# Tutorial 31: Importing 3D Medical DICOM Image Data and converting into 3D Solids

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## Complete List of all Tutorials with Publishable MATLAB Files of this Solid-Geoemtries Toolbox

**The following topics are covered an explained in the specific tutorials:**

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- Tutorial 02: Using the VLFL-Toolbox for STL-File Export and Import
- Tutorial 03: Closed 2D Contours and Boolean Operations in 2D
- Tutorial 04: 2½D Design Using Boolean Operators on Closed Polygon Lists (CPL)
- Tutorial 05: Creation, Relative Positioning and Merging of Solid Geometries (SG)
- Tutorial 06: Relative Positioning and Alignment of Solid Geometries (SG)
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### Motivation for this tutorial: (Originally SolidGeometry 3.4 required)

- VMreaddicomdir - reads in a voxel model
- VMresize - resizes of a voxel model
- SGofVMdelaunay - creates a surface model using delaunay (slow)
- SGofVMmarchcube - creates a surface model using marching cube (fast)
- SGcut - cuts surface models
- CPLofSGslice - creates a slice contour at a specific height/direction
- PLFLofCPLdelauny - tesselates the facets of a CPL using delaunay
- PLFLofCPLpoly - tesselates the facets of a CPL using mapping toolbox
- VMplot - plots a voxel mode
- VMplotslide - plots a voxel mode for slider navigation
- VMimage - plots a voxel image
- VMmontage - montage of voxel
- VMpseudo3D - creates a pesudo 3D image
- VMuidicom - select and read a voxel model
- VMreaddicom - read a dicom file

### 1. Reading DICOM models as voxel model from disk and resize voxel models (VM)

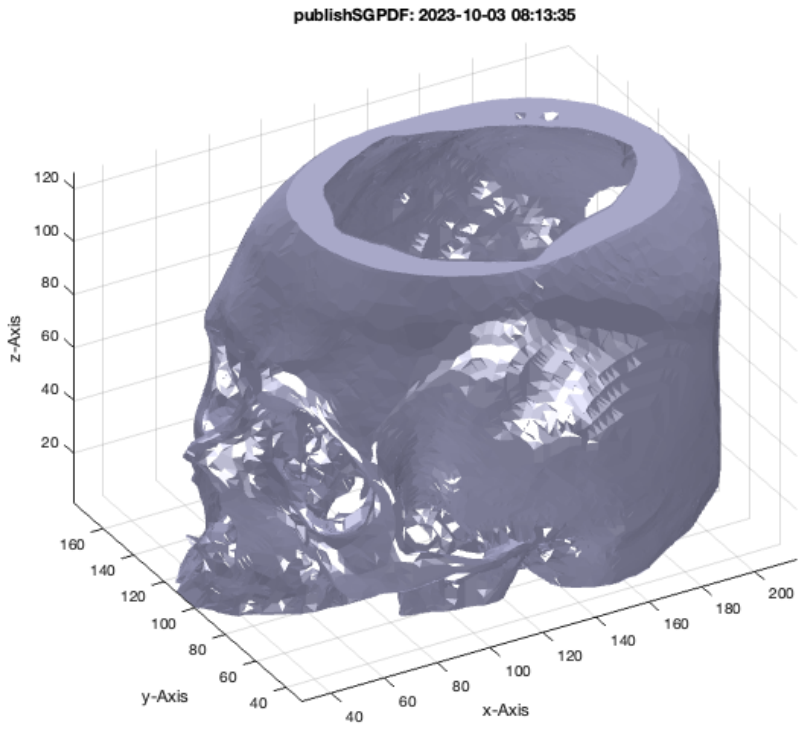
```
% load AIM_Patientmodel.mat % Does work world-wide=

[V,vs]=VMreaddicomdir('/Volumes/LUETH-WIN/WIN AIM Matlab Libraries/SolidGeometry-Code/AIM_DICOMFILES');
vs
[a,as]=VMresize(V,[0.5 0.5 0.5],vs);
as
[a,as]=VMresize(V,vs,vs);
as
```

```
vs =
    0.4219    0.4219    1.0000
VMresize: Resize voxel image [512 512 126] to [256 256 63] with voxel size [0.84mm 0.84mm 2.00mm]
as =
    0.8438    0.8438    2.0000
VMresize: Resize voxel image [512 512 126] to [216 216 126] with voxel size [1.00mm 1.00mm 1.00mm]
as =
     1     1     1
```

### 2. Solid skull bone reconstruction using SGofVMdelaunay

```
tic
SG1=SGofVMdelaunay(a>1400,as);       % Takes about 30 seconds
toc
SGfigure(-30,30);
SGplotalpha(SG1,'w');
drawnow
```

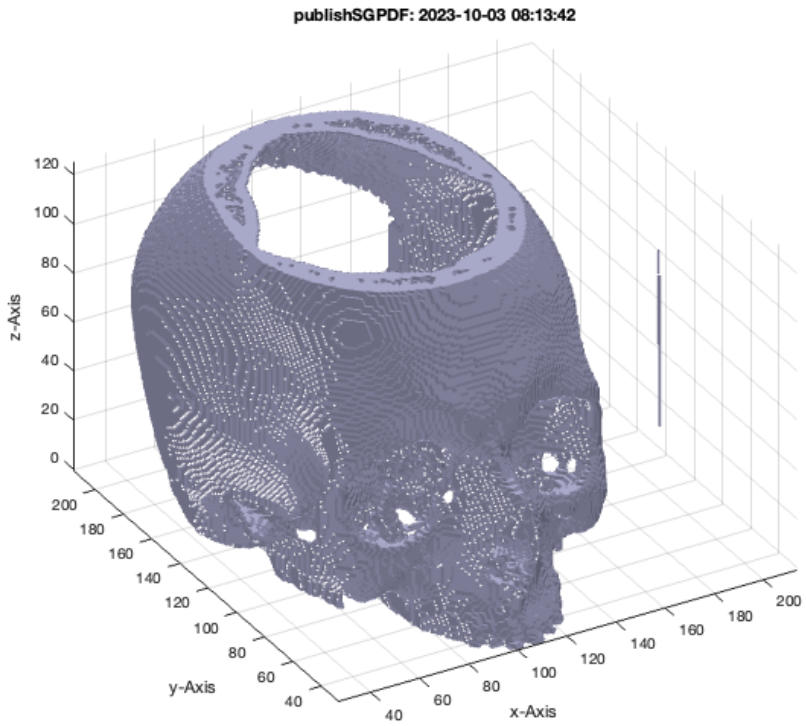
```
Elapsed time is 3.336853 seconds.
Elapsed time is 6.001050 seconds.
Elapsed time is 6.975977 seconds.
```




### 3. Solid skull bone reconstruction using SGofVMisosurface

```
tic
SG2=SGofVMisosurface(a>1400,as);       % Takes about 7 seconds
toc
SGfigure(-30,30);
SGplotalpha(SG2,'w');
drawnow
```

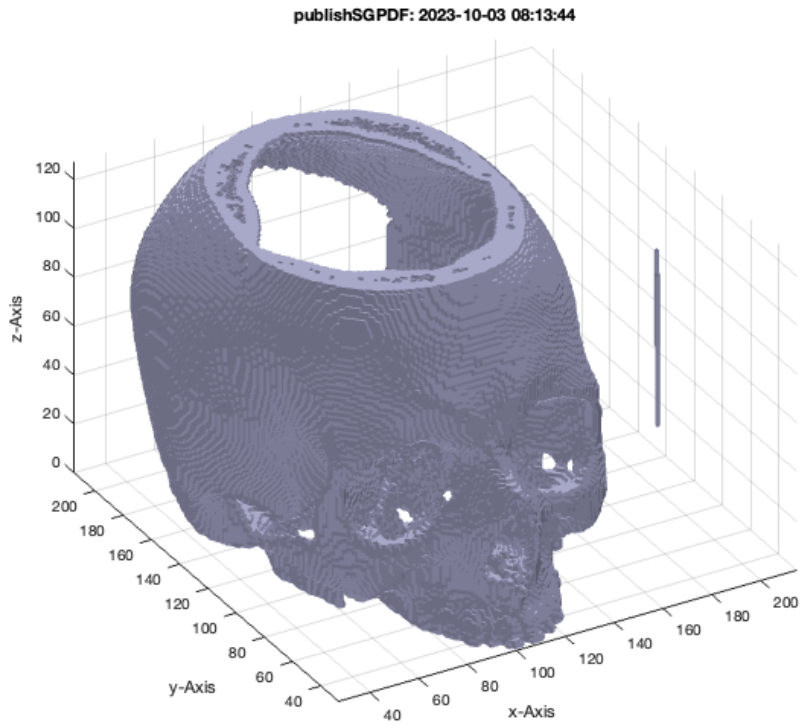
```
Elapsed time is 5.774328 seconds.
```




### 4. Solid skull bone reconstruction using SGofVMmarchcub

```
tic
SG3=SGofVMmarchcube(a>1400,as);       % Takes about 2 seconds
toc
SGfigure(-30,30);
SGplotalpha(SG3,'w',1);
drawnow
```

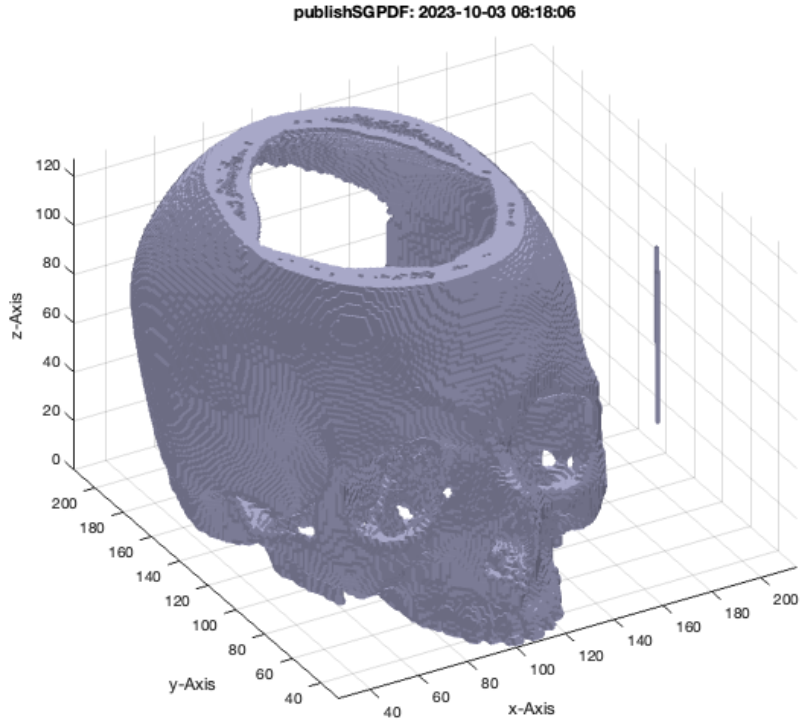
```
Elapsed time is 0.733963 seconds.
```




### 5. Reduce the numbers Facets to 300.000 facets

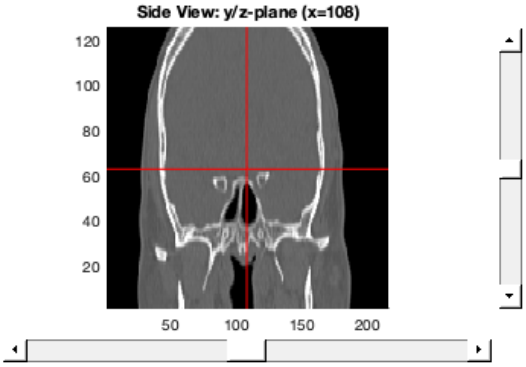
```
tic
SG4=SGreduceVLFL(SG3,300000); % Takes about 2 seconds
toc
SGfigure (-30,30);
SGplotalpha(SG4,'w',1);
drawnow
```

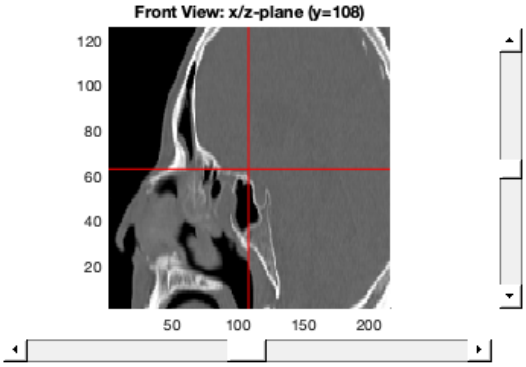
```
Elapsed time is 0.894774 seconds.
```

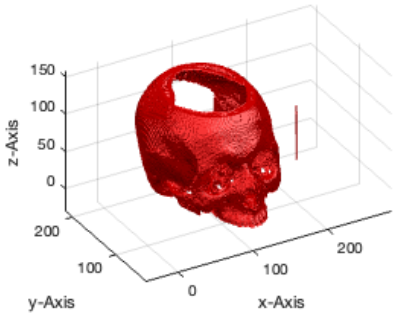


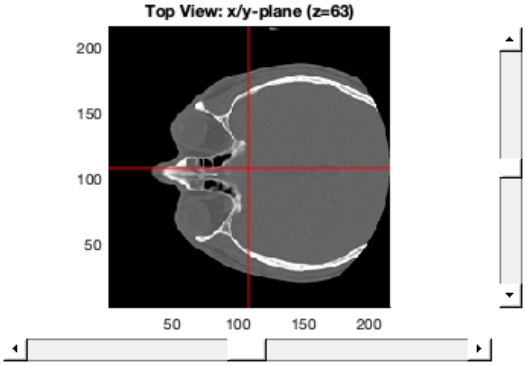

### 6 Show the Voxel model in quadrant 1-2-4 and surface model in quadrant 3

```
SGfigure (-30,30);
VMplot(a,'',SG4)
drawnow
```



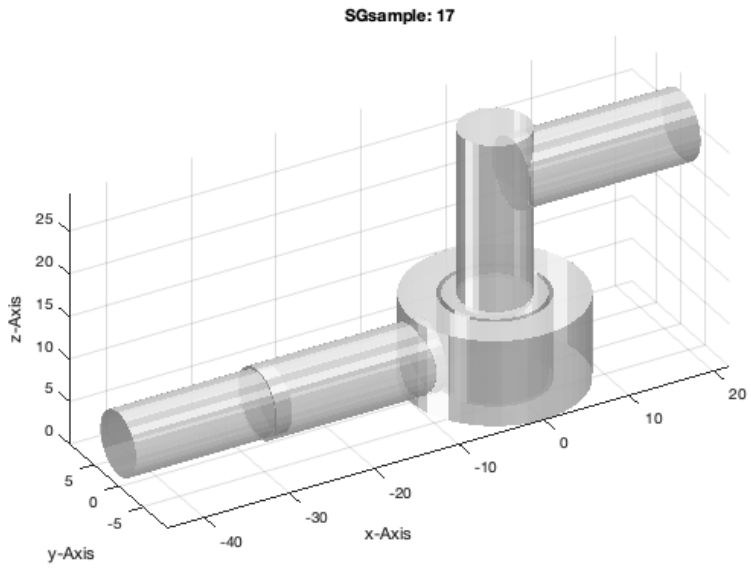




### 7. Create a surface model and convert it into a Voxel model

```
SGsample(17);

[VM,ms,SG3]=VMofSG(SGsample(17),[128 128 128],true);
whos VM
ms
SG3
```

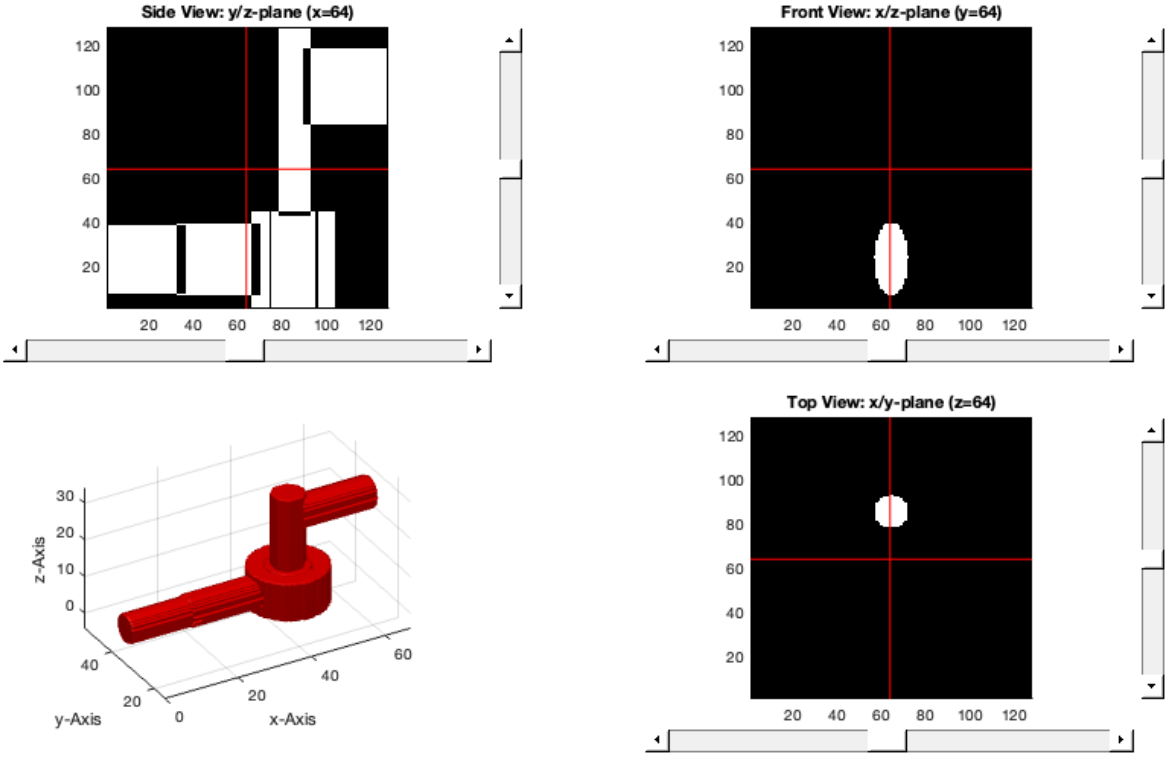
```
VMofSG: 5% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
10% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
15% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
20% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
25% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
30% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
```

```
35% 40% 45% 50% 55% 60% 65% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
70% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
75% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
80% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
85% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
90% Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
Warning: Points added or removed by DelaunayTri
95% 100%
  Name        Size                    Bytes  Class     Attributes

  VM        128x128x128            16777216  double

ms =
    0.5267    0.5267    0.2340
SG3 =
  struct with fields:

    VL: [23240×3 double]
    FL: [67356×3 double]
```




### 8. Plot the surface model in 4 quadrant plot

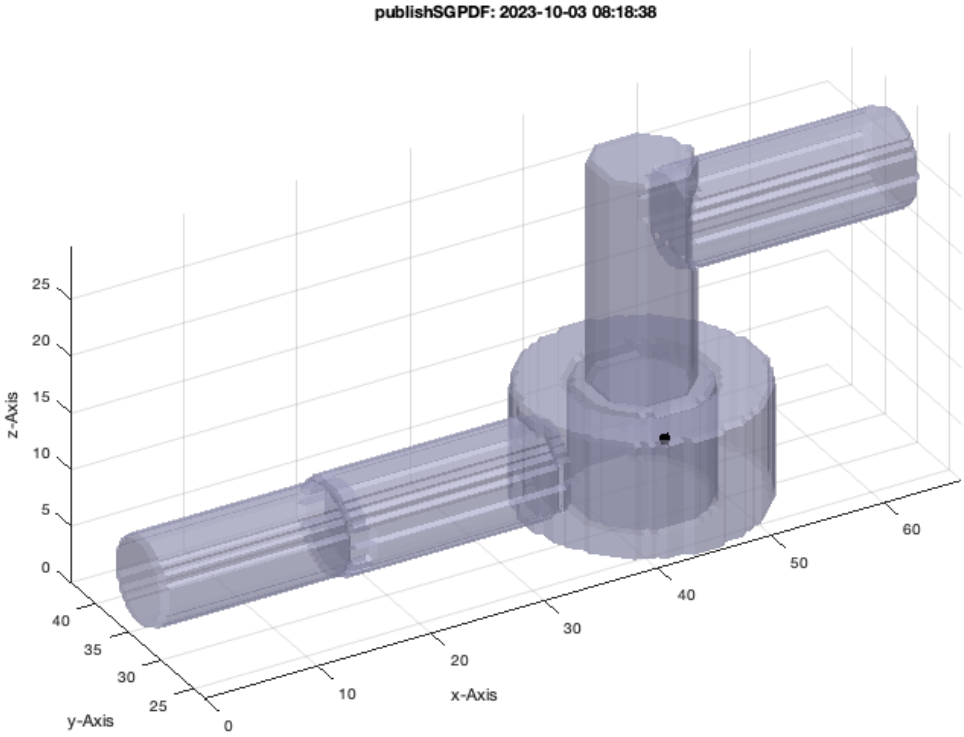
```
SGfigure (-30,30);
VMplot(VM,'',SG3);
drawnow
```




### 9. Select Point in 3D

SGfigure(SG3); view(-30,30); VLFLplotlight (1,.5);

```
SGfigure(-30,30); SGplotalpha(SG3,'w',0.5); drawnow;
ginput(1); p=select3d; pplot(p,'k*',4); rotate3d on
```




## Final Remarks

```
close all
VLFLlicense
```

```
This VLFL-Lib, Rel.  (2023-Oct-03), is for limited non commercial educational use only!
Licensee: Tim Lueth (Development Version)!
Please contact Tim Lueth, Professor at TU Munich, Germany!
WARNING: This VLFL-Lib (Rel. ) license will exceed at 06-Jul-2078 08:18:56!
Executed 03-Oct-2023 08:18:58 by 'timlueth' on a MACI64 using Mac OSX 13.6 | R2023a Update 5 | SG-Lib 5.4
======================================== Used Matlab products: ========================================
distrib_computing_toolbox
fixed_point_toolbox
image_toolbox
map_toolbox
matlab
simmechanics
simscape
simulink
=======================================================================================================
```

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