siplt Octave package, User's Guide*

version 0.2.6

François Cuvelier†

March 5, 2023

Abstract

This Octave package uses a siMesh object, comming from the simesh package, to display simplicial meshes or datas on simplicial meshes. Its kernel uses the graphics4mesh package.

0 Contents

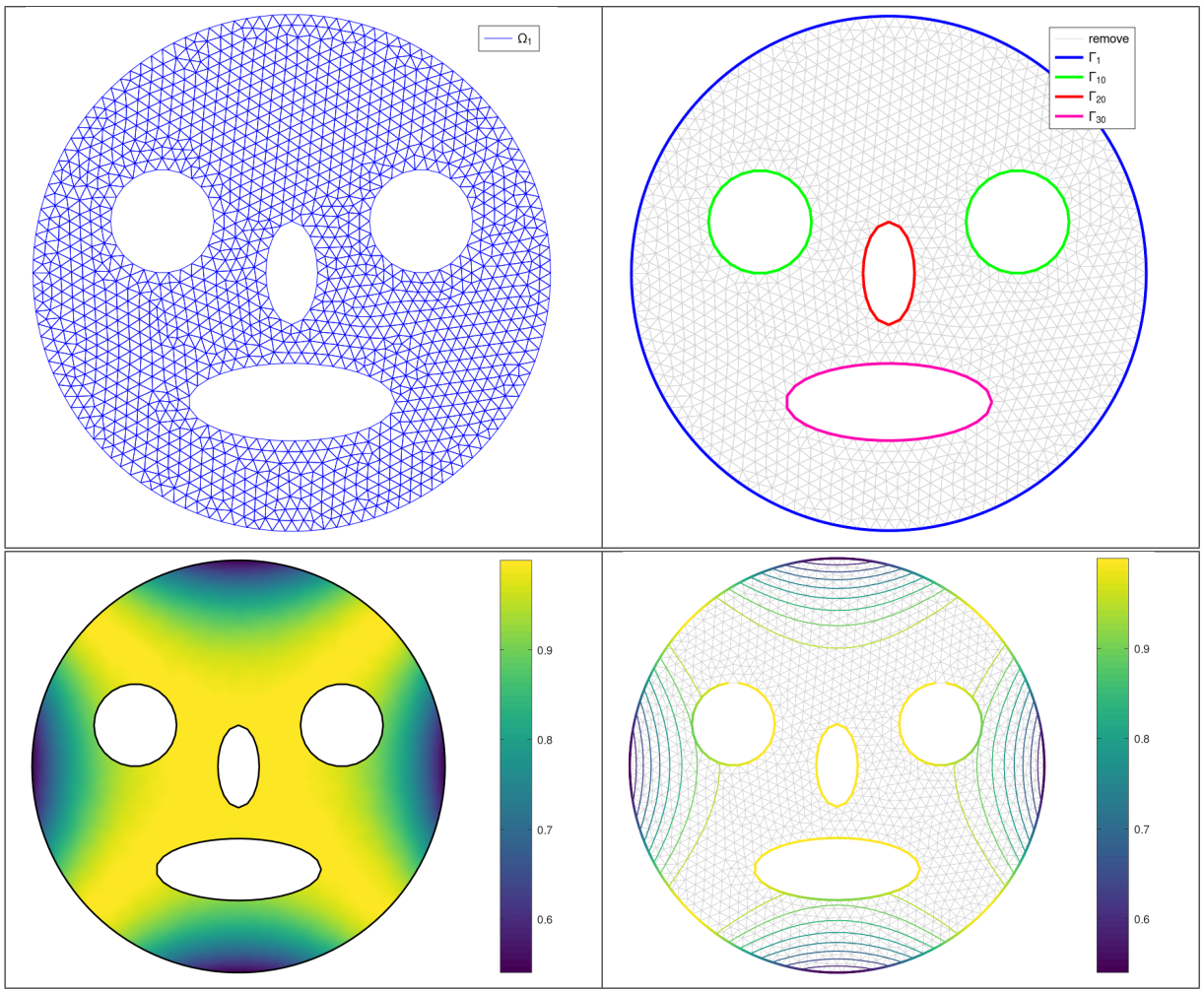
*LaTeX manual, revision 0.2.6, compiled with Octave 7.3.0, and packages `fc-siplt`[0.2.6], `fc-tools`[0.0.35], `fc-bench`[0.1.3], `fc-hypermesh`[1.0.4], `fc-amat`[0.1.3], `fc-meshtools`[0.1.4], `fc-graphics4mesh`[0.1.6], `fc-oogmsh`[0.3.0], `fc-simesh`[0.4.6]

†Université Sorbonne Paris Nord, LAGA, CNRS, UMR 7539, F-93430, Villetaneuse, France, `cuvelier@math.univ-paris13.fr`.
This work was supported by the ANR project DEDALES under grant ANR-14-CE23-0005.

1 Introduction

This **experimental** Octave package uses the graphics4mesh package[1] to do some graphic representations on a sıMesh object of the simesh package[2].

In Listing 1, a 2D example is provided with the 4 generated figures. For graphic representations, one can also used Th.**plotmesh**(...) instead of **fc_siplt.plotmesh**(Th,...), Th.**plot**(...) instead of **fc_siplt.plot**(Th,...) and so on.




```
geofile=fc_simesh.get_geo(2,2,'sample2D01.geo');
% Using GMSH >= 4.0.0 to create mesh file
meshfile=fc_oogmsh.gmsh.buildmesh2d(geofile,200,'force',true);
% Creating siMesh object by reading the mesh file
Th=fc_simesh.siMesh(meshfile);
% Computing datas on siMesh object
u=@(x,y) cos(x.^2-y.^2);
U=Th.eval(u);
% Graphics
figure(1)
fc_siplt.plotmesh(Th,'inlegend',true)
axis image;axis off
legend()

figure(2)
fc_siplt.plotmesh(Th,'color','LightGray')
hold on
fc_siplt.plotmesh(Th,'d',1,'inlegend',true,'LineWidth',2)
axis image;axis off
legend()

figure(3)
fc_siplt.plot(Th,U,'plane',true)
colorbar
shading interp
axis image;axis off
hold on
fc_siplt.plotmesh(Th,'d',1,'LineWidth',1.5,'color','k')

figure(4)
fc_siplt.plotmesh(Th,'color','LightGray')
axis image;axis off
hold on
fc_siplt.plot(Th,U,'d',1,'LineWidth',2,'plane',true)
colorbar
fc_siplt.plotiso(Th,U,'niso',10,'LineWidth',1,'plane',true)
```

Listing 1: fc_siplt.demos.sample2D01 script with figure 1 (top left), figure 2 (top right), figure 3 (bottom left) and figure 4 (bottom right).

2 Installation

This package was only tested on Ubuntu 22.04.1 with Octave 7.3.0.

One just has to get/download the install file

ofc_siplt_install.m

or get it on the dedicated web page. Thereafter, one run it under Octave. This command download, extract and configure the *fc-siplt* package and all the required packages in the current directory.

For example, to install this package in `~/Octave/packages` directory, one have to copy the file mfc_siplt_install.m in the `~/Octave/packages` directory. Then in a Octave terminal run the following commands

```
>> cd ~/Octave/packages
>> mfc_siplt_install
```

There is the output of the `mfc_siplt_install` command on a Linux computer:

```
Parts of the <fc-siplt> Octave package.
Copyright (C) 2017-2023 F. Cuvelier

1- Downloading and extracting the packages
2- Setting the <fc-siplt> package
Write in ~/Octave/fc-siplt-full/fc_siplt-0.2.6/configure_loc.m ...
3- Using packages :
   ->             fc-tools : 0.0.35
   ->             fc-bench : 0.1.3
   ->         fc-hypermesh : 1.0.4
   ->              fc-amat : 0.1.3
   ->         fc-meshtools : 0.1.4
   ->     fc-graphics4mesh : 0.1.6
   ->            fc-oogmsh : 0.3.0
   ->            fc-simesh : 0.4.6
 with             fc-siplt : 0.2.6
*** Using instructions
   To use the <fc-siplt> package:
   addpath('~/Octave/fc-siplt-full/fc_siplt-0.2.6')
   fc_siplt.init()

   See ~/Octave/ofc_siplt_set.m
```

The complete package (i.e. with all the other needed packages) is stored in the directory

`~/Octave/packages/fc-siplt-full`

and, for each Octave session, one have to set the package by:

```
>> addpath('~/Octave/packages/fc-siplt-full/fc_siplt-0.2.6')
>> fc_siplt.init()
```

If it's the first time the `fc_siplt.init()` function is used, then its output is

```
Try to use default parameters!
 Use fc_tools.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_tools-0.0.35/configure_loc.m ...
Try to use default parameters!
 Use fc_bench.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_bench-0.1.3/configure_loc.m ...
Try to use default parameters!
 Use fc_hypermesh.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_hypermesh-1.0.4/configure_loc.m ...
Try to use default parameters!
 Use fc_amat.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_amat-0.1.3/configure_loc.m ...
Try to use default parameters!
 Use fc_meshtools.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_meshtools-0.1.4/configure_loc.m ...
Try to use default parameters!
 Use fc_graphics4mesh.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_graphics4mesh-0.1.6/configure_loc.m ...
Try to use default parameters!
 Use fc_oogmsh.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_oogmsh-0.3.0/configure_loc.m ...
Try to use default parameters!
 Use fc_simesh.configure to configure.
Write in ~/Octave/fc-siplt-full/fc_simesh-0.4.6/configure_loc.m ...
Using fc_siplt[0.2.6] with fc_tools[0.0.35], fc_bench[0.1.3], fc_hypermesh[1.0.4],
                           fc_amat[0.1.3], fc_meshtools[0.1.4], fc_graphics4mesh[0.1.6],
                           fc_oogmsh[0.3.0], fc_simesh[0.4.6].
[fc-oogmsh] Configured to use gmsh 4.11.1 with default MSH file format version 4.1
```

Otherwise, the output of the `fc_siplt.init()` function is

```
Using fc_siplt[0.2.6] with fc_tools[0.0.35], fc_bench[0.1.3], fc_hypermesh[1.0.4],
                           fc_amat[0.1.3], fc_meshtools[0.1.4], fc_graphics4mesh[0.1.6],
                           fc_oogmsh[0.3.0], fc_simesh[0.4.6].
[fc-oogmsh] Configured to use gmsh 4.11.1 with default MSH file format version 4.1
```

For **uninstalling**, one just have to delete directory

```
~/Octave/packages/fc-siplt-full
```

3 fc_siplt.plotmesh function

The **fc_siplt.plotmesh** function displays the mesh or parts of the mesh defined by an SIMESH object.

Syntaxe

```
fc_siplt.plotmesh(Th)
fc_siplt.plotmesh(Th,Name,Value, ...)
```

Description

fc_siplt.plotmesh(Th) displays all the (Th.d)-dimensional simplices elements of Th, a SIMESH object.

fc_siplt.plotmesh(Th,Name,Value, ...) specifies function options using one or more Name,Value pair arguments. Options of first level are

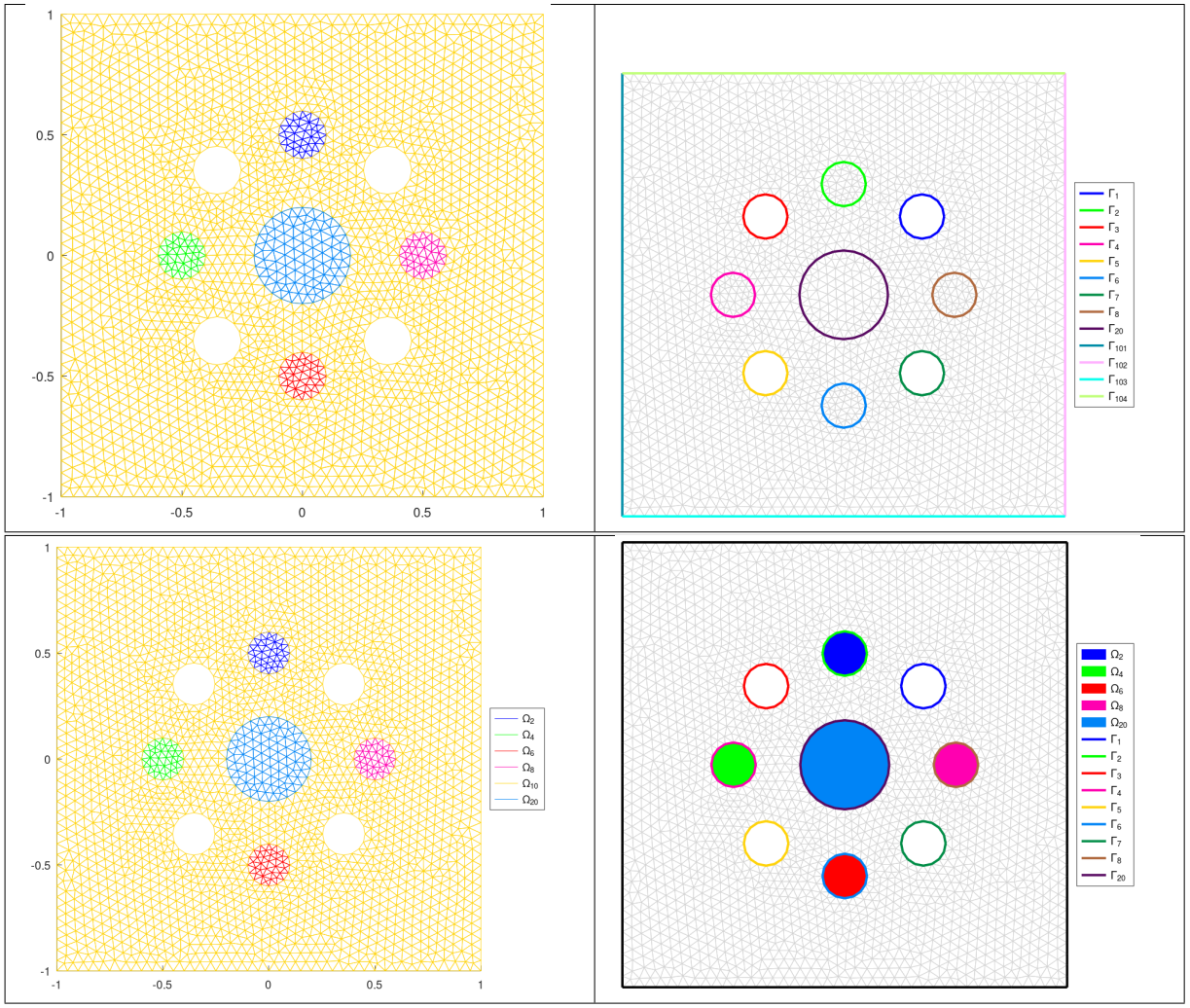
- 'd' : to specify the dimension of the simplices elements (default : Th.d)
- 'labels' : to select the labels of the elements to display,
- 'color' : to specify the color of the displayed mesh elements. (default : use one color by displayed mesh elements),
- 'inlegend' : add a legend name to graph if true (default : **false**)
- 'bounds' : If **true**, draw the borders of the selected elementaries mesh elements (only for 2-dimensional simplices). (default : **false**)
- 'cutPlane' : cut mesh by n plans given by n-by-4 array P where the equation of the i-th cut plane is given by
$$P(i,1)\,x + P(i,2)\,y + P(i,3)\,z + P(i,4) = 0.$$
The normal vector $P(i, 1:3)$ pointed to the part of the mesh not displayed. (only for simplices in dimension 3) default : [] (no cut).

The options of second level depend on the type of elementaries mesh elements to represent.
One can use any option of the following functions according to the type of d-simplex to be represented.

- In dimension 3,
  - if $d == 3$, **patch** function is used,
  - if $d == 2$, **trimesh** function is used,
  - if $d == 1$, **plot3** function is used,
  - if $d == 0$, **plot3** function is used,
- In dimension 2,
  - if $d == 2$, **trimesh** function is used,
  - if $d == 1$, **plot** function is used,
  - if $d == 0$, **plot** function is used,
- In dimension 1,
  - if $d == 1$, **line** function is used,
  - if $d == 0$, **plot** function is used,

3.1 2D example

the following code is part of the **fc_siplt.demos.plotmesh2D** function.

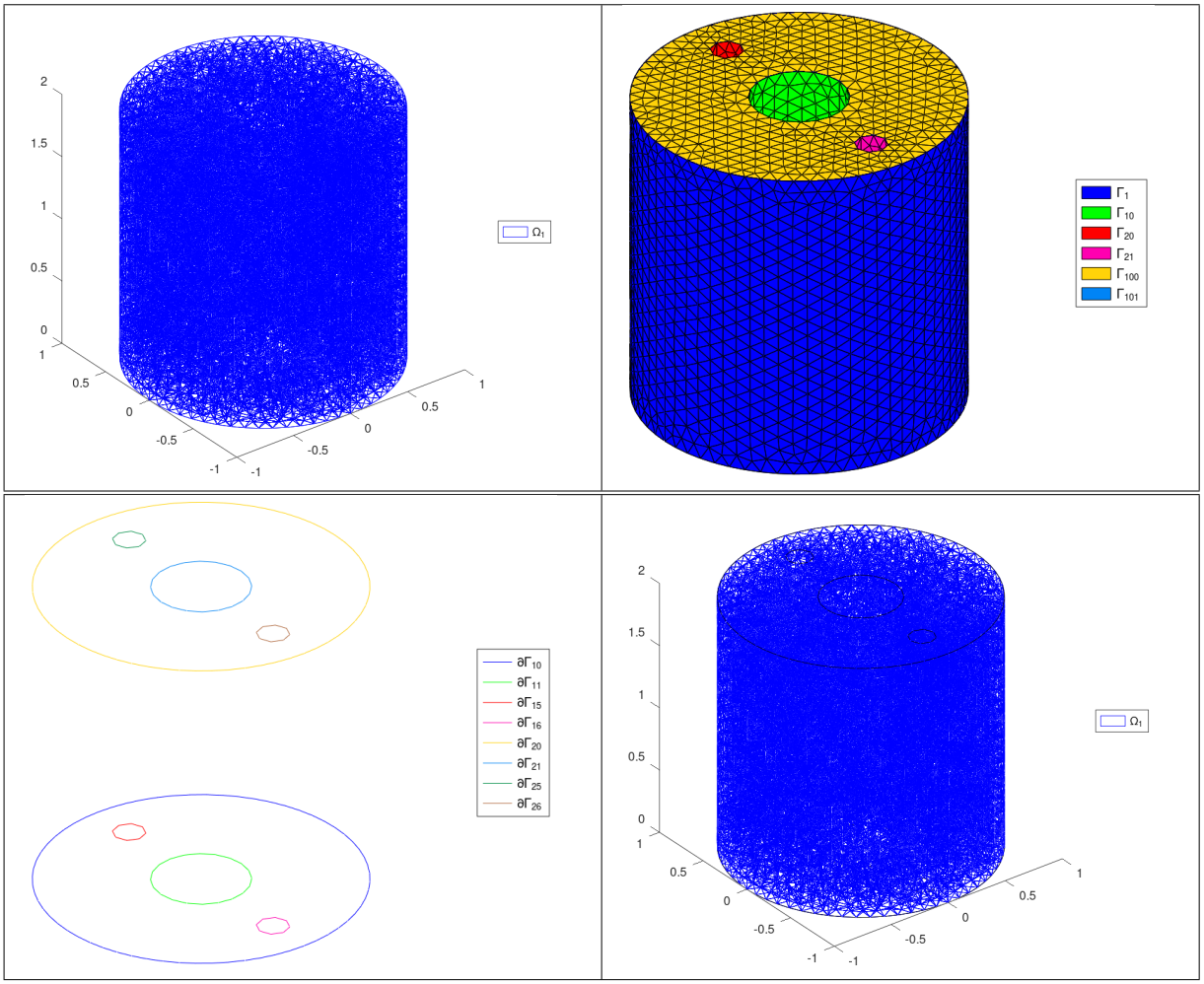



```
meshfile=fc_oogmsh.gmsh.buildmesh2d('condenser11',20,varargin{:});
Th=fc_simesh.siMesh(meshfile);
fc_tools.graphics.monitors.onGrid(2,2);
figure(1)
fc_siplt.plotmesh(Th);
axis image

figure(2)
fc_siplt.plotmesh(Th,'color','LightGray')
hold on;axis image;axis off
fc_siplt.plotmesh(Th,'d',1,'Linewidth',2,'inlegend',true);
fc_graphics4mesh.legend('Location','eastoutside')

figure(3)
fc_siplt.plotmesh(Th,'inlegend',true);
axis image
fc_graphics4mesh.legend('Location','eastoutside')

figure(4)
fc_siplt.plotmesh(Th,'color','LightGray','labels',10)
hold on;axis image;axis off
fc_siplt.plotmesh(Th,'fill',true,'labels',[2:2:8,20],'inlegend',true)
fc_siplt.plotmesh(Th,'d',1,'Linewidth',2,'inlegend',true,'labels',[1:8,20]);
fc_siplt.plotmesh(Th,'d',1,'Linewidth',2,'color','k','labels',[101:104]);
```

Listing 2: Using fc_siplt.plotmesh function with a 2D mesh

3.2 3D example

the following code is part of the **fc_siplt.demos.plotmesh3D** function.

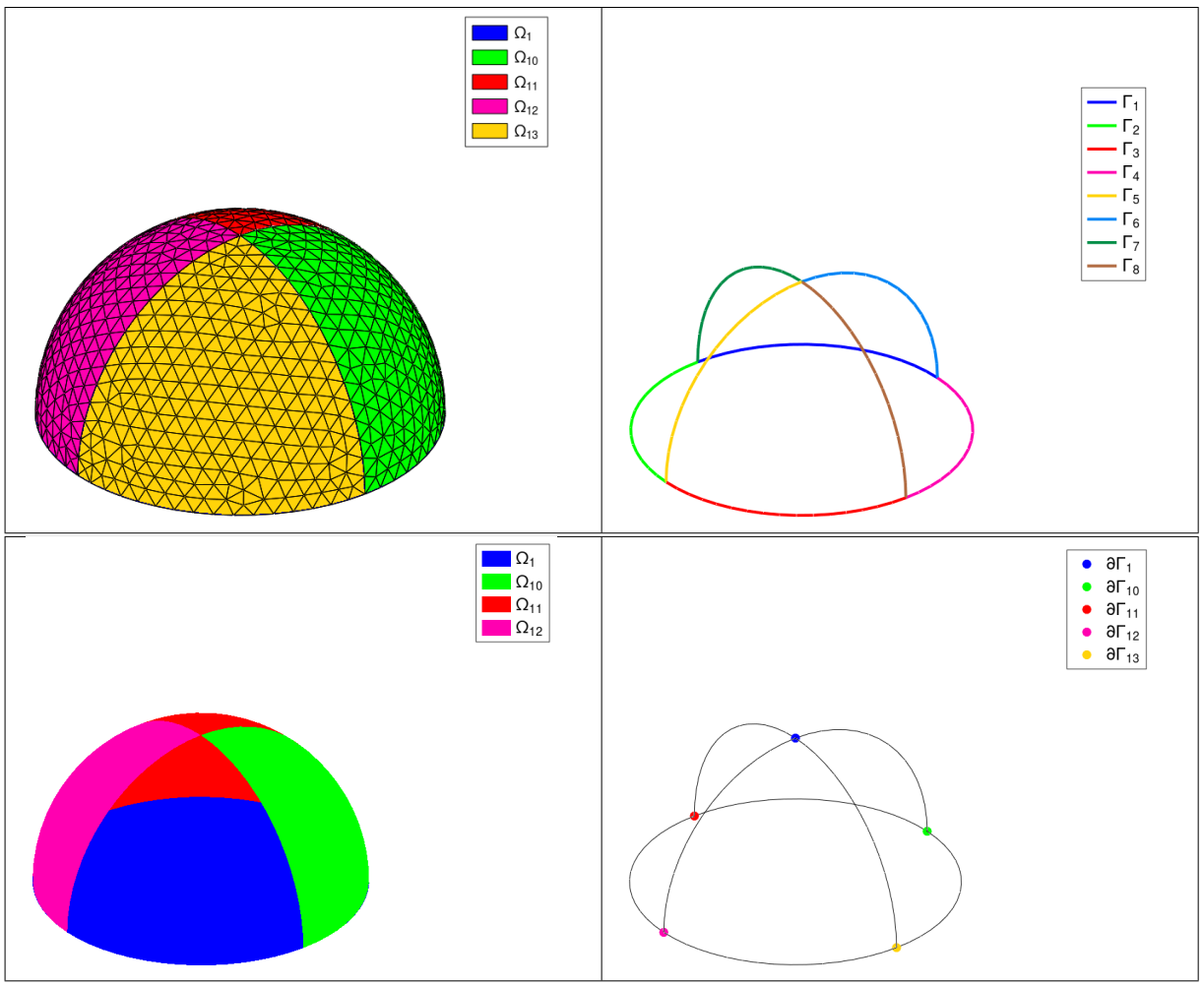



```
meshfile=fc_oogmsh.gmsh.buildmesh3d('cylinder3holes',10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
fc_tools.graphics.monitors.onGrid(3,3,'figures',1:7);
figure(1)
fc_siplt.plotmesh(Th,'inlegend',true)
axis image
fc_graphics4mesh.legend('Location','eastoutside')

figure(2)
fc_siplt.plotmesh(Th,'d',2,'inlegend',true);
axis image;axis off
fc_graphics4mesh.legend('Location','eastoutside')

figure(3)
fc_siplt.plotmesh(Th,'d',1,'inlegend',true);
axis image;axis off
fc_graphics4mesh.legend('Location','eastoutside')

figure(4)
fc_siplt.plotmesh(Th,'inlegend',true)
hold on
fc_siplt.plotmesh(Th,'d',1,'color','k');
axis image
fc_graphics4mesh.legend('Location','eastoutside')

figure(5)
fc_siplt.plotmesh(Th,'d',2,'inlegend',true);
axis image
fc_graphics4mesh.legend('Location','eastoutside')

figure(6)
fc_siplt.plotmesh(Th,'d',2,'edgecolor',0.8*[1 1 1],'facecolor','None','edgealpha',0.5)
hold on;axis image
fc_siplt.plotmesh(Th,'d',1,'inlegend',true);
fc_graphics4mesh.legend('Location','eastoutside')

figure(7)
P=[fc_tools.graphics.PlaneCoefs([0 0 1],[0 0 1]); fc_tools.graphics.PlaneCoefs([0 0 1],[-1 0 0])];
fc_siplt.plotmesh(Th,'cutPlane',P,'Color','DarkGrey')
hold on;axis image
fc_siplt.plotmesh(Th,'d',2,'cutPlane',P,'inlegend',true);
```

Listing 3: Using fc_siplt.plotmesh function with a 3D mesh

3.3 3Ds example

the following code is part of the **fc_siplt.demos.plotmesh3Ds** function.




```
meshfile=fc_oogmsh.buildmesh3ds('demisphere5',10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
fc_tools.graphics.monitors.onGrid(2,2);
figure(1)
fc_siplt.plotmesh(Th,'inlegend',true)
axis off;axis equal;
fc_graphics4mesh.legend()

figure(2)
fc_siplt.plotmesh(Th,'EdgeColor','LightGray', 'EdgeAlpha',0.4,'FaceColor','none')
view(3);hold on;axis off;axis equal
fc_siplt.plotmesh(Th,'d',1,'inlegend',true,'LineWidth',2)
fc_graphics4mesh.legend('Location','NorthEastOutside','FontSize',12)

figure(3)
fc_siplt.plotmesh(Th,'labels',[1,10,11,12],'EdgeColor','none','inlegend',true)
axis off;axis equal
fc_graphics4mesh.legend('Location','NorthEastOutside','FontSize',12)

figure(4)
fc_siplt.plotmesh(Th,'EdgeColor',0.9*[1,1,1], 'EdgeAlpha',0.4,'FaceColor','none')
hold on;axis off;axis equal
fc_siplt.plotmesh(Th,'d',1,'color','k')
fc_siplt.plotmesh(Th,'d',0,'inlegend',true)
fc_graphics4mesh.legend('Location','NorthEastOutside','FontSize',12)
```

Listing 4: Using **fc_siplt.plotmesh** function with a 3Ds mesh

4 fc_siplt.plot function

The **fc_siplt.plot** function displays scalar datas on the mesh or parts of the mesh defined by an siMesh object.

Syntaxe

```
fc_siplt.plot(Th,u)
fc_siplt.plot(Th,u,Name,Value, ...)
```

Description

fc_siplt.plot(Th,u) displays data u on all the (Th.d)-dimensional simplices elements of Th, a siMesh object. The data u is an 1D-array of size Th.nq or Th.nqGlobal or Th.nqParent.

fc_siplt.plot(Th,u,Name,Value, ...) specifies function options using one or more Name,Value pair arguments. Options of first level are

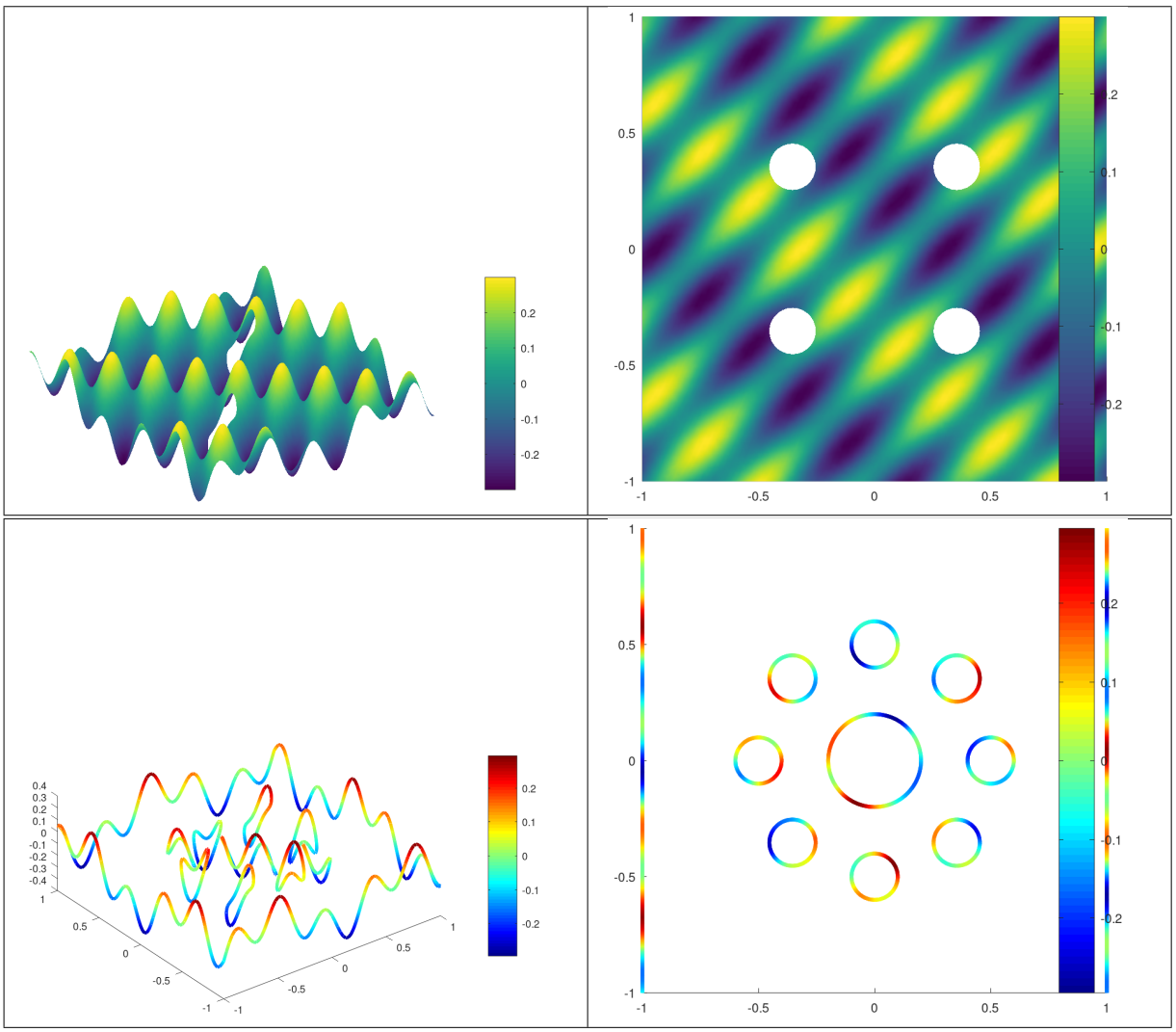
- 'd' : to specify the dimension of the simplices elements (default : Th.d)
- 'labels' : to select the labels of the elements to display data,
- 'plane' : if true, made a 2D representation in the xy-plane, otherwise made a 3D representation with z-value set to u (default : **false**)

The options of second level depend on the type of elementaries mesh elements on which we want to represent datas.
One can use any option of the following functions according to the type of d-simplex.

- In dimension 3, **patch** function is used for $d \in [\![1, 3]\!]$.
- In dimension 2,
  - for $d == 2$, if 'plane' option is true, **patch** function is used, otherwise it's **trisurf** function,
  - for $d == 1$, **patch** function is used.
- In dimension 1 and $d == 1$, **plot** function is used

4.1 2D example

the following code is part of the **fc_siplt.demos.plot2D** function.

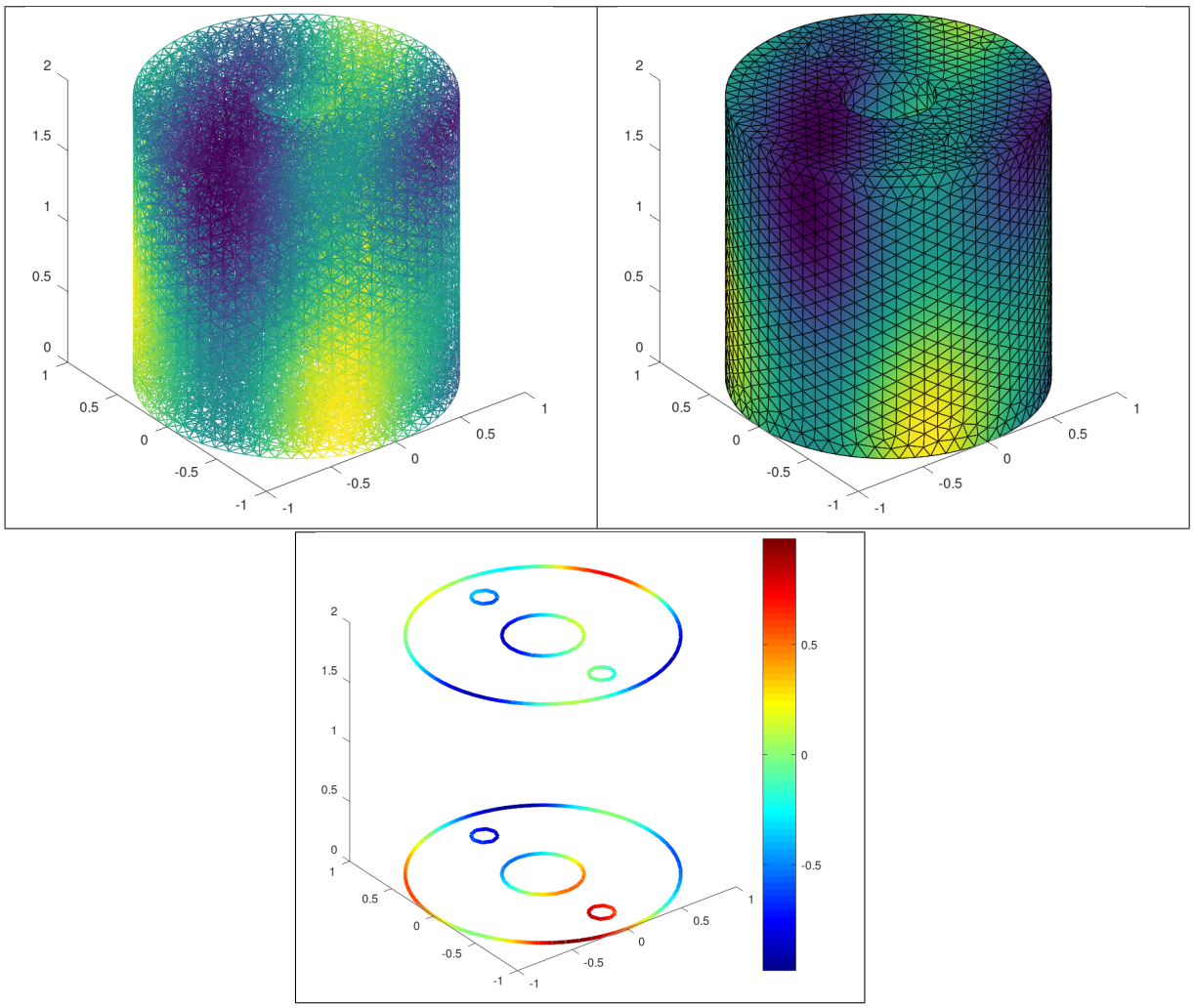


```
meshfile=fc_oogmsh.gmsh.buildmesh2d('condenser11',40,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=@(x,y) 0.3*cos(5*(2*x-y)).*sin(5*(x-2*y));
U=Th.eval(u);

fc_tools.graphics.monitors.onGrid(2,2);
figure(1)
fc_siplt.plot(Th,U);
axis image;axis off;view(3)
colorbar
shading interp

figure(2)
fc_siplt.plot(Th,U,'plane',true);
axis image
colorbar
shading interp

figure(3)
fc_siplt.plot(Th,U,'d',1,'Linewidth',3);
axis image
colormap('jet')
view(3)
colorbar

figure(4)
fc_siplt.plot(Th,U,'d',1,'Linewidth',3,'plane',true);
axis image
colormap('jet')
```

Listing 5: Using fc_siplt.plot function with a 2D mesh

4.2 3D example

the following code is part of the **fc_siplt.demos.plot3D** function.

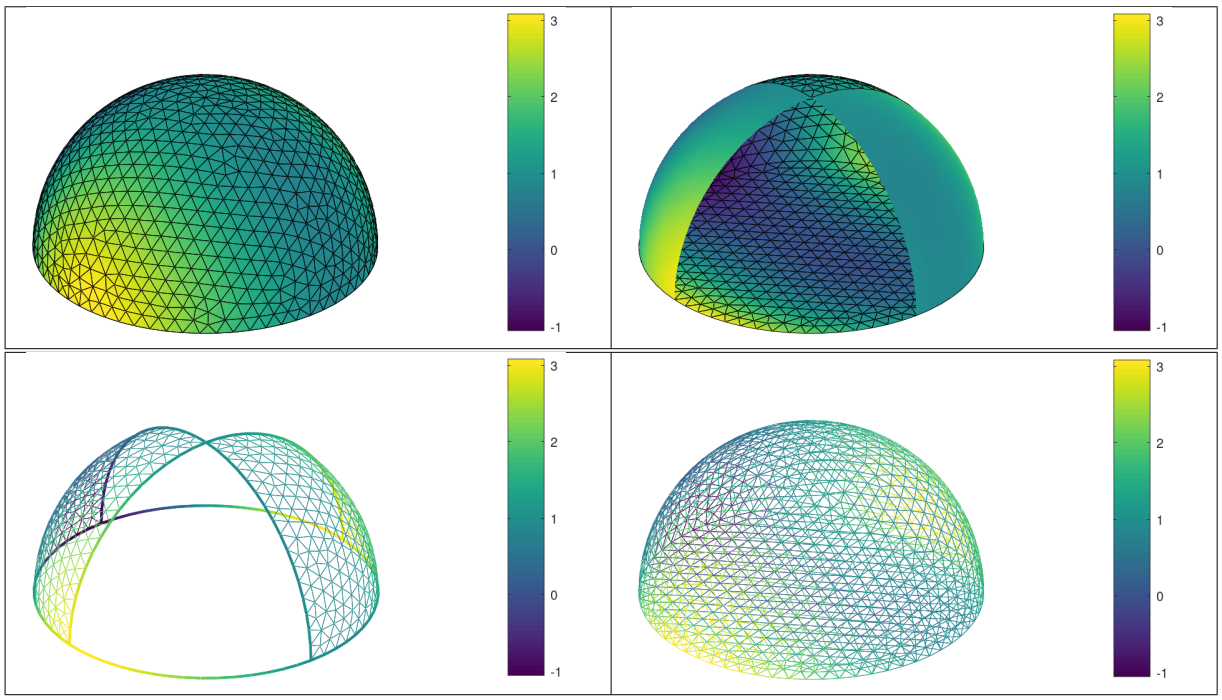


```
meshfile=fc_oogmsh.gmsh.buildmesh3d('cylinder3holes',10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=@(x,y,z) cos(2*x-y-z).*sin(x-2*y+z);
U=Th.eval(u);

fc_tools.graphics.monitors.onGrid(2,2,'figures',1:3);
figure(1)
fc_siplt.plot(Th,U);
axis image

figure(2)
fc_siplt.plot(Th,U,'d',2);
axis image

figure(3)
fc_siplt.plot(Th,U,'d',1,'Linewidth',3);
axis image
colormap('jet')
```

Listing 6: Using **fc_siplt.plot** function with a 3D mesh

4.3 3Ds example

the following code is part of the **fc_siplt.demos.plot3Ds** function.



```
geofile=fc_simesh.get_geo(3,2,'demisphere5');
meshfile=fc_oogmsh.buildmesh3ds(geofile,10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y);

fc_tools.graphics.monitors.onGrid(2,2);
figure(1)
fc_siplt.plot(Th,u)
axis off;axis image;colorbar;
figure(2)
fc_siplt.plot(Th,u,'labels',[1,11])
hold on;axis off;axis image;colorbar;
fc_siplt.plot(Th,u,'labels',[10,12], 'FaceColor','interp', 'EdgeColor','none')
figure(3)
fc_siplt.plot(Th,u,'d',1,'LineWidth',2)
hold on;axis off;axis image;colorbar
fc_siplt.plot(Th,u,'labels',[10,12], 'FaceColor','none', 'EdgeColor','interp')
figure(4)
fc_siplt.plot(Th,u,'FaceColor','none', 'EdgeColor','interp')
```

Listing 7: Using **fc_siplt.plot** function with a 3Ds mesh

5 fc_siplt.plotiso function

The **fc_siplt.plotiso** function displays isolines from datas on the mesh or parts of the mesh defined by an siMesh object. This function only works with 2-simplices in space dimension 2 or 3.

Syntaxe

```
fc_siplt.plotiso(Th,u)
fc_siplt.plotiso(Th,u,Name,Value, ...)
```

Description

fc_siplt.plotiso(Th,u) displays data u on all the 2-dimensional simplices elements of Th, a siMesh object.. The data u is an 1D-array of size Th.nq or Th.nqGlobal or Th.nqParent.

fc_siplt.plotiso(Th,u,key,value, ...) specifies function options using one or more key,value pair arguments. Options of first level are

- 'niso' : to specify the number of isolines (default : 10)
- 'isorange' : to specify the list of isovalues (default : empty)
- 'isocolorbar' : if **true**, colorbar with isovalues is drawn (default : **false**)
- 'format' : to specify the format of the isovalues on the colorbar (default : '%g')

- 'labels' : to select the labels of the elements to display data,
- 'plane' : if true, isolines are in the xy-plane, otherwise isolines are in 3D with z-value set to u (default : **false**)
- 'color' : to specify one color for all isolines (default : empty)
- 'mouse' : if **true**, display information on clicked isoline (default : **false**)

The options of second level are all options of

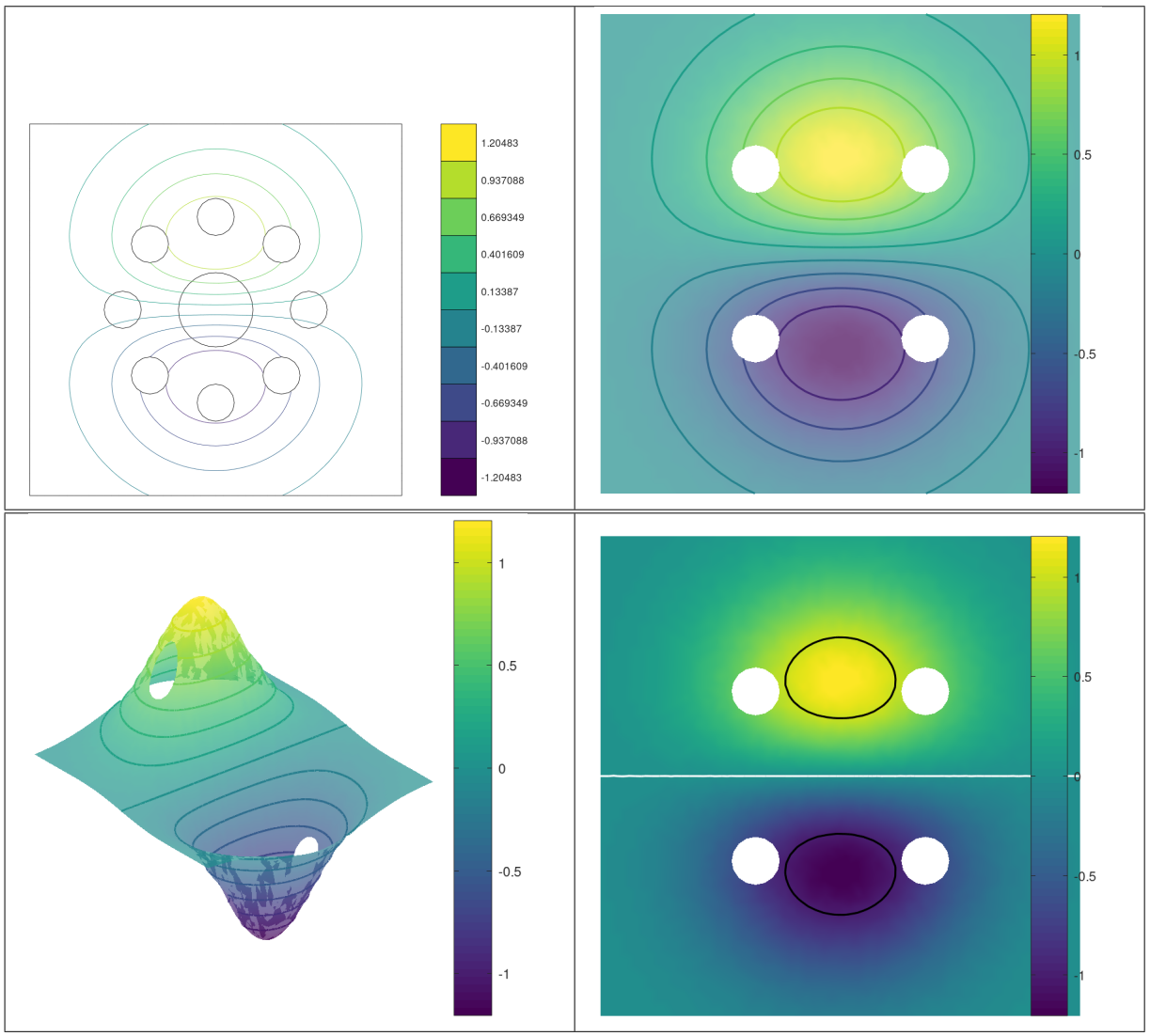
- **plot3** function in dimension 3 or in dimension 2 with 'plane' option set to **false**
- **plot** function in 2 with 'plane' option set to **true**

This function accepts until 4 output arguments :

- 1st output is the colors of the isolines
- 2nd output is the isovalues of the isolines
- 3th output is the handle of the colobar iso.
- 4th output is all the handles of the isolines as an 2D-array of dimension N-by-niso, where N is the number of 2-simplex elementary meshes where isolines are drawn.

5.1 2D example

the following code is part of the **fc_siplt.demos.plotiso2D** function.

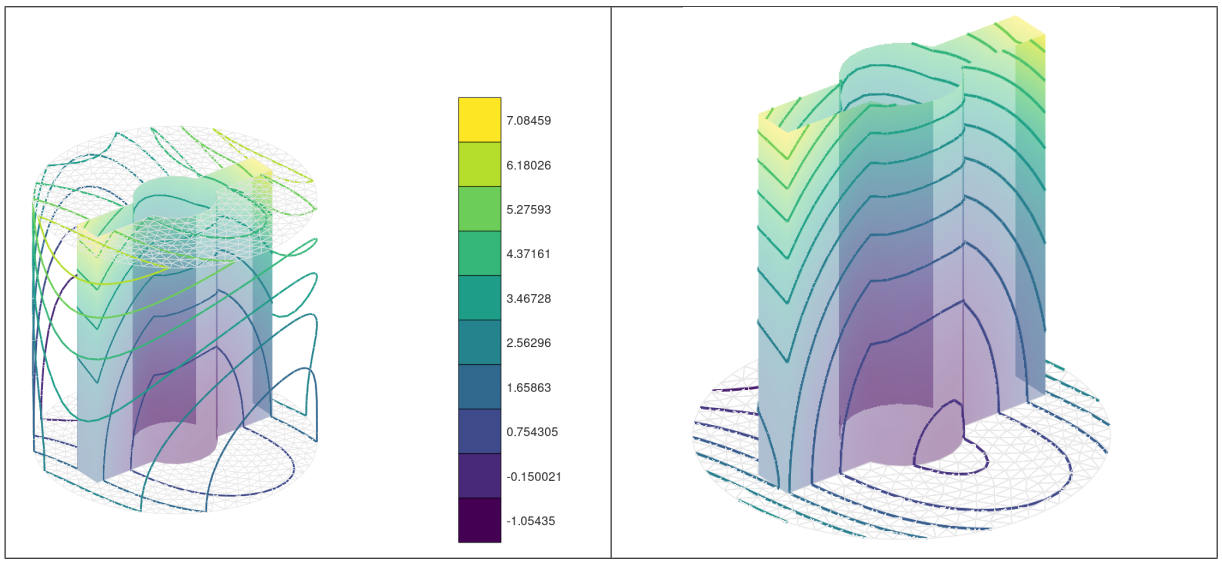



```
meshfile=fc_oogmsh.gmsh.buildmesh2d('condenser11',25,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=Th.eval(@(x,y) 5*exp(-3*(x.^2+y.^2)).*cos(x).*sin(y));
fc_tools.graphics.monitors.onGrid(2,2);
figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','k')
hold on;axis off;axis image;
fc_siplt.plotiso(Th,u,'isocolorbar',true)
figure(2)
fc_siplt.plot(Th,u,'plane',true,'FaceAlpha',0.7)
hold on;axis off;axis image;shading interp;
fc_siplt.plotiso(Th,u,'plane',true,'LineWidth',1.5)
colorbar
figure(3)
fc_siplt.plot(Th,u,'FaceAlpha',0.7)
view(3)
shading interp;hold on;axis off;axis image;
fc_siplt.plotiso(Th,u,'niso',15,'LineWidth',1.5)
colorbar
figure(4)
fc_siplt.plot(Th,u,'plane',true)
shading interp;hold on;axis off;axis image;
fc_siplt.plotiso(Th,u,'isorange',0, 'LineWidth',1.5, 'color','w')
fc_siplt.plotiso(Th,u,'isorange',[-1,1], 'LineWidth',1.5, 'color','k','plane',true)
```

Listing 8: Using fc_siplt.plotiso function with a 2D mesh

5.2 3D example

the following code is part of the **fc_siplt.demos.plotiso3D** function.

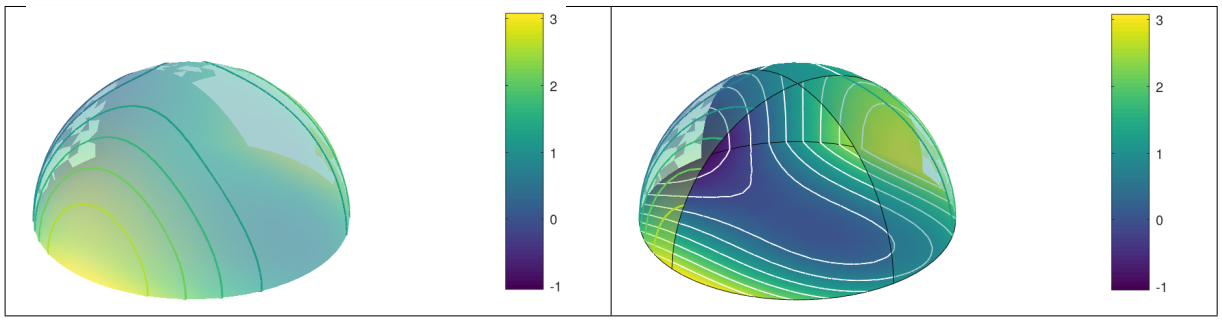



```
geofile=fc_simesh.get_geo(3,3,'cylinderkey');
meshfile=fc_oogmsh.gmsh.buildmesh3d(geofile,10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y);
fc_tools.graphics.monitors.onGrid(1,2);
figure(1)
fc_siplt.plot(Th,u,'d',2,'labels',[10,11,31],'FaceColor','interp', 'EdgeColor','none','FaceAlpha',0.4)
hold on;view(3);axis off;axis equal;
fc_siplt.plotmesh(Th,'d',2,'labels',[1000,1020,1021,2000,2020,2021], 'FaceColor','none','EdgeColor',0.9*[1,1,1])
fc_siplt.plotiso(Th,u,'isocolorbar',true,'LineWidth',1.5)
figure(2)
fc_siplt.plot(Th,u,'d',2,'labels',[10,11,31],'FaceColor','interp', 'EdgeColor','none','FaceAlpha',0.4)
hold on;axis off;axis equal;
fc_siplt.plotmesh(Th,'d',2,'labels',[2000,2020,2021], 'FaceColor','none','EdgeColor',0.9*[1,1,1])
fc_siplt.plotiso(Th,u,'labels',[10,11,31,2000,2020,2021],'LineWidth',1.5, 'niso',15)
```

Listing 9: Using fc_siplt.plotiso function with a 3D mesh

5.3 3Ds example

the following code is part of the **fc_siplt.demos.plotiso3Ds** function.




```
meshfile=fc_oogmsh.gmsh.buildmesh3ds('demisphere5',10,varargin{:});
Th=fc_simesh.siMesh(meshfile);

u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y);
fc_tools.graphics.monitors.onGrid(1,2);
figure(1)
fc_siplt.plot(Th,u,'FaceColor','interp', 'EdgeColor','none','FaceAlpha',0.4)
hold on;axis off;axis equal;colorbar
fc_siplt.plotiso(Th,u,'LineWidth',1.5)

figure(2)
fc_siplt.plot(Th,u,'labels',[1,11],'FaceColor','interp', 'EdgeColor','none')
hold on;axis off;axis equal;colorbar;
fc_siplt.plotiso(Th,u,'labels',[1,11],'LineWidth',1.,'color','w')
fc_siplt.plot(Th,u,'labels',[10,12],'FaceColor','interp', 'EdgeColor','none','FaceAlpha',0.4)
fc_siplt.plotiso(Th,u,'labels',[10,12],'LineWidth',1.5)
```

Listing 10: Using fc_siplt.plotiso function with a 3Ds mesh

6 fc_siplt.slicemesh function

The **fc_siplt.slicemesh** function displays intersection of a plane and a 3D mesh or parts of a 3D mesh defined by an siMesh object.

Syntaxe

```
fc_siplt.slicemesh(Th,P)
fc_siplt.slicemesh(Th,P,Name,Value, ...)
```

Description

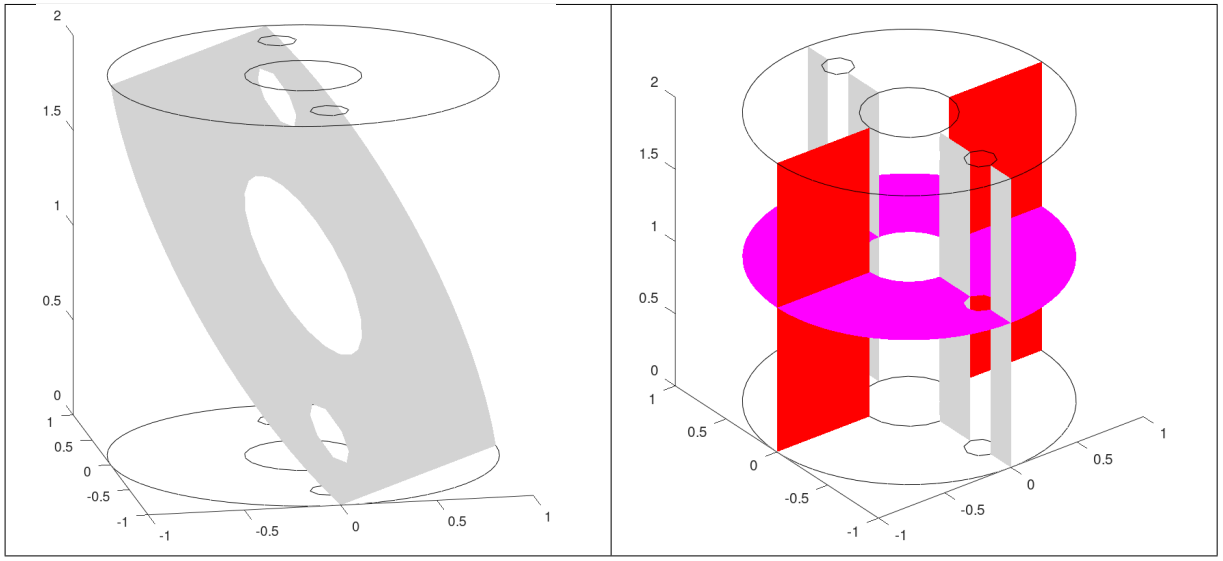
fc_siplt.slicemesh(Th,P) displays intersection of the plane defined by $P(1)x + P(2)y + P(3)z + P(4) = 0$ and all the 3-dimensional simplices elements of Th, a siMesh object. To compute P one can use the function fc_tools.graphics.PlaneCoefs of the fctools package. With this function, the array P, is obtained with P=fc_tools.graphics.PlaneCoefs(Q,V) where Q is a point in the plane and V is a vector orthogonal to it.

fc_siplt.slicemesh(Th,P,Name,Value, ...) specifies function options using one or more Name,Value pair arguments. Options of first level are

- 'color' : to specify the slice color (default : 'lightgrey', rgb =[0.9,0.9,0.9])
- 'labels' : to select the labels of the elements to intersect,

6.1 3D example

the following code is part of the **fc_siplt.demos.slicemesh3D** function.



```
meshfile=fc_oogmsh.buildmesh3d('cylinder3holes',10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
fc_tools.graphics.monitors.onGrid(1,2);
figure(1)
P=fc_tools.graphics.PlaneCoefs([0 0 1],[1 -1 1]);
fc_siplt.slicemesh(Th,P)
hold on;axis equal;
fc_siplt.plotmesh(Th,'d',1,'color','k')
view(-11,15)

figure(2)
P=[fc_tools.graphics.PlaneCoefs([0 0 1],[1 0 0]); ...
   fc_tools.graphics.PlaneCoefs([0 0 1],[0 1 0]); ...
   fc_tools.graphics.PlaneCoefs([0 0 1],[0 0 1])];
fc_siplt.slicemesh(Th,P,'color',{'LightGray',[1,0,0],'m'}) % [1,0,0] -> RGB => red
hold on;axis equal;
fc_siplt.plotmesh(Th,'d',1,'color','k')
```

Listing 11: Using fc_siplt.slicemesh function with a 3D mesh

7 fc_siplt.slice function

The method **fc_siplt.slice** function displays datas on the intersection of a plane and a 3D mesh or parts of a 3D mesh defined by an siMesh object.

Syntaxe

```
fc_siplt.slice(Th,u,P)
fc_siplt.slice(Th,u,P,Name,Value, ...)
```

Description

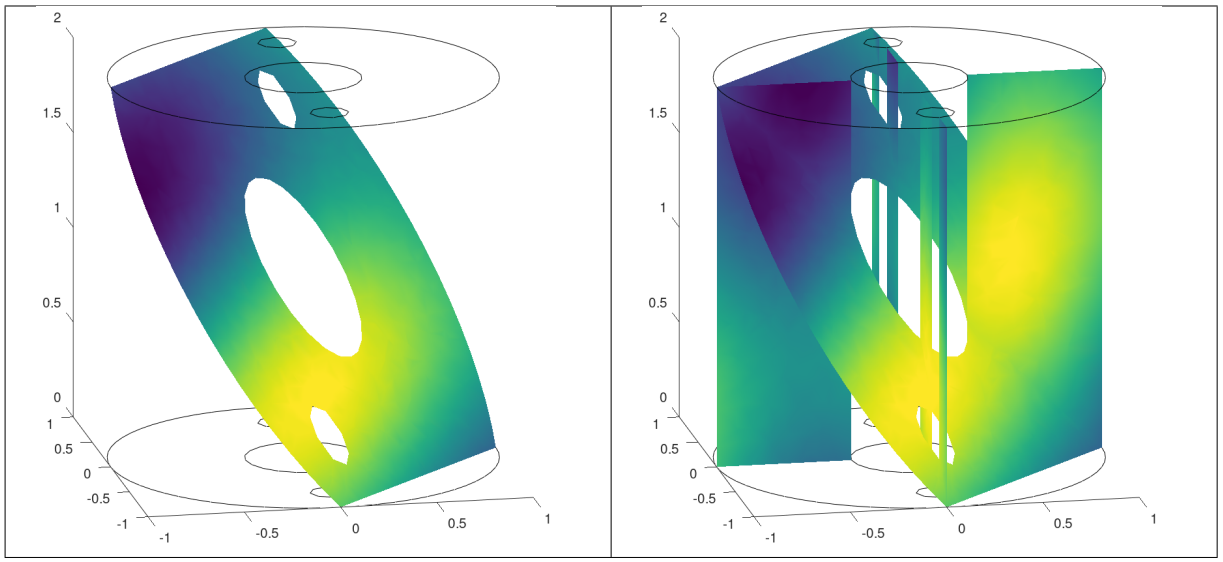
fc_siplt.slice(Th,u,P) displays u data on the intersection of the plane defined by $P(1)x + P(2)y + P(3)z + P(4) = 0$ and all the 3-dimensional simplices elements of Th, a siMesh object. The data u is an 1D-array of size Th.nq or Th.nqGlobal or Th.nqParent. To compute P one can use the function fc_tools.graphics.PlaneCoefs of the fc tools package. With this function, the array P, is obtained with P=fc_tools.graphics.PlaneCoefs(Q,V) where Q is a point in the plane and V is a vector orthogonal to it.

fc_siplt.slice(Th,u,P,Name,Value, ...) specifies function options using one or more Name,Value pair arguments. Options of first level are

- 'labels' : to select the labels of the elements to intersect,

7.1 3D example

the following code is part of the **fc_siplt.demos.slice3D** function.



```
meshfile=fc_oogmsh.buildmesh3d('cylinder3holes',10,varargin{:});
Th=fc_simesh.siMesh(meshfile);

u=@(x,y,z) cos(2*x-y-z).*sin(x-2*y+z);
U=Th.eval(u);

figure(1)
P=fc_tools.graphics.PlaneCoefs([0 0 1],[1 -1 1]);
fc_siplt.slice(Th,U,P)
hold on
fc_siplt.plotmesh(Th,'d',1,'color','k')
axis equal
view(-11,15)

P=[fc_tools.graphics.PlaneCoefs([0 0 1/2],[1 0 0]); ...
   fc_tools.graphics.PlaneCoefs([0 0 1/2],[0 1 0]); ...
   fc_tools.graphics.PlaneCoefs([0 0 1],[1 -1 1])];
figure(2)
fc_siplt.slice(Th,U,P)
hold on
fc_siplt.plotmesh(Th,'d',1,'color','k')
axis equal
```

Listing 12: Using fc_siplt.slice function with a 3D mesh

8 fc_siplt.sliceiso function

The **fc_siplt.sliceiso** function displays isolines of data on the intersection of a plane and a 3D mesh or parts of a 3D mesh defined by an SIMESH object.

Syntaxe

```
fc_siplt.sliceiso(Th,u,P)
fc_siplt.sliceiso(Th,u,P,Name,Value, ...)
```

Description

fc_siplt.sliceiso(Th,u,P) displays u data as isolines on the intersection of the plane defined by $P(1)x + P(2)y + P(3)z + P(4) = 0$ and all the 3-dimensional simplices elements of Th, a SIMESH object. The data u is an 1D-array of size Th.nq or Th.nqGlobal or Th.nqParent. To compute P one can use the function fc_tools.graphics.PlaneCoefs of the fctools package. With this function, the array P, is obtained with P=fc_tools.graphics.PlaneCoefs(Q,V) where Q is a point in the plane and V is a vector orthogonal to the plane.

fc_siplt.sliceiso(Th,u,P,key,value, ...) allows additional key/value pairs to be used when displaying u. The key strings could be

- 'labels' : to select the labels of the elements to intersect,
- 'niso' : to specify the number of isolines (default : 10)
- 'isorange' : to specify the list of isovalues (default : empty)
- 'color' : to specify one color for all isolines (default : empty)
- 'isocolorbar' : if true display a colorbar.Default is false.
- 'format' : to specify the format of the isovalues print in the colorbar. Default is `'%g'`.

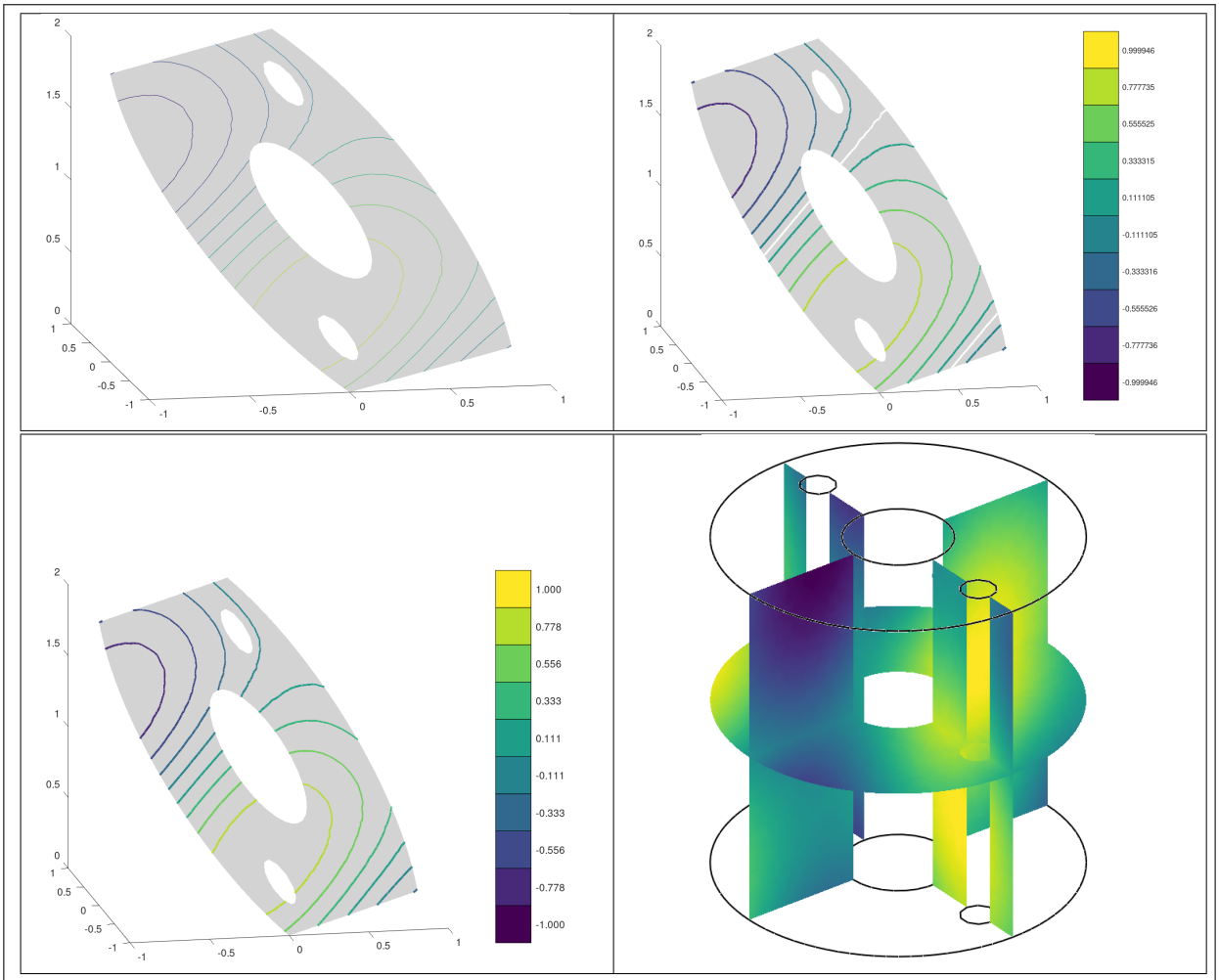
For key strings, one could also used any options of the plot3 function.

This function accepts until 4 output arguments :

- 1st output is the colors of the isolines
- 2nd output is the isovalues of the isolines
- 3th output is the handle of the colobar iso.
- 4th output is all the handles of the isolines as an 2D-array of dimension N-by-niso, where N is the number of elementary meshes where isolines are drawn.

8.1 3D example

the following code is part of the **fc_siplt.demos.sliceiso3D** function.




```
meshfile=fc_oogmsh.buildmesh3d('cylinder3holes',15,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=@(x,y,z) cos(2*x-y-z).*sin(x-2*y+z);
U=Th.eval(u);

fc_tools.graphics.monitors.onGrid(2,3,'figures',1:5);
figure(1)
P=fc_tools.graphics.PlaneCoefs([0 0 1],[1 -1 1]);
fc_siplt.slicemesh(Th,P)
hold on
fc_siplt.sliceiso(Th,U,P)
view(-11,15)

figure(2)
P=fc_tools.graphics.PlaneCoefs([0 0 1],[1 -1 1]);
fc_siplt.slicemesh(Th,P)
hold on
[~,~,cax,h]=fc_siplt.sliceiso(Th,U,P,'isocolorbar',true);
fc_siplt.sliceiso(Th,U,P,'isorange',0,'color','w','Linewidth',2);
view(-11,15)
I=~isnan(h);
set(h(I),'LineWidth',2)
set(cax,'FontSize',8)

figure(3)
P=fc_tools.graphics.PlaneCoefs([0 0 1],[1 -1 1]);
fc_siplt.slicemesh(Th,P)
hold on
fc_siplt.sliceiso(Th,U,P,'isocolorbar',true,'LineWidth',2,'format','%.3f');
view(-11,15)

figure(4)
P=[fc_tools.graphics.PlaneCoefs([0 0 1],[1 0 0]); ...
    fc_tools.graphics.PlaneCoefs([0 0 1],[0 1 0]); ...
    fc_tools.graphics.PlaneCoefs([0 0 1],[0 0 1])];
fc_siplt.plotmesh(Th,'d',1,'LineWidth',1,'color','k');
hold on;axis off;axis image;
fc_siplt.slice(Th,u,P,'Facecolor','interp')

figure(5)
fc_siplt.plotmesh(Th,'d',1,'LineWidth',2,'color','k');
hold on;axis off;axis image;
fc_siplt.slicemesh(Th,P(1:2,:))
fc_siplt.sliceiso(Th,U,P(1:2,:))
fc_siplt.slice(Th,U,P(3,:),'Facecolor','interp')
```

Listing 13: Using fc_siplt.sliceiso function with a 3D mesh

9 fc_siplt.plotquiver function

The **fc_siplt.plotquiver** function displays vector field datas on the mesh or parts of the mesh defined by an siMesh object.

Syntaxe

```
fc_siplt.plotquiver(Th,V)
fc_siplt.plotquiver(Th,V,Key,Value, ...)
```

Description

fc_siplt.plotquiver(Th,V) displays vector field U on all the d-dimensional simplices elements in dimension $d = 2$ or $d = 3$. The data V is an 2D-array of size Th.nq-by-d or 2-by-Th.nq.

fc_siplt.plotquiver(Th,V,Key,Value, ...) specifies function options using one or more Key,Value pair arguments. Options of first level are

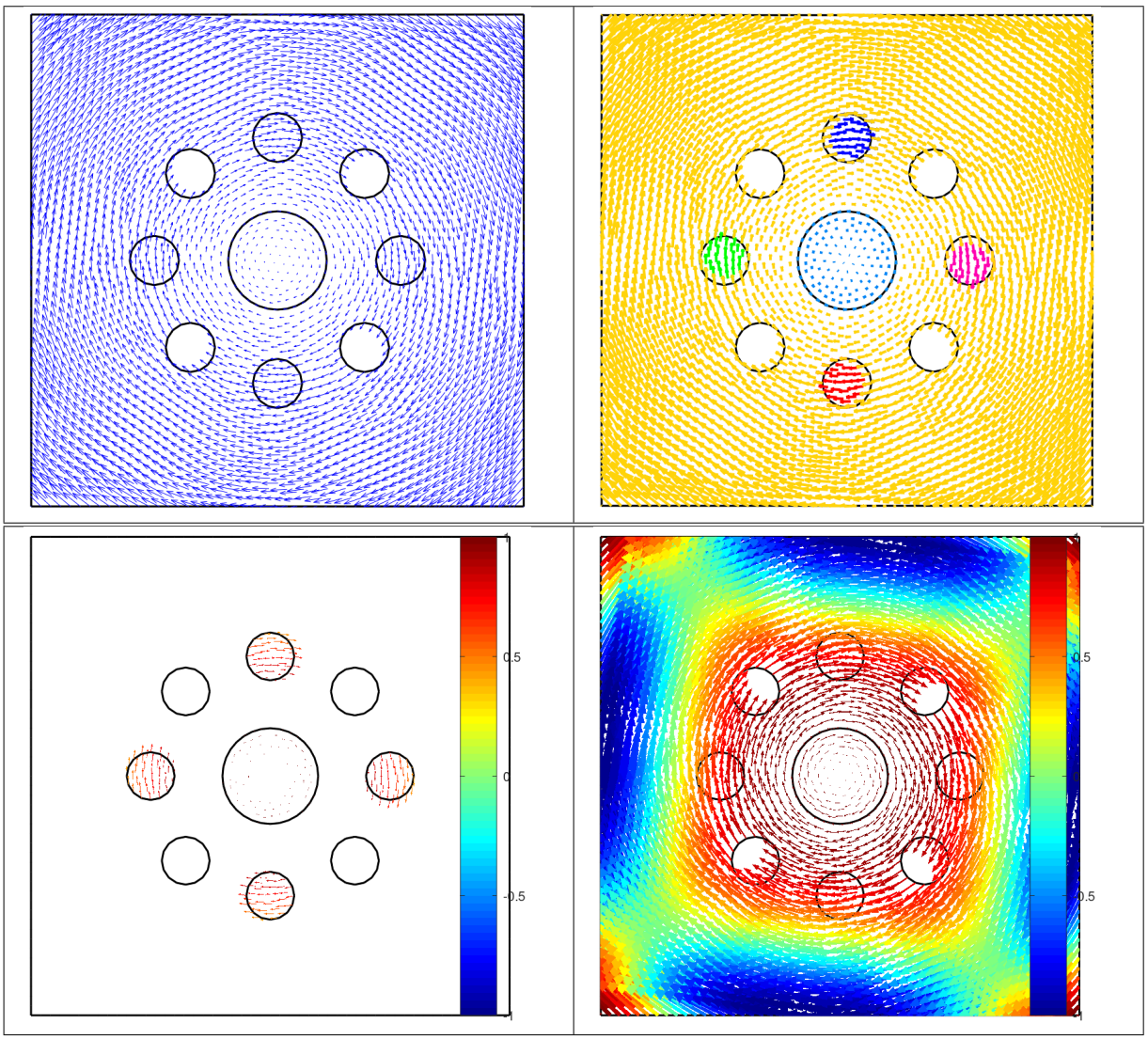
- 'labels' : to select the labels of the elements to display data,
- 'freq' : quiver frequencie, (default : 1)
- 'scale' : quiver scale, (default : ...)
- 'colordata' : set colors on each quiver (default : empty).

The options of second level depend on space dimension and 'colordata' option. One can use any option of the following functions

- **quiver** function in dimension 2 with an empty 'colordata'
- quiver3 function in dimension 3 with an empty 'colordata'
- vfield3 function in dimension 2 or 3 with 'colordata' set to an 1D-array of length Th.nq.

9.1 2D example

the following code is part of the **fc_siplt.demos.plotquiver2D** function.

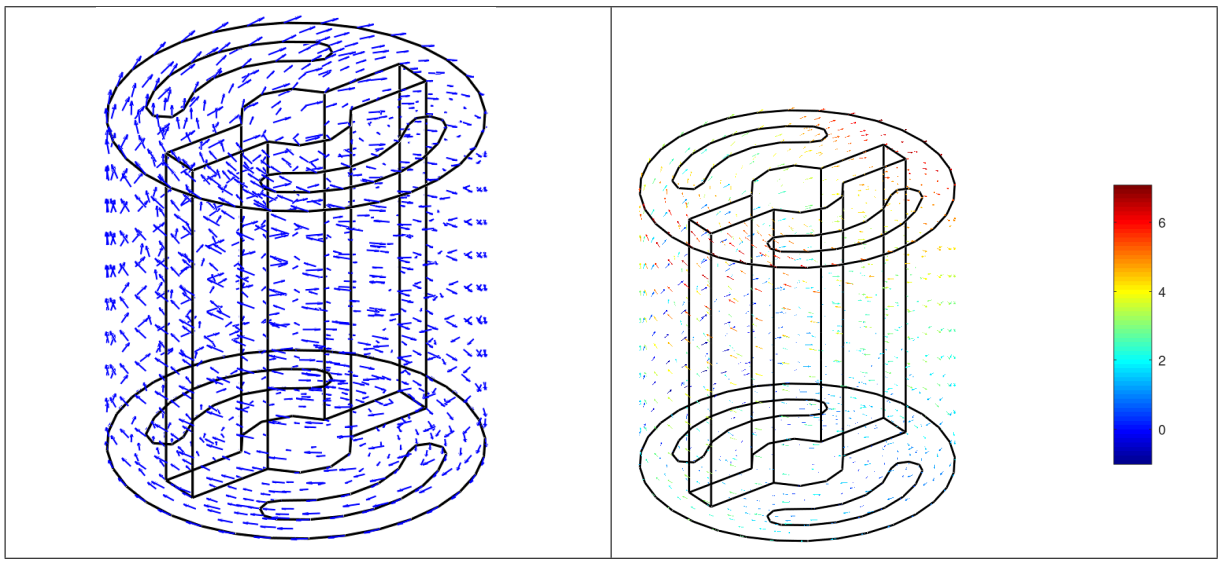



```
geofile=fc_simesh.get_geo(2,2,'condenser11');
meshfile=fc_oogmsh.buildmesh2d(geofile,25,varargin{:});
Th=fc_simesh.siMesh(meshfile);

u=@(x,y) cos(pi*x.^2).*cos(pi*y.^2);
U=Th.eval(u);
w={@(x,y) y.*cos(-(x.^2+y.^2)/10),@(x,y) -x.*cos(-(x.^2+y.^2)/10)};
W=Th.eval(w);
fc_tools.graphics.monitors.onGrid(2,2);
figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W)

figure(2)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W,'LineWidth',2,'merge',false)

figure(3)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W,'colordata',U,'labels',[2:2:8,20])
caxis([min(U) max(U)])
colormap('jet');colorbar

figure(4)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W,'colordata',U, 'scale',0.2)
```

Listing 14: Using fc_siplt.plotquiver function with a 2D mesh

9.2 3D example

the following code is part of the **fc_siplt.demos.plotquiver3D** function.

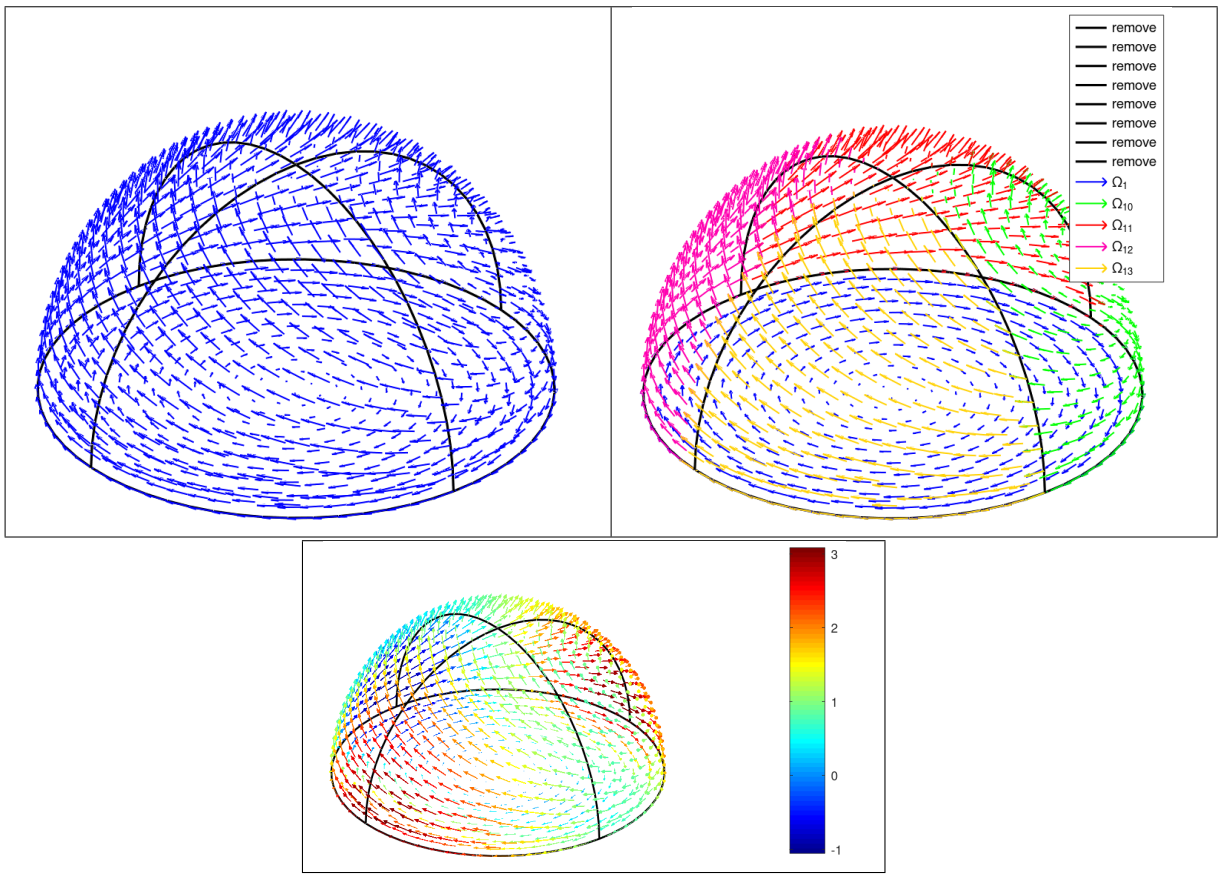



```
geofile=fc_oogmsh.get_geo(3,3,'cylinderkey');
meshfile=fc_oogmsh.buildmesh3d(geofile,5,varargin{:});
Th=fc_simesh.siMesh(meshfile);

w={@(x,y,z) y.*cos(-(x.^2+y.^2)/10),@(x,y,z) -x.*cos(-(x.^2+y.^2)/10),@(x,y,z) z/5 };
W=Th.eval(w);
u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y);
fc_tools.graphics.monitors.onGrid(1,2);
figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on
fc_siplt.plotquiver(Th,W,'LineWidth',1)
axis off;axis image

figure(2)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on
fc_siplt.plotquiver(Th,W,'colordata',u, 'scale',0.05)
axis off;axis image
```

Listing 15: Using **fc_siplt.plotquiver** function with a 3D mesh

9.3 3Ds example

the following code is part of the **fc_siplt.demos.plotquiver3Ds** function.




```
geofile=fc_simesh.get_geo(3,2,'demisphere5');
meshfile=fc_oogmsh.gmsh.buildmesh3ds(geofile,10,varargin{:});
Th=fc_simesh.siMesh(meshfile);

w={@(x,y,z) y.*cos(-(x.^2+y.^2)/10),@(x,y,z) -x.*cos(-(x.^2+y.^2)/10),@(x,y,z) z };
W=Th.eval(w);
u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y);
fc_tools.graphics.monitors.onGrid(2,2,'figures',1:3);
figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W,'LineWidth',1)

figure(2)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W,'LineWidth',1,'merge',false,'inlegend',true)
legend('show')

figure(3)
fc_siplt.plotmesh(Th,'d',1,'color','k', 'LineWidth',1.5)
hold on;axis off;axis image
fc_siplt.plotquiver(Th,W,'colordata',u, 'scale',0.1)
```

Listing 16: Using **fc_siplt.plotquiver** function with a 3Ds mesh

10 fc_siplt.scatter function

The **fc_siplt**.scatter function displays scalar datas as colorized points on the mesh or parts of the mesh defined by an siMesh object.

Syntaxe

```
fc_siplt.scatter(Th,u)
fc_siplt.scatter(Th,u,Name,Value, ...)
```

Description

fc_siplt.scatter(Th,u) displays data u on all the (Th.d)-dimensional simplices elements of Th, a siMesh object.
The data u is an 1D-array of size Th.nq or Th.nqGlobal or Th.nqParent.

fc_siplt.scatter(Th,u,Name,Value, ...) specifies function options using one or more Name,Value pair arguments.

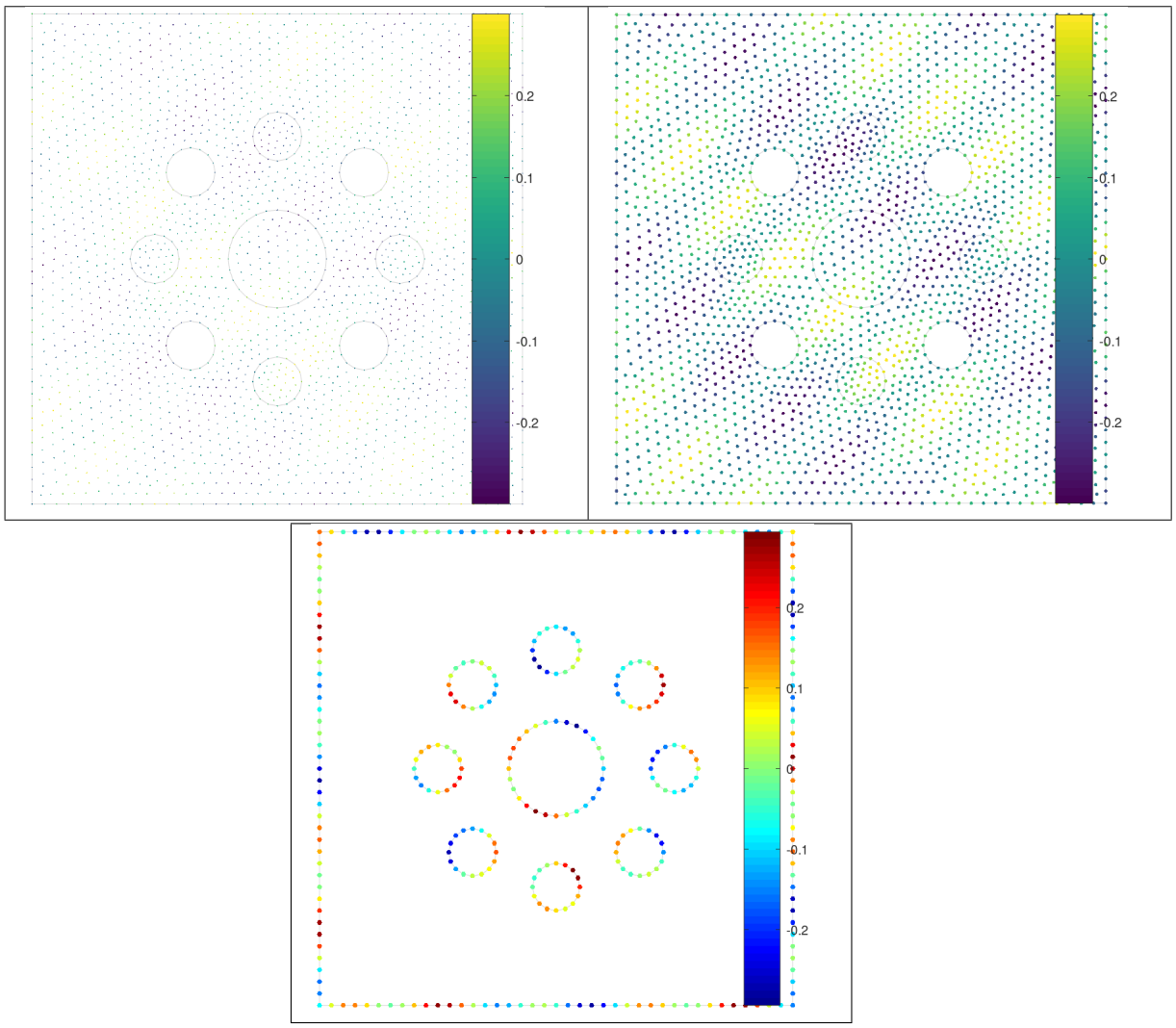
Options of first level are

- 'd' : to specify the dimension of the simplices elements (default : Th.d)
- 'labels' : to select the labels of the elements to display data,
- 'MarkerSize' : size of the marker. Default is 1.
- 'ForcePatch' : if **true**, uses **patch** function, otherwise uses scatter function in dimension 2 or scatter3 function in dimension 3. Default is **true**.

The options of second level are those of the function used (see 'ForcePatch' option).

10.1 2D example

the following code is part of the **fc_siplt.demos.scatter2D** function.

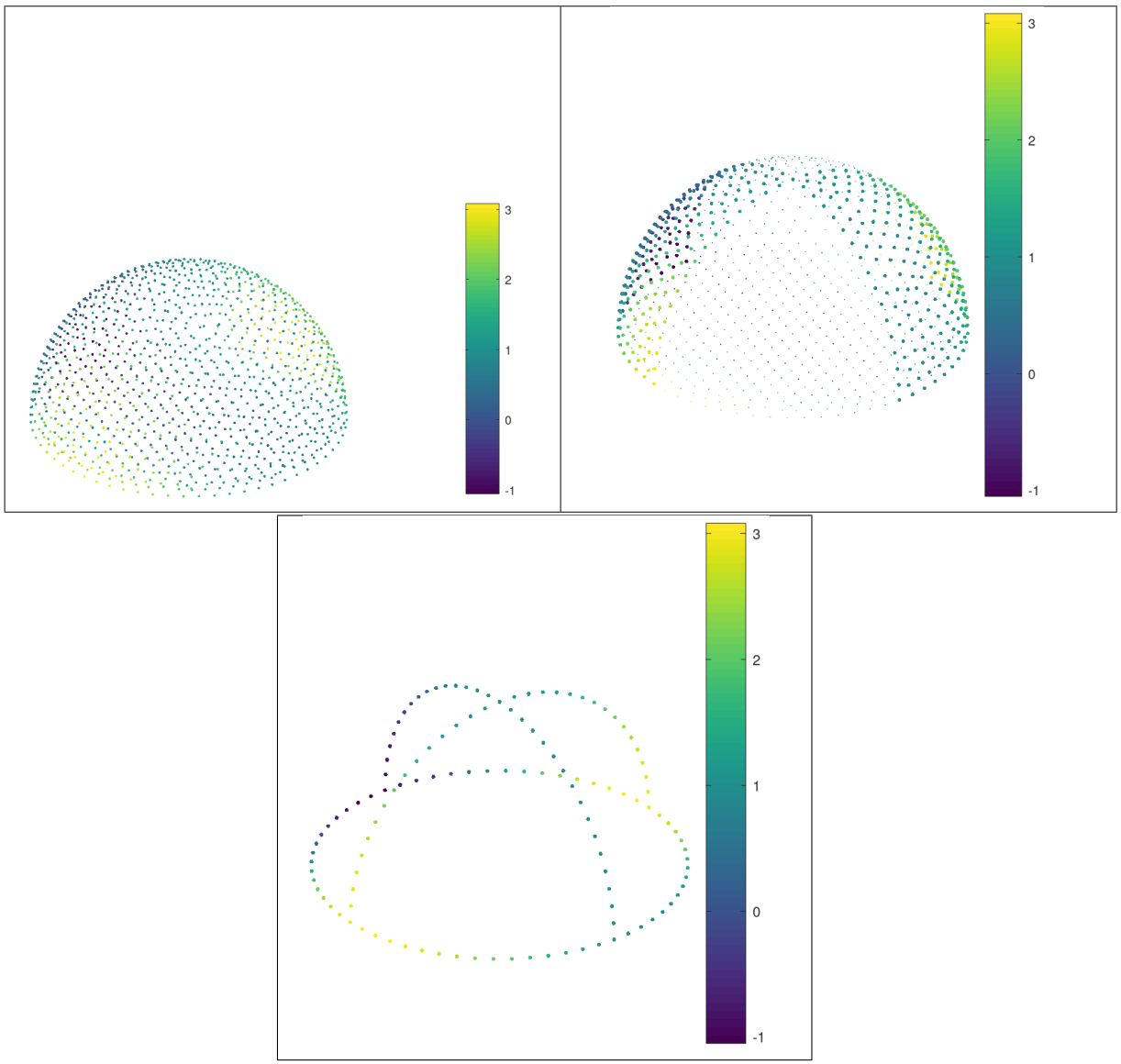



```
meshfile=fc_oogmsh.gmsh.buildmesh2d('condenser11',20,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=@(x,y) 0.3*cos(5*(2*x-y)).*sin(5*(x-2*y));
U=Th.eval(u);

fc_tools.graphics.monitors.onGrid(2,2,'figures',1:3);

figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','LightGray')
hold on
fc_siplt.scatter(Th,U);
axis image;axis off;
colorbar

figure(2)
fc_siplt.plotmesh(Th,'d',1,'color','LightGray')
hold on
fc_siplt.scatter(Th,U,'MarkerSize',8);
axis off;axis image
colorbar

figure(3)
fc_siplt.plotmesh(Th,'d',1,'color','LightGray')
hold on  % '*Alpha' options not yet implemented under Octave
fc_siplt.scatter(Th,U,'d',1,'MarkerSize',12,'MarkerEdgeAlpha',0, 'MarkerFaceColor','flat','MarkerFaceAlpha',0.8)
axis off;axis image
colormap('jet')
colorbar
```

Listing 17: Using **fc_siplt.scatter** function with a 2D mesh

10.2 3Ds example

the following code is part of the **fc_siplt.demos.scatter3Ds** function.

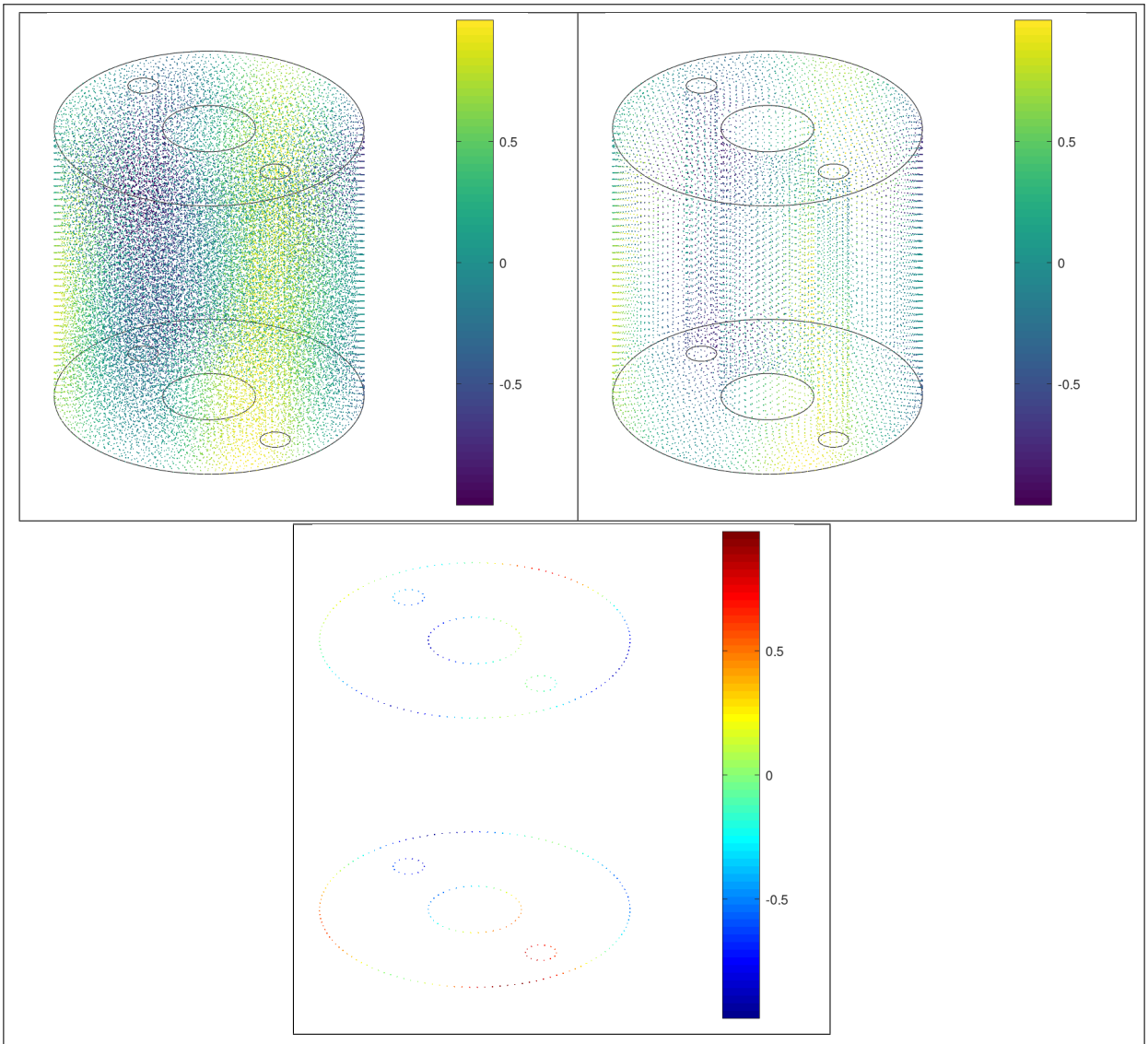



```
geofile=fc_simesh.get_geo(3,2,'demisphere5');
meshfile=fc_oogmsh.buildmesh3ds(geofile,10,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y);

fc_tools.graphics.monitors.onGrid(2,2,'figures',1:3);

figure(1)
fc_siplt.scatter(Th,u,'MarkerSize',7)
view(3);axis off;axis image;colorbar;

figure(2)
fc_siplt.scatter(Th,u,'labels',[1,11])
hold on;axis off;axis image;colorbar;
fc_siplt.scatter(Th,u,'labels',[10,12], 'MarkerSize',9)
view(3)

figure(3)
fc_siplt.scatter(Th,u,'d',1,'MarkerSize',9)
axis off;axis image;colorbar
view(3)
```

Listing 18: Using fc_siplt.scatter function with a 3Ds mesh

10.3 3D example

the following code is part of the **fc_siplt.demos.scatter3D** function.




```
meshfile=fc_oogmsh.gmsh.buildmesh3d('cylinder3holes',20,varargin{:});
Th=fc_simesh.siMesh(meshfile);
u=@(x,y,z) cos(2*x-y-z).*sin(x-2*y+z);
U=Th.eval(u);

fc_tools.graphics.monitors.onGrid(2,2,'figures',1:3);

figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','k')
hold on
fc_siplt.scatter(Th,U,'MarkerEdgeAlpha',0.1);
axis image;axis off;view(3)
colorbar

figure(2)
fc_siplt.plotmesh(Th,'d',1,'color','k')
hold on
fc_siplt.scatter(Th,U,'d',2);
axis image;axis off;view(3)
colorbar

figure(3)
fc_siplt.scatter(Th,U,'d',1);
axis image;axis off;view(3)
colormap('jet')
colorbar
```

Listing 19: Using fc_siplt.scatter function with a 3D mesh

Appendices

A Listings

B References

[1] F. Cuvelier. fc_graphics4mesh: an Octave package for displaying simplices meshes or datas on simplices meshes. `http://www.math.univ-paris13.fr/~cuvelier/software/`, 2017. User's Guide.

[2] F. Cuvelier. fc_simesh: an object-oriented Octabe package for using simplices meshes generated from gmsh (in dimension 2 or 3) or an hypercube triangulation (in any dimension). `http://www.math.univ-paris13.fr/~cuvelier/software/`, 2017. User's Guide.

Informations for git maintainers of the fc siplt Octave package

git informations on the packages used to build this manual

```
------------------------------------------------
  name : fc-siplt
   tag : 0.2.6
commit : 225d8579179b60686b16f116bee8ac4dc858e2d6
  date : 2023-03-05
  time : 17-00-59
status : 0
------------------------------------------------
  name : fc-tools
   tag : 0.0.35
commit : 1469d4cbac235c83155cf9195d9887e0a149177a
  date : 2023-03-03
  time : 13-50-59
status : 0
------------------------------------------------
  name : fc-bench
   tag : 0.1.3
commit : 0639dde1dee68427af4dab19f75b1c58dacf64a4
  date : 2023-03-02
  time : 09-35-44
status : 0
------------------------------------------------
  name : fc-hypermesh
   tag : 1.0.4.b
commit : 3ec06216dde6d376fcb766b085188b259986fe19
  date : 2023-03-02
  time : 12-46-15
status : 0
------------------------------------------------
  name : fc-amat
   tag : 0.1.3.b
commit : 36648a410d06d8af84f4950cd42681309d803dbf
  date : 2023-03-02
  time : 09-49-35
status : 0
------------------------------------------------
  name : fc-meshtools
   tag : 0.1.4.b
commit : 43f58ffcfa2ca359f2d948d156a8165274270376
  date : 2023-03-02
  time : 15-23-05
status : 0
------------------------------------------------
  name : fc-graphics4mesh
   tag : 0.1.6
commit : 184e91b337ead27cb05f945983446dc66ec02795
  date : 2023-03-04
  time : 08-38-29
status : 0
------------------------------------------------
  name : fc-oogmsh
   tag : 0.3.0.a
commit : 9e26c408792500dd34c5f2d90df7cc8fcc20cbbb
  date : 2023-03-05
  time : 06-36-30
status : 0
------------------------------------------------
  name : fc-simesh
   tag : 0.4.6.a
commit : 76deddaf6949d04bcc281cac685e5ba17914845b
  date : 2023-03-05
  time : 17-19-12
status : 0
------------------------------------------------
[fc-tools] waiting 2(s) to finish saving figures
```

git informations on the LaTeX package used to build this manual

```
------------------------------------------------
  name : fctools
   tag :
commit : ce17e5ecb1d9999e3c8b228f7557f77310b7c9c5
  date : 2023-03-05
  time : 06:32:05
status : 1
------------------------------------------------
[fc-tools] waiting 2(s) to finish saving figures
```

Using the remote configuration repository:

url	ssh://lagagit/MCS/Cuvelier/Matlab/fc-config
commit	ca906afbefb4703ef2dbaae43d9b4385267301e1