



# fc siplt Matlab toolbox, User's Guide\*

version 0.2.1

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## Abstract

This Matlab toolbox uses a `fc_simesh.siMesh` object, coming from the `fc_simesh` toolbox, to display simplicial meshes or datas on simplicial meshes. Its kernel uses the `fc_graphics4mesh` toolbox.

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\* $\text{\LaTeX}$  manual, revision 0.2.1, compiled with Matlab 2019a, and toolboxes `fc_siplt`[0.2.1], `fc-tools`[0.0.31], `fc-bench`[0.1.2], `fc-hypermesh`[1.0.3], `fc-amat`[0.1.2], `fc-meshtools`[0.1.3], `fc-graphics4mesh`[0.1.2], `fc-oogmsh`[0.2.3], `fc-simesh`[0.4.1]

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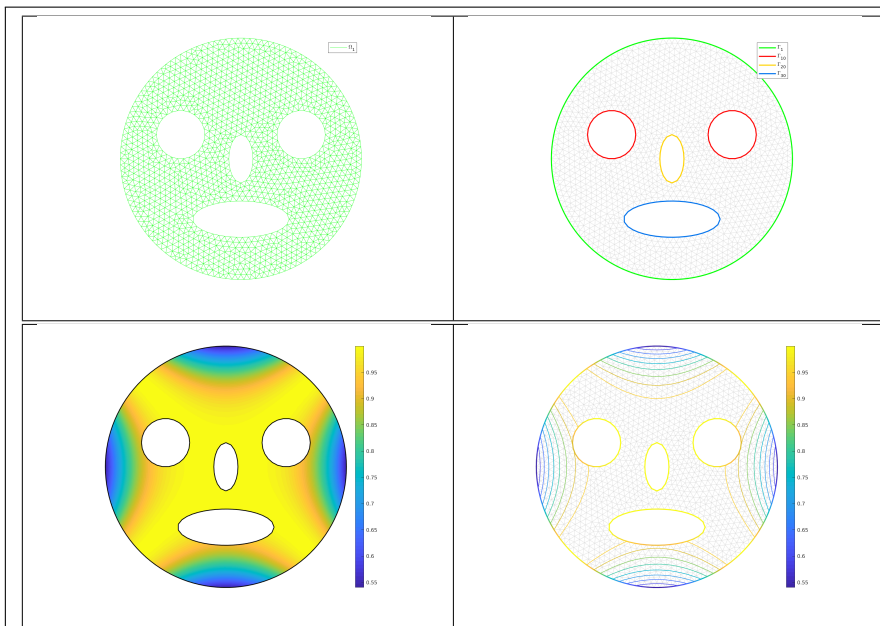
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# 1 Introduction

This **experimental** Matlab toolbox uses the **graphics4mesh** toolbox[1] to do some graphic representations on a **fc\_simesh.siMesh** object of the **simesh** toolbox[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.



```

close all
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 data 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 toolbox was tested on various OS with Matlab releases:

Operating system	2017a	2017b	2018a	2018b	2019a
CentOS 7.7.1908	✓	✓	✓	✓	✓
Debian 9.11	✓	✓	✓	✓	✓
Fedora 29	✓	✓	✓	✓	✓
OpenSUSE Leap 15.0	✓	✓	✓	✓	✓
Ubuntu 18.04.3 LTS	✓	✓	✓	✓	✓
MacOS High Sierra 10.13.6	✓	✓	✓	✓	✓
MacOS Mojave 10.14.4	✓	✓	✓	✓	✓
MacOS Catalina 10.15.2	✓	✓	✓	✓	✓
Windows 10 (1909)	✓	✓	✓	✓	✓

It is not compatible with Matlab releases prior to R2015b.

One just has to get/download the install file

`mfc_siplt_install.m`

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

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

```
>> cd ~/Matlab
>> mfc_siplt_install
```

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

```
Parts of the <fc-siplt> Matlab toolbox.
Copyright (C) 2017-2010 F. Cuvelier

1- Downloading and extracting the toolboxes
2- Setting the <fc-siplt> toolbox
Write in ~/Matlab/fc-siplt-full/fc_siplt-0.2.1/configure_loc.m ...
3- Using toolboxes :
->          fc-tools : 0.0.31
->          fc-bench : 0.1.2
->          fc-hypermesh : 1.0.3
->          fc-amat : 0.1.2
->          fc-meshtools : 0.1.3
->          fc-graphics4mesh : 0.1.2
->          fc-oogmesh : 0.2.3
->          fc-simesh : 0.4.1
with
          fc-siplt : 0.2.1
*** Using instructions
To use the <fc-siplt> toolbox:
addpath('~/Matlab/fc-siplt-full/fc_siplt-0.2.1')
fc_siplt.init()

See ~/Matlab/mfc_siplt_set.m
```

The complete toolbox (i.e. with all the other needed toolboxes) is stored in the directory `~/Matlab/fc-siplt-full` and, for each Matlab session, one have to set the toolbox by:



```
>> addpath('~\Matlab\fc-siplt-full\mfc-siplt-0.2.1')
>> 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 ~\Matlab\fc-siplt-full\fc_tools-0.0.31\configure_loc.m ...
Try to use default parameters!
Use fc_bench.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_bench-0.1.2\configure_loc.m ...
Try to use default parameters!
Use fc_hypermesh.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_hypermesh-1.0.3\configure_loc.m ...
Try to use default parameters!
Use fc_amat.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_amat-0.1.2\configure_loc.m ...
Try to use default parameters!
Use fc_meshtools.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_meshtools-0.1.3\configure_loc.m ...
Try to use default parameters!
Use fc_graphics4mesh.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_graphics4mesh-0.1.2\configure_loc.m ...
...
Try to use default parameters!
Use fc_oogmsh.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_oogmsh-0.2.3\configure_loc.m ...
Configured to use gmsh 4.5.1 with default MSH file format version 4.1
Try to use default parameters!
Use fc_simesh.configure to configure.
Write in ~\Matlab\fc-siplt-full\fc_simesh-0.4.1\configure_loc.m ...
Using fc_siplt[0.2.1] with fc_tools[0.0.31], fc_bench[0.1.2], ...
    fc_hypermesh[1.0.3],
        fc_amat[0.1.2], fc_meshtools[0.1.3], ...
            fc_graphics4mesh[0.1.2],
                fc_oogmsh[0.2.3], fc_simesh[0.4.1].
```

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

```
Configured to use gmsh 4.5.1 with default MSH file format version 4.1
Using fc_siplt[0.2.0] with fc_tools[0.0.30], fc_bench[0.1.2], ...
    fc_hypermesh[1.0.3],
        fc_amat[0.1.2], fc_meshtools[0.1.3], fc_graphics4mesh[0.1.1], ...
            fc_oogmsh[0.2.2], fc_simesh[0.4.0].
```

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

~\Matlab\fc-siplt-full

### 3 `fc_siplt.plotmesh` function

The `fc_siplt.plotmesh` function displays the mesh or parts of the mesh defined by an `fc_simesh.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 `fc_simesh.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).

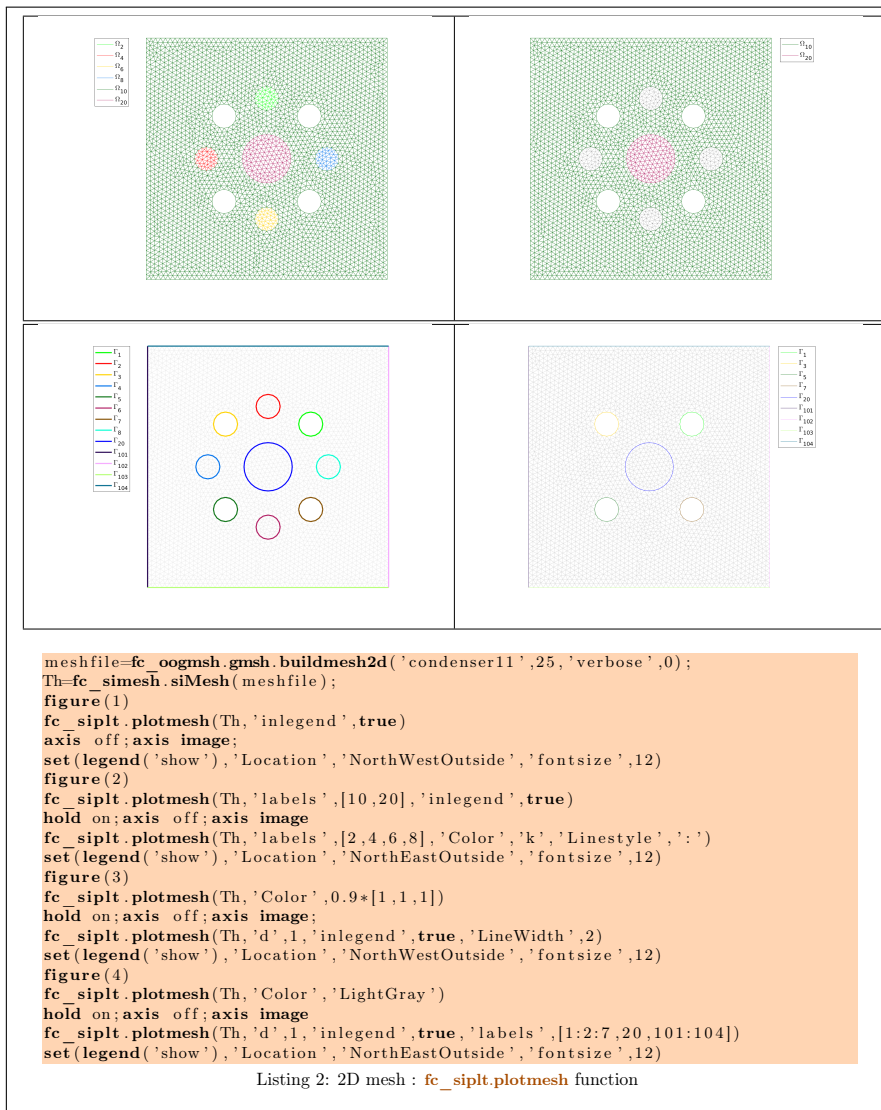
The options of second level depend on the type of elementaries mesh elements to represent.

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,

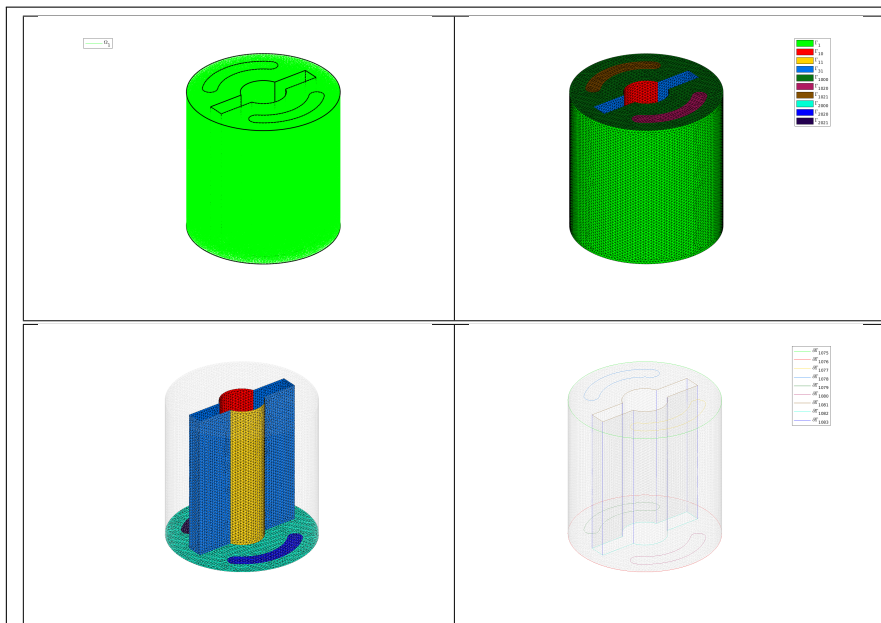
### 3.1 2D example

The following example use the `.geo` file `condenser11.geo` which is in the directory `geodir` of the toolbox ....



## 3.2 3D example

The following example use the `.geo` file `cylinderkey.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.

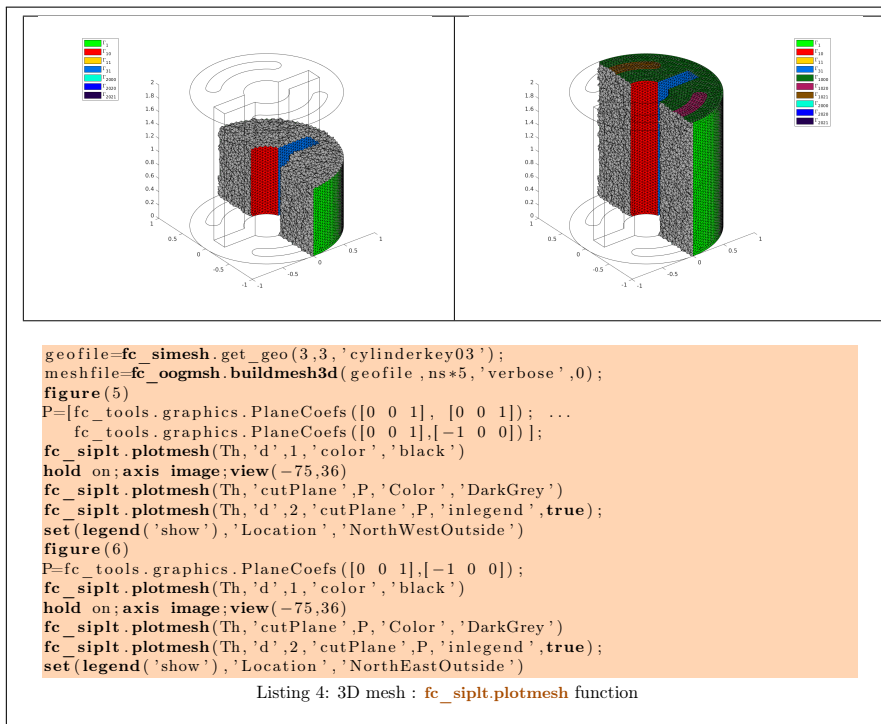


```

geofile=fc_simesh.get_geo(3,3,'cylinderkey03');
meshfile=fc_oognsh.buildmesh3d(geofile,ns*5,'verbose',0);
Th=fc_simesh.siMesh(meshfile);
figure(1)
fc_siplt.plotmesh(Th,'inlegend',true)
hold on;axis off;axis image
fc_siplt.plotmesh(Th,'d',1,'Color','k','Linewidth',1.5)
set(legend('show'),'Location','NorthWestOutside')
figure(2)
fc_siplt.plotmesh(Th,'d',2,'inlegend',true)
view(3);hold on;axis off;axis image
set(legend('show'),'Location','NorthEastOutside')
figure(3)
fc_siplt.plotmesh(Th,'d',2,'labels',[1,1000,1020,1021], 'EdgeColor','LightGray', ...
'EdgeAlpha',0.4,'FaceColor','none')
hold on;axis off;axis image
%fc_siplt.plotmesh(Th,'d',2,'labels',1000,'bounds',true,'color','k')
fc_siplt.plotmesh(Th,'d',2,'labels',[10,11,31,2000,2020,2021])
figure(4)
fc_siplt.plotmesh(Th,'d',2,'EdgeColor','LightGray', ...
'EdgeAlpha',0.4,'FaceColor','none')
hold on;axis off;axis image
fc_siplt.plotmesh(Th,'d',1,'inlegend',true)
set(legend('show'),'Location','NorthEastOutside')

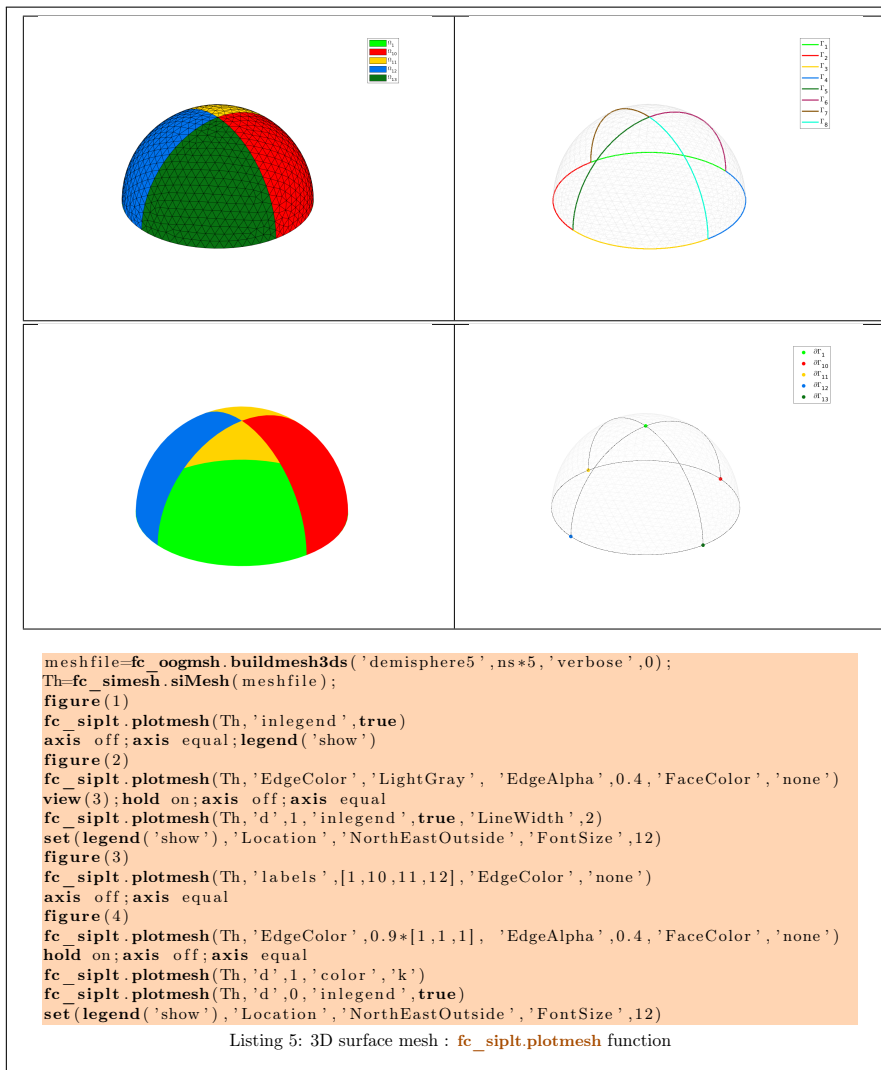
```

Listing 3: 3D plot mesh



### 3.3 3D surface example

The following example use the `.geo` file `demisphere5.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D surface mesh with simplices of dimensions 1 and 2.



## 4 `fc_siplt.plot` function

The `fc_siplt.plot` function displays scalar datas on the mesh or parts of the mesh defined by an `fc_simesh.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 `fc_simesh.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`)

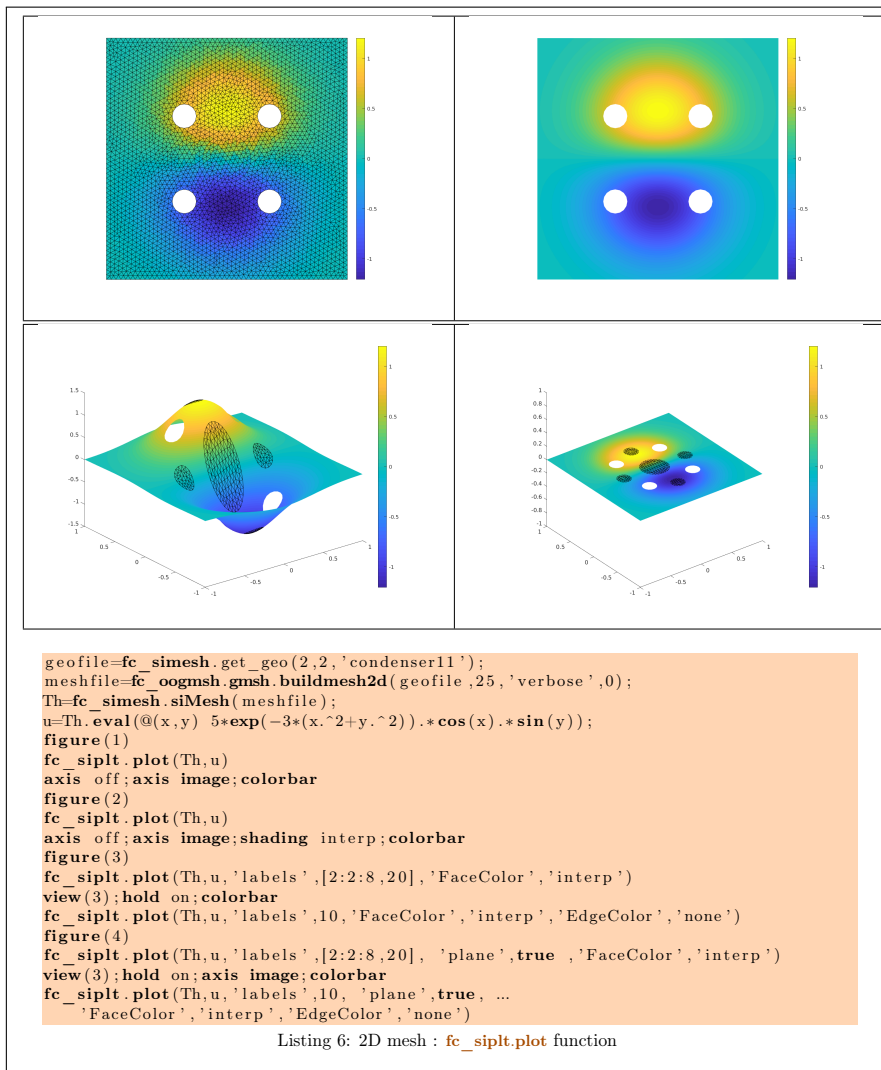
The options of second level depend on the type of elementaries mesh elements on which we want to represent datas.

One can use any option of the following functions according to the type of  $d$ -simplex.

- In dimension 3, `patch` function is used for  $d \in \llbracket 1, 3 \rrbracket$ .
- 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

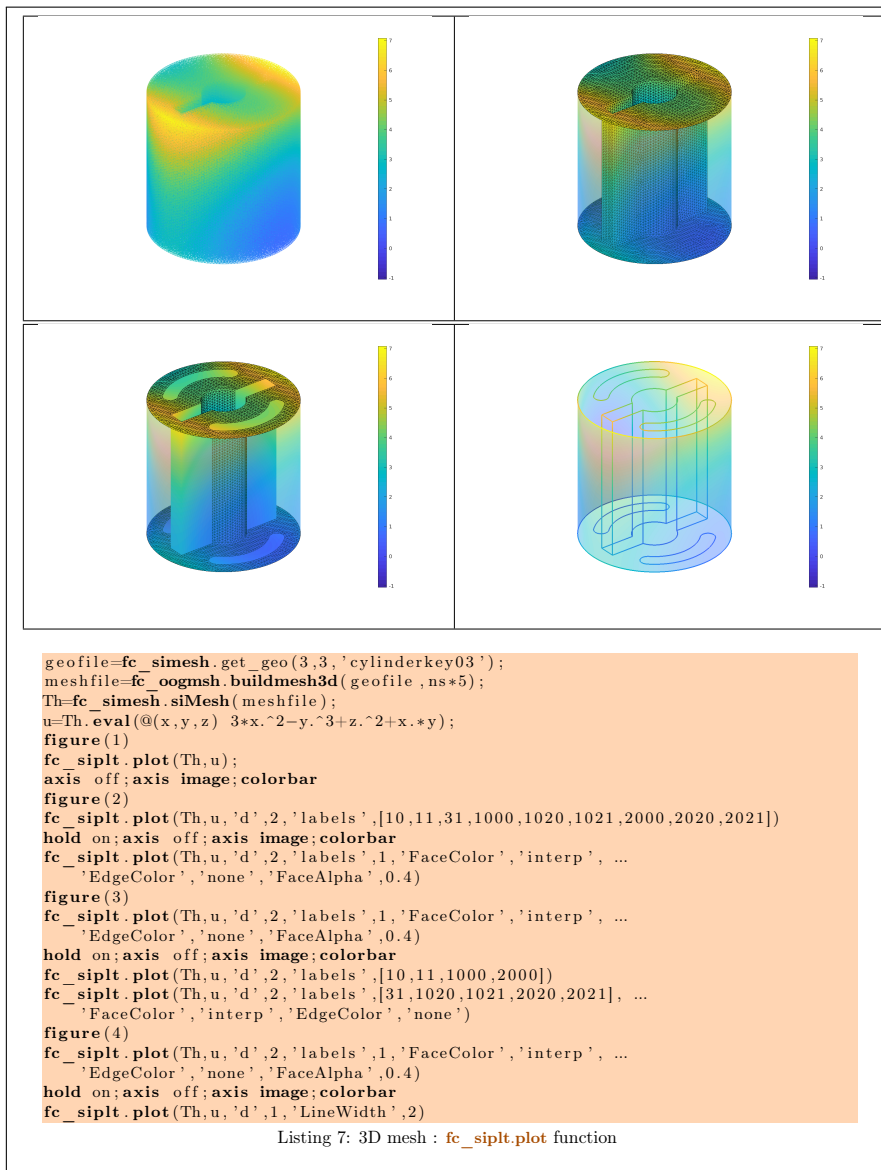
The following example use the `.geo` file `condenser11.geo` which is in the directory `geodir` of the toolbox.



## 4.2 3D example

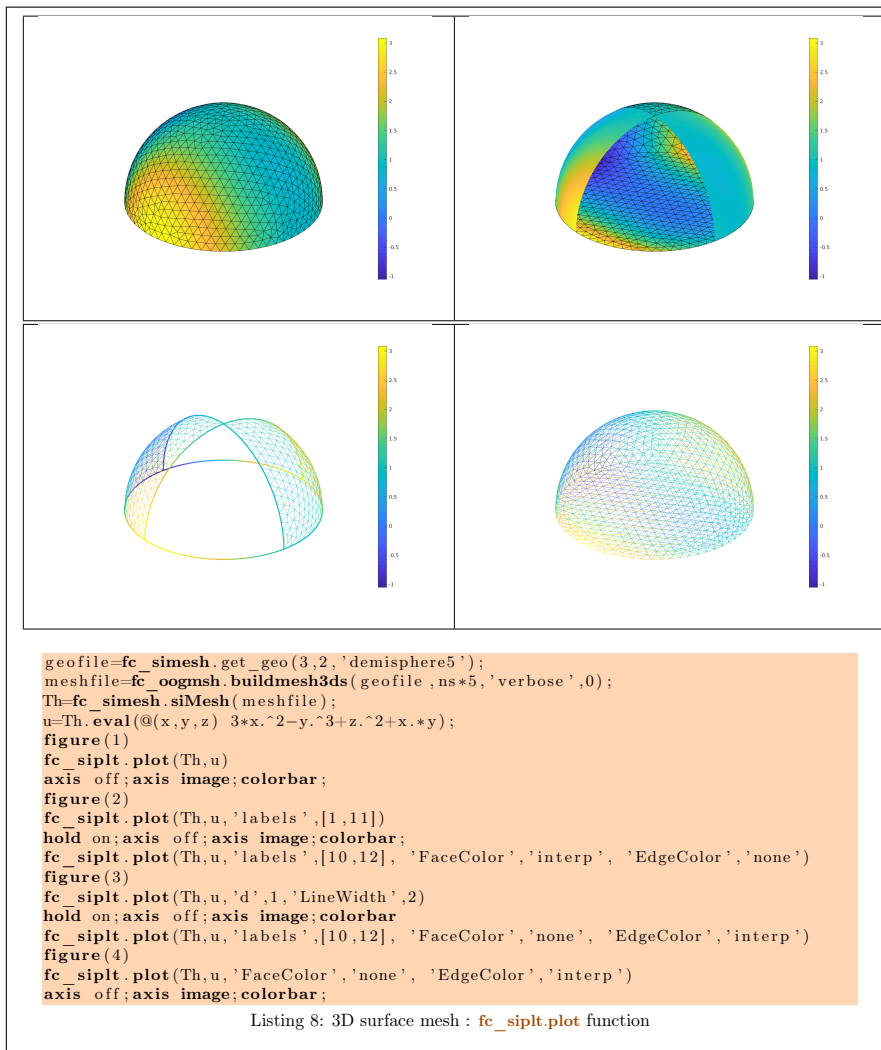
The following example use the `.geo` file `cylinderkey.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.





### 4.3 3D surface example

The following example use the `.geo` file `demisphere5.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D surface mesh with simplices of dimensions 1 and 2.



## 5 `fc_siplt.plotiso` function

The `fc_siplt.plotiso` function displays isolines from data on the mesh or parts of the mesh defined by an `fc_simesh.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 `fc_simesh.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

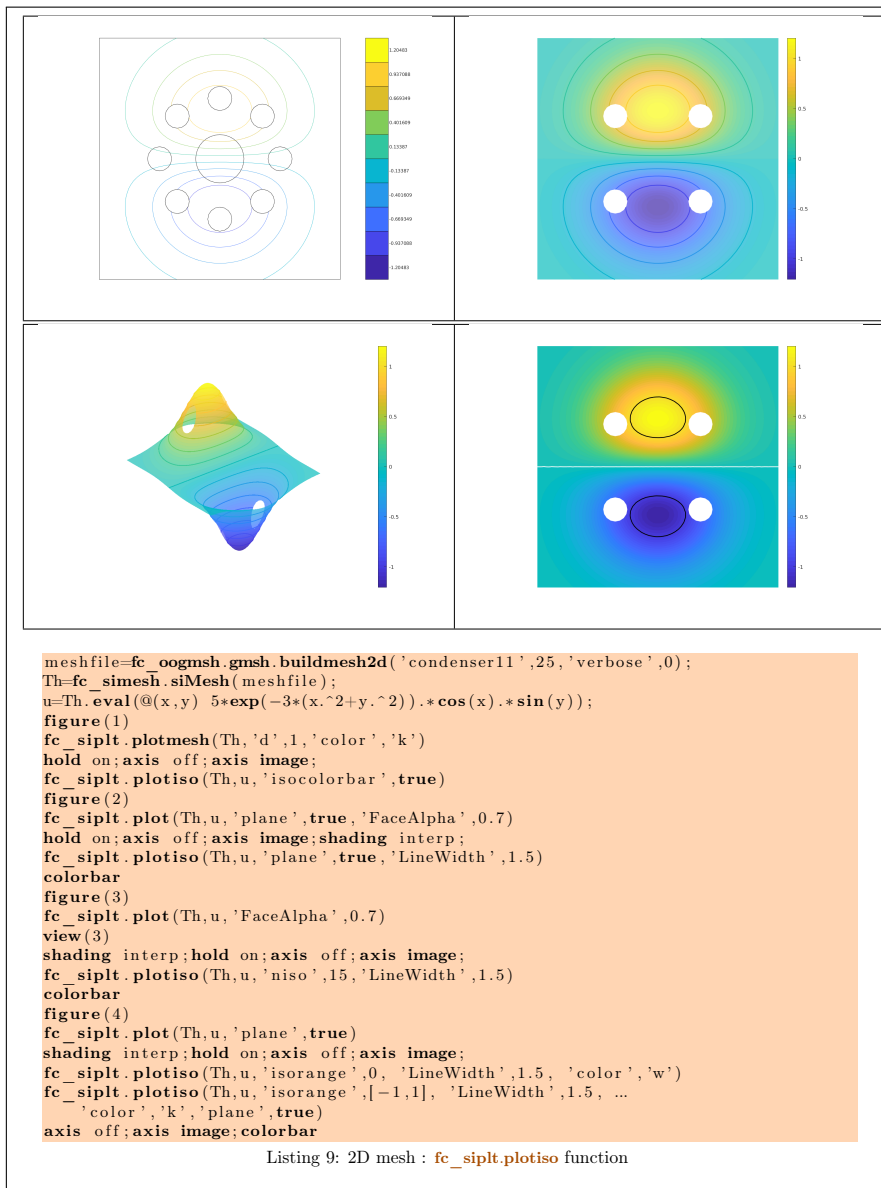
- `plot3` function in dimension 3 or in dimension 2 with `'plane'` option set to `false`
- `plot` function in 2 with `'plane'` option set to `true`

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.

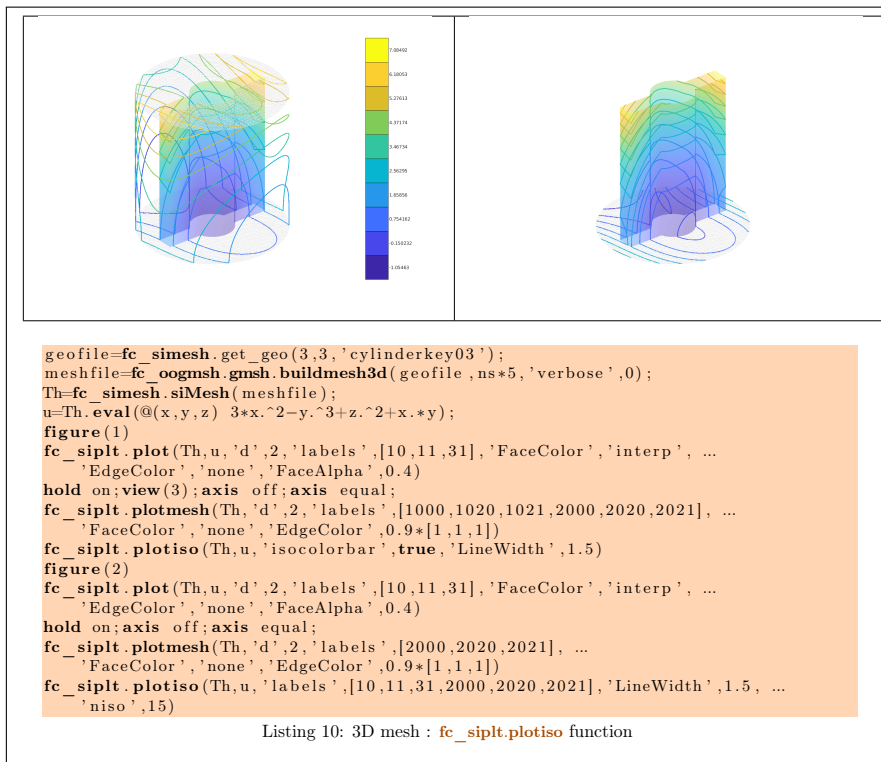
## 5.1 2D example

The following example use the `.geo` file `condenser11.geo` which is in the directory `geodir` of the toolbox.



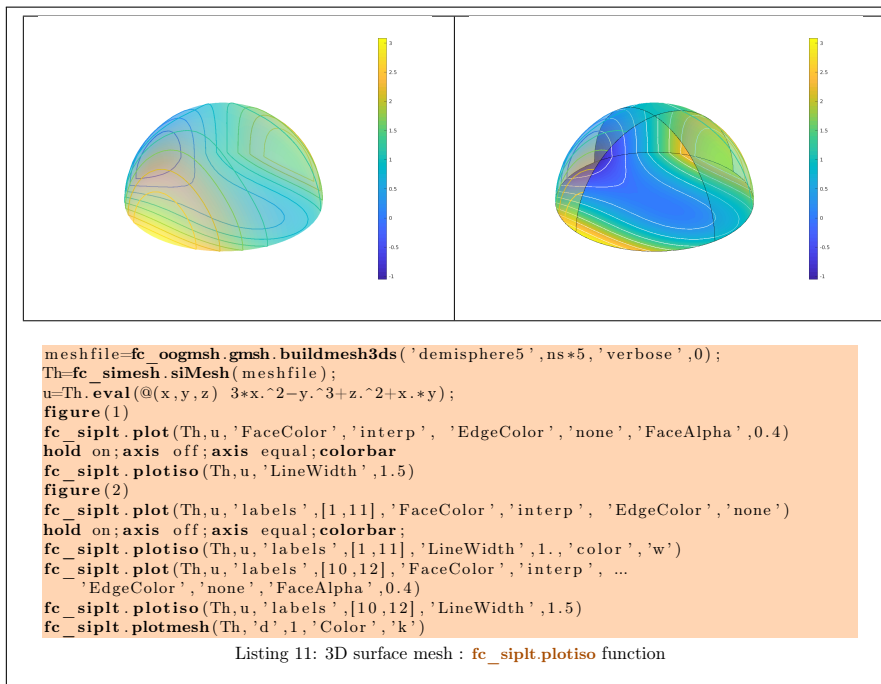
## 5.2 3D example

The following example use the `.geo` file `cylinderkey.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.



### 5.3 3D surface example

The following example use the `.geo` file `demisphere5.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D surface mesh with simplices of dimensions 1 and 2.



## 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 `fc_simesh.siMesh` object.

### Syntaxe

```

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

```

### Description

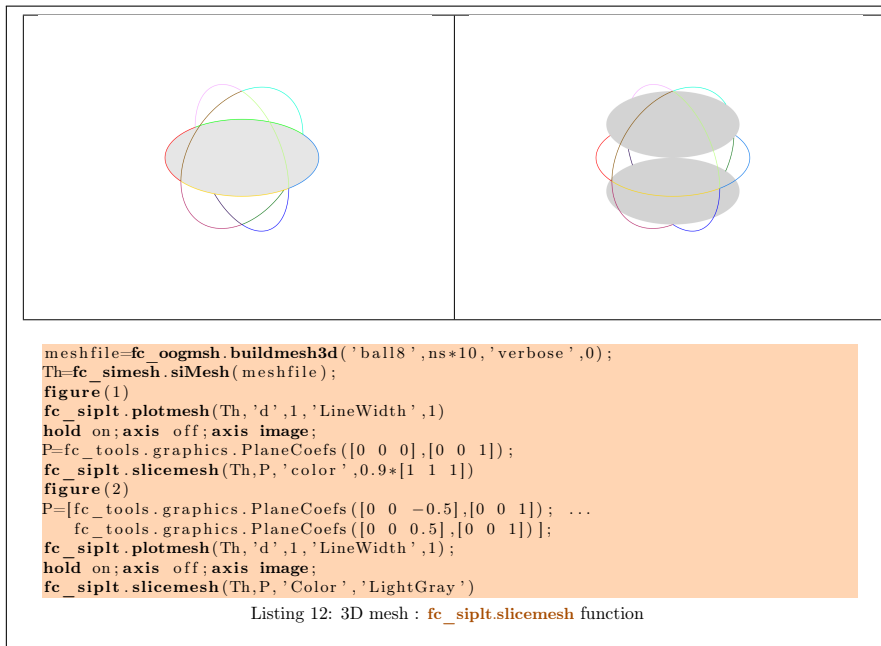
`fc_siplt.slicemesh(Th,P)` displays intersection of the plane defined by  $P(1)x + P(2)y + P(3)z + P(4) = 0$  and all the 3-dimensional simplices elements of `Th`, a `fc_simesh.siMesh` object. To compute `P` one can use the function `fc_tools.graphics.PlaneCoefs` of the `@tools` toolbox. With this function, 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 example use the *.geo* file `ball8.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.



## 7 `fc_siplt.slice` function

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

### Syntaxe

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

### Description

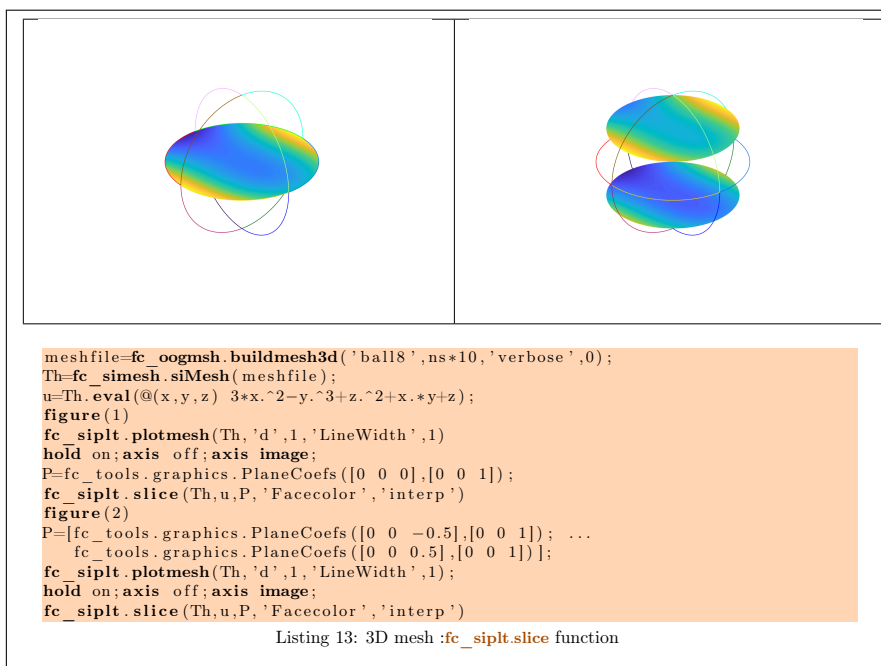
`fc_siplt.slice(Th,u,P)` displays `u` data on the intersection of the plane defined by  $P(1)x + P(2)y + P(3)z + P(4) = 0$  and all the 3-dimensional simplices elements of `Th`, a `fc_simesh.siMesh` object. The data `u` is an 1D-array of size `Th.nq` or `Th.nqGlobal` or `Th.nqParent`. To compute `P` one can use the function `fc_tools.graphics.PlaneCoefs` of the `tools` toolbox. 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 example use the `.geo` file `ball8.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.



## 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 `fc_simesh.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 `fc_simesh.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** toolbox. 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'`.

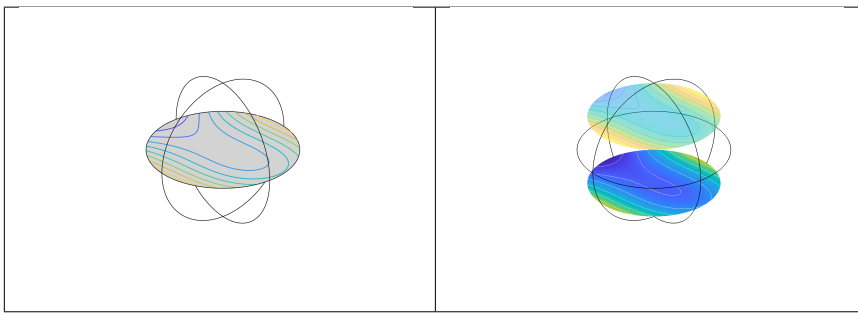
For key strings, one could also used any options of the `plot3` function.

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 example use the `.geo` file `ball18.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.



```

meshfile=fc_oogmsh.buildmesh3d('ball18',ns*10,'verbose',0);
Th=fc_simesh.siMesh(meshfile);
u=Th.eval(@(x,y,z) 3*x.^2-y.^3+z.^2+x.*y+z);
figure(1)
fc_siplt.plotmesh(Th,'d',1,'LineWidth',1,'color','k')
hold on;axis off;axis image;
P=fc_tools.graphics.PlaneCoefs([0 0 0],[0 0 1]);
fc_siplt.slicemesh(Th,P)
fc_siplt.sliceiso(Th,u,P,'LineWidth',1.5)
figure(2)
fc_siplt.plotmesh(Th,'d',1,'LineWidth',1,'color','k')
hold on;axis off;axis image;
P2=fc_tools.graphics.PlaneCoefs([0 0 -0.5],[0 0 1]);
fc_siplt.slice(Th,u,P2)
fc_siplt.sliceiso(Th,u,P2,'color','w')
P3=fc_tools.graphics.PlaneCoefs([0 0 0.5],[0 0 1]);
fc_siplt.slice(Th,u,P3,'FaceAlpha',0.5)
fc_siplt.sliceiso(Th,u,P3,'niso',15)

```

Listing 14: 3D mesh :`fc_siplt.sliceiso` function

## 9 `fc_siplt.plotquiver` function

The `fc_siplt.plotquiver` function displays vector field data on the mesh or parts of the mesh defined by an `fc_simesh.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

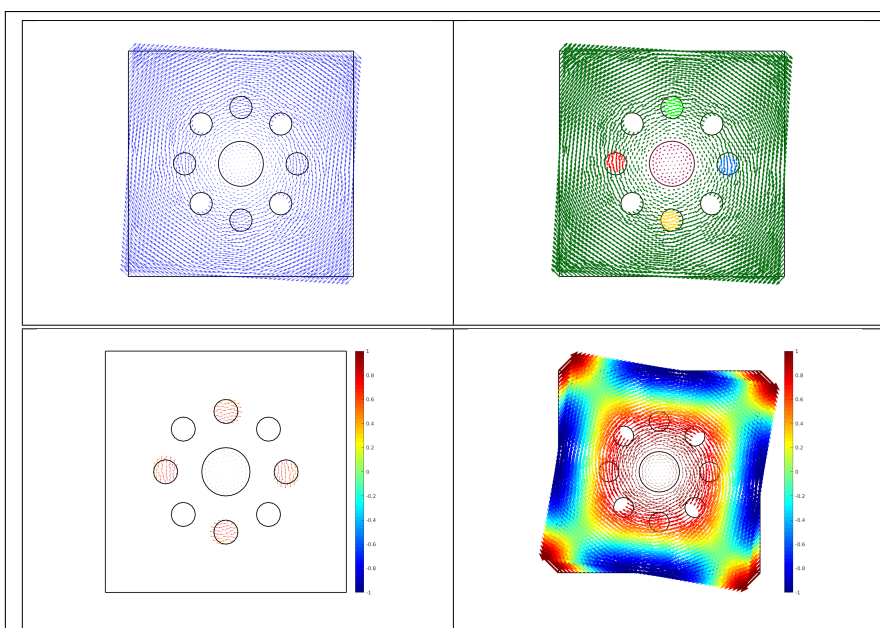
- `'labels'` : to select the labels of the elements to display data,
- `'freq'` : quiver frequencie, (default : 1)
- `'scale'` : quiver scale, (default : ...)
- `'colordata'` : set colors on each quiver (default : empty).

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 example use the `.geo` file `condenser11.geo`.



```

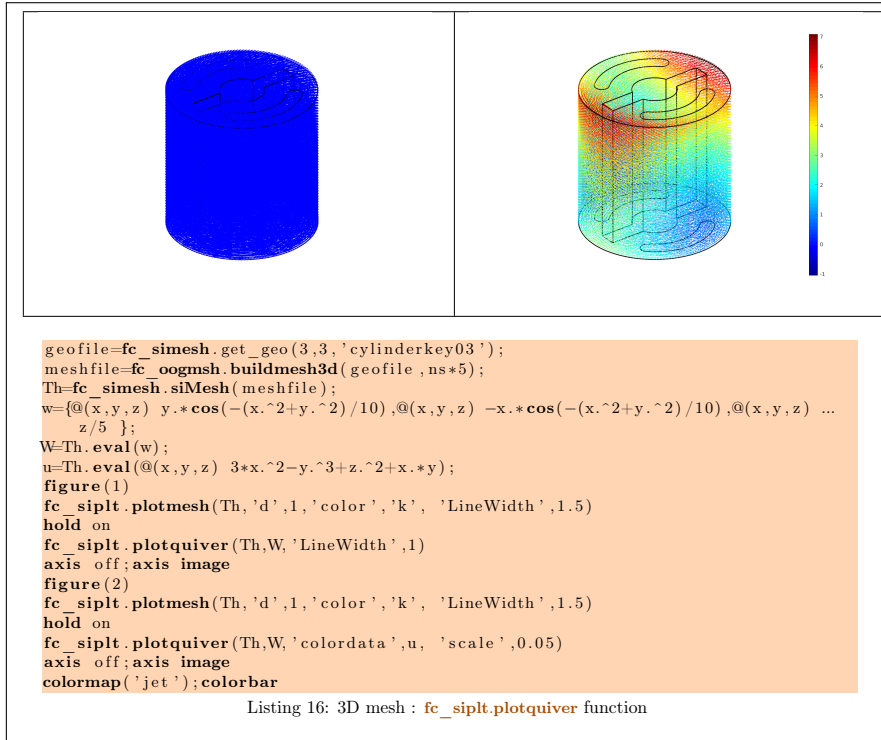
geofile=fc_simesh.get_geo(2,2,'condenser11');
meshfile=fc_oogmsh.buildmesh2d(geofile,25,'verbose',0);
Th=fc_simesh.siMesh(meshfile);
u=@(x,y) cos(pi*x.^2).*cos(pi*y.^2);
U=Th.eval(u);
w=@(x,y) y.*cos(-(x.^2+y.^2)/10),@(x,y) -x.*cos(-(x.^2+y.^2)/10);
W=Th.eval(w);
figure(1)
fc_siplt.plotmesh(Th,'d',1,'color','k','LineWidth',1.5)
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)
colormap('jet');colorbar

```

Listing 15: 2D mesh : `fc_siplt.plotquiver` function

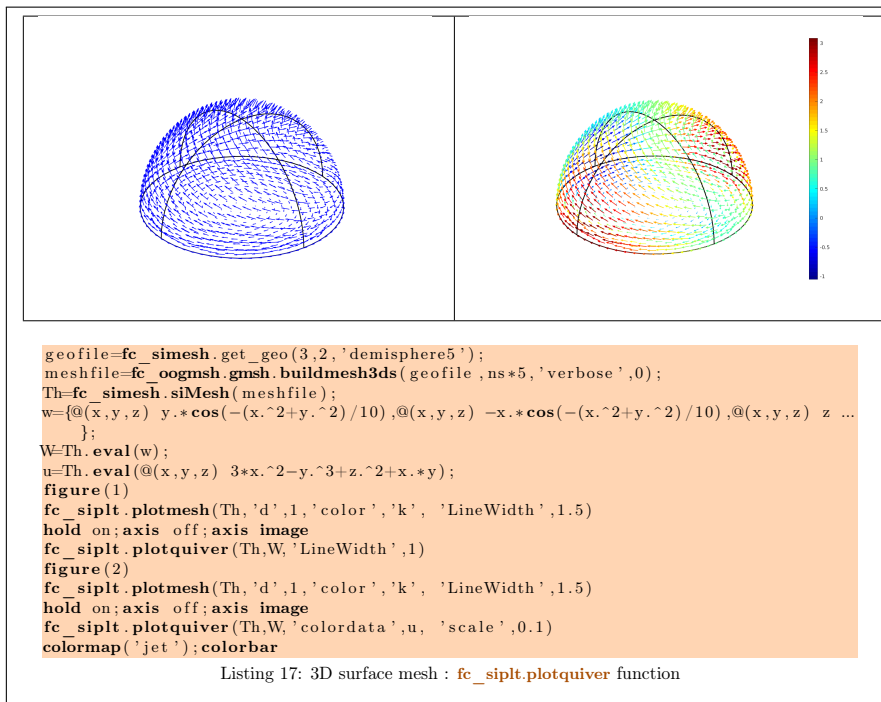
## 9.2 3D example

The following example use the *.geo* file `cylinderkey03.geo`. This file contains description of a 3D mesh with simplices of dimensions 1, 2 and 3.



## 9.3 3D surface example

The following example use the *.geo* file `demisphere5.geo` which is in the directory `geodir` of the toolbox. This file contains description of a 3D surface mesh with simplices of dimensions 1 and 2.



# Appendices

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## B References

- [1] F. Cuvelier. `fc_graphics4mesh`: a Matlab toolbox 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 Matlab toolbox 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 Matlab toolbox

git informations on the toolboxes used to build this manual

```
-----  
name : fc-siplt  
tag : 0.2.1  
commit : ab3aa2d1994def0e64eef5de3fb0a21f1337ff01  
date : 2020-03-08  
time : 08-15-24  
status : 0  
-----  
name : fc-tools  
tag : 0.0.31  
commit : 3a25f08630ff69e7f8ef4ab451671e454c492e36  
date : 2020-02-23  
time : 11-27-44  
status : 0  
-----  
name : fc-bench  
tag : 0.1.2  
commit : 666dc60d1277f5fa9c99dee4ae1c33270f22c57d  
date : 2020-02-16  
time : 06-38-46  
status : 0  
-----  
name : fc-hypermesh  
tag : 1.0.3  
commit : c520b34cfd7eb0dbf9e4ecd459fd7162db73cc58  
date : 2020-02-16  
time : 08-34-19  
status : 0  
-----  
name : fc-amat  
tag : 0.1.2  
commit : 957340f6e71d805dbd8b9d04c434b24fd3f92591  
date : 2020-02-16  
time : 06-39-42  
status : 0  
-----  
name : fc-meshtools  
tag : 0.1.3  
commit : cdbc41bc98af4e4facc1746024aced1f21aae53  
date : 2020-02-17  
time : 10-52-56  
status : 0  
-----  
name : fc-graphics4mesh  
tag : 0.1.2  
commit : e922041e090275b69207ed6d4fb52df06f5e3fba  
date : 2020-03-07  
time : 16-09-48  
status : 0  
-----  
name : fc-oogmsh  
tag : 0.2.3  
commit : 614c8154b265a17a6dd31e328100974ea7e9e0bc  
date : 2020-03-06  
time : 05-19-37  
status : 0  
-----  
name : fc-simesh  
tag : 0.4.1  
commit : 6a226cf06d42c576ab67fe23a2cb0d5e700effae  
date : 2020-03-08  
time : 07-13-43  
status : 0  
-----
```

git informations on the L<sup>A</sup>T<sub>E</sub>X package used to build this manual

```
-----  
name : fctools  
tag :  
commit : 57968c4a96c2593cccc9da9efd3e52b2ff012cb5  
date : 2020-02-07  
time : 06:41:09  
status : 1  
-----
```

Using the remote configuration repository:

```
url      ssh://lagagit/MCS/Cuvelier/Matlab/fc-config  
commit  81d0561dcc0535351928c138132cebb80deef3d
```