

Tutorial 44: Creation of solids and kinematics from 3D curves and transformation matrices

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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:

- Tutorial 01: First Steps Using the VLFL-Toolbox for Solid Object Design
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- 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)
- Tutorial 07: Rotation of Closed Polygon Lists for Solid Geometry Design
- Tutorial 08: Slicing, Closing, Cutting and Separation of Solid Geometries
- Tutorial 09: Boolean Operations with Solid Geometries
- Tutorial 10: Packaging of Sets of Solid Geometries (SG)
- Tutorial 11: Attaching Coordinates Frames to Create Kinematik Models
- Tutorial 12: Define Robot Kinematics and Detect Collisions
- Tutorial 13: Mounting Faces and Conversion of Blocks into Leightweight-structures
- Tutorial 14: Manipulation Functions for Closed Polygons and Laser Cutting (SVG)
- Tutorial 15: Create a Solid by 2 Closed Polygons
- Tutorial 16: Create Tube-Style Solids by Succeeding Polygons
- Tutorial 17: Filling and Bending of Polygons and Solids
- Tutorial 18: Analyzing and modifying STL files from CSG modeler (Catia)
- Tutorial 19: Creating drawing templates and dimensioning from polygon lines
- Tutorial 20: Programmatically Interface to SimMechanics Multi-Body Toolbox
- Tutorial 21: Programmatically Convert Joints into Drives (SimMechanics)
- Tutorial 22: Adding Simulink Signals to Record Frame Movements
- Tutorial 23: Automatic Creation of a Missing Link and 3D Print of a Complete Model
- Tutorial 24: Automatic Creation of a Joint Limitations
- Tutorial 25: Automatic Creation of Video Titels, Endtitels and Textpages
- Tutorial 26: Create Mechanisms using Universal Planar Links
- Tutorial 27: Fourbar-Linkage: 2 Pose Syntheses and Linkage Export for 3D Printing
- Tutorial 28: Fourbar-Linkage: 3 Pose Syntheses and Linkage Export for 3D Printing
- Tutorial 29: Create a multi body simulation using several mass points
- Tutorial 30: Creating graphical drawings using point, lines, surfaces, frames etc.
- Tutorial 31: Importing 3D Medical DICOM Image Data and converting into 3D Solids
- Tutorial 32: Exchanging Data with a FileMaker Database
- Tutorial 33: Using a Round-Robin realtime multi-tasking system
- Tutorial 34: 2D Projection Images and Camera Coordinate System Reconstruction

- Tutorial 35: Creation of Kinematic Chains and Robot Structures
- Tutorial 36: Creating a Patient-Individual Arm-Skin Protector-Shell
- Tutorial 37: Dimensioning of STL Files and Surface Data
- Tutorial 38: Some more solid geometry modelling function
- Tutorial 39: HEBO Modules robot design
- Tutorial 40: JACO Robot Simulation and Control
- Tutorial 41: Inserting Blades, Cuts and Joints into Solid Geometries
- Tutorial 42: Performing FEM Stress and Displacement Analysis and Structural Optimization of Solids
- Tutorial 43: Performing FEM Structural Optimization (CAO) and Topological Optimization (SKO) of Solids
- Tutorial 44: Creation of solids and kinematics from 3D curves and transformation matrices

Motivation for this tutorial: (Originally SolidGeometry 4.2 required)

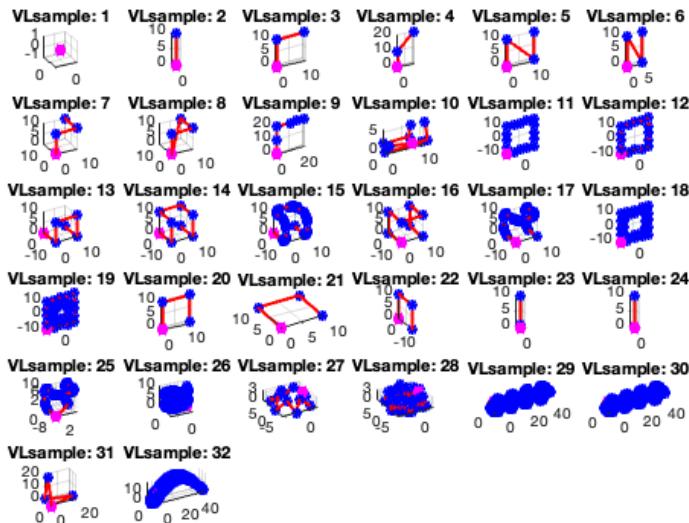
The creation of solids from space curves and a cross-section polygon is not trivial. The affected persons in the SGLib are VLsample - for generating example curves VLedgeNormal - Non trivial function for creating normal orthogonal vectors The creation of solids from space curves and a cross-section polygon is not trivial. The affected functions in the SGLib are VLsample - for generating example curves VLedgeNormal - Non-trivial function for generating normal orthogonal vectors SGcontourtube - The first function with rotating matrices (error in special cases) SGcontourtube2 - The new function with VLedgeNormal (previously error-free) SGofCPLCVLR - Now based on SGcontourtube2 SGof2T - Now based on SGcontourtube2 SGTofDenavitHartenberg - Based on SGof2T SGTofDHset - Based on SGTofDenavitHartenberg

List of function introduced in this tutorial

Using VLsample to create example funktions

```
VLsample;
```

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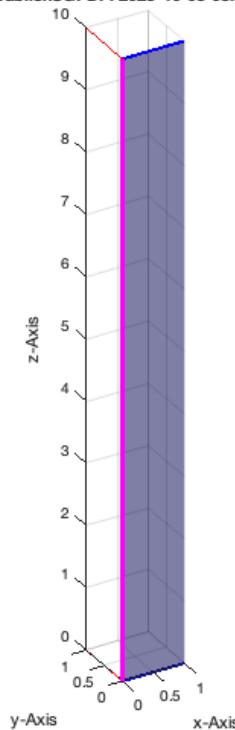


Creating edge normal function for an open spatial curve

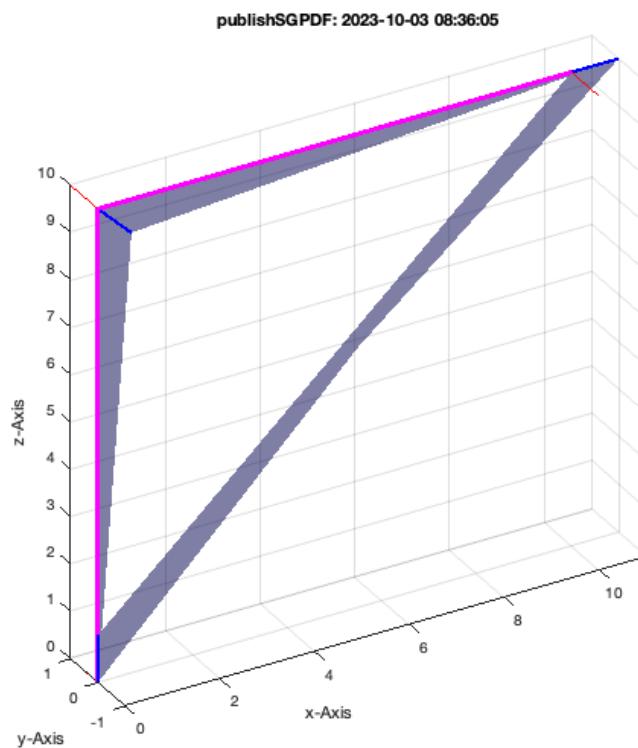
If angles are larger than 90 degree ($\pi/2$)

```
VLedgeNormal(VLsample(2));
```

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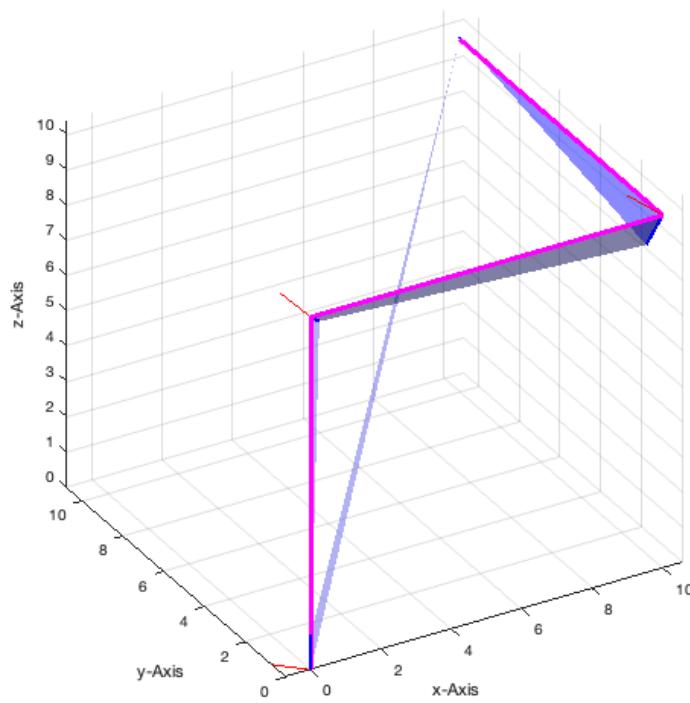


```
VLedgeNormal(VLsample(3));
```

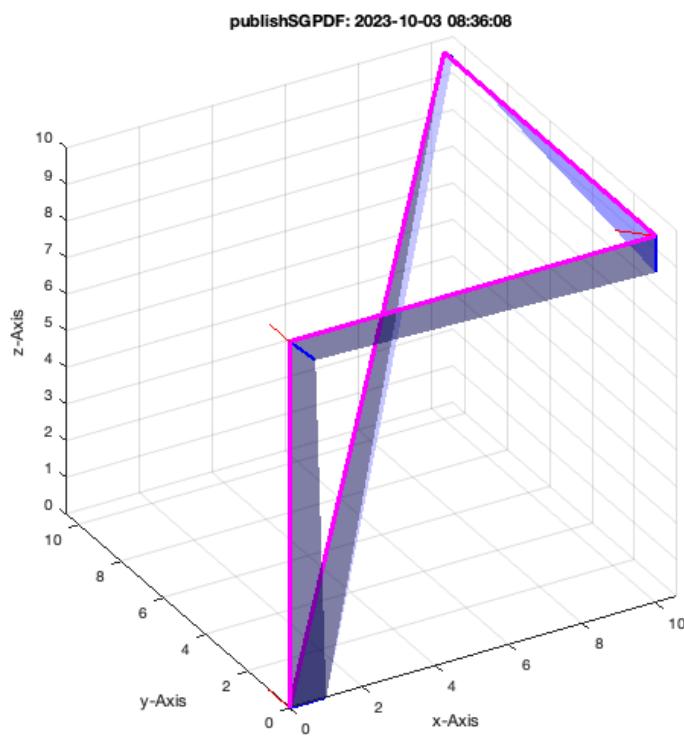


```
VLedgeNormal(VLsample(7));
```

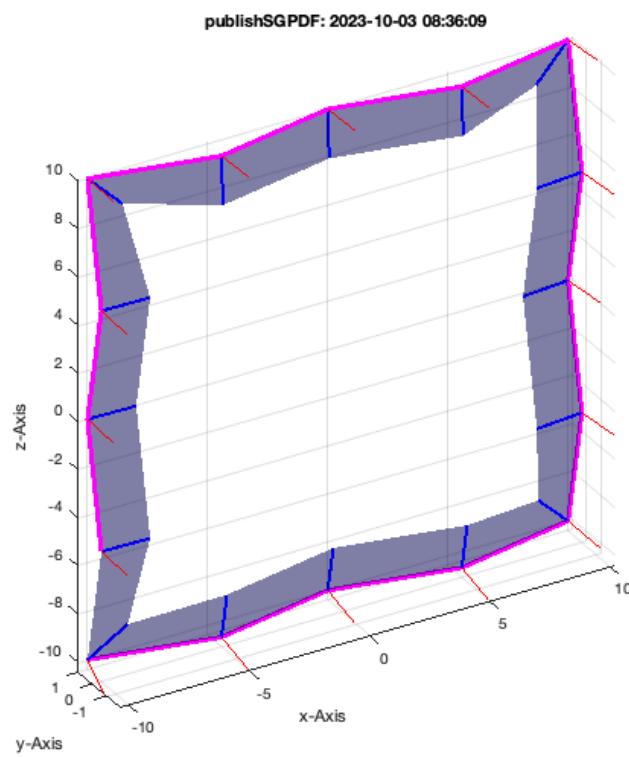
publishSGPDF: 2023-10-03 08:36:07



```
VLedgeNormal(VLsample(8));
```

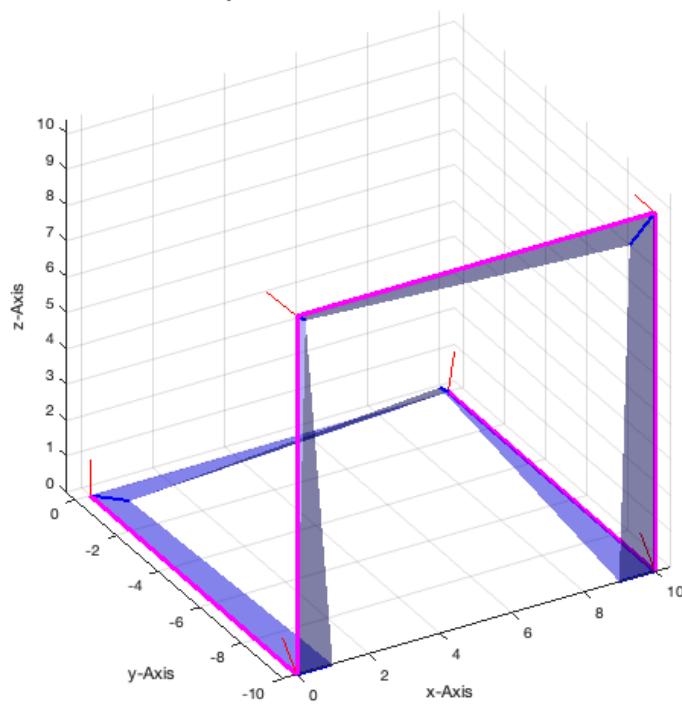


```
VLedgeNormal(VLsample(12));
```

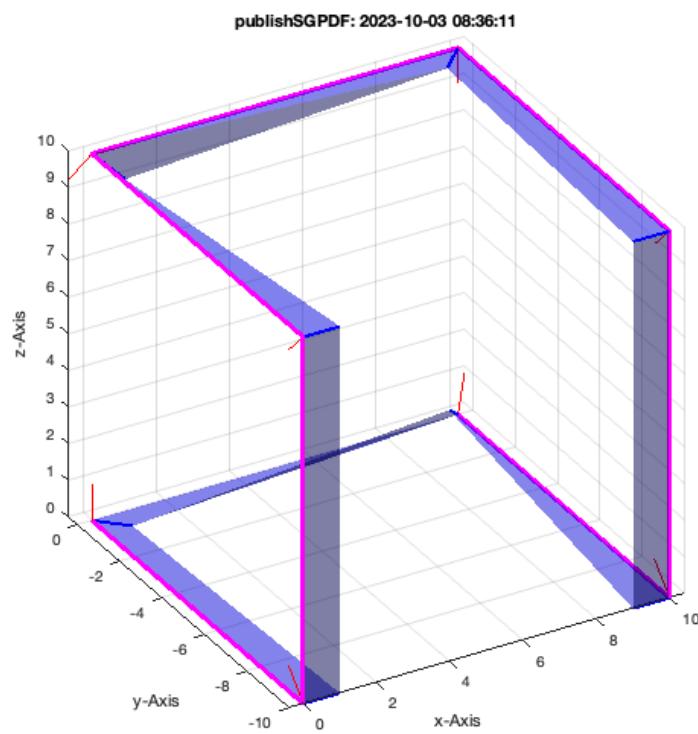


```
VLedgeNormal(VLsample(13));
```

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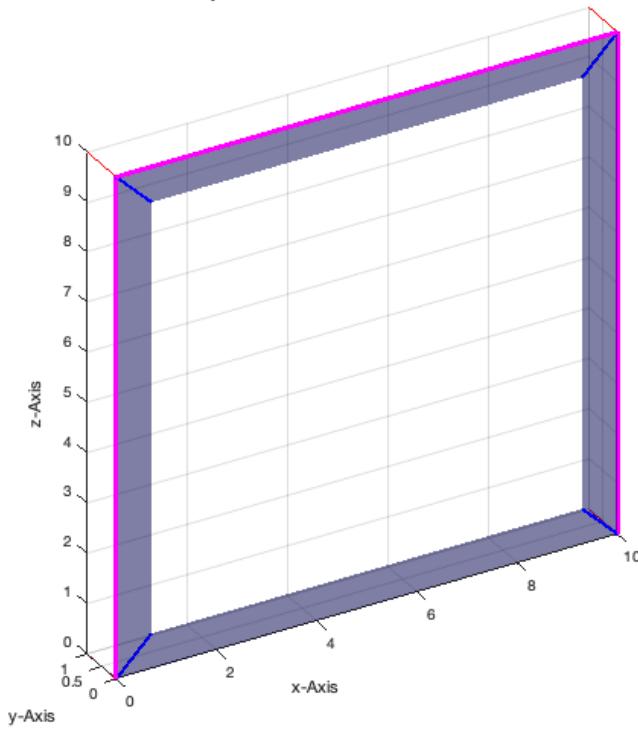


```
VLedgeNormal(VLsample(14));
```



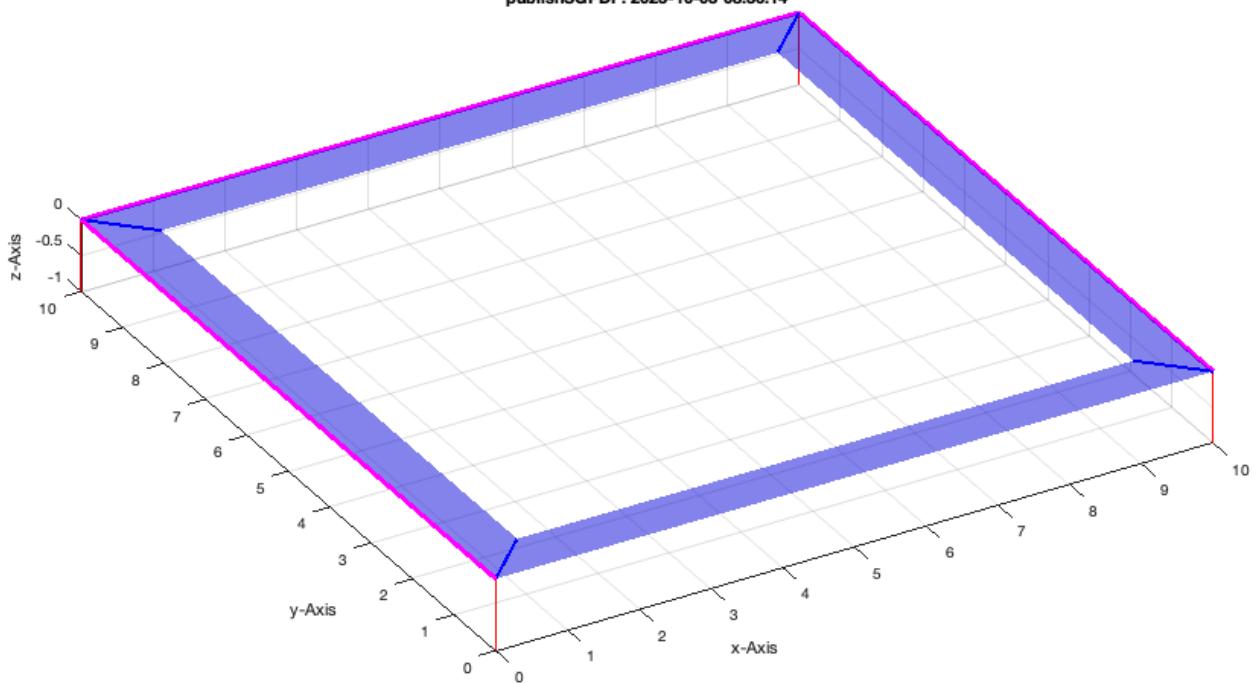
```
VLedgeNormal(VLsample(20));
```

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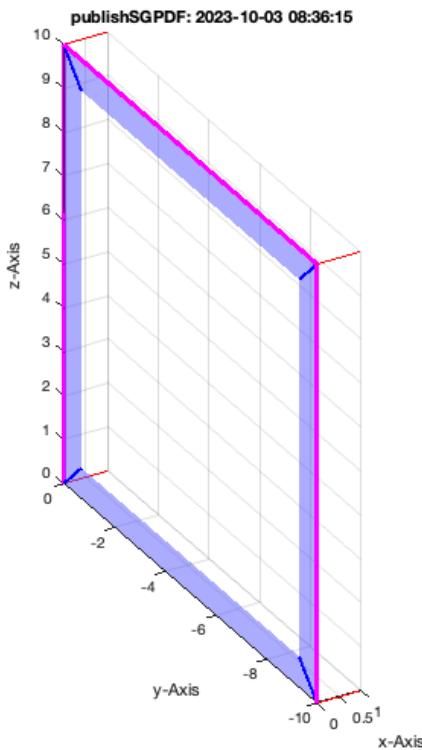


```
VLedgeNormal(VLsample(21));
```

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```
VLedgeNormal(VLsample(22));
```

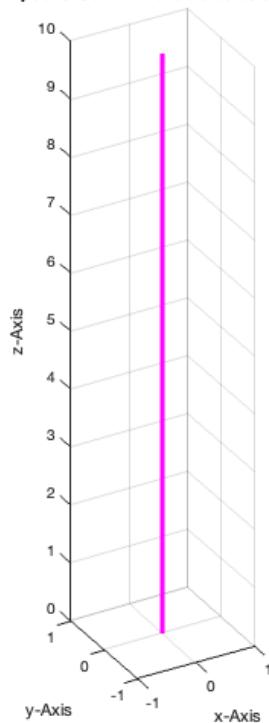


Creating normal function for a closed spatial curve

If angles are larger than 90 degree ($\pi/2$)

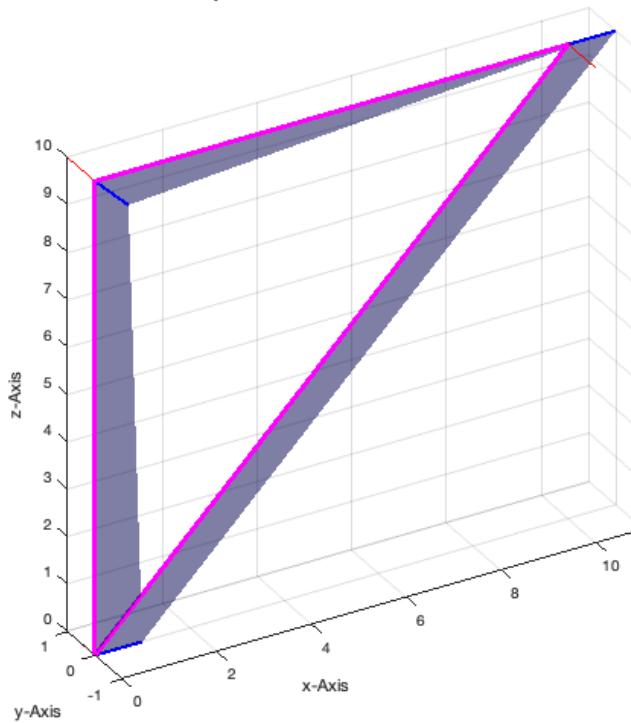
```
VLedgeNormal(CVLofVL(VLsample(2)));
```

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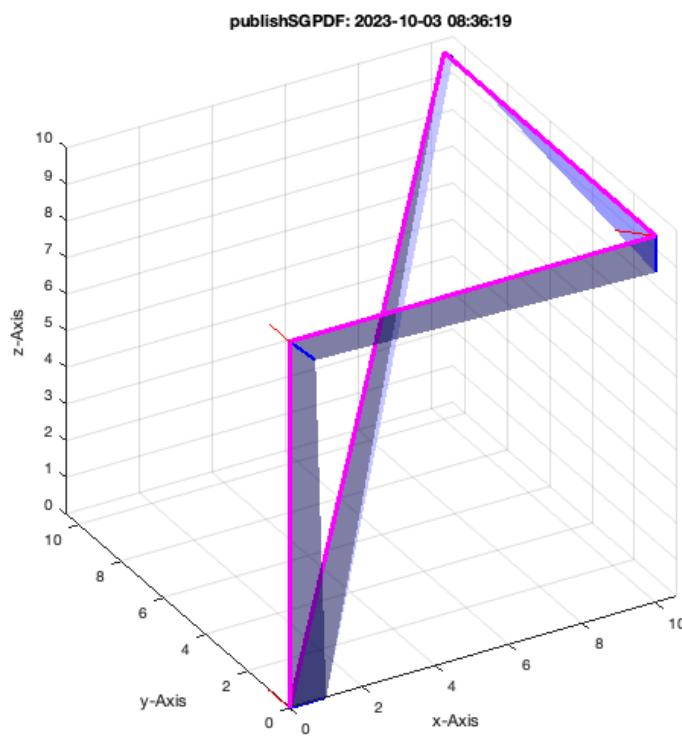


```
VLEDgeNormal(CVLofVL(VLsample(3)));
```

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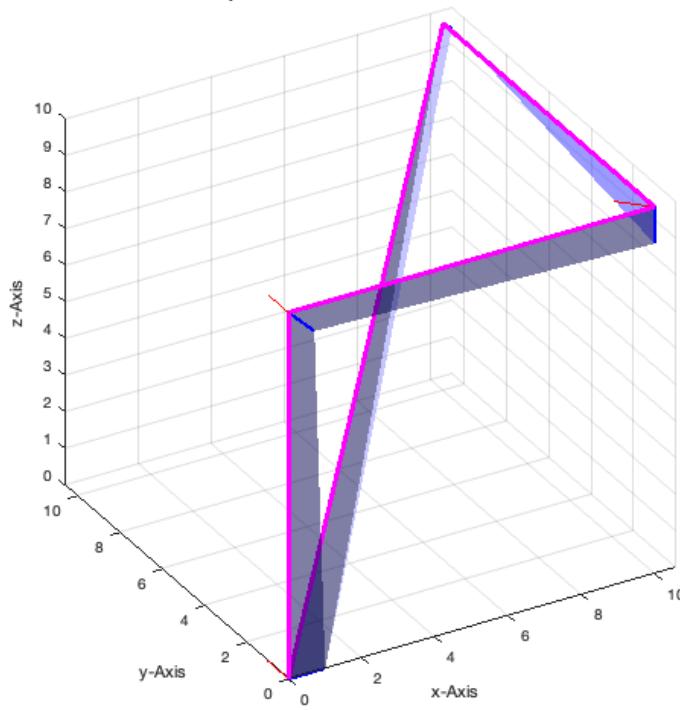


```
VLedgeNormal(CVLofVL(VLsample(7)));
```



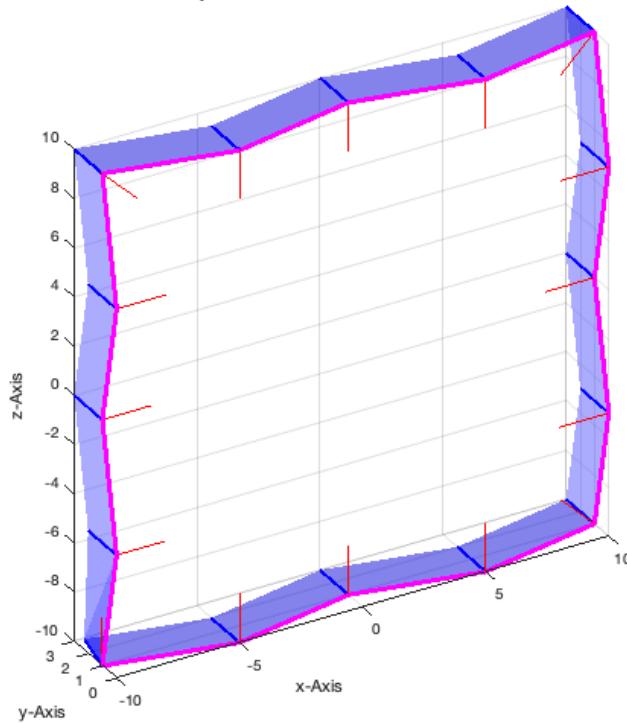
```
VLedgeNormal(CVLofVL(VLsample(8)));
```

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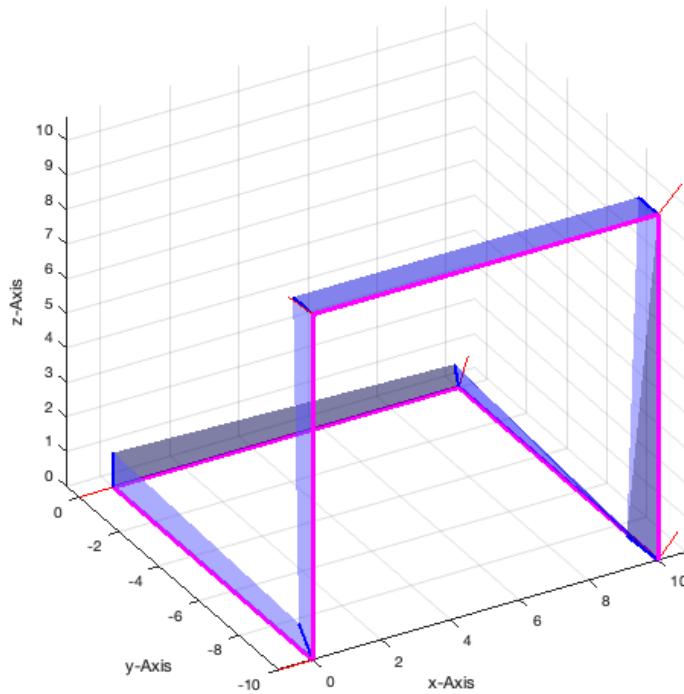
```
VLedgeNormal(CVLofVL(VLsample(12)));
```

publishSGPDF: 2023-10-03 08:36:22



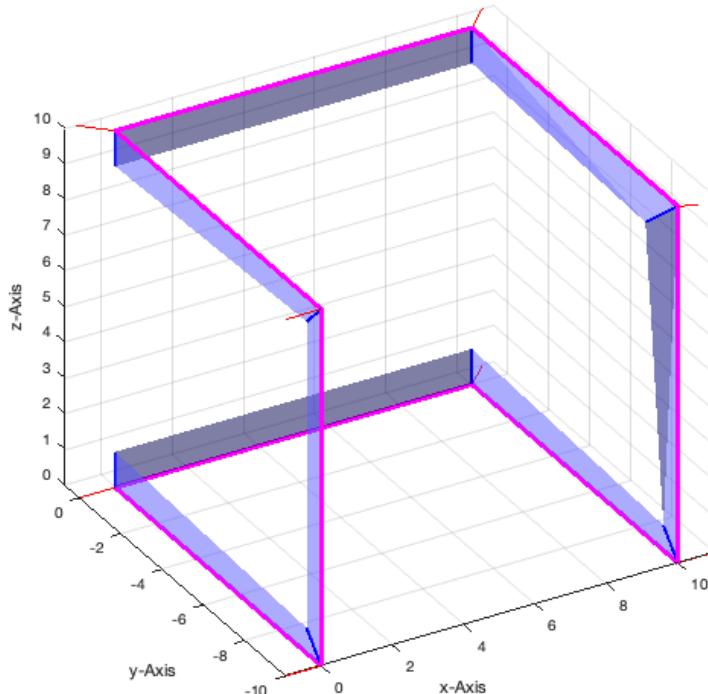
```
VLedgeNormal(CVLofVL(VLsample(13)));
```

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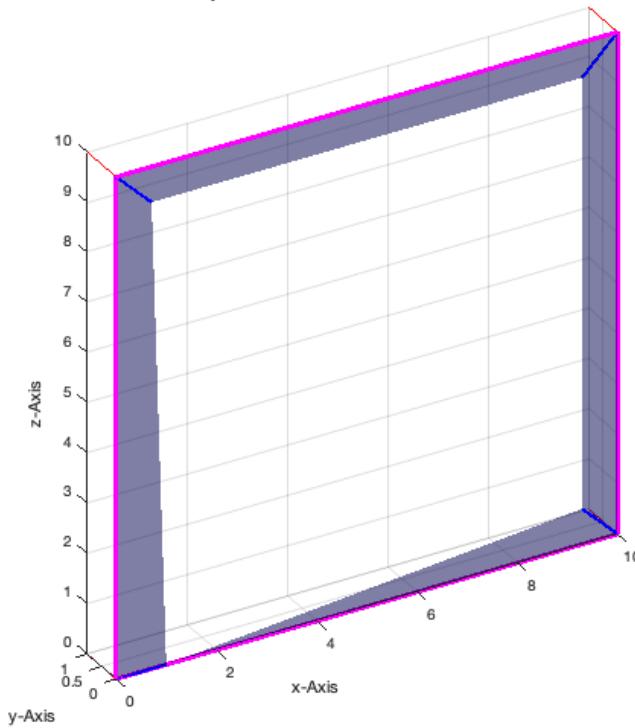
```
VLedgeNormal(CVLofVL(VLsample(14)));
```

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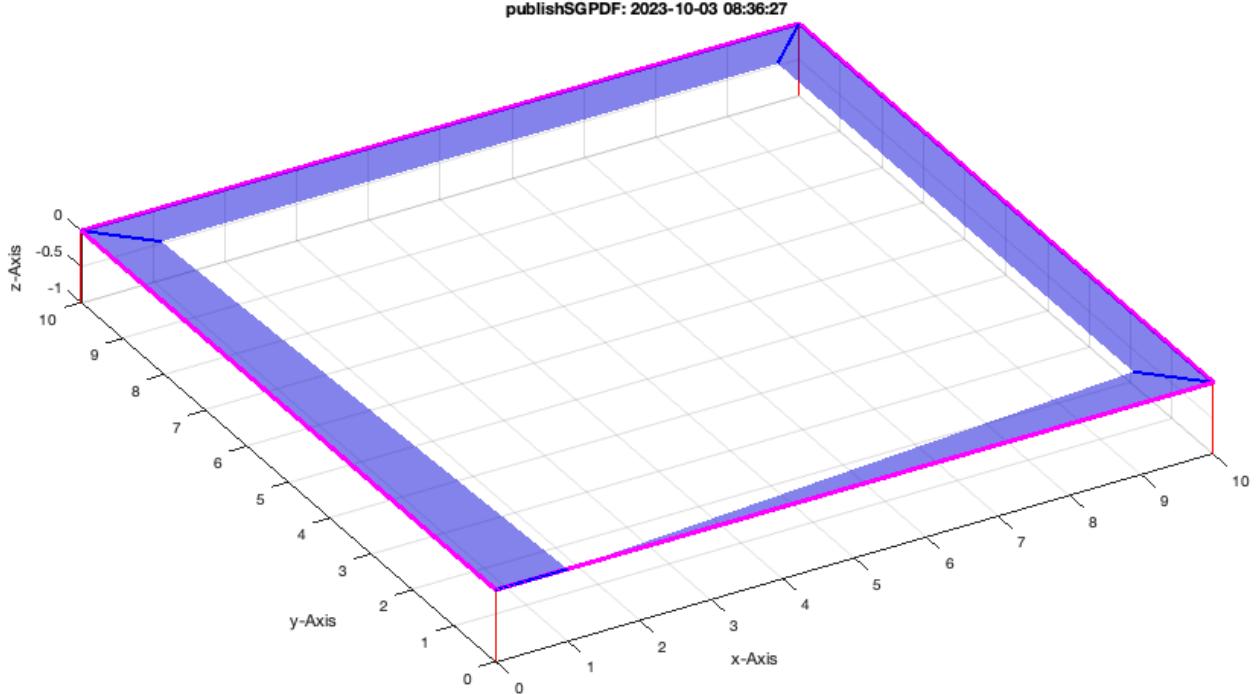
```
VLedgeNormal(CVLofVL(VLsample(20)));
```

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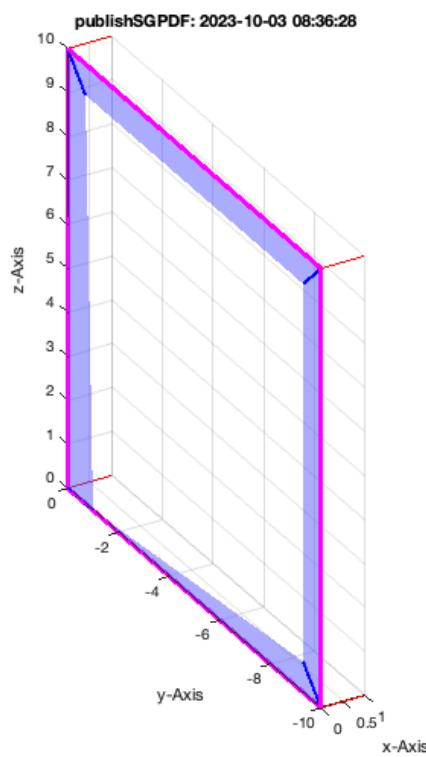


```
VLedgeNormal(CVLofVL(VLsample(21)));
```

publishSGPDF: 2023-10-03 08:36:27



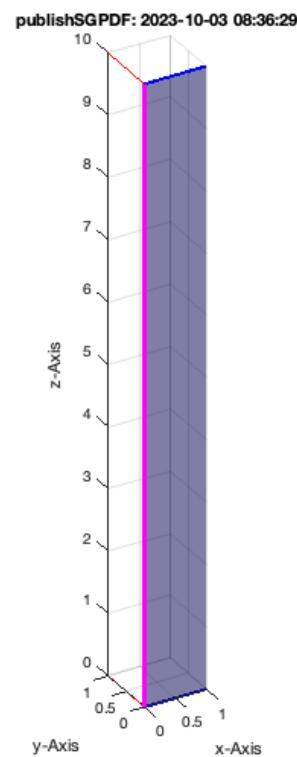
```
VLedgeNormal(CVLofVL(VLsample(22)));
```



Creating normal function for open spatial radial curve

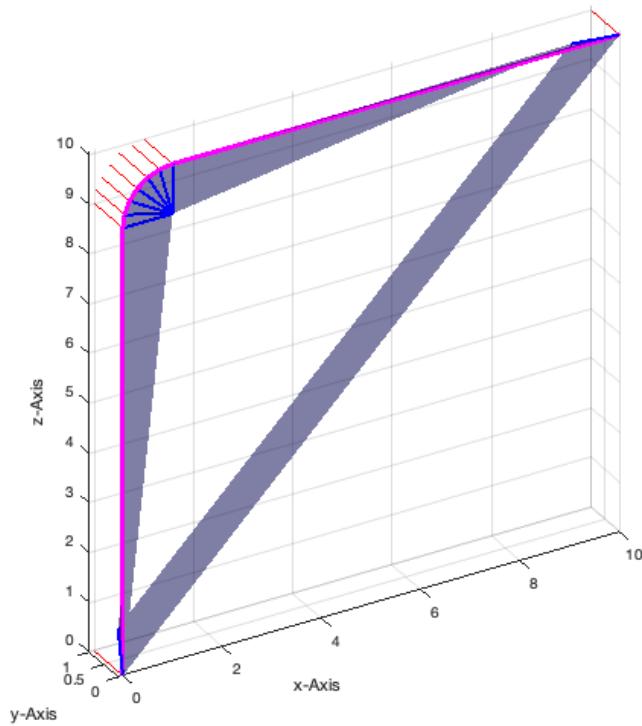
If angles are larger than 90 degree ($\pi/2$)

```
VLedgeNormal(VLradialEdges(VLsample(2)));
```



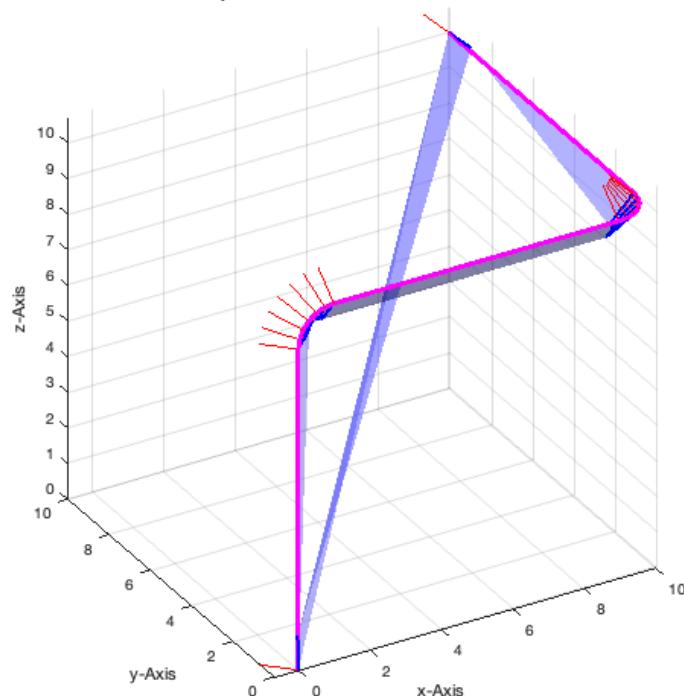
```
VLedgeNormal(VLradialEdges(VLsample(3)));
```

publishSGPDF: 2023-10-03 08:36:31



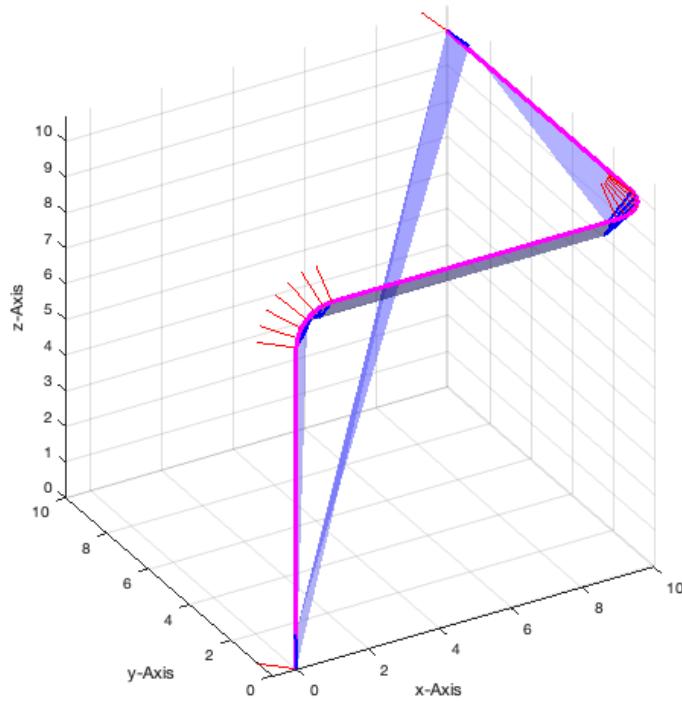
```
VLedgeNormal(VLradialEdges(VLsample(7)));
```

publishSGPDF: 2023-10-03 08:36:32



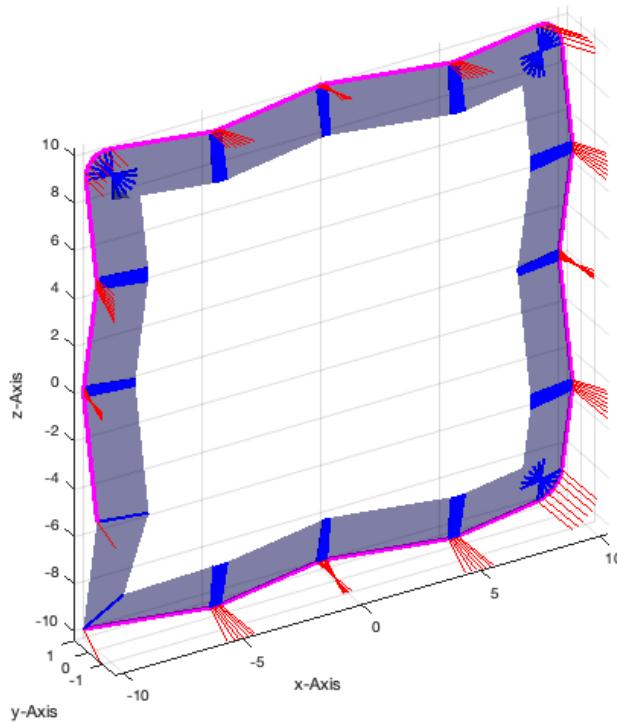
```
VLedgeNormal(VLradialEdges(VLsample(8)));
```

publishSGPDF: 2023-10-03 08:36:33



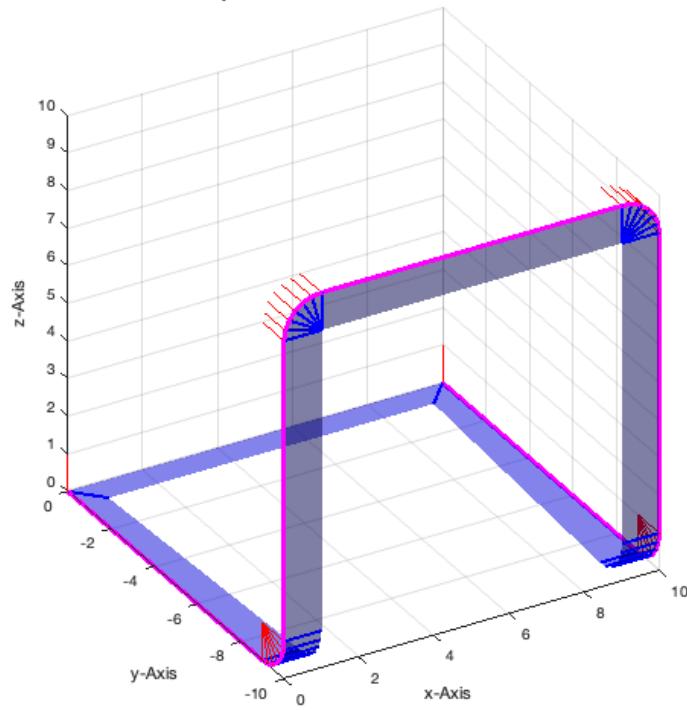
```
VLedgeNormal(VLradialEdges(VLsample(12)));
```

publishSGPDF: 2023-10-03 08:36:35



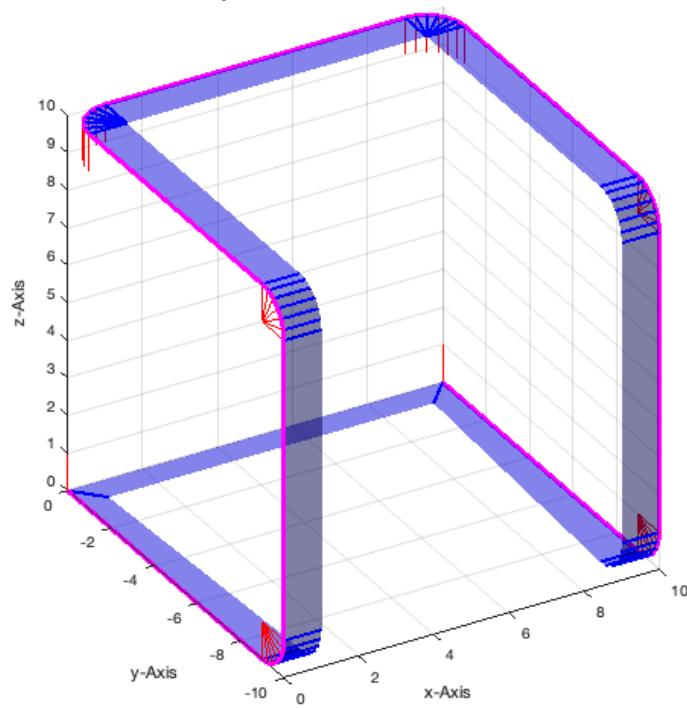
```
VLedgeNormal(VLradialEdges(VLsample(13)));
```

publishSGPDF: 2023-10-03 08:36:37



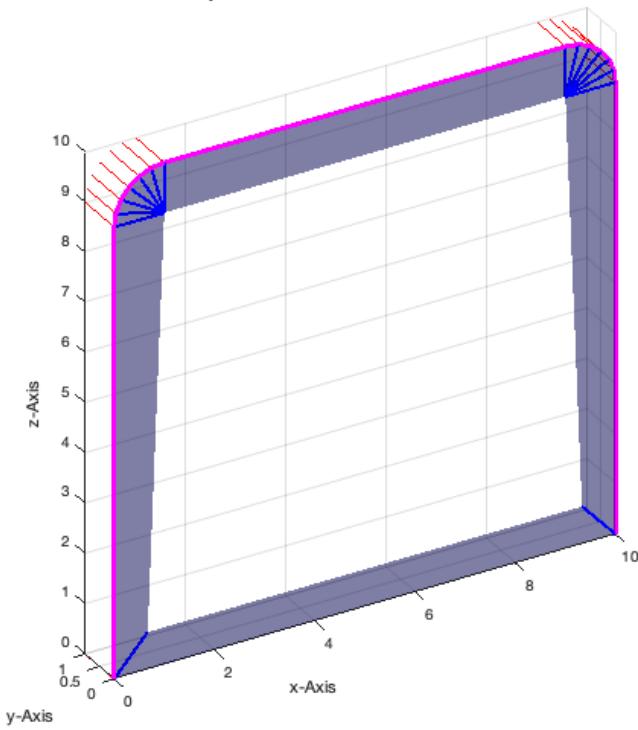
```
VLedgeNormal(VLradialEdges(VLsample(14)));
```

publishSGPDF: 2023-10-03 08:36:39



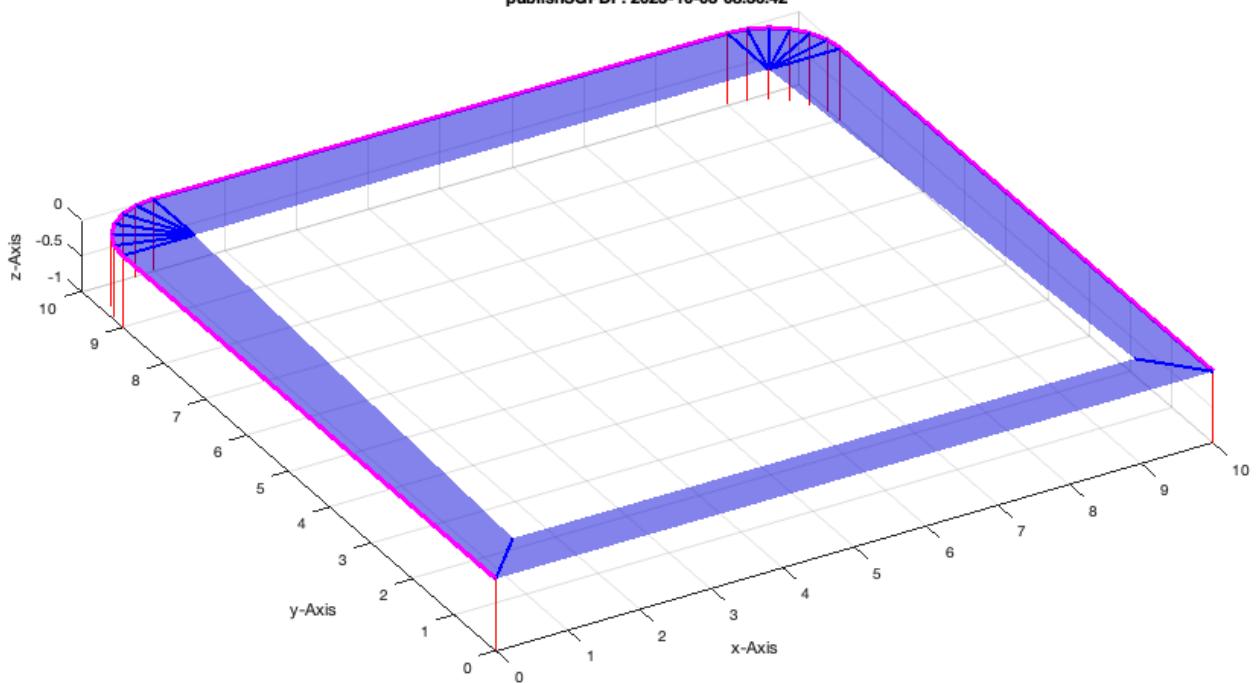
```
VLedgeNormal(VLradialEdges(VLsample(20)));
```

publishSGPDF: 2023-10-03 08:36:41

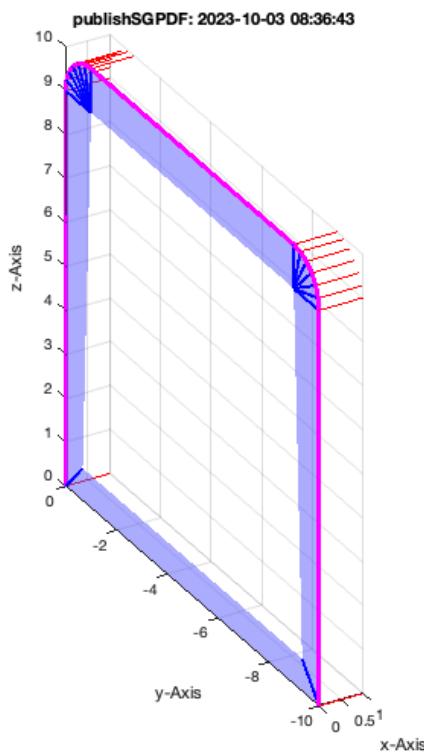


```
VLedgeNormal(VLradialEdges(VLsample(21)));
```

publishSGPDF: 2023-10-03 08:36:42



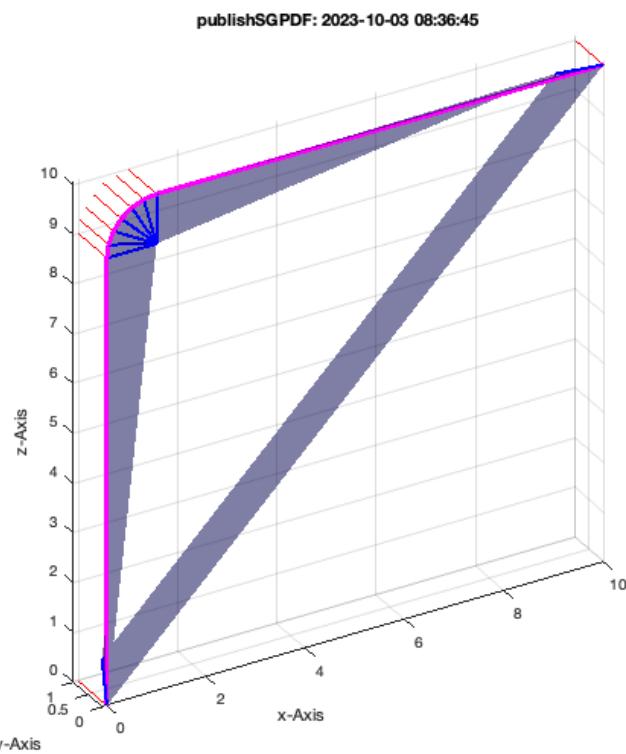
```
VLedgeNormal(VLradialEdges(VLsample(22)));
```



Creating normal function for closed spatial radial curve

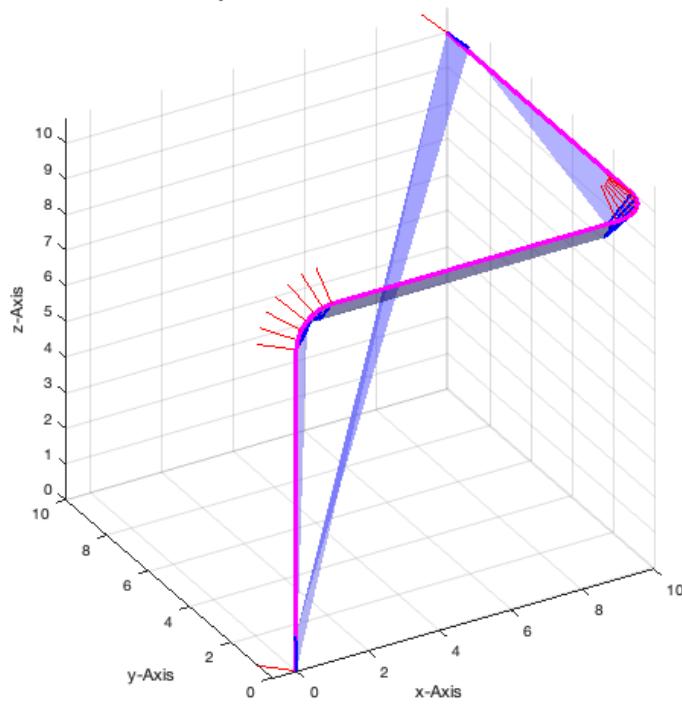
If angles are larger than 90 degree ($\pi/2$)

```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(3))));
```



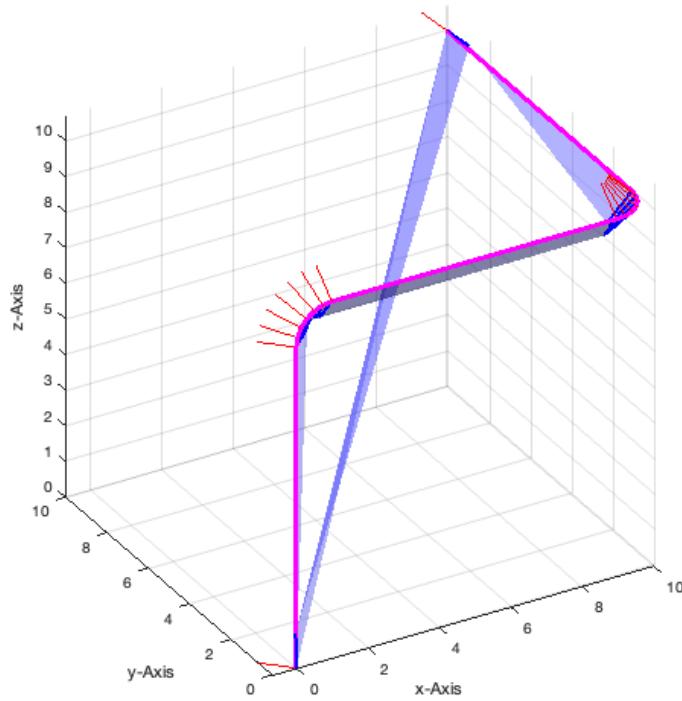
```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(7))));
```

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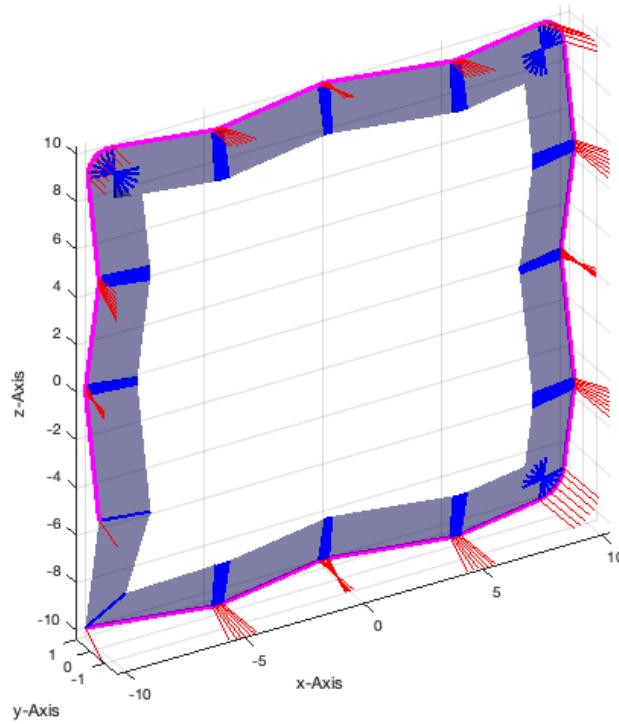
```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(8))));
```

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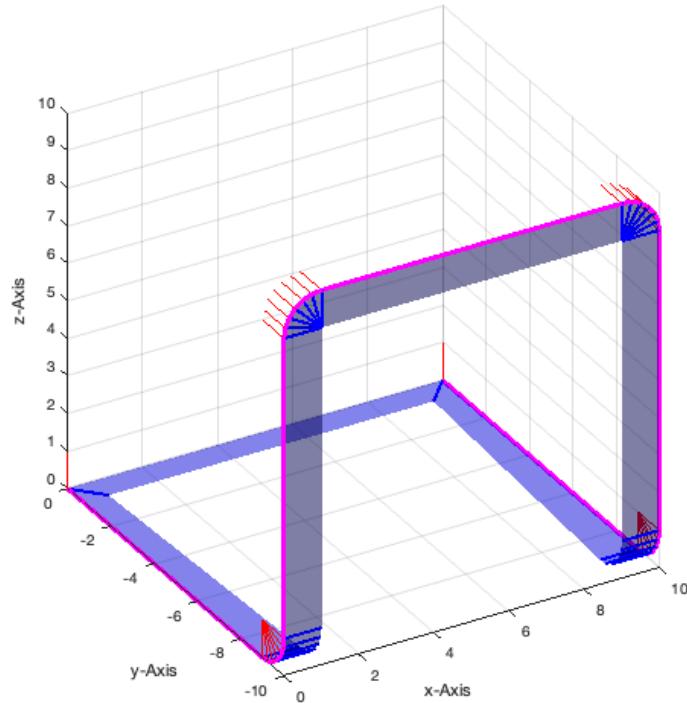
```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(12))));
```

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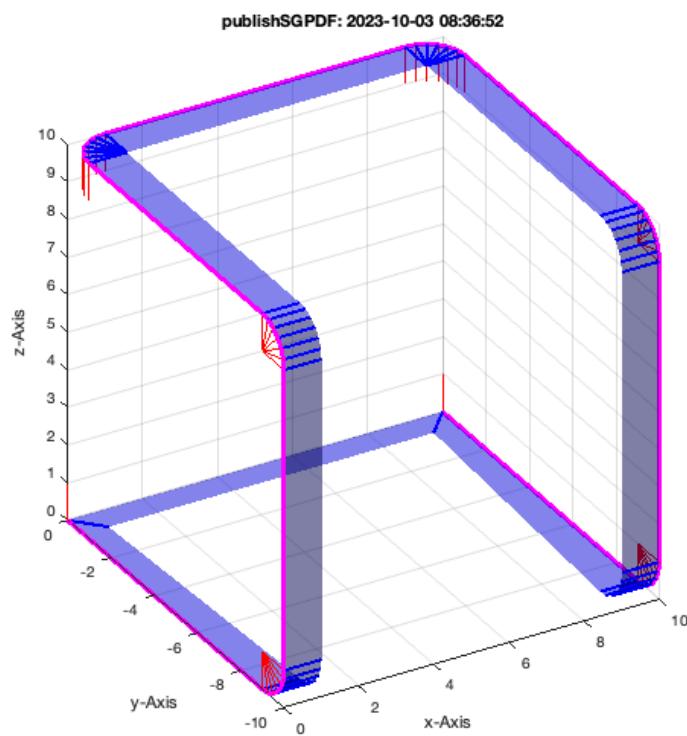


```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(13))));
```

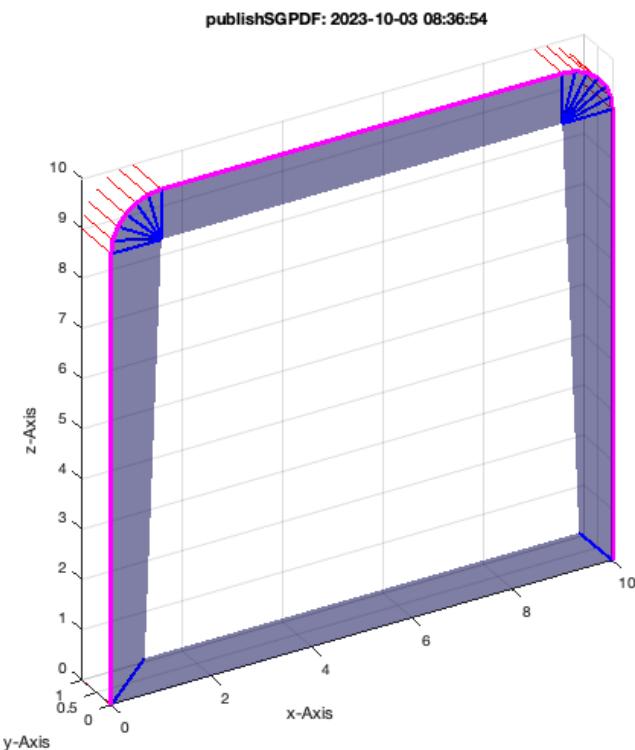
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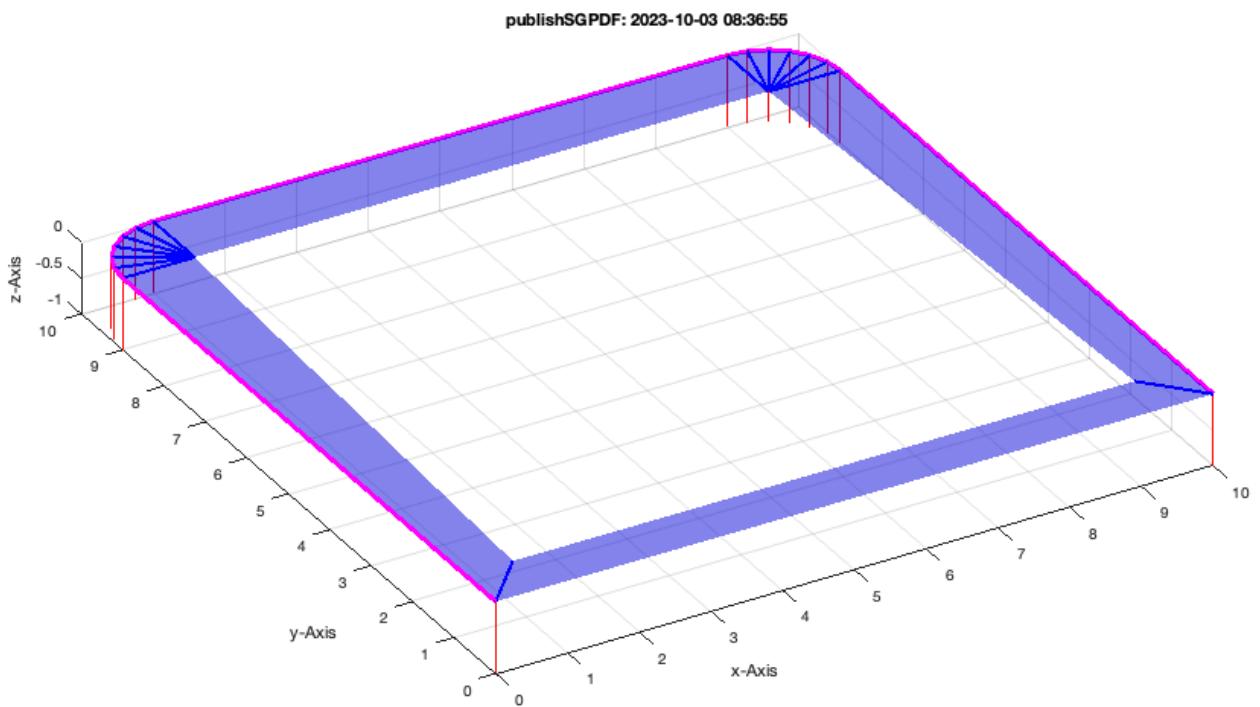
```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(14))));
```



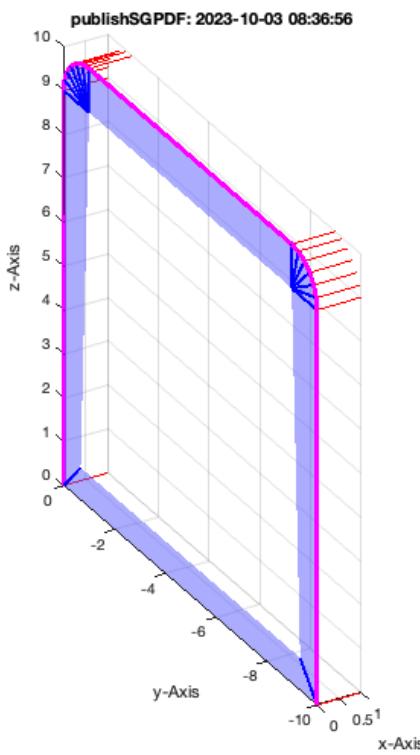
```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(20))));
```



```
VLedgeNormal(VLradialEdges(CVLofVL(VLsample(21))));
```



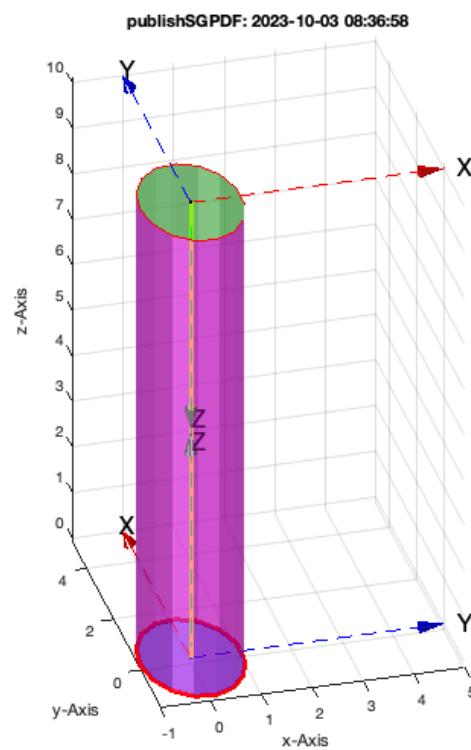
```
VLEdgeNormal(VLradialEdges(CVLofVL(VLsample(22))));
```



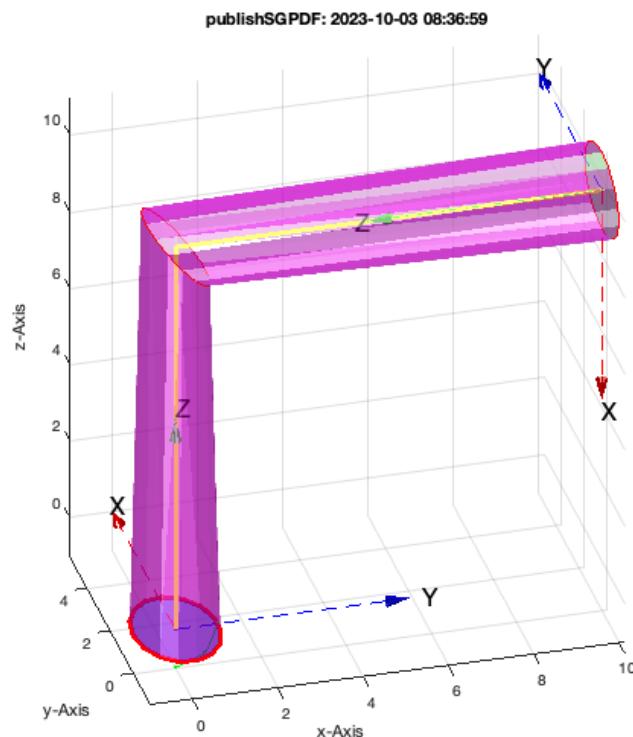
Creating Solid Geometries open

If angles are larger than 90 degree ($\pi/2$)

```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(2));
```

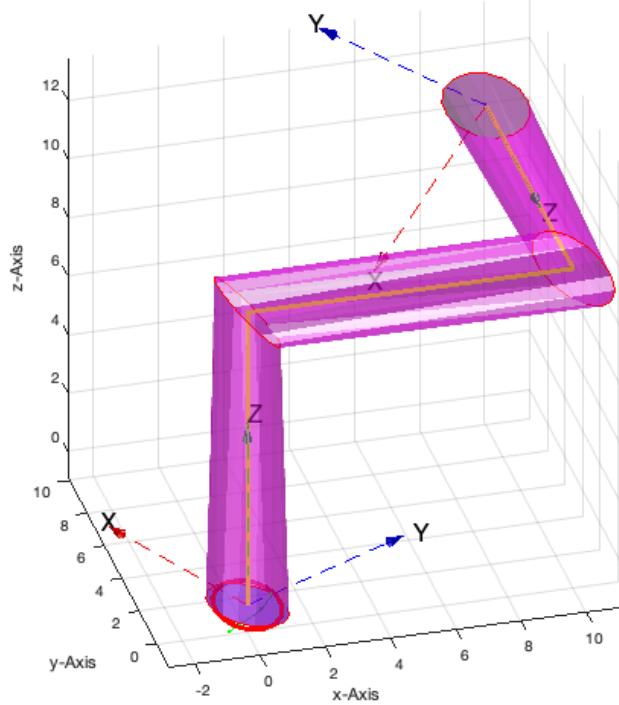


```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(3));
```



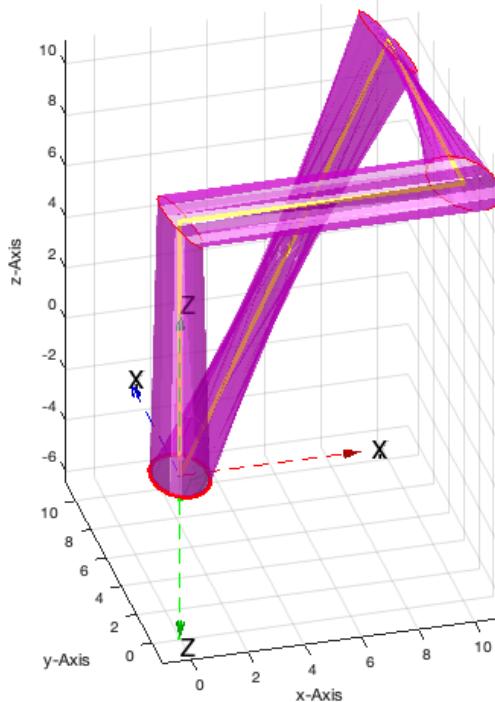
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(7));
```

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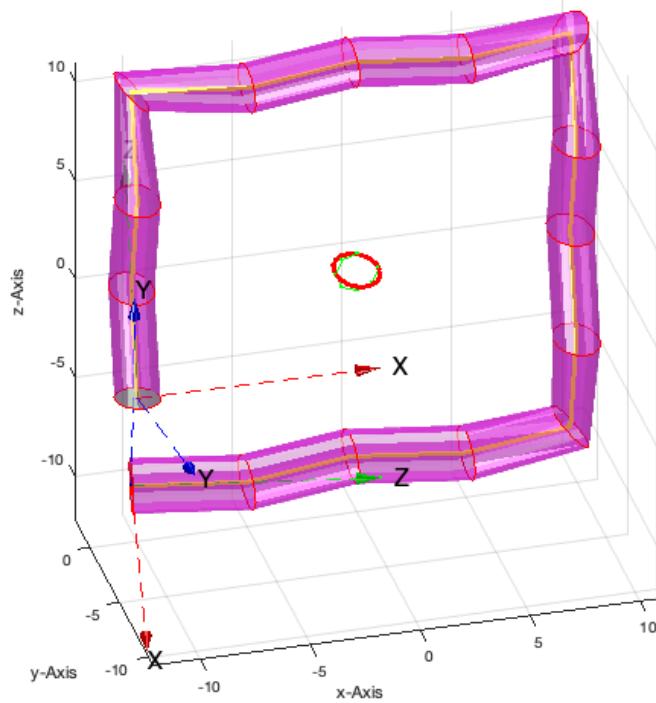
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(8));
```

publishSGPDF: 2023-10-03 08:37:02



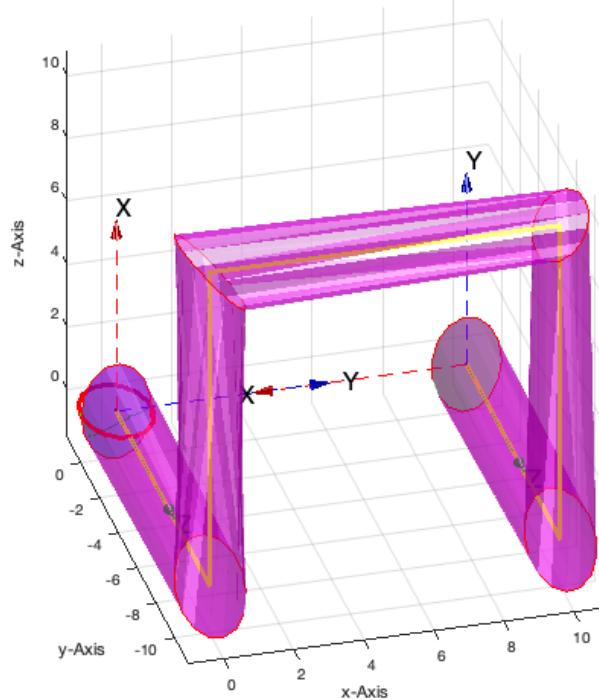
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(12));
```

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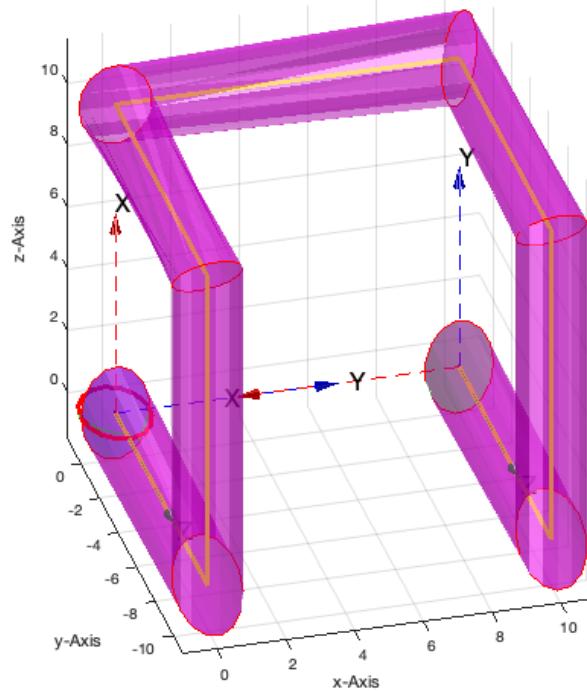
```
SGcontourtube2(PLcircle(1, '^', '^', 1.5), VLsample(13));
```

publishSGPDF: 2023-10-03 08:37:05



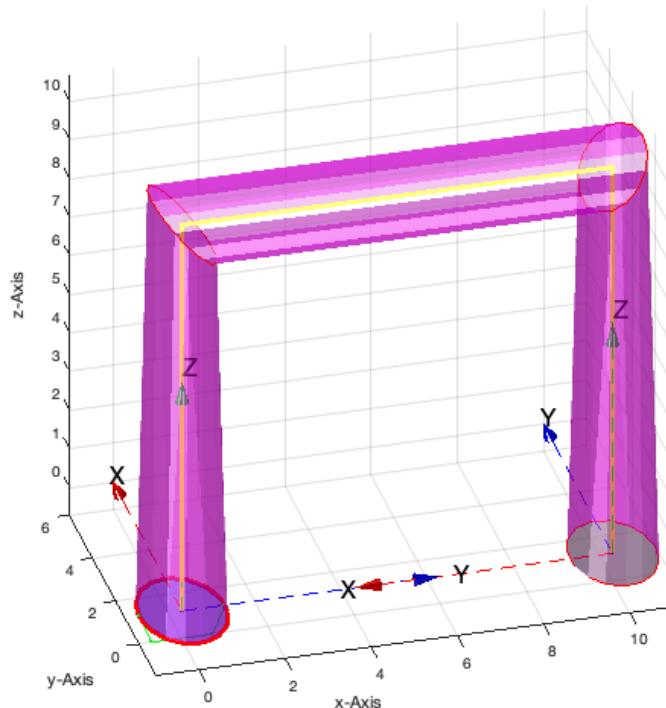
```
SGcontourtube2(PLcircle(1, '^', '^', 1.5), VLsample(14));
```

publishSGPDF: 2023-10-03 08:37:06



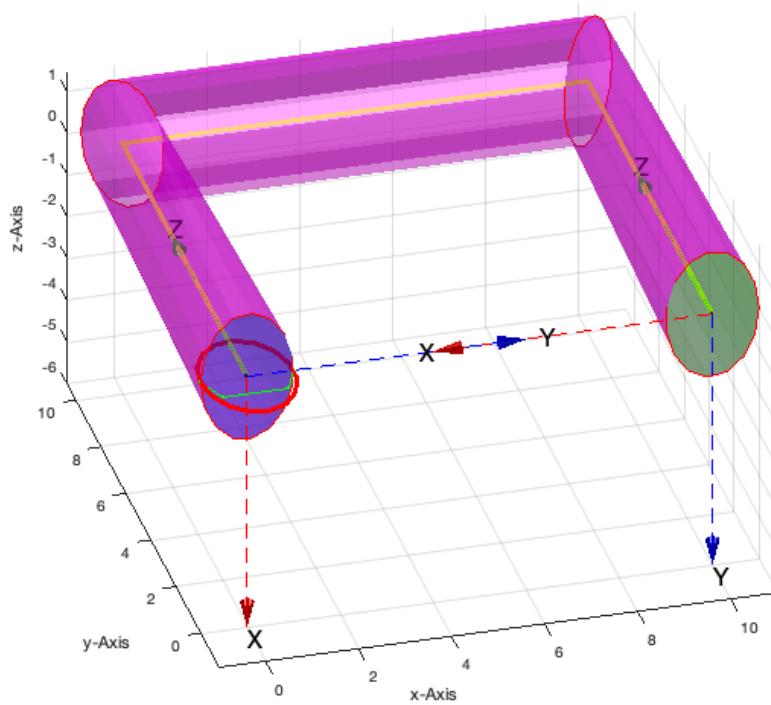
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(20));
```

publishSGPDF: 2023-10-03 08:37:07



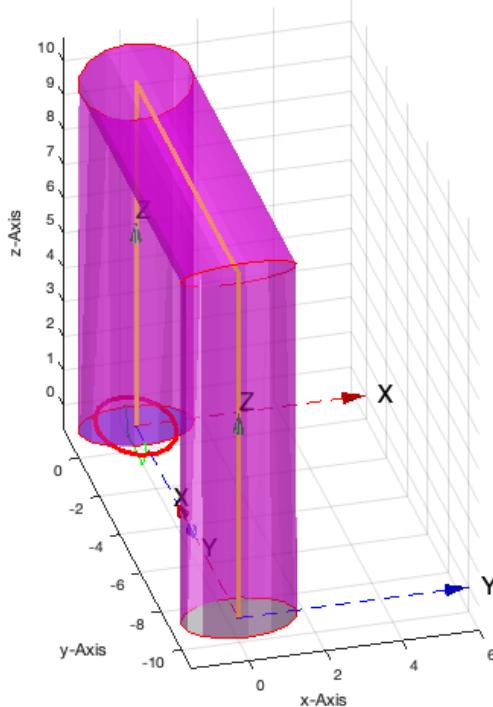
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(21));
```

publishSGPDF: 2023-10-03 08:37:09



```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLsample(22));
```

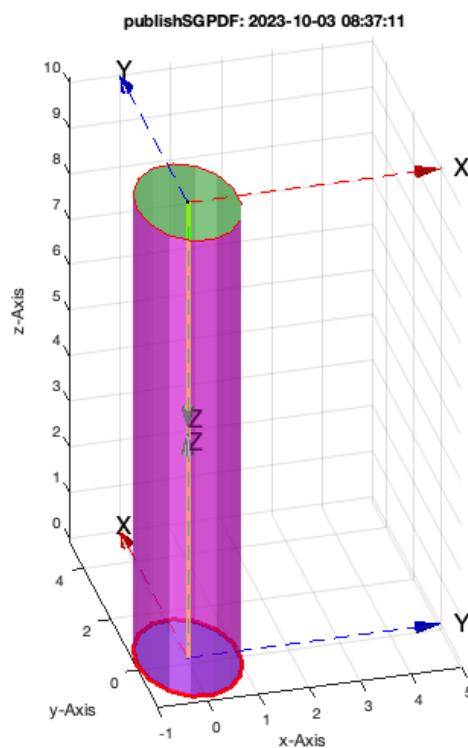
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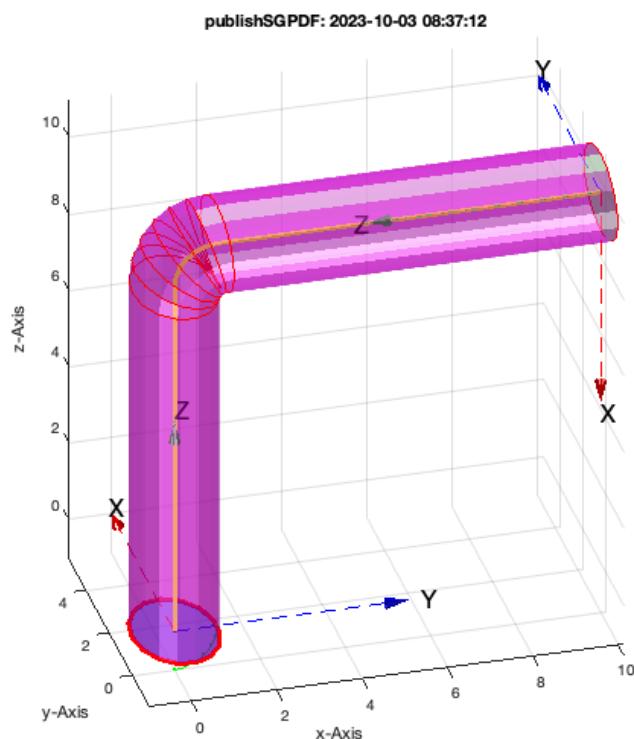
Creating Solid Geometries open

If angles are larger than 90 degree ($\pi/2$)

```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(2)));
```

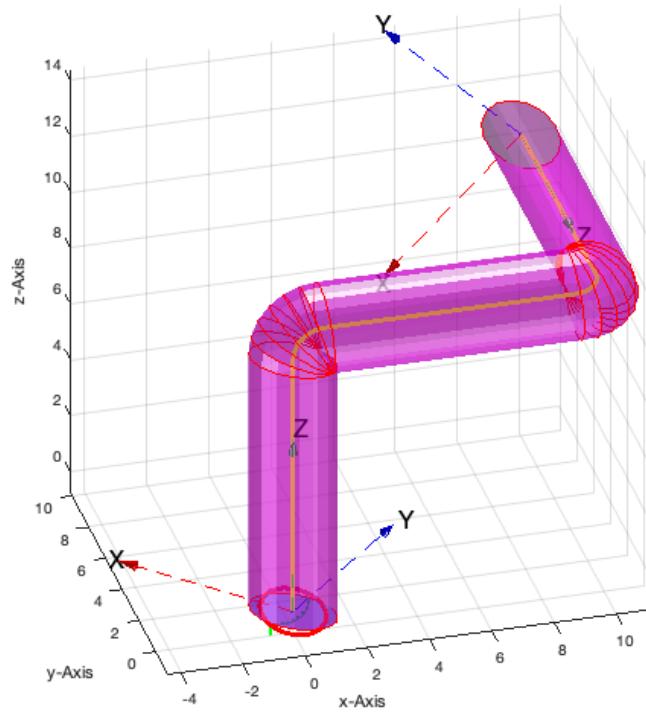


```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(3)));
```



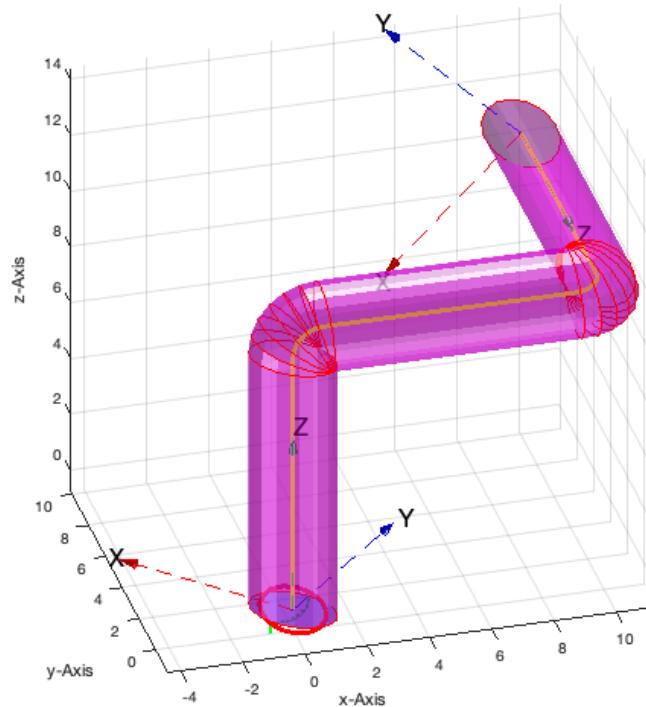
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(7)));
```

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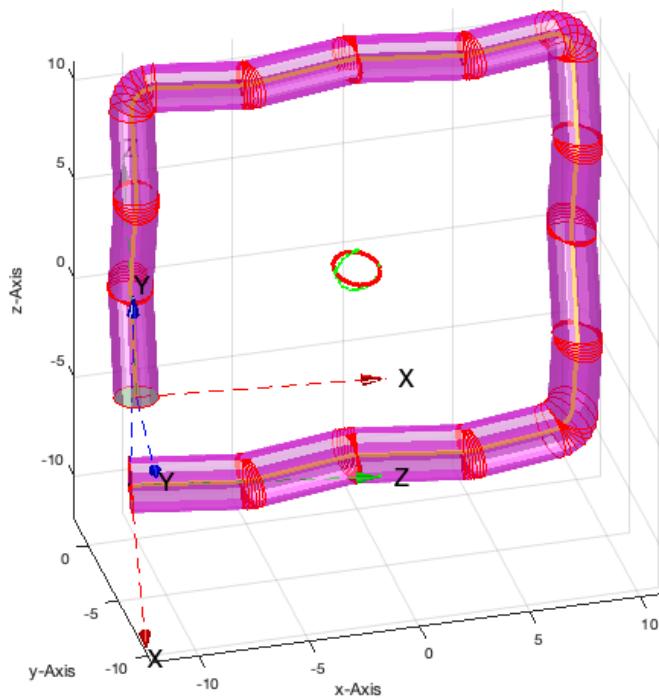
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(8)));
```

publishSGPDF: 2023-10-03 08:37:15



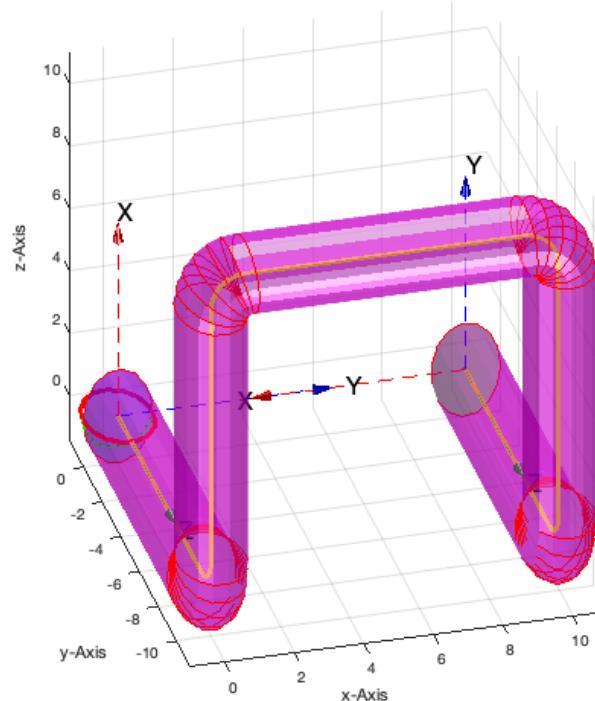
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(12)));
```

publishSGPDF: 2023-10-03 08:37:17



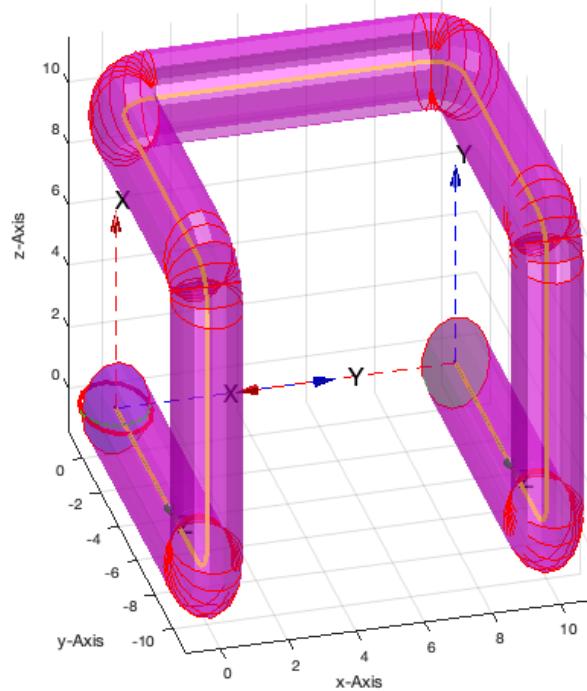
```
SGcontourtube2(PLcircle(1, '^', '^', 1.5), VLradialEdges(VLsample(13)));
```

publishSGPDF: 2023-10-03 08:37:18



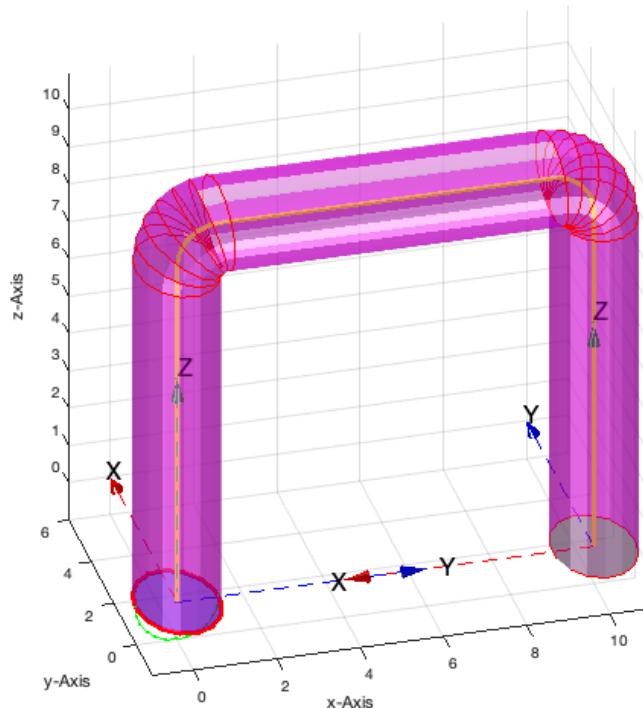
```
SGcontourtube2(PLcircle(1, '^', '^', 1.5), VLradialEdges(VLsample(14)));
```

publishSGPDF: 2023-10-03 08:37:20



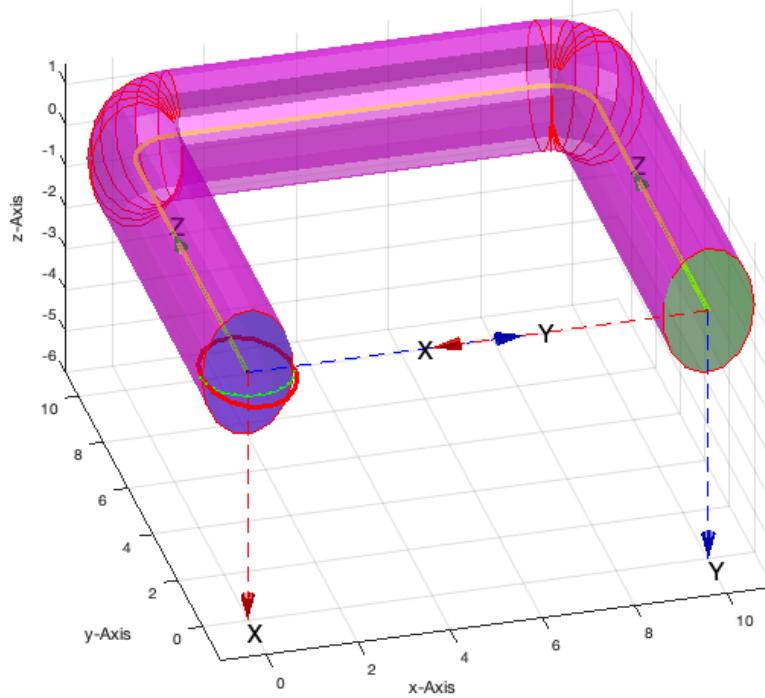
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(20)));
```

publishSGPDF: 2023-10-03 08:37:21



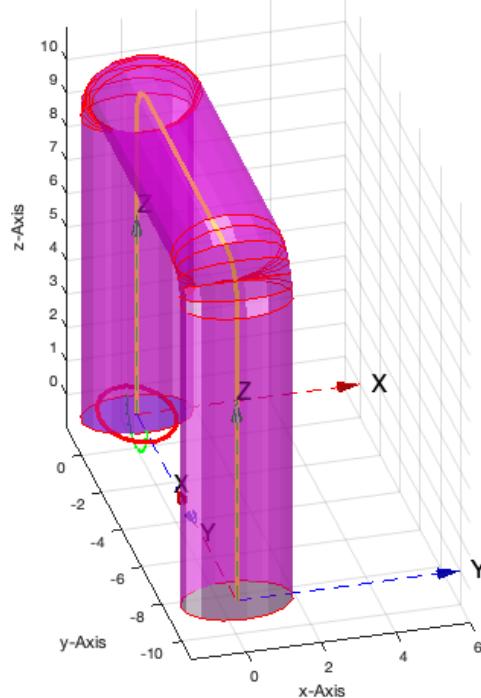
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(21)));
```

publishSGPDF: 2023-10-03 08:37:22



```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(VLsample(22)));
```

publishSGPDF: 2023-10-03 08:37:24

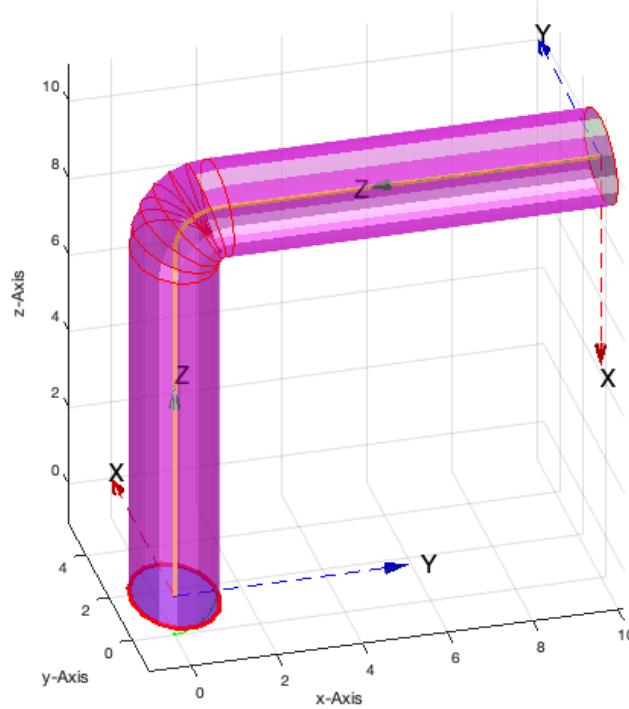


Creating Solid Geometries open

If angles are larger than 90 degree ($\pi/2$)

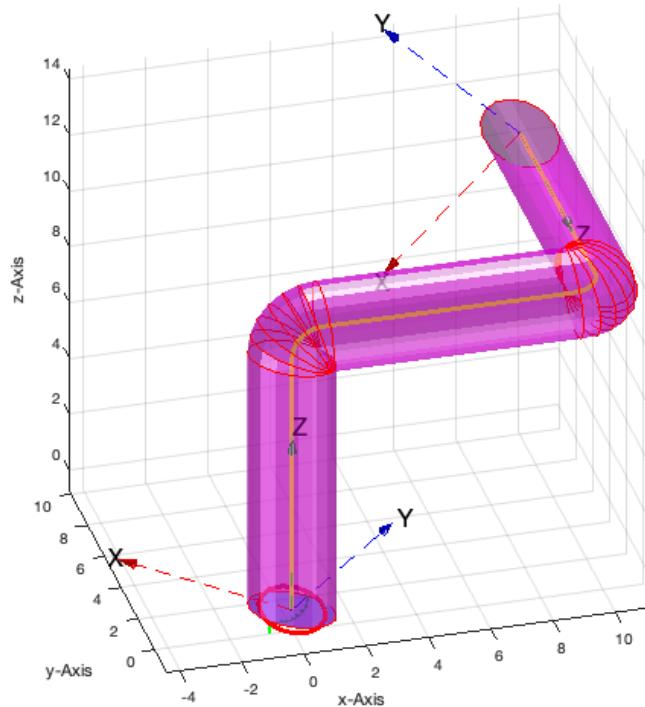
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(3))));
```

publishSGPDF: 2023-10-03 08:37:25



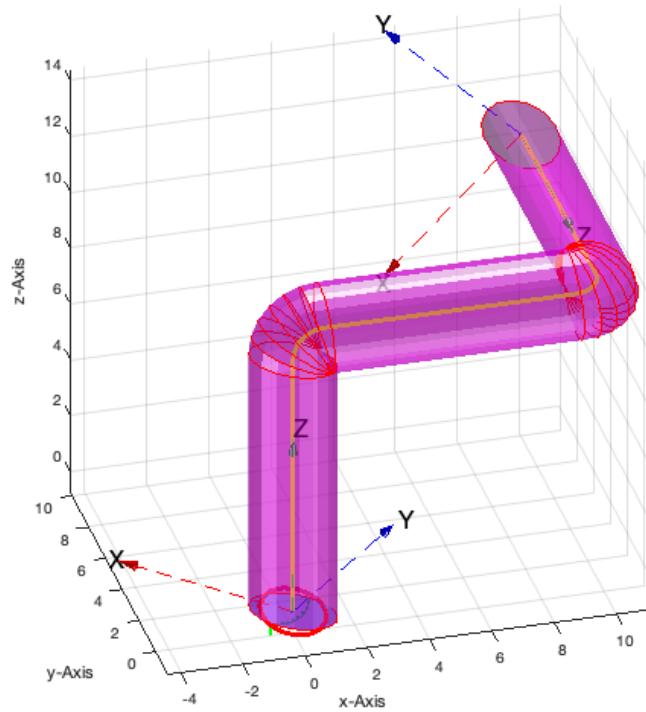
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(7))));
```

publishSGPDF: 2023-10-03 08:37:27



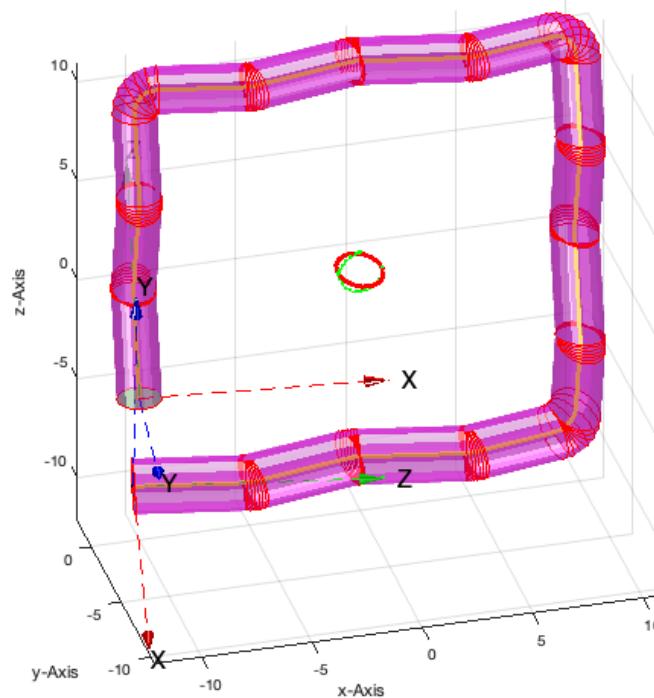
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(8))));
```

publishSGPDF: 2023-10-03 08:37:28



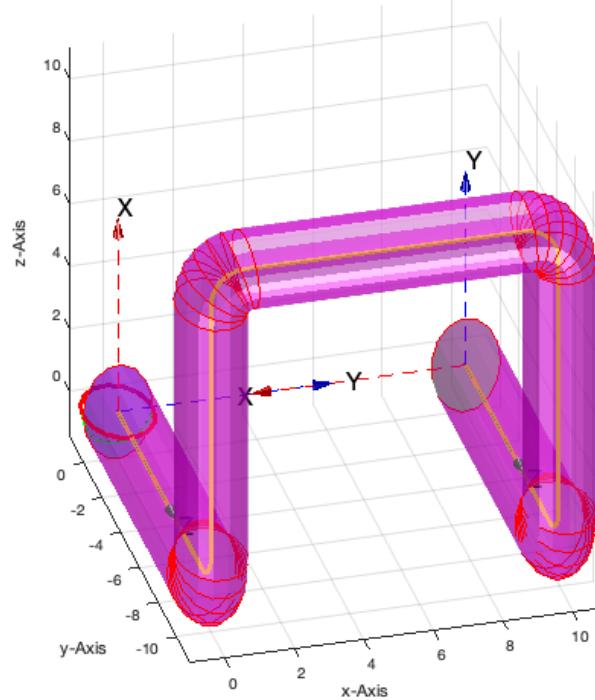
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(12))));
```

publishSGPDF: 2023-10-03 08:37:29



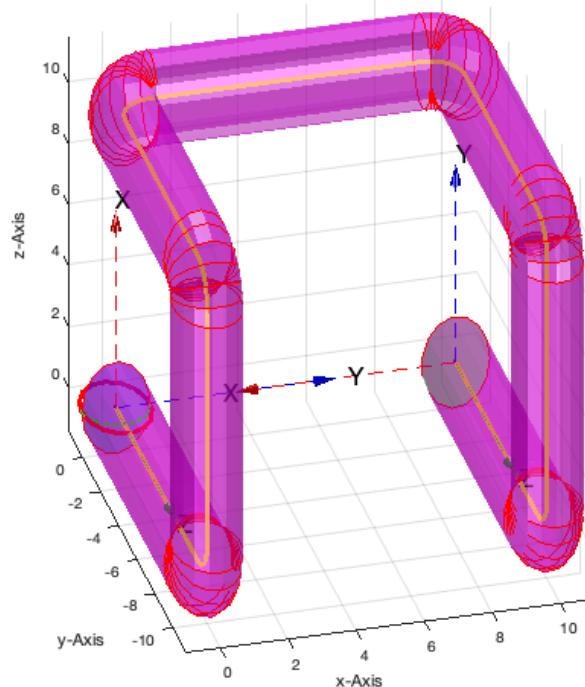
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(13))));
```

publishSGPDF: 2023-10-03 08:37:31



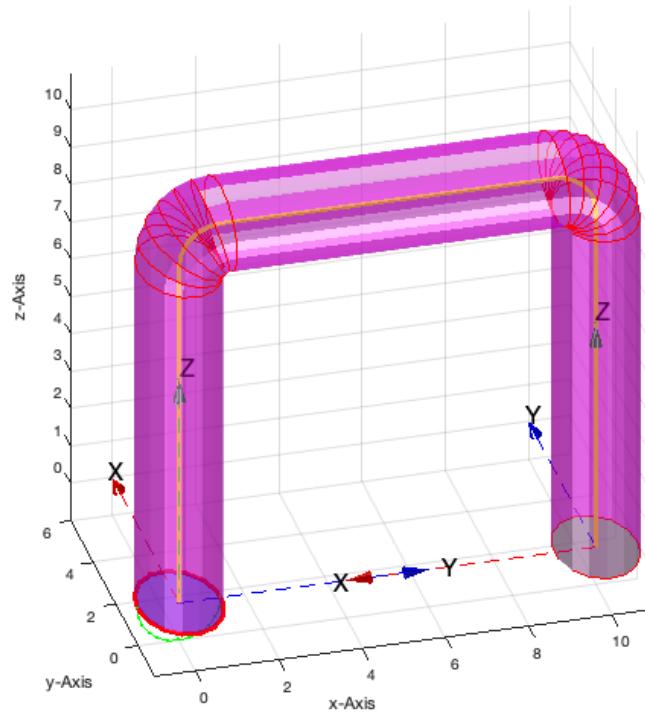
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(14))));
```

publishSGPDF: 2023-10-03 08:37:32



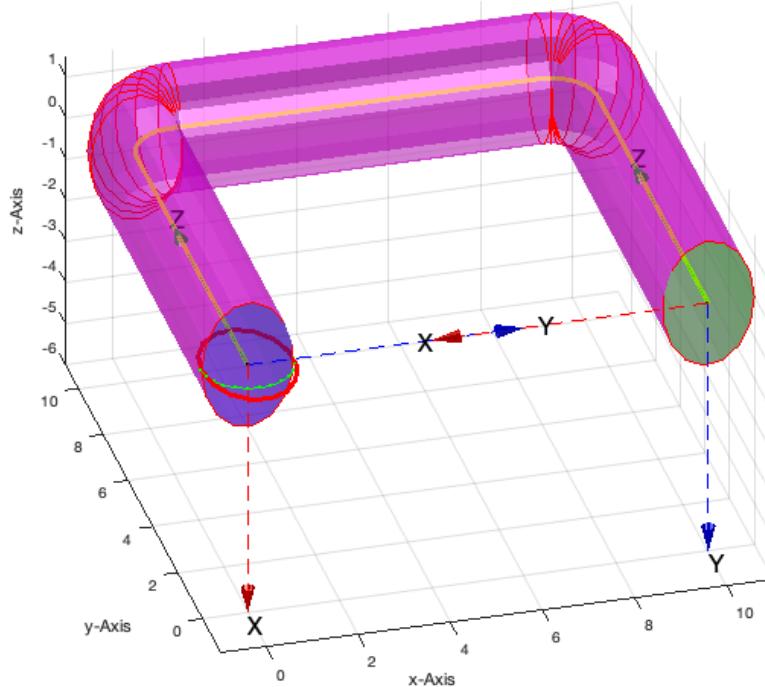
```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(20))));
```

publishSGPDF: 2023-10-03 08:37:34

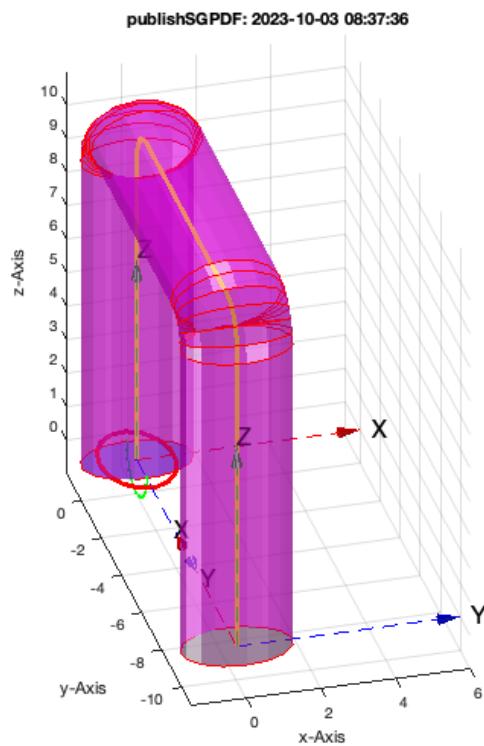


```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(21))));
```

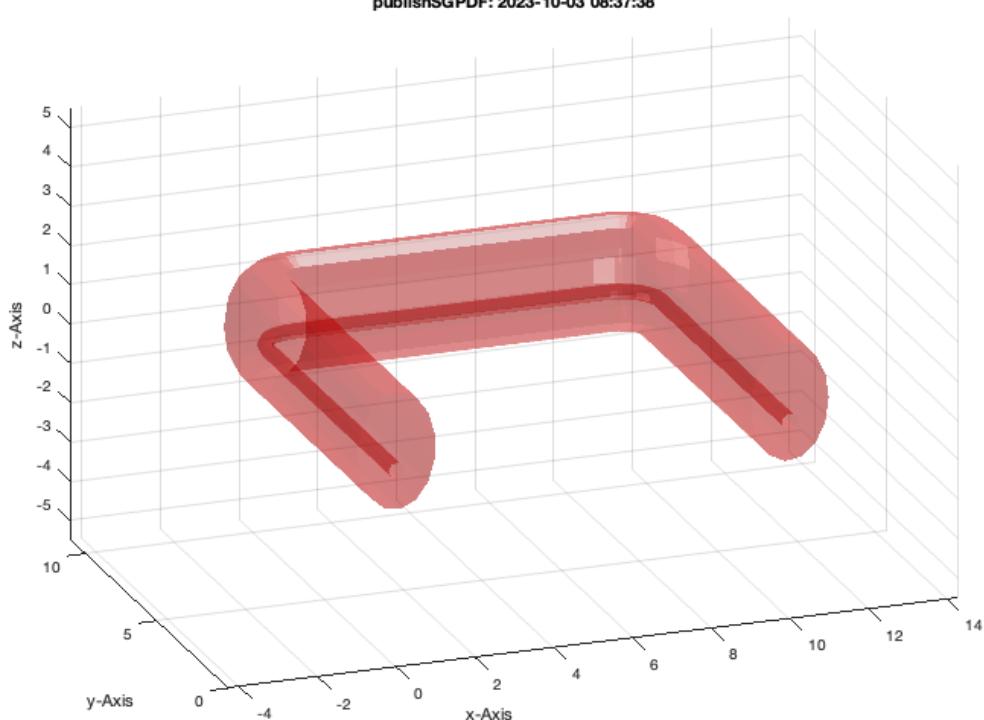
publishSGPDF: 2023-10-03 08:37:35



```
SGcontourtube2(PLcircle(1, 1, 1, 1.5), VLradialEdges(CVLofVL(VLsample(22))));
```



```
SGcontourtube2([PLcircle(1,'','',[1.5];NaN NaN;PLcircle(0.2)+[0 0.5]),VLradialEdges(VLsample(21))); SG=ans;
SGfigure(SG);VLFLplotlight(1,0.3); view(-20,20);
```



1. Conversion between triangle surface model and tetrahedron volumen model

Final Remarks

```
close all
```

VLFLlicense

```
This VLFL-Lib, Rel. (2023-Oct-03), is for limited non commercial educational use only!
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Please contact Tim Lueth, Professor at TU Munich, Germany!
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Executed 03-Oct-2023 08:37:41 by 'timlueth' on a MACI64 using Mac OSX 13.6 | R2023a Update 5 | SG-Lib 5.4
===== Used Matlab products: =====
database_toolbox
distrib_computing_toolbox
fixed_point_toolbox
image_toolbox
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