Exercise 23: Automatic Creation of a Missing Link and 3D Print of a Complete Model

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Contents

- 1. Summary of the already explained aspects of the VLFL-Toolbox
- 2. Open a system and create several fixed nodes and attach revolute joints
- 3. Create a cylindric joint from two solids an attach it to revolute joint
- 4. Attach two frame sensor to record the movement of the falling cylinder
- 5. Show the Simulation
- 6. Now create a solid between the revolute joint and cylindric joint
- 7. Now connect the new solid in the model
- 8. Show the Simulation: The Mechnism has no Movement anymore
- 9. Now Create a Solid Model of Movement Status at Time = 0.1 Seconds
- Final Remarks

1. Summary of the already explained aspects of the VLFL-Toolbox

The previous examples of this series covered the following topics:

- Example 01: First Steps Using the VLFL-Toolbox for Solid Object Design
- Example 02: Using the VLFL-Toolbox for STL-File Export and Import
- Example 03: Closed 2D Contours and Boolean Operations in 2D
- Example 04: 2.5D Design Using Boolean Operators on Closed Polygon Lists (CPL)
- Example 05: Creation, Relative Positioning and Merging of Solid Geometries (SG)
- Example 06: Relative Positioning and Alignment of Solid Geometries (SG)
- Example 07: Rotation of Closed Polygon Lists for Solid Geometry Design
- Example 08: Slicing, Closing, Cutting and Separation of Solid Geometries
- Example 09: Boolean Operations with Solid Geometries
- Example 10: Packaging of Sets of Solid Geometries (SG)
- Example 11: Attaching Coordinates Frames to Create Kinematik Models
- Example 12: Define Robot Kinematics and Detect Collisions
- Example 13: Mounting Faces and Conversion of Blocks into Leightweight-structures
- Example 14: Manipulation Functions for Closed Polygons and Laser Cutting (SVG)
- Example 15: Create a Solid by 2 Closed Polygons
- Example 16: Create a Solid along a contour
- Example 20: Programmaticaly Interface to SimMechanics Multi-Body Toolbox
- Example 21: Programmaticaly Design of SimMechanisms Mechanisms and Simulink Signals
- Example 22: Creation of fixed nodes for the assembly of joints
- Example 23: Automatic Creation of a Missing Link and 3D Print of a Complete Model

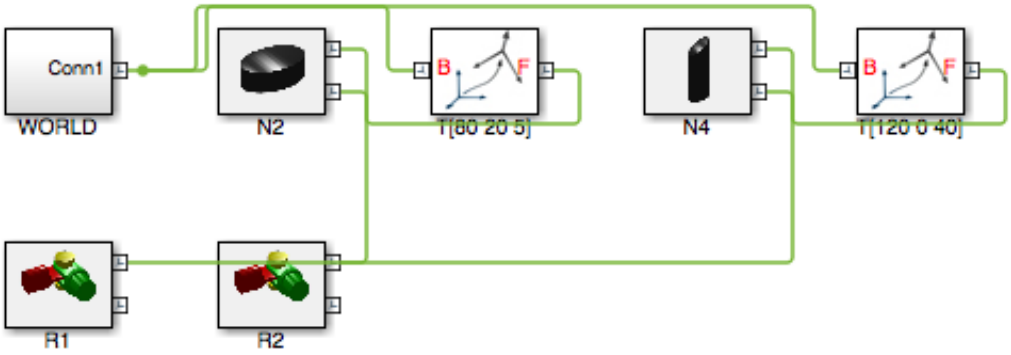
2. Open a system and create several fixed nodes and attach revolute joints

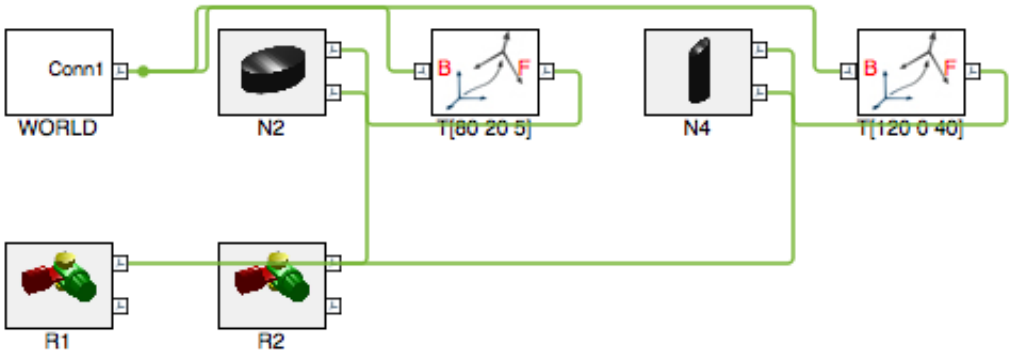
```
function VLFL_EXP23
```

```
smbNewSystem ('SG_LIB_EXP_23');

smbCreateSGNode ([80  20  5],'N2');
smbCreateSGNode ([120 0 40],'N4','',rot(0,-pi/8,0));
A=SGmodelJoint('R',pi/2);
smbCreateSGJoint('R','R1', A,'N4.F');
smbCreateSGJoint('R','R2',A,'N2.F');
smbDrawNow;
```

```
Creating temporary directory '/Users/lueth/Desktop/tmp_SG_LIB_EXP_23/'
```





3. Create a cylindric joint from two solids an attach it to revolute joint

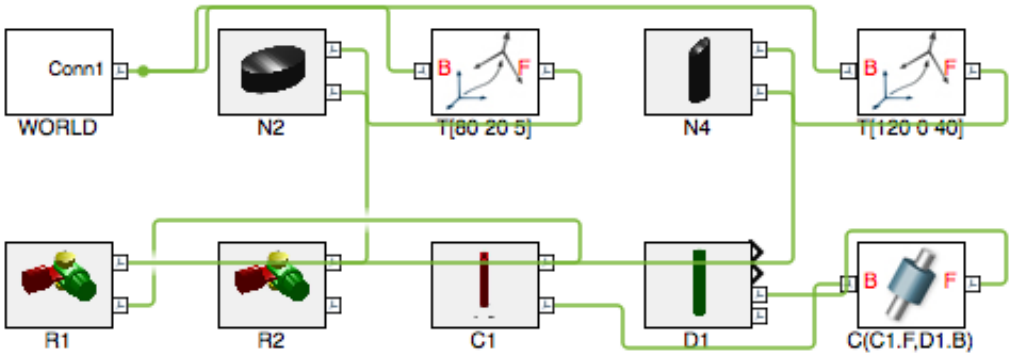
```
Ro=5;
Ri=3;
slot=0.3;

C1=SGofCPLz([PLcircle(Ro);NaN NaN;PLcircle(Ri+slot)],30);
% C1=SGTset(C1,'B',TofSG(C1,'bottom','roty',pi));
```

```
C1=SGTset(C1,'B',TofSG(C1,'incenter','right',-1,'roty',pi/2));
C1=SGTset(C1,'F',TofSG(C1,'bottom'));
smbCreateSG(C1,'C1','r','R1_M');
D1=SGofCPLz(PLcircle(3),30);
D1=SGTset(D1,'B',TofSG(D1,'incenter'));
D1=SGTset(D1,'F',TofSG(D1,'top'));
```

4. Attach two frame sensor to record the movement of the falling cylinder

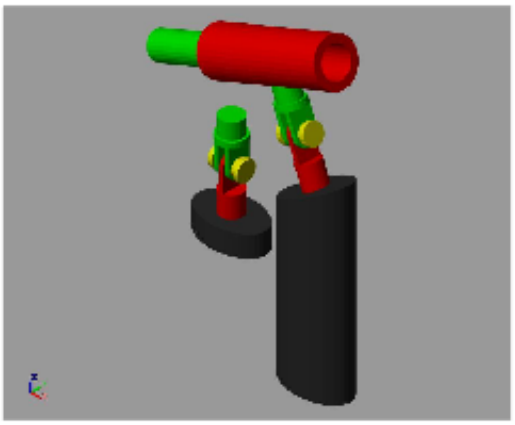
```
smbCreateSG(D1,'D1','g');
smbCreateConnection('C1.F','D1.B','C');
smbAddFrameSensor('R2_M.F');
smbAddFrameSensor('D1.F');
smbDrawNow;
```



5. Show the Simulation

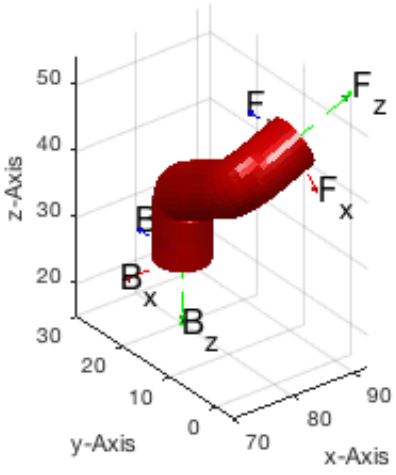
```
simOut=smbSimulate(0.1);
smbVideoSimulation(1);
```

....



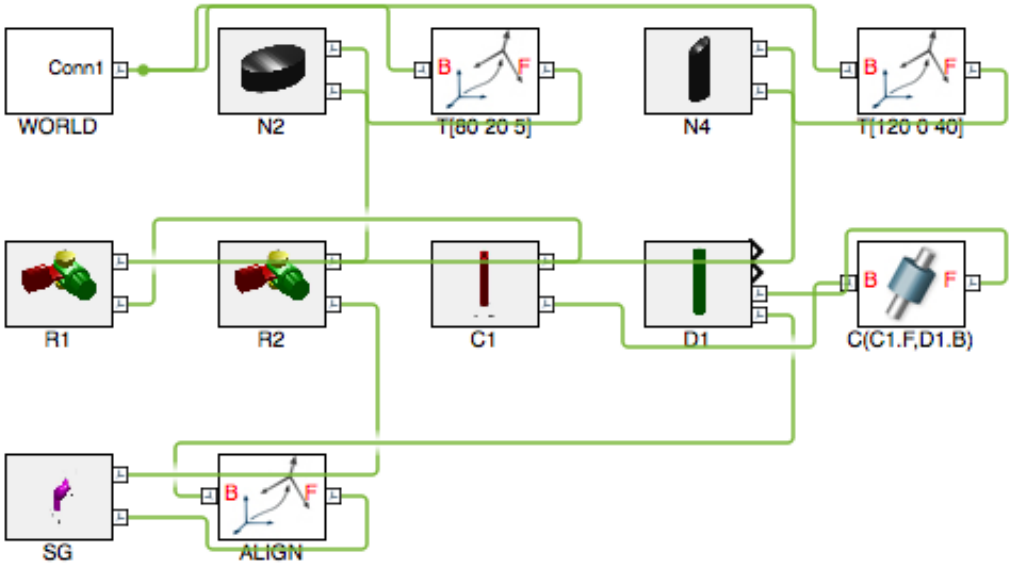
6. Now create a solid between the revolute joint and cylindric joint

```
[T,ta]=smbTofSimOut(simOut,'R2_M.F'); T1=squeeze(T(:,:,1));
[T,tb]=smbTofSimOut(simOut,'D1.F');   T2=squeeze(T(:,:,1));
SG=SGof2T(T1,T2*TofR(rot(0,pi,0)),'',4); % Radius 4
SGTplot(SG);
```



7. Now connect the new solid in the model

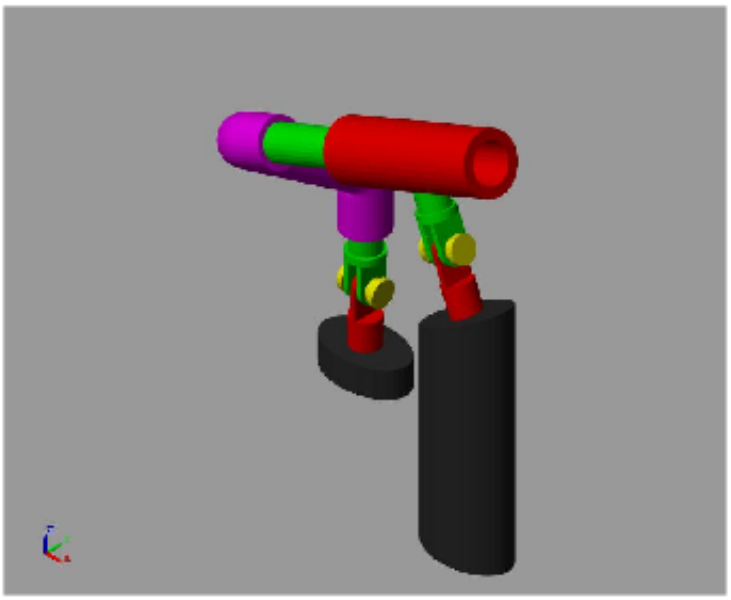
```
smbCreateSG(SG,'SG','m');
smbCreateConnection('R2_M','SG.B');
smbCreateConnection('D1.F','SG.F','align');
smbDrawNow;
```



8. Show the Simulation: The Mechnism has no Movement anymore

```
smbVideoSimulation(1);
```

...



9. Now Create a Solid Model of Movement Status at Time = 0.1 Seconds

```
SG=smbFullModelSimulation(0.1);
```

```
SGfigure; SGplot(SG); view (7,20);
```

```
CREATING A FULL SOLID-MOVEMENT SIMULATION-MODEL 'SG_LIB_EXP_23' THAT RUNS At LEAST 0.10 SEC
ONDS
================================================================================================
========
Adding frame sensors for all solids of the model
Add frame sensors for 'C1.SG'
Add frame sensors for 'D1.SG'
Add frame sensors for 'N2.SG'
Add frame sensors for 'N4.SG'
Add frame sensors for 'R1.FIX1.SG'
Add frame sensors for 'R1_M.SG'
Add frame sensors for 'R1_S.SG'
Add frame sensors for 'R2.FIX1.SG'
Add frame sensors for 'R2_M.SG'
Add frame sensors for 'R2_S.SG'
Add frame sensors for 'SG.SG'
================================================================================================
========

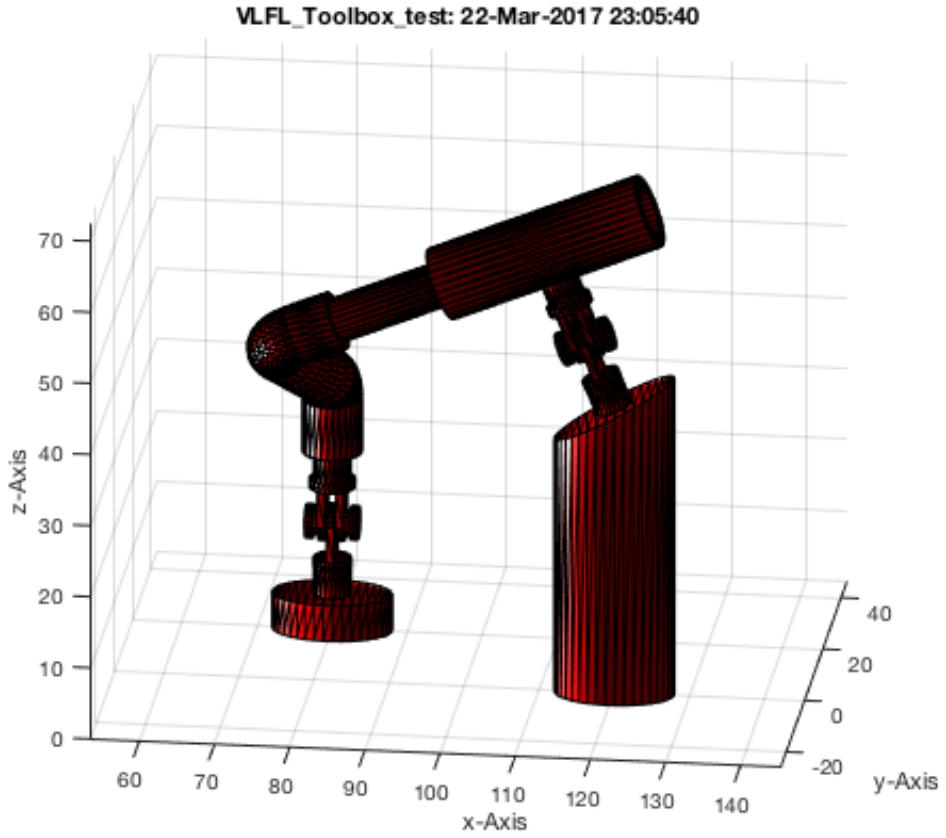
Simulink.SimulationOutput:

    simlog: [1×1 simscape.logging.Node]
      sout: [1×1 Simulink.SimulationData.Dataset]
      tout: [51×1 double]
      xout: [1×1 Simulink.SimulationData.Dataset]

Use 'get' to access a variable by name.
Use 'getSimulationMetadata' to access metadata about the simulation.

LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_C1.stl
Header:
Number of facets: 232
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_D1.stl
Header:
Number of facets: 96
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_N2.stl
Header:
Number of facets: 156
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_N4.stl
Header:
Number of facets: 156
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_R1.FIX1.stl
Header:
Number of facets: 240
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_R1_M.stl
Header:
Number of facets: 456
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_R1_S.stl
Header:
Number of facets: 448
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_R2.FIX1.stl
Header:
Number of facets: 240
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_R2_M.stl
```

```
Header:
Number of facets: 456
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_R2_S.stl
Header:
Number of facets: 448
0..LOADING BINARY STL-File: /Users/lueth/Desktop/tmp_SG_LIB_EXP_23/sbm_temp_SG.stl
Header:
Number of facets: 1214
0..
CREATED A SOLID GEOMETRY OF THE FULL SIMULATION-MODEL 'SG_LIB_EXP_23' AT TIME: 0.10 SECONDS
================================================================================================
========
```



Write the STL file on disk for 3D printing

```
SGwriteSTL(SG);
```

Final Remarks

```
VLFLlicense
```

```
This VLFL-Lib, Rel. 3.6 (2017-Mar-23), is for limited non commercial educational use only!
Licensee: 3.6 Tim Lueth for academic and education 05-Mar-2017 !
Please contact Tim Lueth, Professor at TU Munich, Germany!
WARNING: This VLFL-Lib (Rel. 3.6) license will exceed at 18-Mar-2018!
```

```
Executed 22-Mar-2017 23:05:43 by 'lueth' using Matlab 9.1.0.441655 (R2016b) on a MACI64
======================================== Used Matlab products: ============================
==========
map_toolbox
matlab
robotics_system_toolbox
simmechanics
simscape
simulink
================================================================================================
==========
```

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