# Documentation of the fc-oogmsh Matlab toolbox version 0.0.8*

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**Abstract**

This Matlab toolbox make it possible to generate mesh files from *.geo* file by using `gmsh`. It's also possible with the ooGmsh class to read the mesh file and to store its contains in more user-friendly form.

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# 1 gmsh interface

`gmsh`is a three-dimensional finite element mesh generator with built-in pre- and post-processing facilities. It can also build two-dimensional meshes and three-dimensional surface meshes.

The source code and various pre-compiled versions of Gmsh (for Windows, Mac and Unix) can be downloaded from `http://gmsh.info`.

All the functions provided in this section use `gmsh` to create a mesh file from a `gmsh` geometry script file (extension *.geo*) which the object. . To read the mesh file, one can used `ooMesh` constructor or `ooMeshDD` constructor for a

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partitioned mesh. Some gmsh geometry script samples are given in directory geodir of the mooMesh toolbox.

In a first step we quickly present the installation of gmsh on Linux (for Windows and Mac OS X precompiled software are also provided on http://gmsh.info). Then, we explain how to configure the mooMesh toolbox for using gmsh. Finaly, we describe the mooMesh's functions which use gmsh to create mesh files.

## 1.1 gmsh installation (Linux 64bit)

```
mkdir -p ~/software/GMSH
cd ~/software/GMSH
wget http://gmsh.info/bin/Linux/gmsh-svn-Linux64.tgz
tar zxvf gmsh-svn-Linux64.tgz
```

To run gmsh we can used the following command in a terminal

```
~/software/GMSH/gmsh-2.12.1-svn-Linux/bin/gmsh &
```

## 1.2 Configuration in mooMesh toolbox

We must configure the toolbox for access to

- gmsh binary,
- geo files directory,
- msh files directory.

For that, under Matlab and in mooMesh toolbox directory, we do :

Command Window

```
>> InitmooMesh
>> mooMesh.configure
Configuration of mooMesh toolbox
  -> Computer : hercule
  -> User     : cuvelier
1) Select gmsh binary ...
2) Select <geo> files directory ...
3) Select <msh> files directory ...
Write in /home/cuvelier/Travail/Recherch/CJS/VISUMESH/mooMesh/environment_hercule_cuvelier.m
  ...
  -> done
>>
```

## 1.3 function gmsh.buildmesh2d

This function uses gmsh and a *.geo* file (describing a 2D-geometry) to generate a 2D-mesh.

**Syntaxe**

```
meshfile=gmsh.buildmesh2d(geofile,N)
```

```
meshfile=gmsh.buildmesh2d(geofile,N,Name,Value)
```

### Description

meshfile=gmsh.buildmesh2d(geofile,N) create a 2D-mesh using `gmsh` and the *geo* file geofile (without path). The integer N has two functions : numbering the name of the generated mesh as <geofile without extension and path> + <-N.msh> and passing this number to `gmsh` via the option "-setnumber N <N>". Usually we used this parameter in `gmsh` to set the prescribed mesh element size at the points. (see given *geo* files)
As output return a file name (with full path) corresponding to the mesh generated by `gmsh`.

meshfile=gmsh.buildmesh2d(geofile,N,Name,Value, ...) specifies function options using one or more Name,Value pair arguments. The Name options can be

- `'geodir'` : to specify the directory of the *geo* file geofile ,
- `'meshdir'` : to specify the directory where the mesh file will be written,
- `'meshfile'` : to specify the name of the mesh file (with path and `.msh` extension),
- `'check'` : to perform various consistency checks on mesh with `gmsh`, if Value is true. (default : false)
- `'force'` : to force meshing even if the mesh file already exists if Value is true (default : false)
- `'verbose'` : to specify the degree of verbosity ( 0, silence; 2, default; ...)
- `'strings'` : cells array of strings corresponding to `gmsh` options given with `-string "..."` (default empty) (see `gmsh` documentation)

**Examples** All the following examples use the *.geo* file `condenser11.geo` which is in the directory `geodir` of the toolbox.

Matlab commands with output

```
disp('**** gmsh.buildmesh2d : 1st call')
meshfile=gmsh.buildmesh2d('condenser11',25,'force',true);
disp('**** gmsh.buildmesh2d : 2nd call')
meshfile=gmsh.buildmesh2d('condenser11',25);
```

```
**** gmsh.buildmesh2d : 1st call
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo
[ooGmsh] Overwritting mesh file /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh
[ooGmsh] Starting building mesh /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh with gmsh 2.13.2
[ooGmsh] Using command : /usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -setnumber N 25 ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo -o ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh
 Be patient...
**** gmsh.buildmesh2d : 2nd call
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo
[ooGmsh] Mesh file /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh already exists.
  -> Use "force" flag to rebuild if needed.
```

Matlab commands with output

```
meshfile=gmsh.buildmesh2d('condenser11',25,'force',true, ...
    'verbose',4, 'strings',{'Mesh.Algorithm=1;', ...
    'Mesh.ScalingFactor=2;'});
```

```
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo
[ooGmsh] Overwritting mesh file /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh
[ooGmsh] Starting building mesh /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh with gmsh 2.13.2
[ooGmsh] Using command : /usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -setnumber N 25 -string ...
       "Mesh.Algorithm=1;Mesh.ScalingFactor=2;" /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo ...
       -o /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh
 Be patient...
[ooGmsh] gmsh output :
Info    : Running '/usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -setnumber N 25 -string ...
       Mesh.Algorithm=1;Mesh.ScalingFactor=2; /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo -o ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh' [Gmsh 2.13.2, 1 node, max. 1 thread]
Info    : Started on Thu Dec 15 15:11:53 2016
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo'...
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/options01_data.geo'...
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/options01_data.geo'
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/shape_functions.geo'...
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/shape_functions.geo'
Info    : Removing duplicate mesh vertices...
Info    : Found 0 duplicate vertices
Info    : No duplicate vertices found
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/condenser11.geo'
Info    : Finalized high order topology of periodic connections
Info    : Meshing 1D...
Info    : Meshing curve 101 (Line)
Info    : Meshing curve 102 (Line)
Info    : Meshing curve 103 (Line)
Info    : Meshing curve 104 (Line)
Info    : Meshing curve 106 (Circle)
Info    : Meshing curve 107 (Circle)
Info    : Meshing curve 108 (Circle)
Info    : Meshing curve 109 (Circle)
Info    : Meshing curve 111 (Circle)
Info    : Meshing curve 112 (Circle)
Info    : Meshing curve 113 (Circle)
Info    : Meshing curve 114 (Circle)
Info    : Meshing curve 116 (Circle)
Info    : Meshing curve 117 (Circle)
Info    : Meshing curve 118 (Circle)
Info    : Meshing curve 119 (Circle)
Info    : Meshing curve 121 (Circle)
Info    : Meshing curve 122 (Circle)
Info    : Meshing curve 123 (Circle)
Info    : Meshing curve 124 (Circle)
Info    : Meshing curve 126 (Circle)
Info    : Meshing curve 127 (Circle)
Info    : Meshing curve 128 (Circle)
Info    : Meshing curve 129 (Circle)
Info    : Meshing curve 131 (Circle)
Info    : Meshing curve 132 (Circle)
Info    : Meshing curve 133 (Circle)
Info    : Meshing curve 134 (Circle)
Info    : Meshing curve 136 (Circle)
Info    : Meshing curve 137 (Circle)
Info    : Meshing curve 138 (Circle)
Info    : Meshing curve 139 (Circle)
Info    : Meshing curve 141 (Circle)
Info    : Meshing curve 142 (Circle)
Info    : Meshing curve 143 (Circle)
Info    : Meshing curve 144 (Circle)
Info    : Meshing curve 146 (Circle)
Info    : Meshing curve 147 (Circle)
Info    : Meshing curve 148 (Circle)
Info    : Meshing curve 149 (Circle)
Info    : Done meshing 1D (0.008505 s)
Info    : Meshing 2D...
Info    : Meshing surface 105 (Plane, MeshAdapt)
Info    : Meshing surface 110 (Plane, MeshAdapt)
Info    : Meshing surface 120 (Plane, MeshAdapt)
Info    : Meshing surface 130 (Plane, MeshAdapt)
Info    : Meshing surface 140 (Plane, MeshAdapt)
Info    : Meshing surface 150 (Plane, MeshAdapt)
Info    : Done meshing 2D (0.35282 s)
Info    : 2999 vertices 6131 elements
Info    : Writing '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh'...
Info    : Done writing '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh'
Info    : Stopped on Thu Dec 15 15:11:54 2016
```

## 1.4 function gmsh.buildmesh3d

This function uses `gmsh` and a *.geo* file (describing a 3D-geometry) to generate a 3D-mesh. See function `gmsh.buildmesh2d` for usage and options.

## 1.5 function gmsh.buildmesh3ds

This function uses `gmsh` and a *.geo* file (describing a 3D surface geometry or a 3D-geometry) to generate a 3D surface mesh. See function `gmsh.buildmesh2d` for usage and options.

## 1.6 function gmsh.buildpartmesh2d

This function uses `gmsh` and a *.msh* file (containing of a 2D-mesh) to generate a 2D partioned mesh.

### Syntaxe

```
partmeshfile=gmsh.buildpartmesh2d(meshfile,np)

partmeshfile=gmsh.buildpartmesh2d(meshfile,np,Name,Value)
```

### Description

partmeshfile=gmsh.buildpartmesh2d(meshfile,np) create a 2D partitioned mesh using `gmsh` and the *msh* file meshfile (with path). The integer np is the number of partitions.
As output return a file name (with full path) corresponding to the partitioned mesh generated by `gmsh`. The output file name is construct as following : <meshfile without extension>-part<np>.msh

partmeshfile=gmsh.buildpartmesh2d(meshfile,np,Name,Value, ...) specifies function options using one or more Name,Value pair arguments. The Name options can be

- `'savedir'` : to specify the directory where the partitioned mesh file will be written,
- `'check'` : to perform various consistency checks on mesh with `gmsh`, if Value is true. (default : false)
- `'force'` : to force meshing even if the mesh file already exists if Value is true (default : false)
- `'verbose'` : to specify the degree of verbosity ( 0, silence; 2, default; ...)
- `'strings'` : cells array of strings corresponding to `gmsh` options given with `-string "..."` (default empty) (see `gmsh` documentation)

**Examples** All the following examples use the `meshfile` as output of the command :
meshfile=gmsh.buildmesh2d('condenser11',25);

Matlab commands with output

```
meshfile=gmsh.buildmesh2d('condenser11',25,'verbose',0);
pmfile=gmsh.buildpartmesh2d(meshfile,5,'force',true);
```

```
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh
[ooGmsh] Overwritting mesh file /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh
[ooGmsh] Starting building mesh /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh with ...
       gmsh 2.13.2
[ooGmsh] Using command : /usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -saveall -part 5 ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh -o ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh
 Be patient...
```

Matlab commands with output

```
meshfile=gmsh.buildmesh2d('condenser11',25,'verbose',0);
pmfile=gmsh.buildpartmesh2d(meshfile,5,'force',true, ...
     'verbose',4, 'strings',{'Mesh.Partitioner=2;', ...
     'Mesh.MetisAlgorithm=3;'});
```

```
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh
[ooGmsh] Overwritting mesh file /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh
[ooGmsh] Starting building mesh /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh with ...
       gmsh 2.13.2
[ooGmsh] Using command : /usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -saveall -part 5 -string ...
       "Mesh.Partitioner=2;Mesh.MetisAlgorithm=3;" ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh -o ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh
 Be patient...
[ooGmsh] gmsh output :
Info    : Running '/usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -saveall -part 5 -string ...
       Mesh.Partitioner=2;Mesh.MetisAlgorithm=3; ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh -o ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh' [Gmsh 2.13.2, 1 node, max. 1 ...
       thread]
Info    : Started on Thu Dec 15 15:12:08 2016
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh'...
Info    : 2990 vertices
Info    : 6082 elements
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25.msh'
Info    : Finalized high order topology of periodic connections
Info    : Meshing 1D...
Info    : Done meshing 1D (2.4e-05 s)
Info    : Meshing 2D...
Info    : Done meshing 2D (1.78814e-05 s)
Info    : 2990 vertices 6082 elements
Info    : Building graph...
Info    : Partitioning graph...
Info    : Launching METIS graph partitioner
METIS with weights
Info    : Number of Edges Cut : 128
Info    : Done partitioning graph
Info    : Writing '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh'...
Info    : Done writing '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/condenser11-25-part5.msh'
Info    : Stopped on Thu Dec 15 15:12:08 2016
```

## 1.7 function gmsh.buildpartmesh3d

This function uses `gmsh` and a *.msh* file (containing of a 3D-mesh) to generate a 3D partioned mesh.

## 1.8 function gmsh.buildpartmesh3ds

This function uses `gmsh` and a *.msh* file (containing of a 3D surface mesh) to generate a 3D partioned surface mesh.

## 1.9 function gmsh.buildPartRectangle

This function uses `gmsh` and the *geodir/rectanglepart.geo* file to generate a 2D regular partioned mesh of the rectangle $[0, Lx] \times [0, Ly]$ with $Nx \times Ny$ partitions.

### Syntaxe

```
meshfile=gmsh.buildpartrectangle(Lx,Ly,Nx,Ny,N)

meshfile=gmsh.buildpartrectangle(Lx,Ly,Nx,Ny,N, ...
    Name,Value)
```

### Description

`meshfile=gmsh.buildpartrectangle(Lx,Ly,Nx,Ny,N)` create a 2D regular partitioned mesh using `gmsh` of the rectangle $[0, Lx] \times [0, Ly]$ with $Nx \times Ny$ partitions. The N parameter is passed to `gmsh` to set the prescribed mesh element size at the points
As output return a file name (with full path) corresponding to the partitioned mesh generated by `gmsh`. The default output file name is construct as following : rectanglepart-Lx%.3f-Ly%.3f-Nx%d-Ny%d-N%d.msh

`meshfile=gmsh.buildpartrectangle(Lx,Ly,Nx,Ny,N,Name,Value, ...)` specifies function options using one or more Name,Value pair arguments. The Name options can be

- `'meshdir'` : to specify the directory where the partitioned mesh file will be written,
- `'meshfile'` : to specify the mesh file name with .msh extension. Without path, the file is written in <meshdir> directory.
- `'check'` : to perform various consistency checks on mesh with `gmsh`, if Value is true. (default : false)
- `'force'` : to force meshing even if the mesh file already exists if Value is true (default : false)
- `'verbose'` : to specify the degree of verbosity ( 0, silence; 2, default; ...)
- `'strings'` : cells array of strings corresponding to `gmsh` options given with `-string "..."` (default empty) (see `gmsh` documentation)

**Examples** All the following examples ...

Matlab commands with output

```
pmfile=gmsh.buildpartrectangle(1,1,3,2,100,'force',true);
```

```
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo
[ooGmsh] Overwritting mesh file ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/rectanglepart-Lx1.000-Ly1.000-Nx3-Ny2-N100.msh
[ooGmsh] Starting building mesh ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/rectanglepart-Lx1.000-Ly1.000-Nx3-Ny2-N100.msh with gmsh ...
       2.13.2
[ooGmsh] Using command : /usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -setnumber N 100 -setnumber NX 3 -setnumber NY ...
       2 -setnumber LX 1 -setnumber LY 1 /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo -o ...
       /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/meshes/rectanglepart-Lx1.000-Ly1.000-Nx3-Ny2-N100.msh
 Be patient...
```

Matlab commands with output

```
pmfile=gmsh.buildpartrectangle(1,1,3,2,100,'verbose',4, ...
    'force',true,'meshfile','./toto.msh');;
```

```
[ooGmsh] Input file : /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo
[ooGmsh] Overwritting mesh file ./toto.msh
[ooGmsh] Starting building mesh ./toto.msh with gmsh 2.13.2
[ooGmsh] Using command : /usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -setnumber N 100 -setnumber NX 3 -setnumber NY ...
       2 -setnumber LX 1 -setnumber LY 1 /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo -o ...
       ./toto.msh
 Be patient...
[ooGmsh] gmsh output :
Info    : Running '/usr/local/GMSH/gmsh-2.13.2-Linux/bin//gmsh -2 -setnumber N 100 -setnumber NX 3 -setnumber NY 2 ...
       -setnumber LX 1 -setnumber LY 1 /home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo -o ...
       ./toto.msh' [Gmsh 2.13.2, 1 node, max. 1 thread]
Info    : Started on Thu Dec 15 15:12:22 2016
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo'...
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/partitions01_data.geo'...
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/partitions01_data.geo'
Info    : Reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/partitions_shape.geo'...
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/partitions_shape.geo'
Info    : Done reading '/home/cuvelier/Travail/Recherch/Matlab/mooGmsh/geodir/rectanglepart.geo'
Info    : Finalized high order topology of periodic connections
Info    : Meshing 1D...
Info    : Meshing curve 1 (Line)
Info    : Meshing curve 2 (Line)
Info    : Meshing curve 3 (Line)
Info    : Meshing curve 4 (Line)
Info    : Meshing curve 5 (Line)
Info    : Meshing curve 6 (Line)
Info    : Meshing curve 7 (Line)
Info    : Meshing curve 8 (Line)
Info    : Meshing curve 9 (Line)
Info    : Meshing curve 10 (Line)
Info    : Meshing curve 11 (Line)
Info    : Meshing curve 12 (Line)
Info    : Meshing curve 13 (Line)
Info    : Meshing curve 14 (Line)
Info    : Meshing curve 15 (Line)
Info    : Meshing curve 16 (Line)
Info    : Meshing curve 17 (Line)
Info    : Done meshing 1D (0.001523 s)
Info    : Meshing 2D...
Info    : Meshing surface 19 (Plane, Delaunay)
Info    : Meshing surface 21 (Plane, Delaunay)
Info    : Meshing surface 23 (Plane, Delaunay)
Info    : Meshing surface 25 (Plane, Delaunay)
Info    : Meshing surface 27 (Plane, Delaunay)
Info    : Meshing surface 29 (Plane, Delaunay)
Info    : Done meshing 2D (0.484035 s)
Info    : 13685 vertices 27682 elements
Info    : Writing './toto.msh'...
Info    : Done writing './toto.msh'
Info    : Stopped on Thu Dec 15 15:12:22 2016
```

# 2 ooGmsh class

The `ooGmsh` class can be used to read `gmsh` mesh files with the MSH ASCII file format described for example in [1], section 9.1.

### Properties of `ooGmsh` class

| | | |
|---|---|---|
| dim | : | integer<br>space dimension |
| $n_q$ | : | integer<br>number of vertices/nodes |
| q | : | dim-by-$n_q$ array of reals<br>array of vertex coordinates |
| types | : | array of integers<br>List of the element types found in the mesh file. |
| orders | : | array of integers<br>List of the orders of the element types found in the mesh file. |
| sElts | : | array of `Elmt` structure<br>One `Elmt` structure by element type, such that sElts($i$) contains all the elements of type types($i$) and order orders($i$). |

### Fields of `Elmt` structure

| | | |
|---|---|---|
| type | : | integer<br>refers to the type of the element : 1 for 2-node line, 2 for 3-node triangle, ... See the *elm-type* description of [1], section 9.1. |
| geo | : | string<br>contains the kind of geometry: 'line', 'triangle', 'tetrahedron', ... |
| $d$ | : | integer<br>space dimension or $d$-simplex. |
| order | : | integer<br>order of the element |
| $n_{me}$ | : | integer<br>number of mesh elements |
| me | : | array of $d+1$-by-$n_{me}$ integers<br>connectivity array |
| phys_lab | : | array of $n_{me}$-by-... integers<br>physical labels of the elements |
| geo_lab | : | array of $n_{me}$-by-... integers<br>geometrical labels of the elements |
| nb_parts | : | array of $n_{me}$-by-1 integers<br>number of mesh partitions to which the element belongs |
| part_lab | : | array of $n_{me}$-by-max(nb_parts) integers<br>part_lab($i$, 1 : nb_parts($i$)) contains all the partitions index to which the $i$-th element belongs. |

The `ooGmsh` class have only one constructor :

```
Gh=ooGmsh(meshfile)
```

where meshfile is the name of ... a mesh file

Matlab commands with output

```
meshfile=gmsh.buildmesh2d('condenser',25,'verbose',0);
Gh=ooGmsh(meshfile)
```

```
Gh =

  ooGmsh with properties:
                 q: [2x55670 double]
               dim: 2 double
                nq: 55670 double
             sElts: [2x1 struct]
          toGlobal: [1x55670 double]
    partitionnedfile: 0 logical
            orders: 1 double
             types: [1x2 int32]
```

## References

[1] Gmsh 2.15.0. http://gmsh.info, 2016.