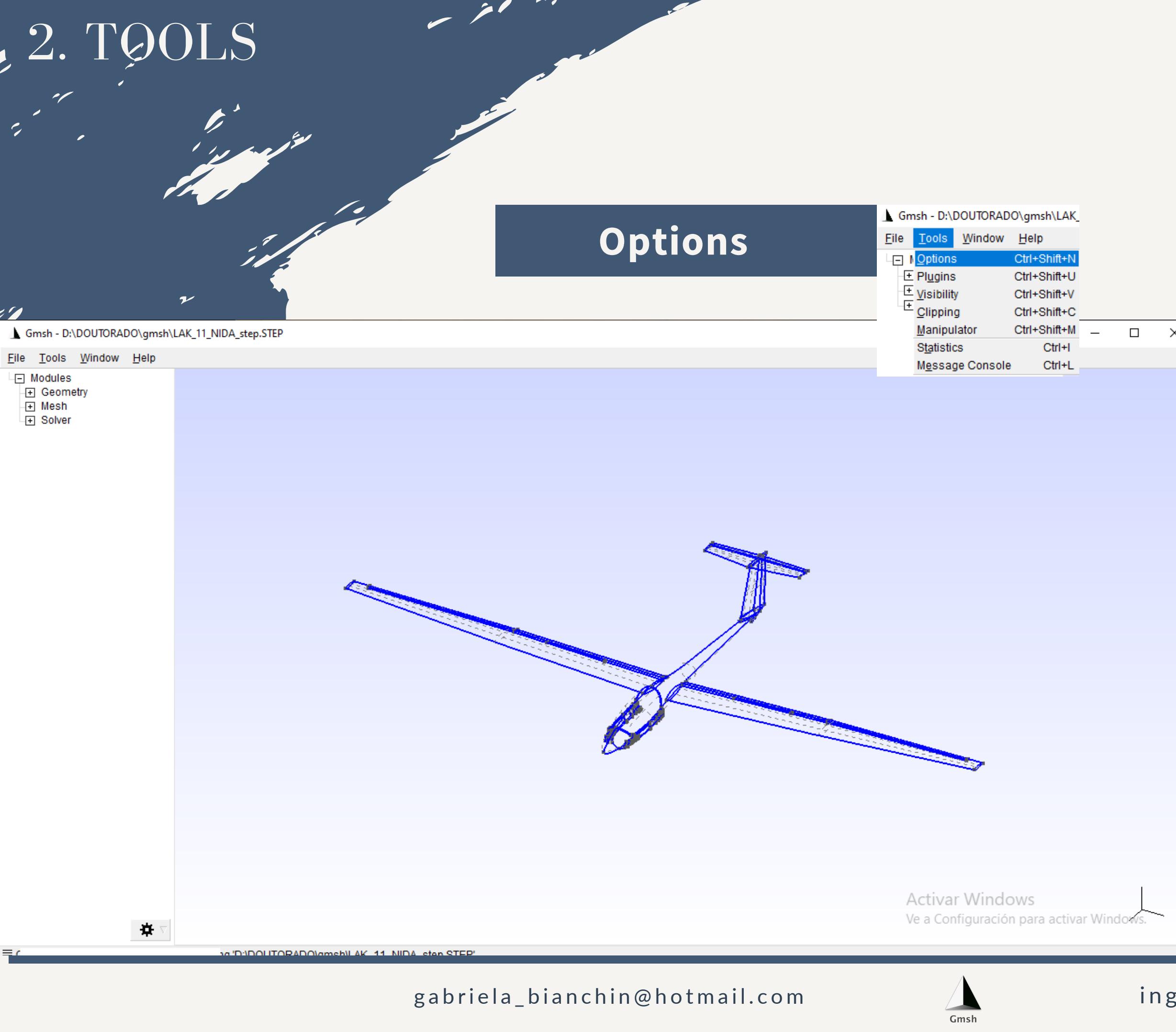
2. TOOLS



The image shows the Gmsh software interface. On the left, there is a 3D view of a model with a coordinate system (X, Y, Z) and a perspective projection indicator. The main window title is "Gmsh - D:\DOUTORADO\gmsh\LAK_11_NIDA.IGS". The menu bar includes File, Tools, Window, Help, and Options. The Options menu is open, showing sub-options like Plugins, Visibility, Clipping, Manipulator, Statistics, and Message Console, each with a keyboard shortcut. A secondary "Options -- General" window is also open, showing settings for General, Advanced, Axes, Aspect, Color, and Camera modes. The "Axes" tab is selected, showing options for "None", "Simple axes", "Box", "Full grid", "Open grid", and "Ruler". The "Perspective" tab is selected under "Projection mode", with settings for Z-clipping distance factor (1.00), Polygon offset factor/units (1.00), Always apply polygon offset (unchecked), Quadric subdivisions (6), Point size (3.0), Line width (1.0), Vector display (3D arrow), Font rendering engine (Native), Default font (Helvetica 15), and Title font (Helvetica 18). A watermark for "Activar Windows" and "Ve a Configuración para activar Windows." is visible in the background.

- Opções gerais, para a Geometria e para a Malha.
- Forma dos Eixos (Axes mode) e forma da projeção (Projection mode).

2. TOOLS

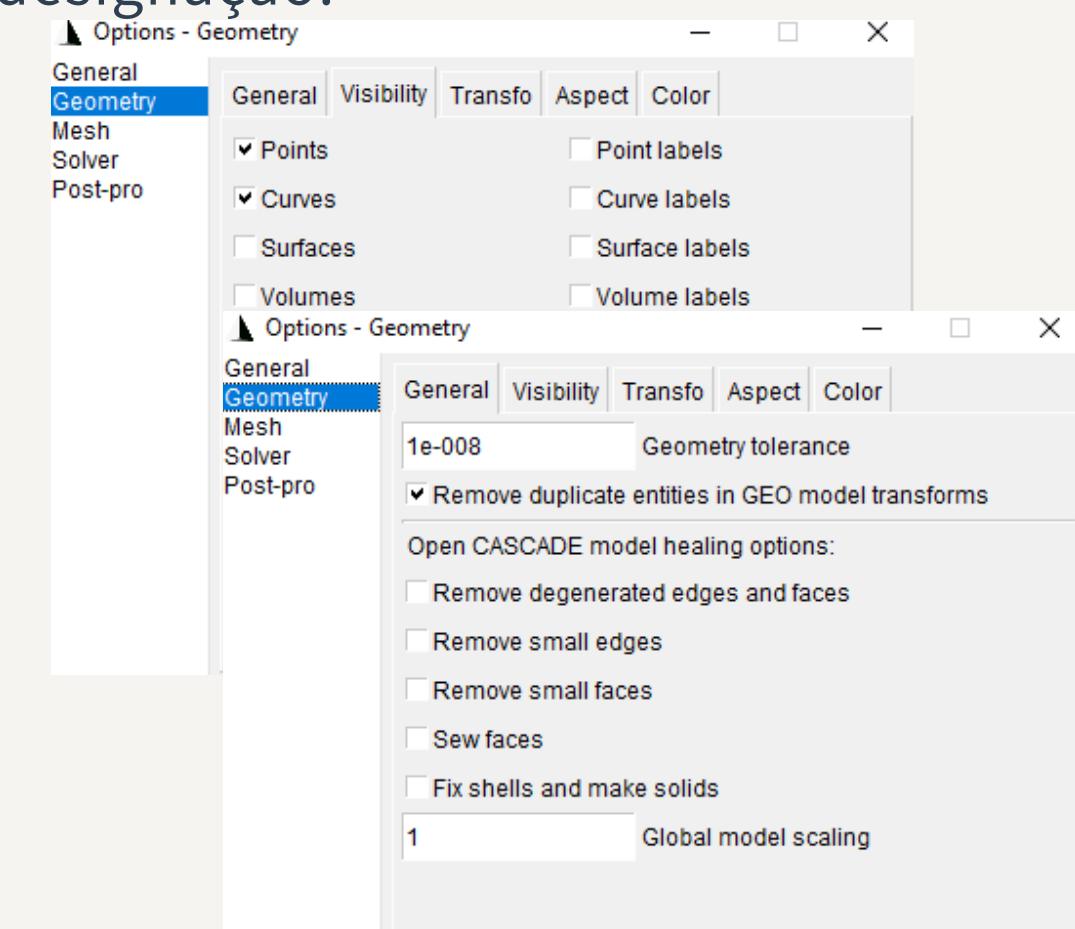


The screenshot shows the Gmsh software interface. On the left, there is a 3D view of a mechanical part, likely a bracket or bracket, with blue edges indicating selected features. The main menu bar at the top includes File, Tools, Window, Help, and Options. The Options menu is open, showing sub-options like Plugins, Visibility, Clipping, Manipulator, Statistics, and Message Console, each with a keyboard shortcut. Below the menu is a toolbar with icons for opening files, saving, and other operations. A status bar at the bottom displays the file path "D:\DOUTORADO\gmsh\LAK_11_NIDA_step.STEP".

- Opções gerais, para a Geometria e para a Malha.

Options -- Geometry

- Visibilidade de pontos, linhas, superfícies e volumes e sua designação.



The image shows three nested windows titled "Options - Geometry". The innermost window has tabs for General, Visibility, Transfo, Aspect, and Color, with "Visibility" selected. It contains checkboxes for Points, Curves, Surfaces, and Volumes, all of which are checked. The middle window has tabs for General, Geometry, Mesh, Solver, and Post-pro, with "Geometry" selected. The outermost window also has tabs for General, Visibility, Transfo, Aspect, and Color, with "Visibility" selected. It contains a "Geometry tolerance" field set to "1e-008", a checkbox for "Remove duplicate entities in GEO model transforms" (which is checked), and several options under "Open CASCADE model healing options" (Remove degenerated edges and faces, Remove small edges, Remove small faces, Sew faces, Fix shells and make solids), none of which are checked. There is also a "Global model scaling" field set to "1".

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Gmsh

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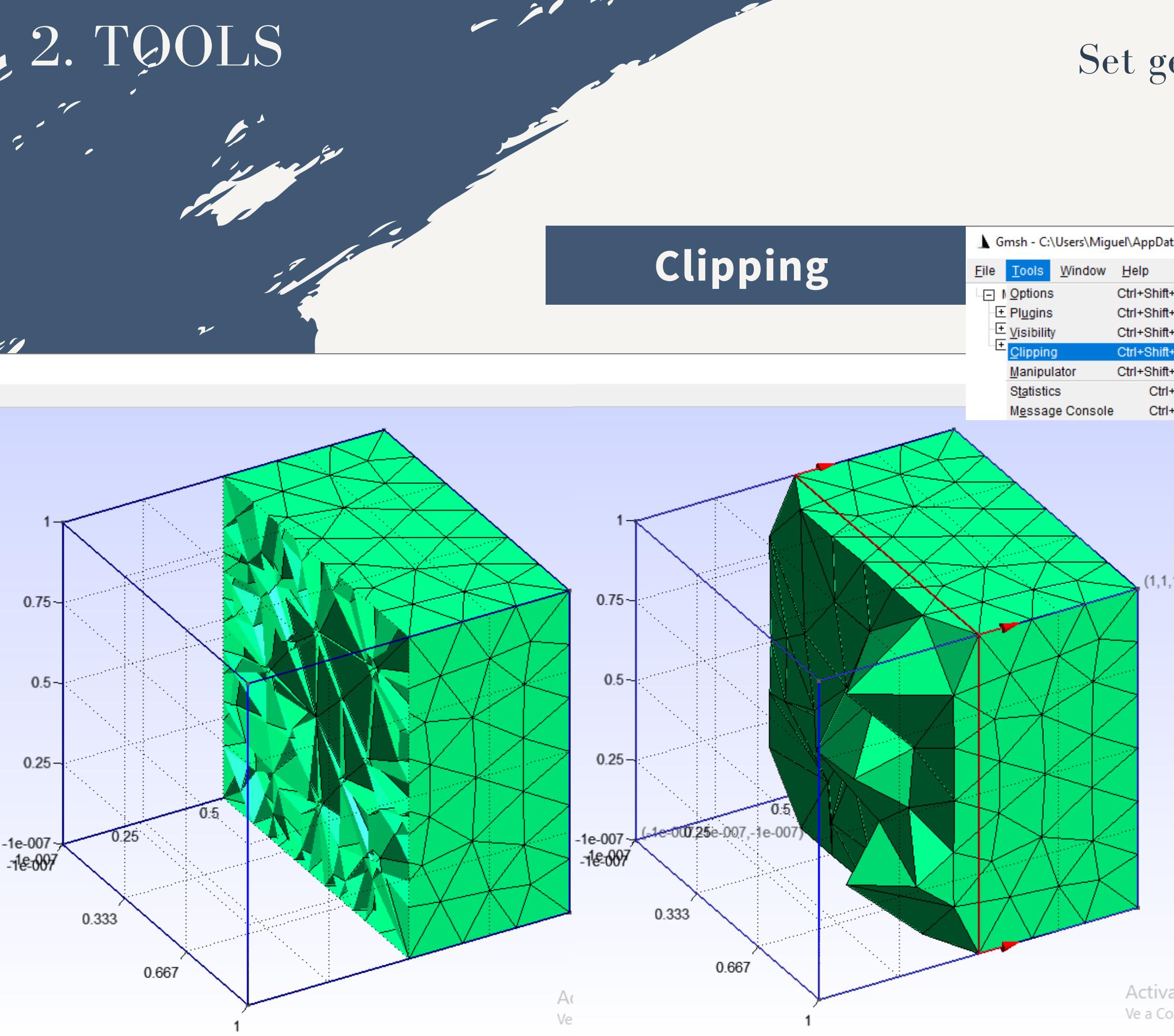
2. TOOLS

The figure consists of several panels illustrating Gmsh's tools:

- Top Left:** A screenshot of the Gmsh interface showing the "Options" menu. The menu includes "File", "Tools", "Window", and "Help". Under "Tools", "Options" is selected, with sub-options: Plugins (Ctrl+Shift+U), Visibility (Ctrl+Shift+V), Clipping (Ctrl+Shift+C), Manipulator (Ctrl+Shift+M), Statistics (Ctrl+I), and Message Console (Ctrl+L).
- Top Right:** A list of bullet points describing the "Options" menu:
 - Opções gerais, para a Geometria e para a Malha.
- Middle Left:** A histogram titled "Element Quality" showing the distribution of γ_K for a mesh of about 600,000 tetrahedra. The x-axis ranges from 0 to 1, and the y-axis ranges from 0 to 25,000. Three curves are shown: "no optimization" (black), "gmsh optimization" (white), and "both netgen and gmsh optimizations" (grey). The "both" curve is the most uniform, peaking around 0.75.
- Middle Center:** A 3D visualization of a complex mesh structure, likely a torus, composed of many small tetrahedra.
- Middle Right:** A screenshot of the "Options - Mesh" dialog box. The "Mesh" tab is active. It contains sections for "General", "Advanced", "Visibility", "Aspect", and "Color". Under "General", there are checkboxes for "Compute element sizes using point values" (checked) and "Compute element sizes from curvature" (unchecked). Under "Advanced", there is a dropdown for "Number of elements per 2 pi radians" set to 6. Under "Visibility", there are checkboxes for "Extend element sizes from boundary" (checked), "Optimize quality of tetrahedra" (checked), "Optimize quality of tetrahedra with Netgen" (unchecked), and "Optimize high-order meshes" (unchecked).
- Bottom Left:** A caption: "Figure 9. Distribution of γ_K in a mesh of about 600,000 tetrahedra."
- Bottom Center:** The Gmsh logo.
- Bottom Right:** Two email addresses: "gabriela_bianchin@hotmail.com" and "ing.amangel@gmail.com".
- Page Number:** "5" at the bottom right corner.

2. TOOLS

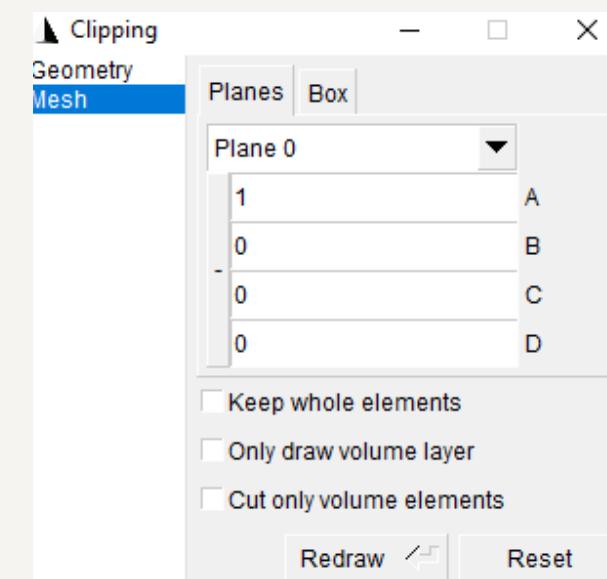
Set geometry kernel -- OpenCASCADE



- Recorta a geometria e a malha.

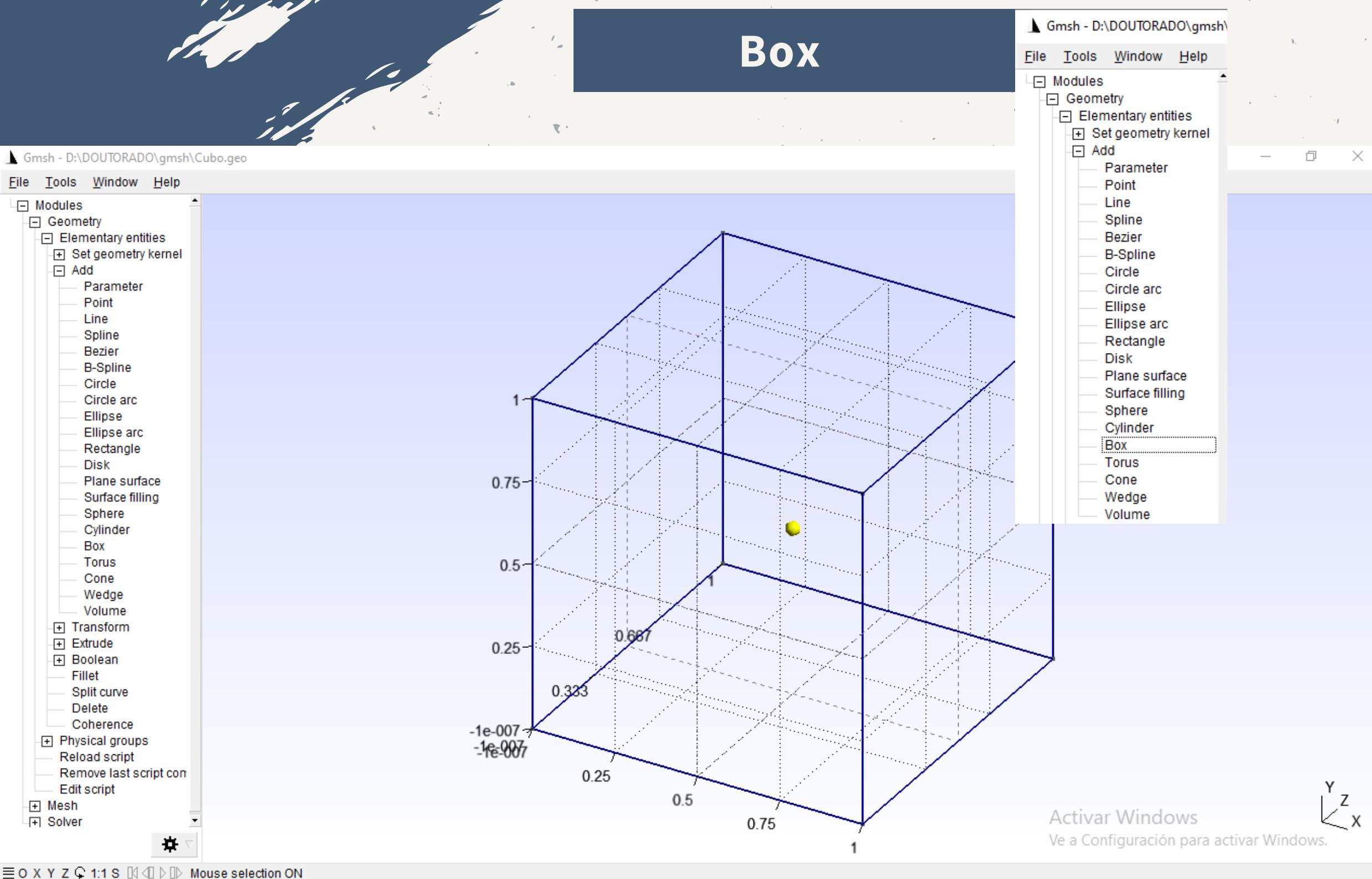
Clipping -- Mesh

- Cada plano é definido pelas constantes da equação em coordenadas cartesianas.
- Os elementos podem aparecer completos ou cortados.



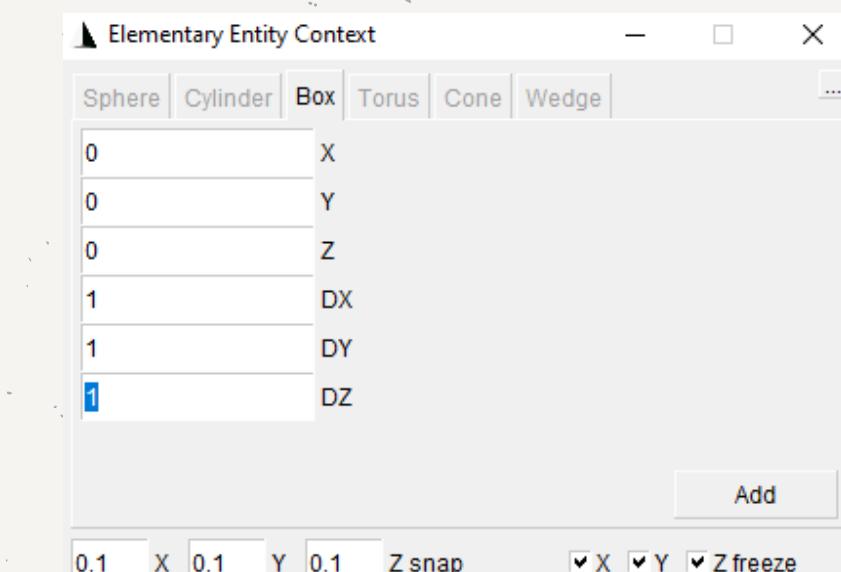
3. GEOMETRY

Set geometry kernel -- OpenCASCADE



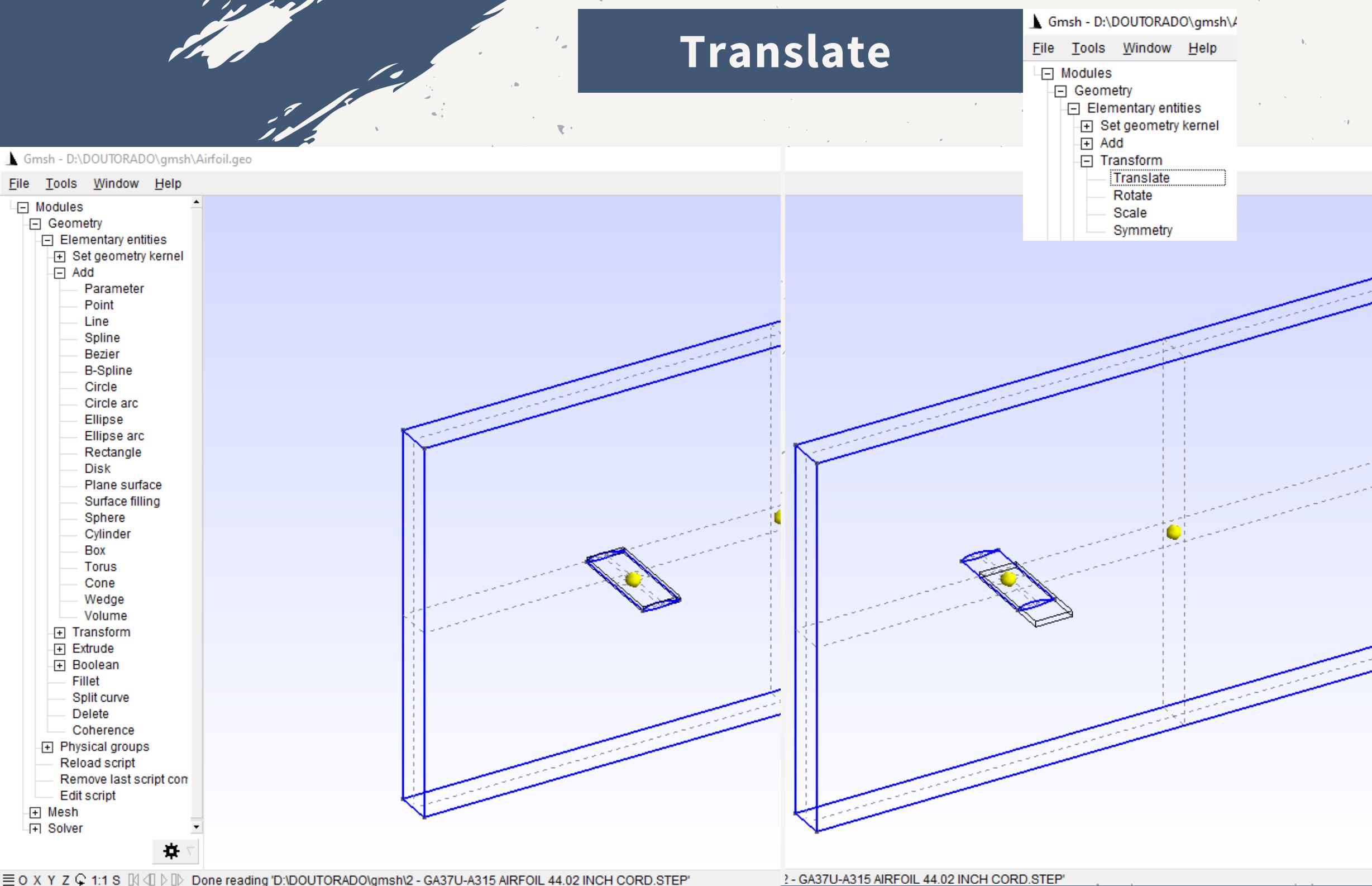
Add -- Box

- Cria uma caixa com pontos, linhas, superfícies e volume.



3. GEOMETRY

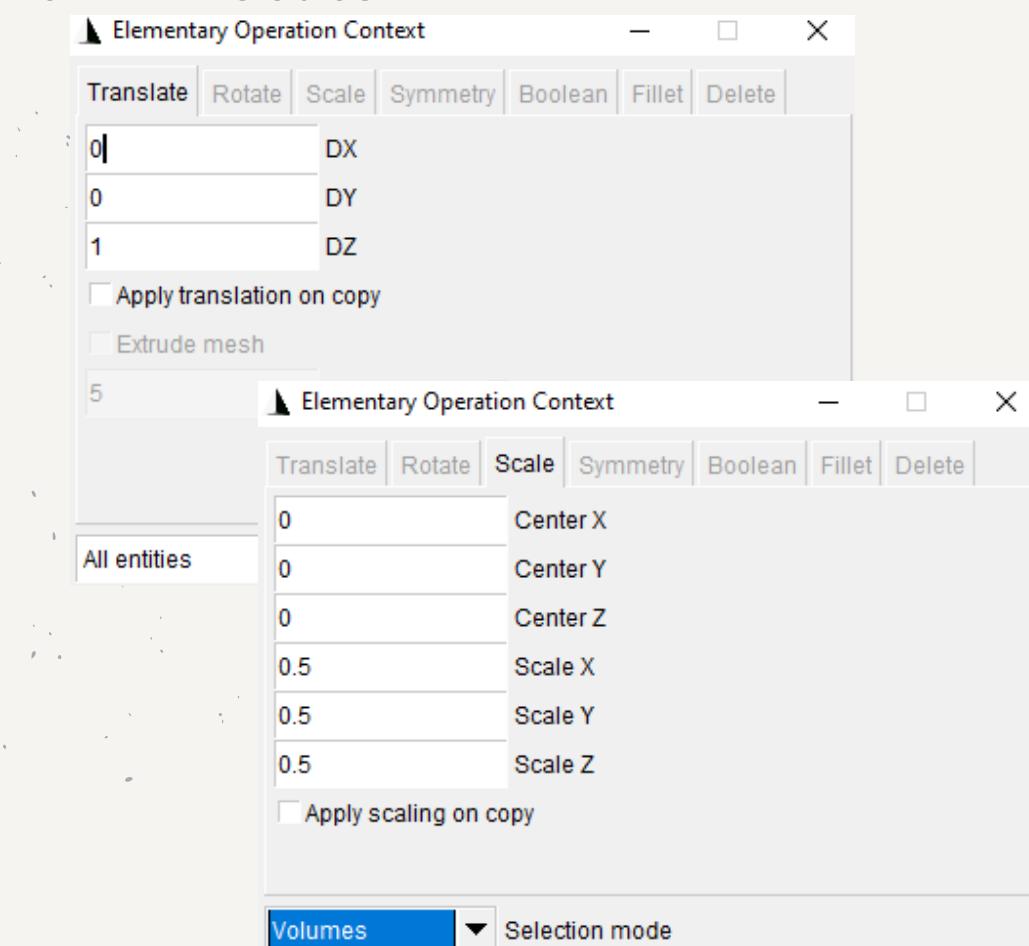
Set geometry kernel -- OpenCASCADE



Transform -- Translate

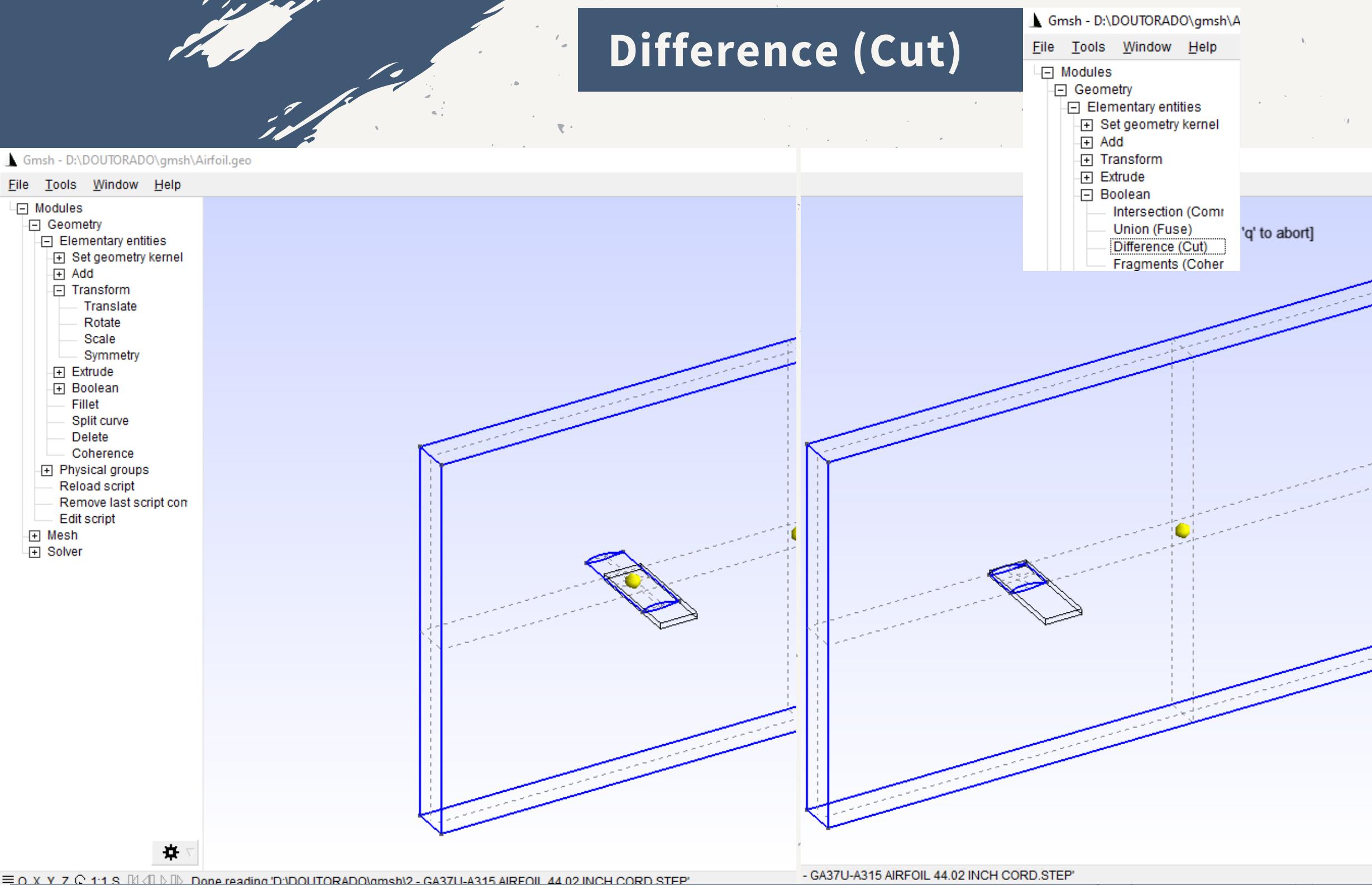
- Desloca a entidade (ponto, linha, superfície e/ou volume) nas três direções.
- Mantem a original no lugar e cria uma cópia deslocada.

Transform -- Scale



3. GEOMETRY

Set geometry kernel -- OpenCASCADE

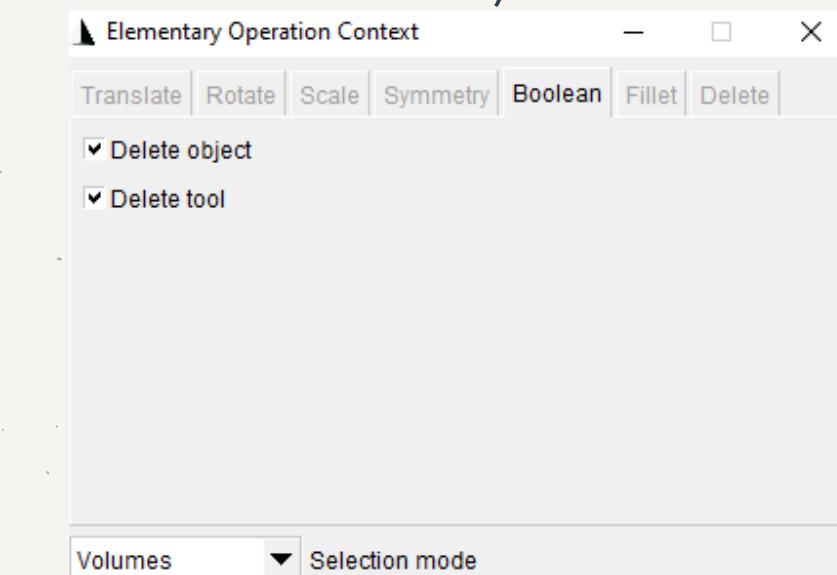


Boolean -- Difference (Cut)

- Usa um volume para gerar uma abertura em outro volume (some um volume).

Boolean -- Union (Fuse)

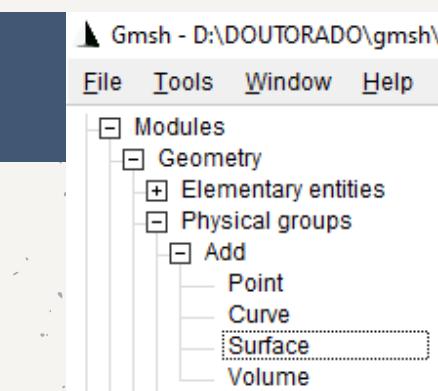
- Funde dois volumes (substitui por um novo volume).



3. GEOMETRY

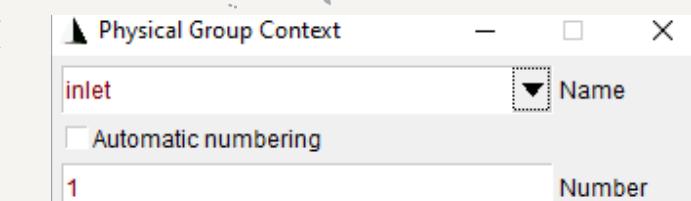
Set geometry kernel -- OpenCASCADE

Physical groups



Physical groups -- Add

- Confere um nome físico e um número a uma entidade (ponto, linha, superfície ou volume).
- A entidade conserva sua designação.

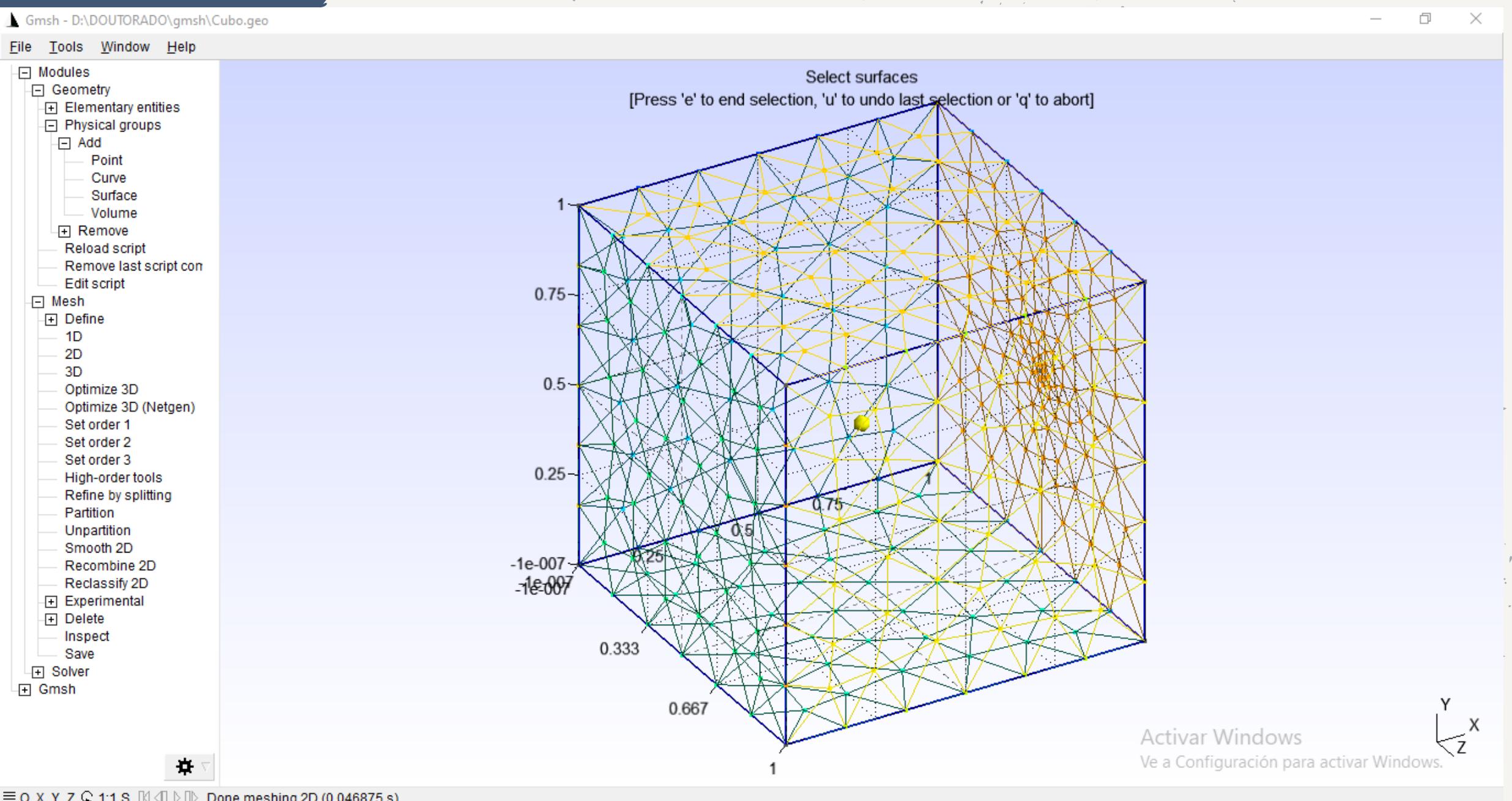


The screenshot shows two windows of the Gmsh software. Both windows have the title 'Cubo: Bloc de notas' and the file path 'D:\DOUTORADO\gmsh\Cubo'. The left window shows the 'Elementary entities' tree node expanded, revealing a list of nodes and elements. The right window shows the same list. Both windows contain the following text:

```
Archivo Edición Formato Ver Ayuda
341 0.1598237993076805 0.3586548717091264 1652 4 2 5 1 337 305 240 293
$EndNodes
1653 4 2 5 1 282 329 291 284
1654 4 2 5 1 282 291 329 276
1655 4 2 5 1 323 291 329 284
1656 4 2 5 1 323 329 291 276
1657 4 2 5 1 310 97 85 291
1658 4 2 5 1 310 85 97 83
1659 4 2 5 1 312 93 310 81
1660 4 2 5 1 312 310 93 288
1661 4 2 5 1 85 239 16 264
1662 4 2 5 1 85 16 239 70
1663 4 2 5 1 334 131 113 116
1664 4 2 5 1 334 113 131 309
1665 4 2 5 1 220 336 217 230
1666 4 2 5 1 217 336 220 316
1667 4 2 5 1 331 327 314 287
1668 4 2 5 1 331 314 327 275
1669 4 2 5 1 331 321 282 275
1670 4 2 5 1 331 282 321 284
1671 4 2 5 1 333 334 296 309
1672 4 2 5 1 296 334 333 279
$EndElement
```

4. MESH

Point In Surface



- Associa um ponto a uma superfície e permite refinar localmente.

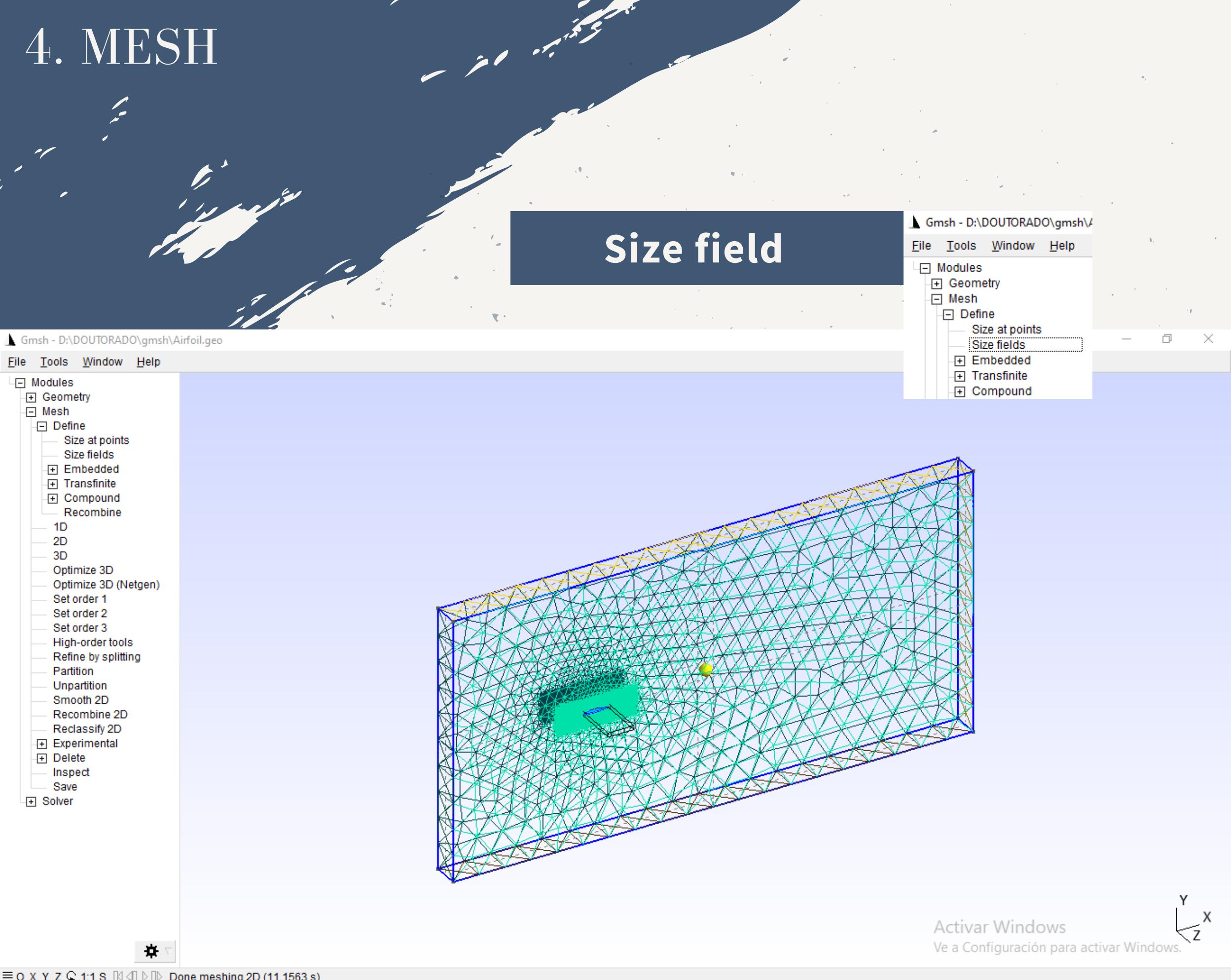
Line In Surface

```
Cubo: Bloc de notas
Archivo Edición Formato Ver Ayuda
Mesh.MshFileVersion = 2.2;

SetFactory("OpenCASCADE");
//+
Box(1) = {0, 0, 0, 1, 1, 1};
//+
Physical Surface("inlet", 1) = {1};
//+
Physical Surface("outlet", 2) = {2};
//+
Physical Surface("lateral", 3) = {5, 4, 6, 3};
//+
Physical Volume("Fluid", 5) = {1};

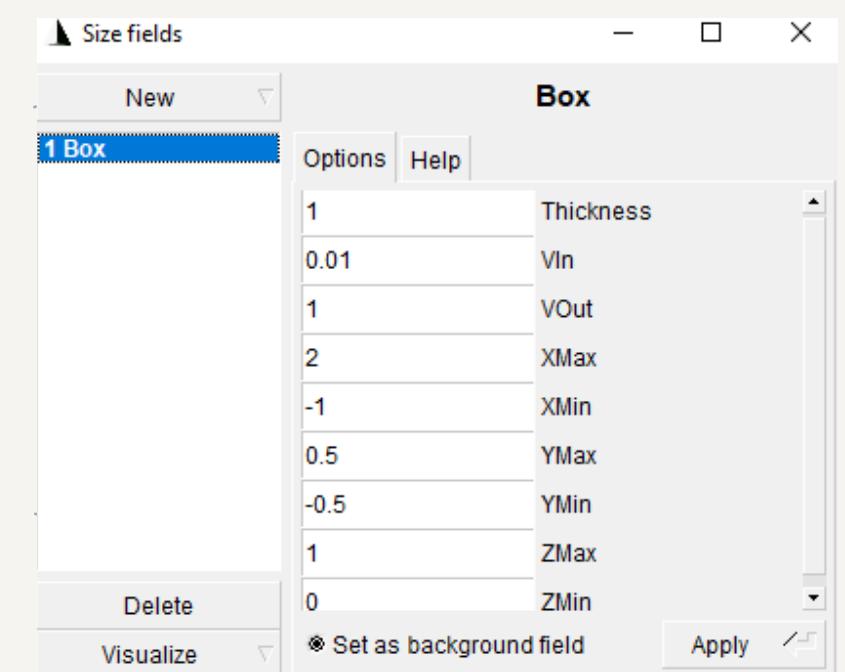
Point(10) = {1.0,0.5,0.5,0.01};
Point{10} In Surface{2};
```

4. MESH



Size field -- Box

- Estabelece um tamanho constante para uma região do domínio.



REFERÊNCIAS:

GEUZAIN, C.; REMACLE, J.-F. Gmsh: a three-dimensional finite element mesh generator with built-in pre- and post-processing facilities. **International Journal for Numerical Methods in Engineering** 79(11), pp. 1309-1331, 2009.

GEUZAIN, C.; REMACLE, J.-F. **Gmsh Reference Manual**. Copyright, 2020, 364 p. Disponível em: <https://gmsh.info/doc/texinfo/gmsh.html>. Acesso em: 04 de Nov. de 2020.

Download: <http://gmsh.info/#Download>

Manual de referência: <http://gmsh.info/doc/texinfo/gmsh.html>

LINKS:

OBRIGADO PELA ATENÇÃO!