

Explore ViZiR 4 in 30 minutes

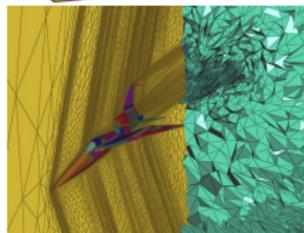
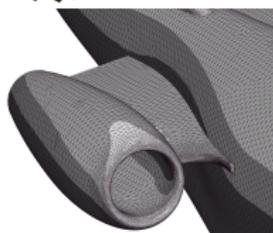
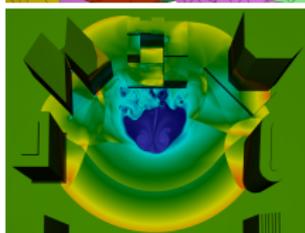
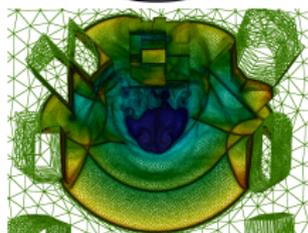
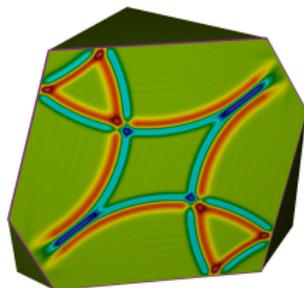
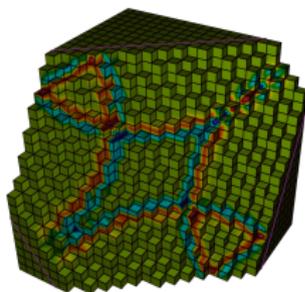
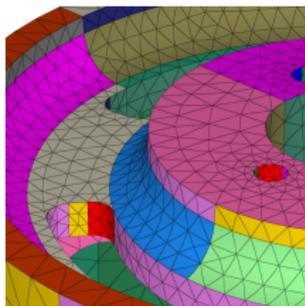
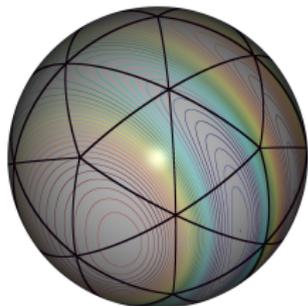
Inria, Gamma Project Team

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Main features of ViZiR 4:

- **Light, simple** and **interactive** visualization software.
- **Surface** and **volume** (tetrahedra, pyramids, prisms, hexahedra) meshes.
- **Pixel exact** rendering of **high-order** solutions on straight elements.
- **Almost pixel exact** rendering on curved elements (high-order meshes).
- **Post-processing tools**, such as picking, isolines, clipping, capping.



The goal of this document is to present the main features of ViZiR 4 and give the main shortcuts to discover the possibilities of ViZiR 4.

The organization of the document is the following :

- Presentation of the graphical interface and in particular the menus.
- Tutorials to manipulate meshes / solutions.

A more complete user guide is available in ViZiR 4 website:

- ViZiR 4 web site: <https://pyamg.saclay.inria.fr/vizir4.html>
- ViZiR 4 user guide:
https://pyamg.saclay.inria.fr/download/vizir/vizir4_user_guide.pdf

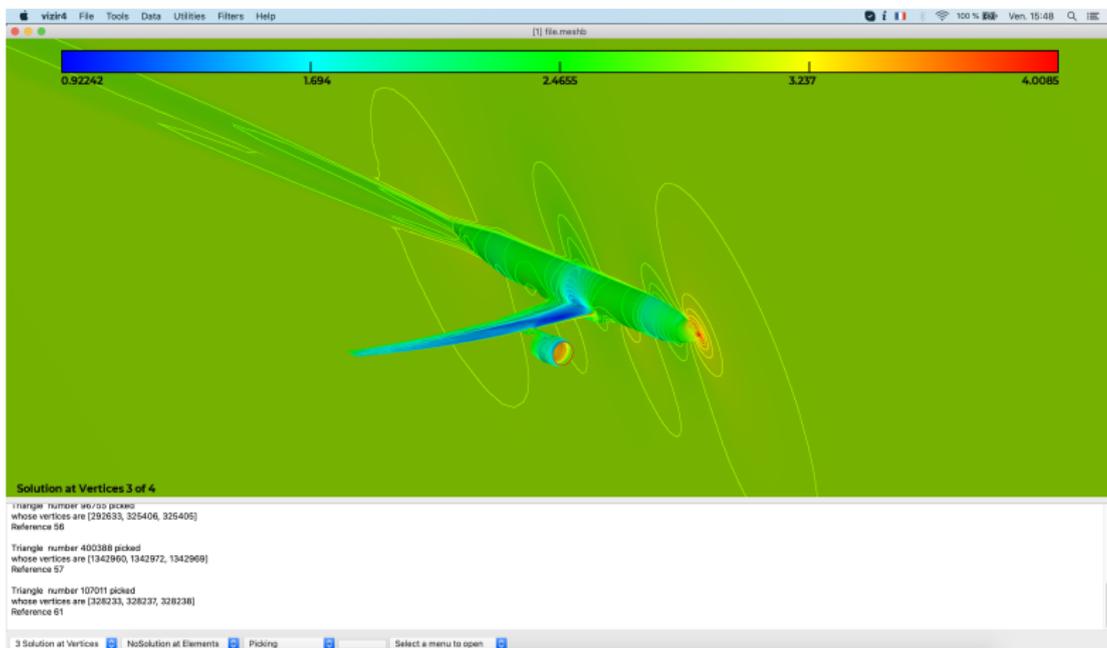
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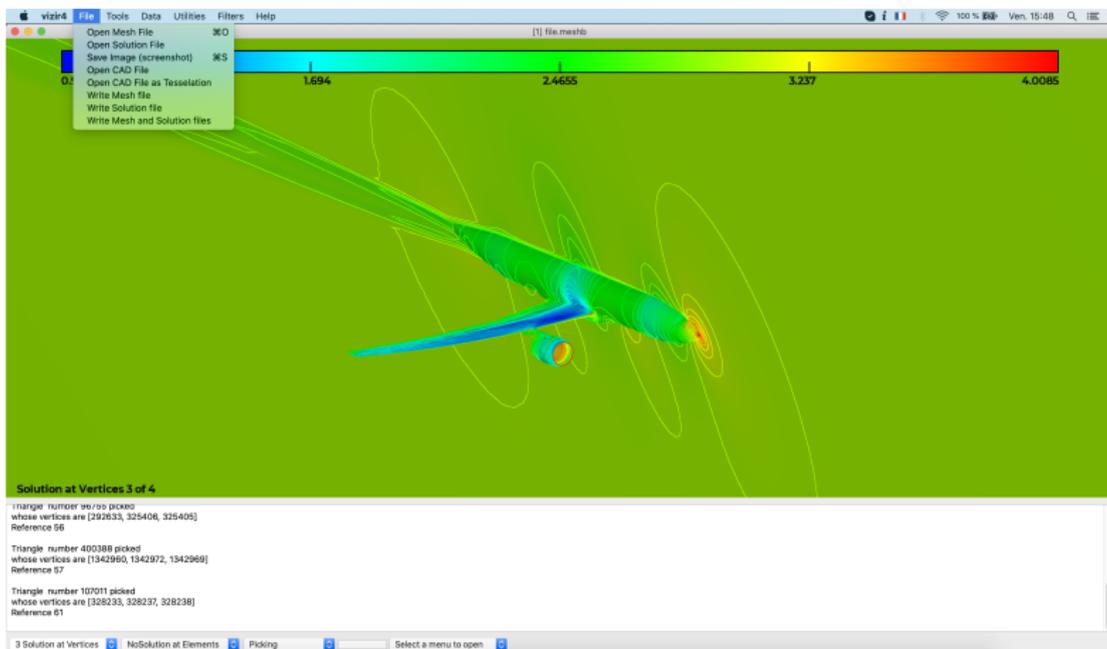
General interface of ViZiR 4 (from top to bottom)

- Menu bar to open menus: File, Tools, State, Utilities, Help...
- Main window with the mesh / solution.
- Inside terminal to print information (more information in the external terminal).
- Bottom bar to select a solution, pick an element from its number...



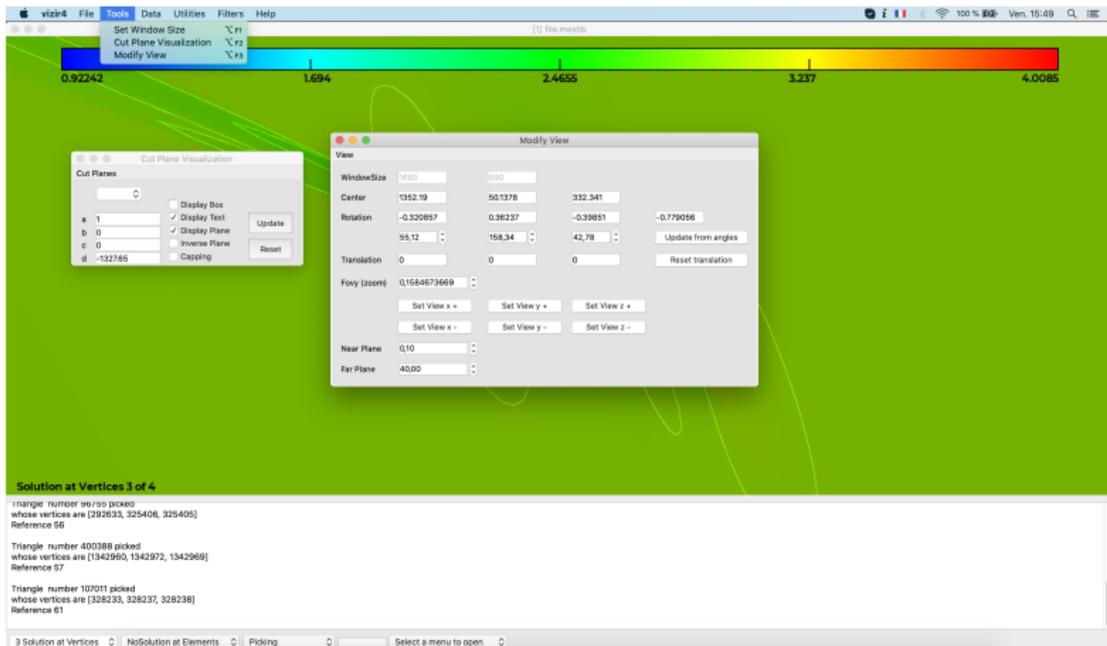
File menu

- Open a mesh / solution (mainly libMeshb format).
- Save a screenshot (png, jpg, jpeg, bmp).
- Write your mesh / solution.
- Open preferences : change default settings.



Tools menus

- Set the window size.
- Cut Plane Menu : set the cut plane equation and display options.
- View Menu : set the rotation, translation, zoom of the view...



State menus

- Load / Write State file.
- Modify the state options:
 - **Clip planes**: change equation, activate cut plane, show cut plane, use capping.
 - **Mesh** : display the mesh, the tessellation, modify the level of tessellation (for HO).
 - **Solution**: select the field, show solution / isolines / palette, modify the palette.
 - **Other**: change rendering and shading rendering, display text, use transparency...

The screenshot shows the 'Options Data Manager' dialog box in the VizIR 4 application. The background is a 3D visualization of a fish-like object with a color gradient from blue to red. A color bar at the top indicates values from 0.92242 to 4.0085. The dialog box has the following sections:

- Clip Planes**: (Its equation is $ax + by + cz + d = 0$)

a	b	c	d
1	0	0	-132765

 Buttons: Update Cut, UseCutPlane, ShowCut, Capping.
- Mesh**:

LineOn	TessLevel: 4	TessaOn
--------	--------------	---------
- Solution**:

Solver	3 Solution at Vertices			
Pal Min	Pal 2	Pal 3	Pal 4	Pal Max
0.922425	1.69396	2.46549	3.23702	4.00855

 Buttons: Update Palette, Interpolate Pal from Min/Max, Reset Palette.
- Other**:

TexOn	LineSurfOn	TransOn
UseShading	23: grey color	WireSiz: 0.25

 Buttons: Load Data File, Generate Data File.

At the bottom of the window, there is a section titled 'Solution at Vertices 3 of 4' with the following text:

```

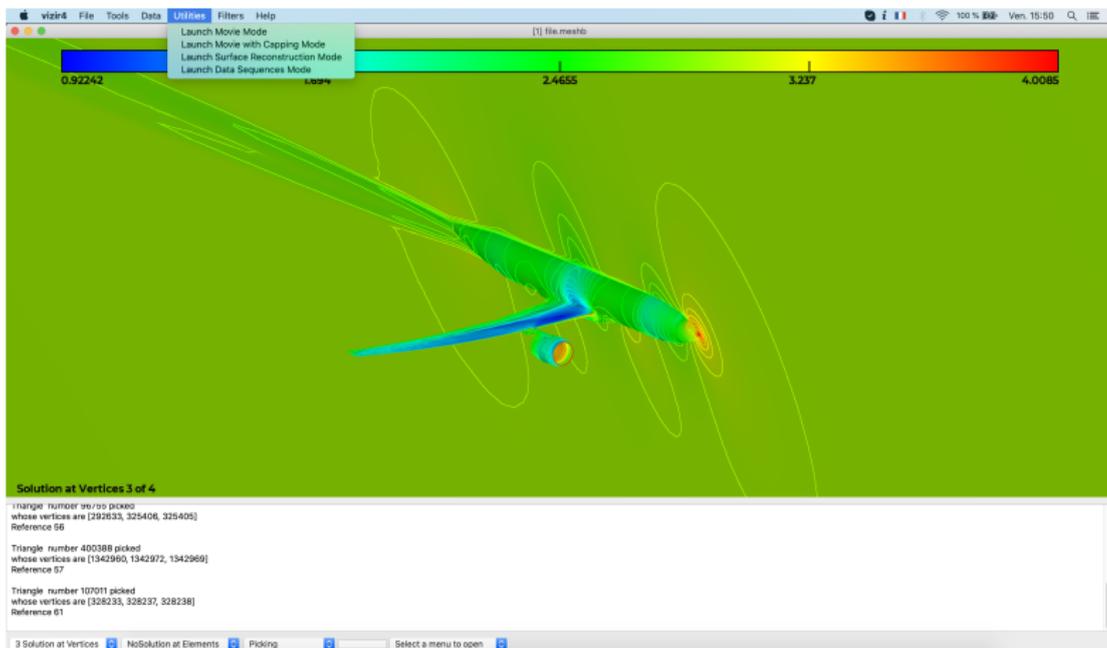
Triangle number 96700 picked
whose vertices are [292633, 325406, 325405]
Reference 56

Triangle number 400388 picked
whose vertices are [1342890, 1342872, 1342969]
Reference 57

Triangle number 107011 picked
whose vertices are [328233, 328237, 328238]
Reference 61
  
```

Utilities menus

- **Movie mode:** take screenshots from a list of meshes/solutions.
- **Movie capping mode:** take screenshots from a list of meshes/solutions.
- **Surface reconstruction mode:** add the missing surfaces (mesh and solution).
- **State Sequence mode:** load several state files and generate the images.



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All examples, meshes and solutions files are available here:

<https://pyamg.saclay.inria.fr/download/vizir/samples/Tutorial.zip>

To install ViZiR 4, please have a look at our website and user guide. Choose the executable you want depending of your OS: dmg for macOS, zip for Windows and tar.gz for Linux.

Note that many shortcuts are also given in the menu Help directly in ViZiR 4.

How to: open a mesh (eventually with a solution) file

Two possibilities to open a mesh file:

- Use the command line:

```
vizir4 -in name.mesh[b]
```

- Use the menu: File > Open Mesh file

If a solution file exists and has the same name except the extension (i.e. in this case name.sol[b]), the solution will be loaded. If the mesh and solution names are different, there are two solutions:

- Use the command line:

```
vizir4 -in xxx.mesh[b] -sol yyy.sol[b]
```

- Use the menu: Once the mesh has been open, open the solution with File > Open Solution file

How to: modify the view

- Zoom in / out: **z/Z**
- Rotate the view: **left** button of the mouse
- Translate the view: **middle** button of the mouse
- Go to initial view: **i**



Initial view



View after zoom, rotation and translation

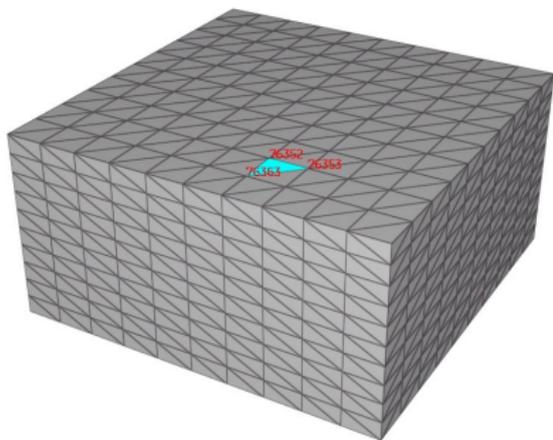
Launch:

```
vizir4 -in tower3.meshb
```

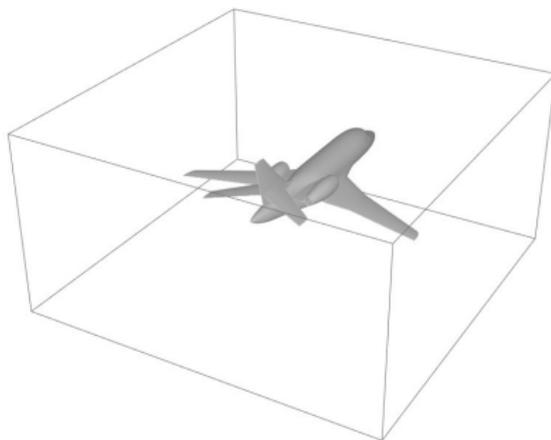
How to: pick elements and hide elements to explore meshes

Picking is important to have information (for instance the number of the element, or its vertices), to hide all the elements whose reference is the same or to center the scene:

- Pick an element : **double** click or **shift** + click on it
- Hide elements by reference (after picking): **s**
- Show elements which have been hidden: **S**
- Center the scene to the picked element: **V**



(a) First pick an element



(b) Then press **s** to hide these elements

Figure 1: Use picking and hide to explore 3-D meshes

How to: change rendering options

The main rendering options are:

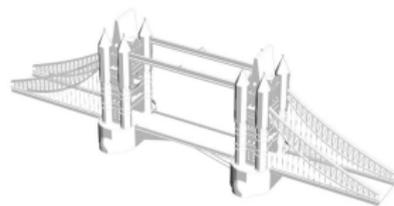
- Display/hide mesh edges: **l**
- Increase/Decrease mesh thickness: **+/-**
- Change type of rendering of solid faces: **f** (4 modes: grey, off, back, ref color)
- Change type of rendering of edges: **F** (3 modes: grey, off, ref color)
- Change shadow rendering: **r** (4 modes: usual, Phong, Toon, no shading)



(a) Hide mesh edges with **l**



(b) Show references with **f**



(c) Set toon shading with **r**

Figure 2: Modification of rendering options

How to: set a cut plane

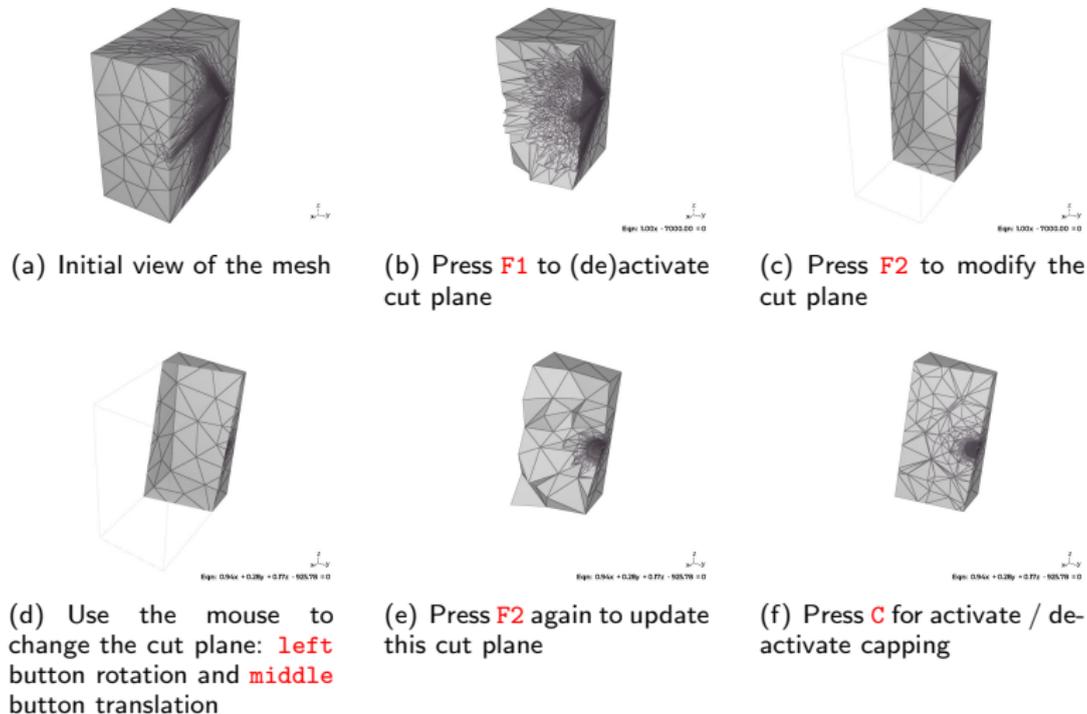
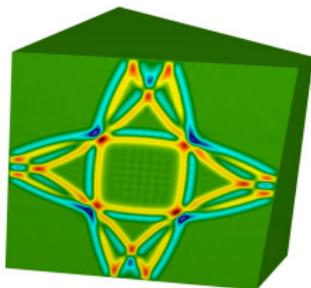


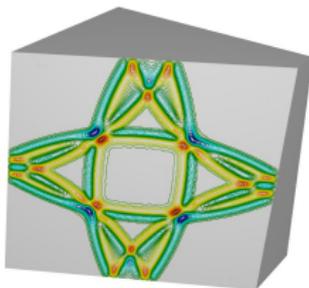
Figure 3: Set a cut plane

How to: display solutions

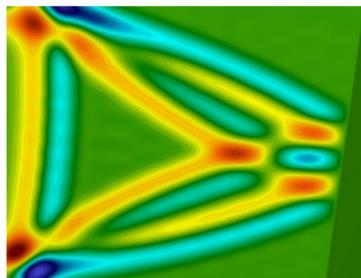
- Display/hide solution: **m** (3 modes: off, exact, filled)
- Display/hide isolines: **o** (3 modes: off, color, black)
- Go to next / previous field: **>** / **<**



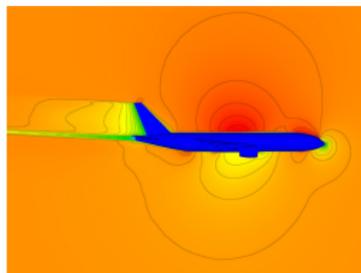
(a) Display solution with **m**



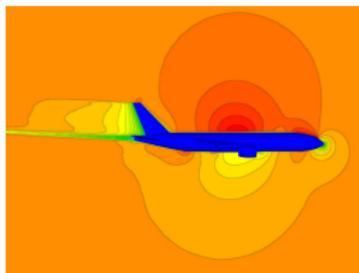
(b) Display isolines with **o**



(c) Display solution & isolines



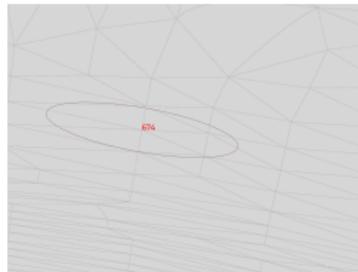
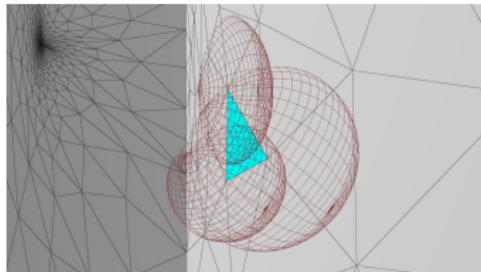
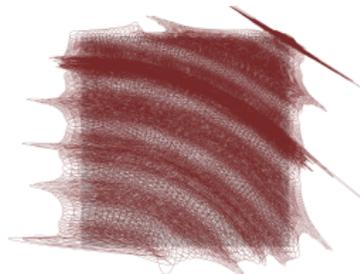
(d) Exact rendering



(e) Filled rendering

How to: display metrics

- Press **M** to display all the metric.
- Pick an element to display its metric (**double** click or **shift+left** click).
- Pick a vertex to display its metric (**shift+middle** click).



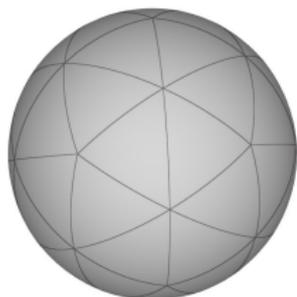
In Preferences menu, buttons to activate/deactivate:

- Show metric when picking element (by default shown only if solution is displayed)
- Display ellipsoids or vectors (for metrics field)

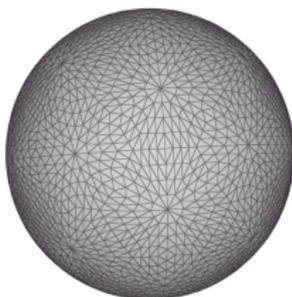
How to: handle high-order meshes

The remarkable work of shaders of OpenGL (and here in particular tessellation shaders) allows to handle high-order meshes. For this purpose, a tessellation of high-order elements is done and can be on the fly modified.

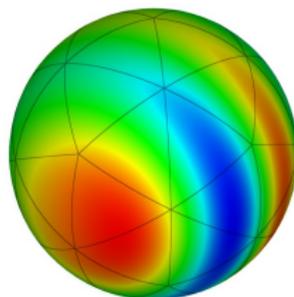
- Increase/Decrease tessellation: t / T
- Display/hide tessellation: L



(f) A high-order mesh



(g) Display tessellation with L



(h) A high-order solution / mesh

Figure 4: A P^3 mesh of a sphere with a P^6 solution

How to: save/load view and rendering options (state file)

It is possible to save rendering options and load it when ViZiR 4 is launched (or use dedicated menu).

State file contains information on the view (center of the view, rotation, translation...), the plane equation, the solution (on/off), the isolines (on/off), the level of tessellation for high-order elements, the lines thickness...

Launch:

```
vizir4 -in file.meshb -state view1.state
```

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Modes to generate images

3 modes to generate images (based on a state file to load a view with rendering options):

- -movie: only 1 state file, give a list of mesh / solution / name of image
- -seq: only 1 mesh and solution file, give a list of state / name of image
- -images: most complete. Give a list of mesh / solution / state / name of image

```
final1.meshb file1.Cf.solb view1.mesh.state file1_mesh_cf_cfdview_01.jpg
final1.meshb file1.Cf.solb view2.mesh.state file1_mesh_cf_cfdview_02.jpg
final1.meshb file1.Cf.solb view3.mesh.state file1_mesh_cf_cfdview_03.jpg
final1.meshb file1.Cf.solb view1_exact.state file1_cf_cfdview_01.jpg
final1.meshb file1.Cf.solb view2_exact.state file1_cf_cfdview_02.jpg
final1.meshb file1.Cf.solb view3_exact.state file1_cf_cfdview_03.jpg
final2.meshb file2.Cf.solb view1.mesh.state file2_mesh_cf_cfdview_01.jpg
final2.meshb file2.Cf.solb view2.mesh.state file2_mesh_cf_cfdview_02.jpg
final2.meshb file2.Cf.solb view3.mesh.state file2_mesh_cf_cfdview_03.jpg
```

Listing 1: Example of vizir.images file

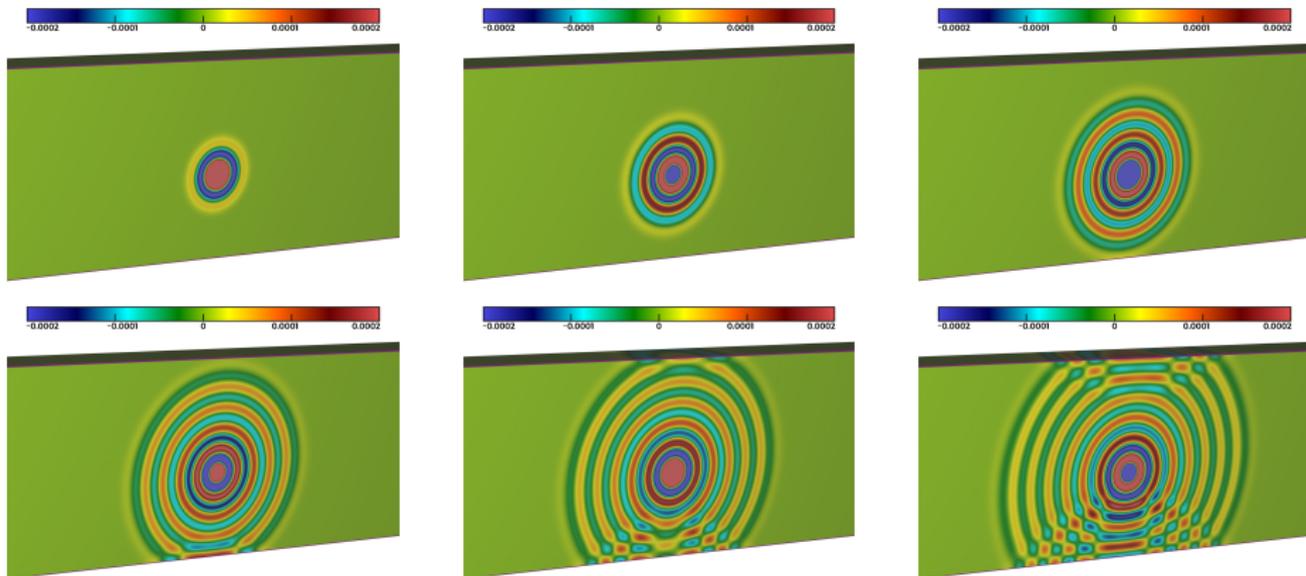
To launch this:

```
vizir4 -images xxx
```

where xxx is the name of the file, for example vizir.images.

Movie Capping Mode: vizir4 -moviecapping. An example of file vizir.movie

mesh1 . meshb	sol1 . solb
mesh2 . meshb	sol2 . solb
mesh3 . meshb	sol3 . solb
mesh4 . meshb	sol4 . solb
mesh5 . meshb	sol5 . solb
mesh6 . meshb	sol6 . solb



Other modes (pre- / post- processing)

- **Launch vizir4 -h or vizir4 -help to print the help**
- -addcorners : add corners (belong to at least 3 surface ids in 3D / 2 edge ids in 2D)
- -addlistcorners : add list of points as corners
- -addedges : add missing edges in a 2D mesh
- -capping : capping (intersection between volume elements and a plane)
- -changeref : change references of elements
- -checksurf : surface reconstruction (add missing surfaces to the mesh/solution files)
- -concatenate : concatenate several meshes into one
- -concatenatesol : concatenate several solutions files into one
- -duplicate : duplicate meshes (rotations/concatenations)
- -extractfields : extract solutions fields
- -extr : surface extraction (with a plane)
- -mergevertices : merge duplicated vertices (based on libOL)
- -minimesh : minimesh around an entity to a given level
- -plotline : plot over line (extraction over a segment)
- -rad : radial distance (slice with a cylinder)
- -rotate : rotate mesh (from angle, axis and center)
- -transform : transform mesh (scaling, translation)

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Summary

ViZiR 4 is based on OpenGL 4 with use of shaders

- Fast I/O.
- Pixel-exact rendering of HO solutions (up to degree 10).
- Tessellation of HO elements on the fly by the GPU (up to degree 4).
- Many post-processing tools.
- Handle large, hybrid, HO, 3D meshes / solutions.

ViZiR 4 web site: <https://pyamg.saclay.inria.fr/vizir4.html> with executables (Mac, Linux, Windows), samples (meshes and solutions files) and user guide.



R. Feuillet, M. Maunoury, A. Loseille. On pixel-exact rendering for high-order mesh and solution. *Journal of Computational Physics* 424, 2021.



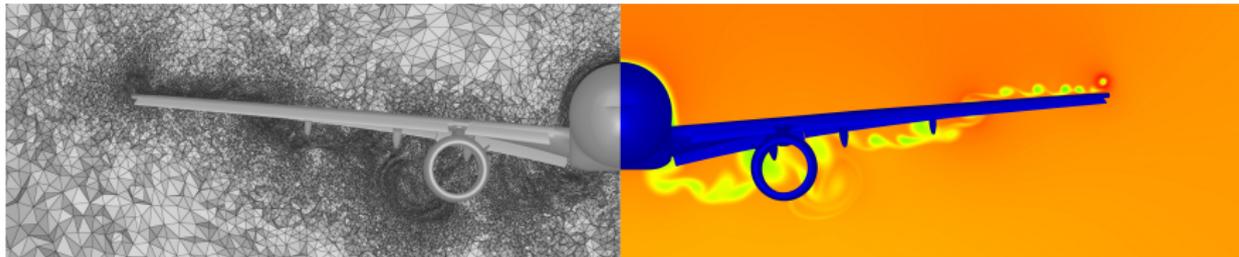
A. Loseille, R. Feuillet. Vizir: High-order mesh and solution visualization using OpenGL 4.0 graphic pipeline. 56th AIAA Aerospace Sciences Meeting, AIAA Scitech, 2018.

Some links:

- ViZiR 4 web site: <https://pyamg.saclay.inria.fr/vizir4.html>
- ViZiR 4 executables: <https://pyamg.saclay.inria.fr/download/vizir/exes/>
- ViZiR 4 user guide:
https://pyamg.saclay.inria.fr/download/vizir/vizir4_user_guide.pdf
- ViZiR 4 shortcuts:
https://pyamg.saclay.inria.fr/download/vizir/vizir4_shortcuts.pdf



Thank you for your attention



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