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Final humman application

|  |  |
| --- | --- |
| Report date | Dec 18, 2024, 12:08:33 AM |

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# Global Definitions

|  |  |
| --- | --- |
| Date | Dec 18, 2024, 12:02:50 AM |

Global settings

|  |  |
| --- | --- |
| Name | Final humman application.mph |
| Path | C:\Users\10\Downloads\Final humman application.mph |
| Version | COMSOL Multiphysics 6.2 (Build: 290) |
| Unit system | SI |

Used products

|  |
| --- |
| Multibody Dynamics Module |
| COMSOL Multiphysics |

Computer information

|  |  |
| --- | --- |
| CPU | Intel64 Family 6 Model 142 Stepping 12, 4 cores, 7.77 GB RAM |
| Operating system | Windows 10 |

## Parameters

Parameters 1

| **Name** | **Expression** | **Value** | **Description** |
| --- | --- | --- | --- |
| m\_head | 7.24[kg] | 7.24 kg | Mass of head |
| I\_head | 0.411[kg\*m^2] | 0.411 kg·m² | Moment of inertia of head |
| m\_torso | 19.9[kg] | 19.9 kg | Mass of torso |
| I\_torso | 1.627[kg\*m^2] | 1.627 kg·m² | Moment of inertia of torso |
| m\_pelvis | 11.01[kg] | 11.01 kg | Mass of pelvis |
| I\_pelvis | 0.692[kg\*m^2] | 0.692 kg·m² | Moment of inertia of pelvis |
| m\_thigh | 20.35[kg] | 20.35 kg | Mass of thigh |
| I\_thigh | 1.18[kg\*m^2] | 1.18 kg·m² | Moment of inertia of thigh |
| m\_viscera | 12.92[kg] | 12.92 kg | Mass of viscera |
| k\_head\_torso\_trans | 113.7 | 113.7 | [kN/m] Translational stiffness: Head-Torso |
| c\_head\_torso\_trans | 0.066 | 0.066 | [kN·s/m] Translational damping: Head-Torso |
| k\_torso\_pelvis\_trans | 0.299 | 0.299 | [kN/m] Translational stiffness: Torso-Pelvis |
| c\_torso\_pelvis\_trans | 1.79 | 1.79 | [kN·s/m] Translational damping: Torso-Pelvis |
| k\_pelvis\_thigh\_trans | 6.40 | 6.4 | [kN/m] Translational stiffness: Pelvis-Thigh |
| c\_pelvis\_thigh\_trans | 0.061 | 0.061 | [kN·s/m] Translational damping: Pelvis-Thigh |
| k\_thigh\_leg\_trans | 23.55 | 23.55 | [kN/m] Translational stiffness: Thigh-Leg |
| c\_thigh\_leg\_trans | 0.154 | 0.154 | [kN·s/m] Translational damping: Thigh-Leg |
| k\_head\_torso\_rot | 0.915 | 0.915 | [kN·m/rad] Rotational stiffness: Head-Torso |
| c\_head\_torso\_rot | 0.340 | 0.34 | [kN·m·s/rad] Rotational damping: Head-Torso |
| k\_torso\_pelvis\_rot | 0.328 | 0.328 | [kN·m/rad] Rotational stiffness: Torso-Pelvis |
| c\_torso\_pelvis\_rot | 0.724 | 0.724 | [kN·m·s/rad] Rotational damping: Torso-Pelvis |
| k\_pelvis\_thigh\_rot | 0.162 | 0.162 | [kN·m/rad] Rotational stiffness: Pelvis-Thigh |
| c\_pelvis\_thigh\_rot | 0.030 | 0.03 | [kN·m·s/rad] Rotational damping: Pelvis-Thigh |
| k\_thigh\_leg\_rot | 0.220 | 0.22 | [kN·m/rad] Rotational stiffness: Thigh-Leg |
| c\_thigh\_leg\_rot | 0.104 | 0.104 | [kN·m·s/rad] Rotational damping: Thigh-Leg |
| k\_viscera\_torso\_trans | 1.93 | 1.93 | [kN/m] Translational stiffness: Viscera-Torso |
| c\_viscera\_torso\_trans | 0.079 | 0.079 | [kN·s/m] Translational damping: Viscera-Torso |
| k\_viscera\_pelvis\_trans | 18.37 | 18.37 | [kN/m] Translational stiffness: Viscera-Pelvis |
| c\_viscera\_pelvis\_trans | 0.197 | 0.197 | [kN·s/m] Translational damping: Viscera-Pelvis |
| k\_seat\_pelvis\_trans | 121.3 | 121.3 | [kN/m] Translational stiffness: Seat-Pelvis |
| c\_seat\_pelvis\_trans | 0.047 | 0.047 | [kN·s/m] Translational damping: Seat-Pelvis |
| k\_seat\_thigh\_trans | 16.71 | 16.71 | [kN/m] Translational stiffness: Seat-Thigh |
| c\_seat\_thigh\_trans | 8.01 | 8.01 | [kN·s/m] Translational damping: Seat-Thigh |
| k1 | 113.7[kN/m] | 1.137E5 N/m | Translational stiffness, head-torso joint |
| c1 | 0.066[kN/(m/s)] | 66 N·s/m | Translational damping coefficient, head-torso joint |
| kr1 | 0.915[kN\*m/rad] | 915 N·m/rad | Rotational stiffness, head-torso joint |
| cr1 | 0.340[kN\*m/(rad/s)] | 340 N·m·s/rad | Rotational damping coefficient, head-torso joint |
| k2 | 0.299[kN/m] | 299 N/m | Translational stiffness, torso-pelvis joint |
| c2 | 1.79[kN/(m/s)] | 1790 N·s/m | Translational damping coefficient, torso-pelvis joint |
| kr2 | 0.328[kN\*m/rad] | 328 N·m/rad | Rotational stiffness, torso-pelvis joint |
| cr2 | 0.724[kN\*m/(rad/s)] | 724 N·m·s/rad | Rotational damping coefficient, torso-pelvis joint |
| k3 | 6.40[kN/m] | 6400 N/m | Translational stiffness, pelvis-thigh joint |
| c3 | 0.061[kN/(m/s)] | 61 N·s/m | Translational damping coefficient, pelvis-thigh joint |
| kr3 | 0.162[kN\*m/rad] | 162 N·m/rad | Rotational stiffness, pelvis-thigh joint |
| cr3 | 0.030[kN\*m/(rad/s)] | 30 N·m·s/rad | Rotational damping coefficient, pelvis-thigh joint |
| k4 | 23.55[kN/m] | 23550 N/m | Translational stiffness, thigh-leg joint |
| c4 | 0.154[kN/(m/s)] | 154 N·s/m | Translational damping coefficient, thigh-leg joint |
| kr4 | 0.220[kN\*m/rad] | 220 N·m/rad | Rotational stiffness, thigh-leg joint |
| cr4 | 0.104[kN\*m/(rad/s)] | 104 N·m·s/rad | Rotational damping coefficient, thigh-leg joint |
| kh5 | 1.93[kN/m] | 1930 N/m | Horizontal stiffness, viscera-torso joint |
| ch5 | 0.079[kN/(m/s)] | 79 N·s/m | Horizontal damping coefficient, viscera-torso joint |
| kv6 | 18.37[kN/m] | 18370 N/m | Vertical stiffness, viscera-pelvis joint |
| cv6 | 0.197[kN/(m/s)] | 197 N·s/m | Vertical damping coefficient, viscera-pelvis joint |
| kh7 | 0.905[kN/m] | 905 N/m | Horizontal stiffness, seat-pelvis joint |
| ch7 | 0.015[kN/(m/s)] | 15 N·s/m | Horizontal damping coefficient, seat-pelvis joint |
| kv7 | 121.3[kN/m] | 1.213E5 N/m | Vertical stiffness, seat-pelvis joint |
| cv7 | 0.047[kN/(m/s)] | 47 N·s/m | Vertical damping coefficient, seat-pelvis joint |
| kh8 | 0.614[kN/m] | 614 N/m | Horizontal stiffness, seat-thigh joint |
| ch8 | 0.014[kN/(m/s)] | 14 N·s/m | Horizontal damping coefficient, seat-thigh joint |
| kv8 | 16.71[kN/m] | 16710 N/m | Vertical stiffness, seat-thigh joint |
| cv8 | 8.01[kN/(m/s)] | 8010 N·s/m | Vertical damping coefficient, seat-thigh joint |
| vtt\_in | 1[m/s^2] | 1 m/s² | Input acceleration |
| i\_c | 1 | 1 | Damping controller |

# Component 1

|  |  |
| --- | --- |
| Date | Dec 11, 2024, 10:32:22 PM |

Settings

| **Description** | **Value** |
| --- | --- |
| Unit system | Same as global system (SI) |
| Geometry shape function | Automatic |

Spatial frame coordinates

| **First** | **Second** | **Third** |
| --- | --- | --- |
| x | y | z |

Material frame coordinates

| **First** | **Second** | **Third** |
| --- | --- | --- |
| X | Y | Z |

Geometry frame coordinates

| **First** | **Second** | **Third** |
| --- | --- | --- |
| Xg | Yg | Zg |

Mesh frame coordinates

| **First** | **Second** | **Third** |
| --- | --- | --- |
| Xm | Ym | Zm |

## Definitions

### Variables

#### Variables 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

| **Name** | **Expression** | **Unit** | **Description** |
| --- | --- | --- | --- |
| H\_vert | abs(mbd.rd2.u\_tty)/vtt\_in |  | Vertical transmissibility |
| H\_rot | abs(mbd.rd2.th\_ttz)/vtt\_in | rad/m | Rotational transmissibility |
| M\_a | abs(mbd.fxj7.Fy + mbd.fxj8.Fy)/vtt\_in | kg | Apparent mass |

### Variable Utilities

#### Participation Factors 1

|  |  |
| --- | --- |
| Tag | mpf1 |

Center of rotation

| **Description** | **Value** |
| --- | --- |
| Center of rotation | Center of mass |

### Coordinate Systems

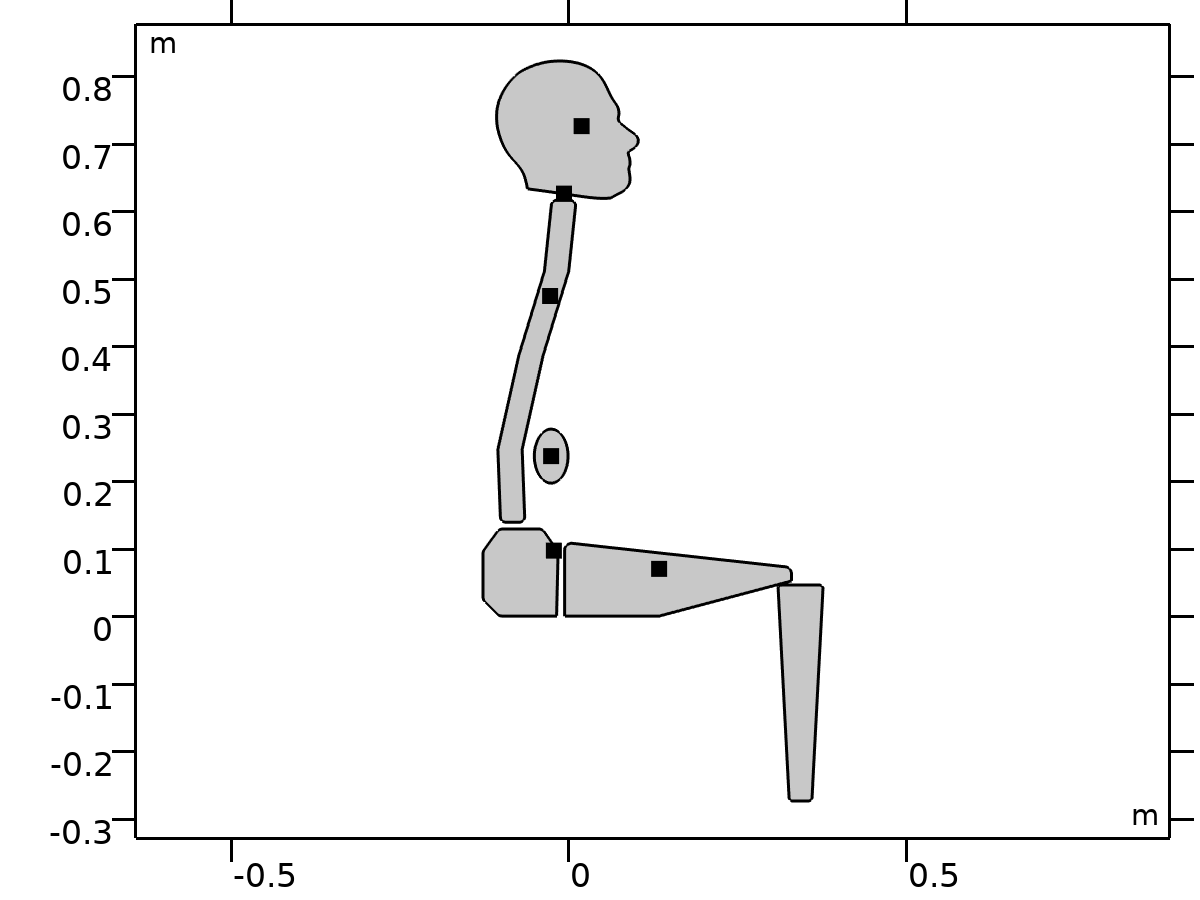
#### Boundary System 1

|  |  |
| --- | --- |
| Coordinate system type | Boundary system |
| Tag | sys1 |

Coordinate names

| **First** | **Second** | **Third** |
| --- | --- | --- |
| t1 | n | to |

## Geometry 1



Geometry 1

Units

|  |  |
| --- | --- |
| Length unit | m |
| Angular unit | deg |

Geometry statistics

| **Description** | **Value** |
| --- | --- |
| Space dimension | 2 |
| Number of domains | 6 |
| Number of boundaries | 67 |
| Number of vertices | 73 |

### Import 1 (imp1)

Domain net selections

| **Description** | **Value** |
| --- | --- |
| Source | COMSOL Multiphysics file |

Settings

| **Description** | **Value** |
| --- | --- |
| Filename | C:\Users\10\Downloads\seated\_human\_body.mphbin |

Information

| **Description** | **Value** |
| --- | --- |
| Details | Imported 6 solid objects from C:\Users\10\Downloads\seated\_human\_body.mphbin. |
| Last build time | < 1 second |
| Built with | COMSOL 6.2.0.290 (win64), Dec 11, 2024, 10:43:49 PM |

### Form Assembly (fin)

Settings

| **Description** | **Value** |
| --- | --- |
| Action | Form an assembly |

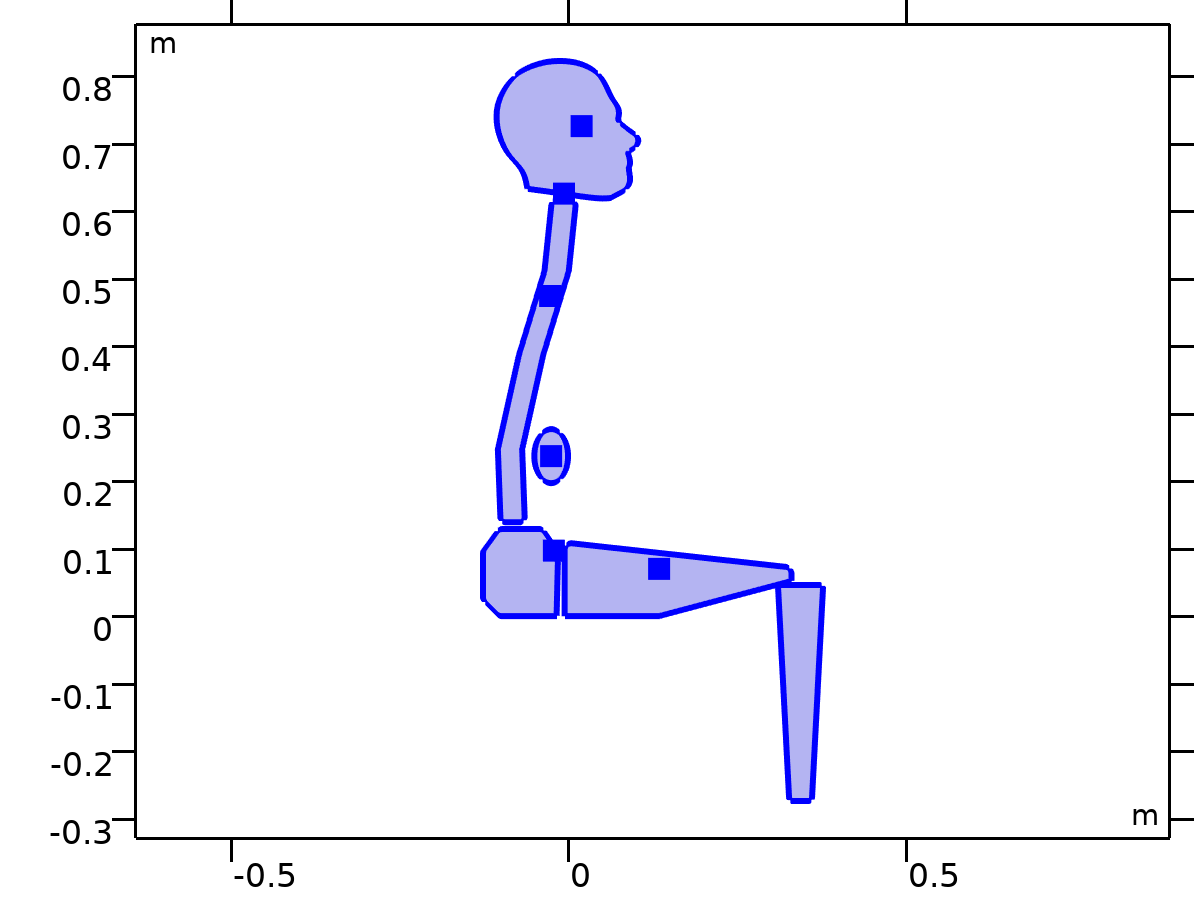
Information

| **Description** | **Value** |
| --- | --- |
| Details | {Formed assembly of 6 solid objects., Assembly has 6 domains, 67 boundaries, and 73 vertices.} |
| Last build time | < 1 second |
| Built with | COMSOL 6.2.0.290 (win64), Dec 11, 2024, 10:46:55 PM |

## Multibody Dynamics

Used products

|  |
| --- |
| Multibody Dynamics Module |
| COMSOL Multiphysics |



Multibody Dynamics

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: All domains |

Equations



### Interface Settings

#### Physics Symbols

Settings

| **Description** | **Value** |
| --- | --- |
| Enable physics symbols | Off |

#### Discretization

Settings

| **Description** | **Value** |
| --- | --- |
| Displacement field | Linear |

Settings

| **Description** | **Value** |
| --- | --- |
| Equation form | Study controlled |

#### 2D Approximation

Settings

| **Description** | **Value** |
| --- | --- |
| 2D approximation | Plane strain |
| Out-of-plane mode extension (time-harmonic) | Off |

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Thickness | 1 | m |

#### Structural Transient Behavior

Settings

| **Description** | **Value** |
| --- | --- |
| Structural transient behavior | Include inertial terms |

#### Initial Values

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Center of rotation, x-component | 0 | m |
| Center of rotation, y-component | 0 | m |
| Center of rotation, z-component | 0 | m |
| Displacement at center of rotation, x-component | 0 | m |
| Displacement at center of rotation, y-component | 0 | m |
| Displacement at center of rotation, z-component | 0 | m |
| Velocity at center of rotation, x-component | 0 | m/s |
| Velocity at center of rotation, y-component | 0 | m/s |
| Velocity at center of rotation, z-component | 0 | m/s |
| Angle of rotation | 0 | rad |
| Angular velocity | 0 | rad/s |

#### Automated Model Setup

Settings

| **Description** | **Value** |
| --- | --- |
| Rigid domains selection | From physics interface |
| Include mass and moment of inertia node | On |
| Straight boundaries | Prismatic joint |
| Circular boundaries | Hinge joint |

#### Results

Settings

| **Description** | **Value** |
| --- | --- |
| Body defining reference frame | None |

#### Joints Summary

| **Joints** | **Source** | **Destination** |
| --- | --- | --- |
| Head-Torso | Head | Torso |
| Torso-Pelvis | Torso | Pelvis |
| Pelvis-Thigh | Pelvis | Thigh |
| Thigh-Leg | Thigh | Leg |
| Viscera-Torso | Viscera | Torso |
| Viscera-Pelvis | Viscera | Pelvis |
| Seat-Pelvis | Seat | Pelvis |
| Seat-Thigh | Seat | Thigh |
| Seat-Leg | Seat | Leg |

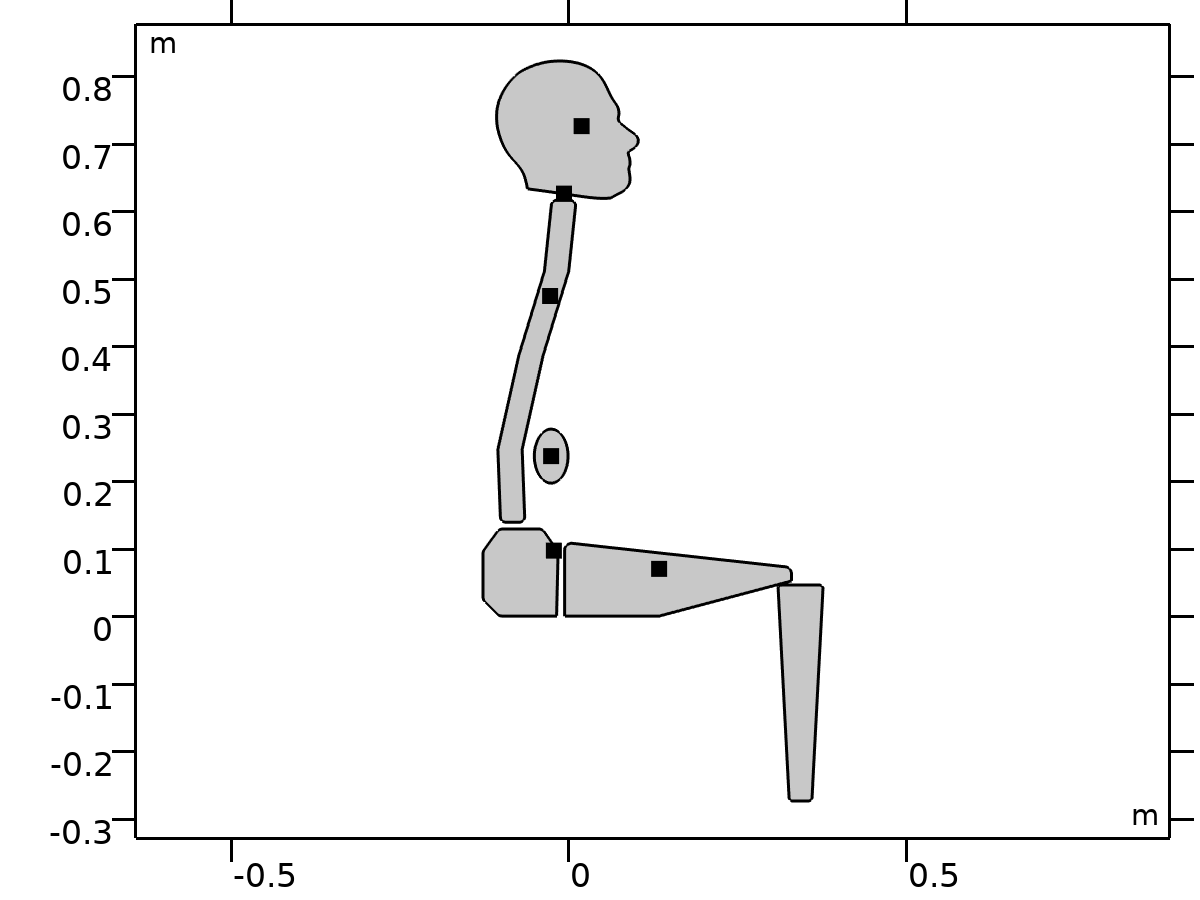
#### Rigid Body DOF Summary

|  | **N** | **DOF** | **Prescribed** | **Constraints** |
| --- | --- | --- | --- | --- |
| Rigid bodies | 6 | 18 | 0 | 1 |
| Fixed joints | 9 | 24 | 0 | 27 |
| Total | - | 42 | 0 | 28 |
| Net | - | 14 | - | - |

### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.X | X | m | Material coordinates, X-component | Domains 1–6 |  |
| mbd.Y | Y | m | Material coordinates, Y-component | Domains 1–6 |  |
| mbd.Z | 0 | m | Material coordinates, Z-component | Domains 1–6 |  |
| mbd.X | X | m | Material coordinates, X-component | Boundaries 1–67 |  |
| mbd.Y | Y | m | Material coordinates, Y-component | Boundaries 1–67 |  |
| mbd.Z | 0 | m | Material coordinates, Z-component | Boundaries 1–67 |  |
| mbd.x | x | m | Spatial coordinates, x-component | Domains 1–6 |  |
| mbd.y | y | m | Spatial coordinates, y-component | Domains 1–6 |  |
| mbd.z | 0 | m | Spatial coordinates, z-component | Domains 1–6 |  |
| mbd.x | x | m | Spatial coordinates, x-component | Boundaries 1–67 |  |
| mbd.y | y | m | Spatial coordinates, y-component | Boundaries 1–67 |  |
| mbd.z | 0 | m | Spatial coordinates, z-component | Boundaries 1–67 |  |
| mbd.uf | u | m | Displacement field, X-component | Domains 1–6 |  |
| mbd.vf | v | m | Displacement field, Y-component | Domains 1–6 |  |
| mbd.wf | 0 | m | Displacement field, Z-component | Domains 1–6 |  |
| mbd.uf | u | m | Displacement field, X-component | Boundaries 1–67 |  |
| mbd.vf | v | m | Displacement field, Y-component | Boundaries 1–67 |  |
| mbd.wf | 0 | m | Displacement field, Z-component | Boundaries 1–67 |  |
| mbd.nX | dnX | 1 | Normal vector, X-component | Boundaries 1–67 |  |
| mbd.nY | dnY | 1 | Normal vector, Y-component | Boundaries 1–67 |  |
| mbd.nZ | 0 | 1 | Normal vector, Z-component | Boundaries 1–67 |  |
| mbd.nx | dnx | 1 | Normal vector, x-component | Boundaries 1–67 |  |
| mbd.ny | dny | 1 | Normal vector, y-component | Boundaries 1–67 |  |
| mbd.nz | 0 | 1 | Normal vector, z-component | Boundaries 1–67 |  |
| mbd.nXmesh | dnXmesh | 1 | Normal vector (mesh), X-component | Boundaries 1–67 |  |
| mbd.nYmesh | dnYmesh | 1 | Normal vector (mesh), Y-component | Boundaries 1–67 |  |
| mbd.nZmesh | 0 | 1 | Normal vector (mesh), Z-component | Boundaries 1–67 |  |
| mbd.nxmesh | dnxmesh | 1 | Normal vector (mesh), x-component | Boundaries 1–67 |  |
| mbd.nymesh | dnymesh | 1 | Normal vector (mesh), y-component | Boundaries 1–67 |  |
| mbd.nzmesh | 0 | 1 | Normal vector (mesh), z-component | Boundaries 1–67 |  |
| mbd.freq | 0.5\*mbd.omega/pi | Hz | Frequency | Global |  |
| mbd.omega | mbd.iomega/i | rad/s | Angular frequency | Global |  |
| mbd.d | 1 | m | Thickness | Domains 1–6 |  |
| u\_ref | u | m | Displacement field, reference frame, x-component | Domains 1–6 |  |
| v\_ref | v | m | Displacement field, reference frame, y-component | Domains 1–6 |  |
| w\_ref | 0 | m | Displacement field, reference frame, z-component | Domains 1–6 |  |
| mbd.disp\_ref | sqrt(u\_ref^2+v\_ref^2+w\_ref^2+eps) | m | Displacement magnitude, reference frame | Domains 1–6 |  |
| mbd.x\_ref | X+u\_ref | m | Spatial coordinate, reference frame, x-component | Domains 1–6 |  |
| mbd.y\_ref | Y+v\_ref | m | Spatial coordinate, reference frame, y-component | Domains 1–6 |  |
| mbd.z\_ref | 0 | m | Spatial coordinate, reference frame, z-component | Domains 1–6 |  |
| mbd.ut\_ref | d(u\_ref,TIME) | m/s | Velocity, reference frame, x-component | Domains 1–6 |  |
| mbd.vt\_ref | d(v\_ref,TIME) | m/s | Velocity, reference frame, y-component | Domains 1–6 |  |
| mbd.wt\_ref | d(w\_ref,TIME) | m/s | Velocity, reference frame, z-component | Domains 1–6 |  |
| mbd.vel\_ref | sqrt(mbd.ut\_ref^2+mbd.vt\_ref^2+mbd.wt\_ref^2+eps) | m/s | Velocity magnitude, reference frame | Domains 1–6 |  |
| mbd.diag | 1.2066654877709018 | m | Bounding Box Diagonal | Global |  |
| mbd.isGeomNon | 0 | 1 | Geometric nonlinearity variable | Global |  |
| mbd.an | real(mbd.accX)\*mbd.nX+real(mbd.accY)\*mbd.nY+real(mbd.accZ)\*mbd.nZ | m/s² | Normal acceleration | Boundaries 1–67 |  |
| mbd.RFtotalx | mbd.sumreaction(mbd.RFx)+mbd.RFfsx+mbd.RFfdx | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | mbd.sumreaction(mbd.RFy)+mbd.RFfsy+mbd.RFfdy | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | mbd.sumreaction(mbd.RFz)+mbd.RFfsz+mbd.RFfdz | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | mbd.sumreaction(mbd.RMx)+mbd.RMmsx+mbd.RMmdx | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | mbd.sumreaction(mbd.RMy)+mbd.RMmsy+mbd.RMmdy | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | mbd.sumreaction(mbd.RMz)+mbd.RMmsz+mbd.RMmdz | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.activation\_multiplier | 1 | 1 | Activation multiplier | Domains 1–6 |  |
| mbd.geomsize | 1.2066654877709018 | m | Bounding box | Global |  |
| mbd.timestep | 0 | s | Time step | Domains 1–6 |  |
| xt | d(x,TIME) | m/s | Mesh velocity, x-component | Global |  |
| yt | d(y,TIME) | m/s | Mesh velocity, y-component | Global |  |
| zt | 0 | m/s | Mesh velocity, z-component | Global |  |
| mbd.iomega | -root.lambda | rad/s | Complex angular frequency | Global |  |

### Linear Elastic Material 1

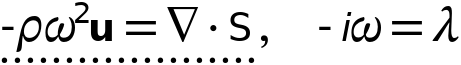


Linear Elastic Material 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: All domains |

Equations

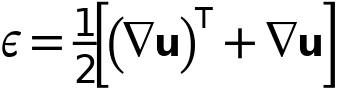














#### Linear Elastic Material

Settings

| **Description** | **Value** |
| --- | --- |
| Material symmetry | Isotropic |
| Specify | Young's modulus and Poisson's ratio |
| Young's modulus | From material |
| Poisson's ratio | From material |
| Density | From material |
| Use mixed formulation | None |

#### Geometric Nonlinearity

Settings

| **Description** | **Value** |
| --- | --- |
| Formulation | From study step |
| Strain decomposition | Automatic |

#### Quadrature Settings

Settings

| **Description** | **Value** |
| --- | --- |
| Reduced integration | Off |

#### Coordinate System Selection

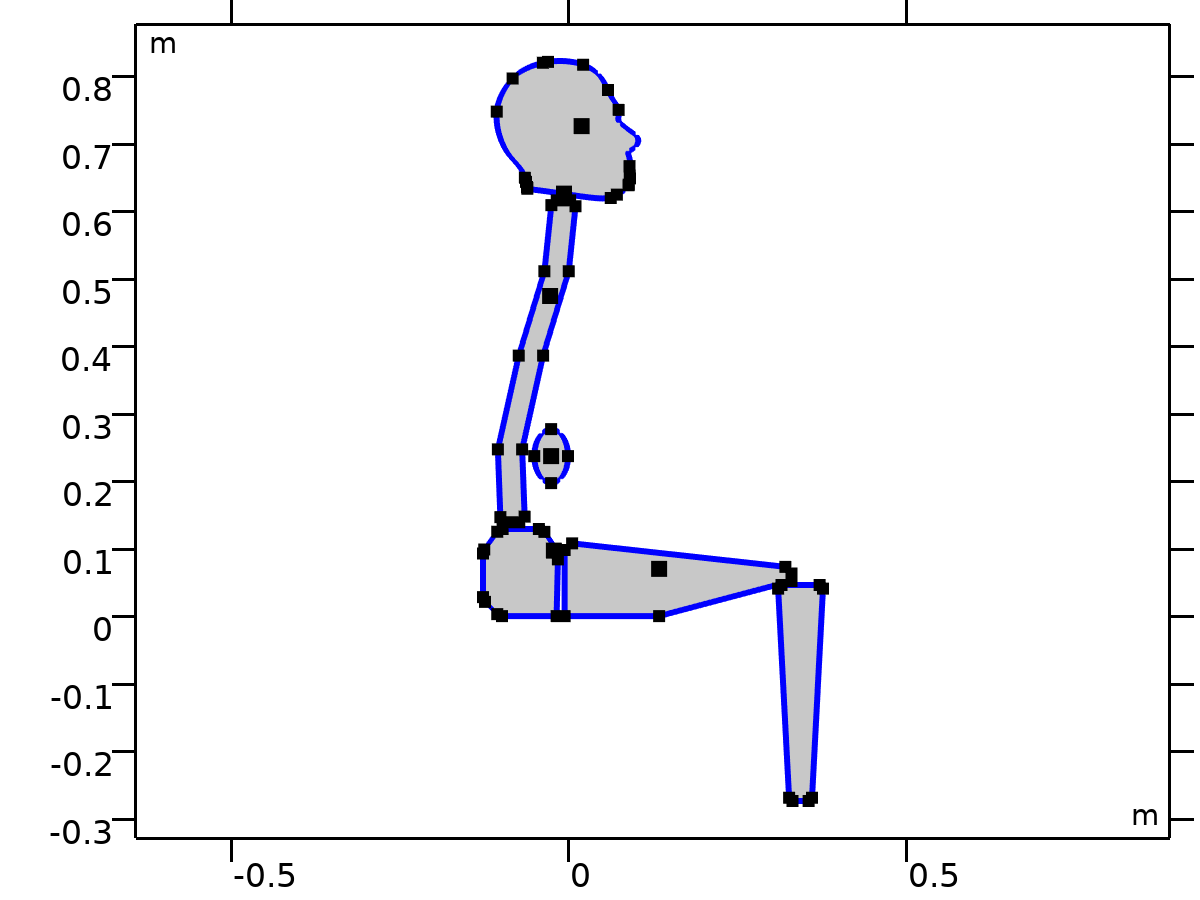
Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| u | Lagrange (Linear) | m | Displacement field, X-component | Material | No domains |
| v | Lagrange (Linear) | m | Displacement field, Y-component | Material | No domains |

### Free 1

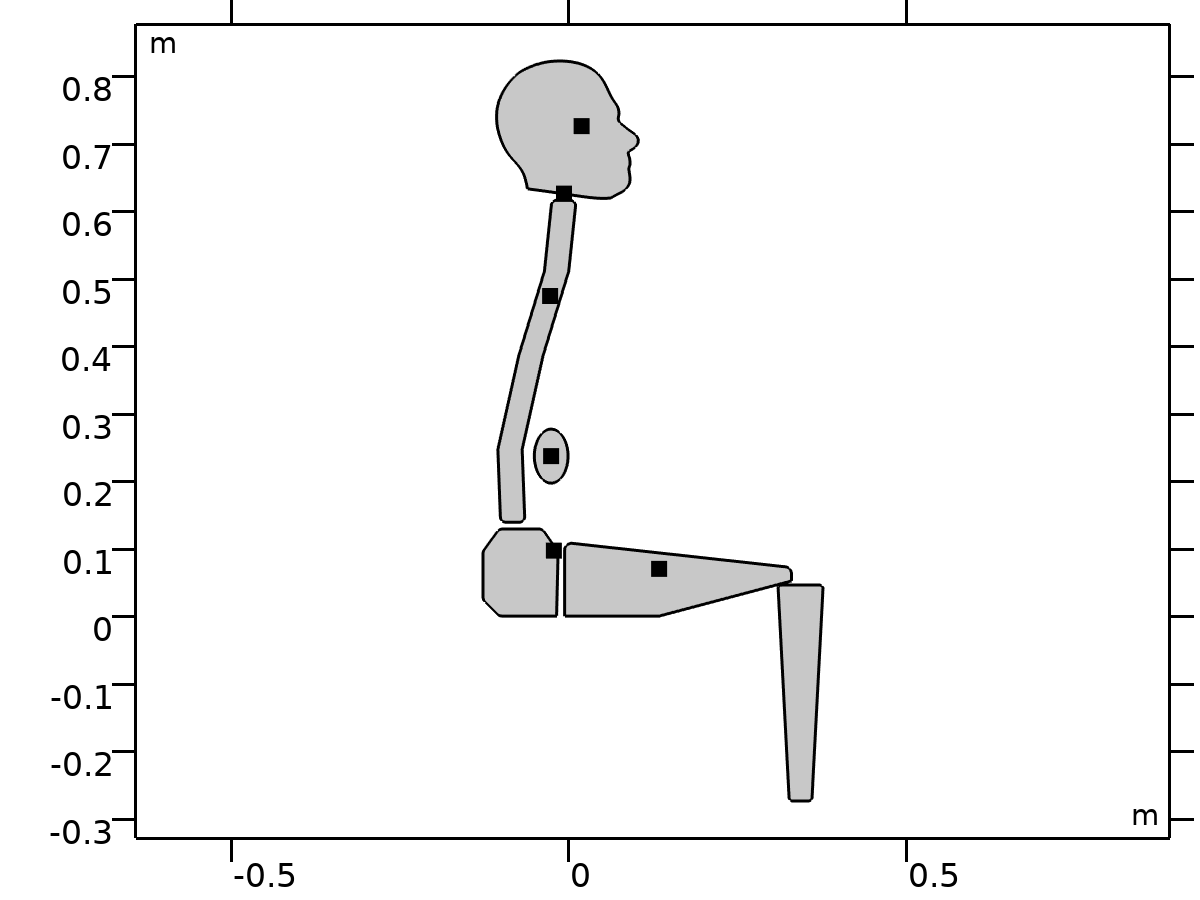


Free 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Geometry geom1: Dimension 1: All boundaries |

### Initial Values 1



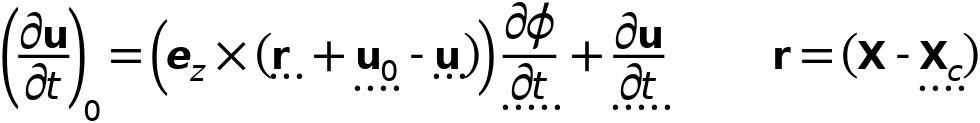
Initial Values 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: All domains |

Equations





#### Initial Values

Settings

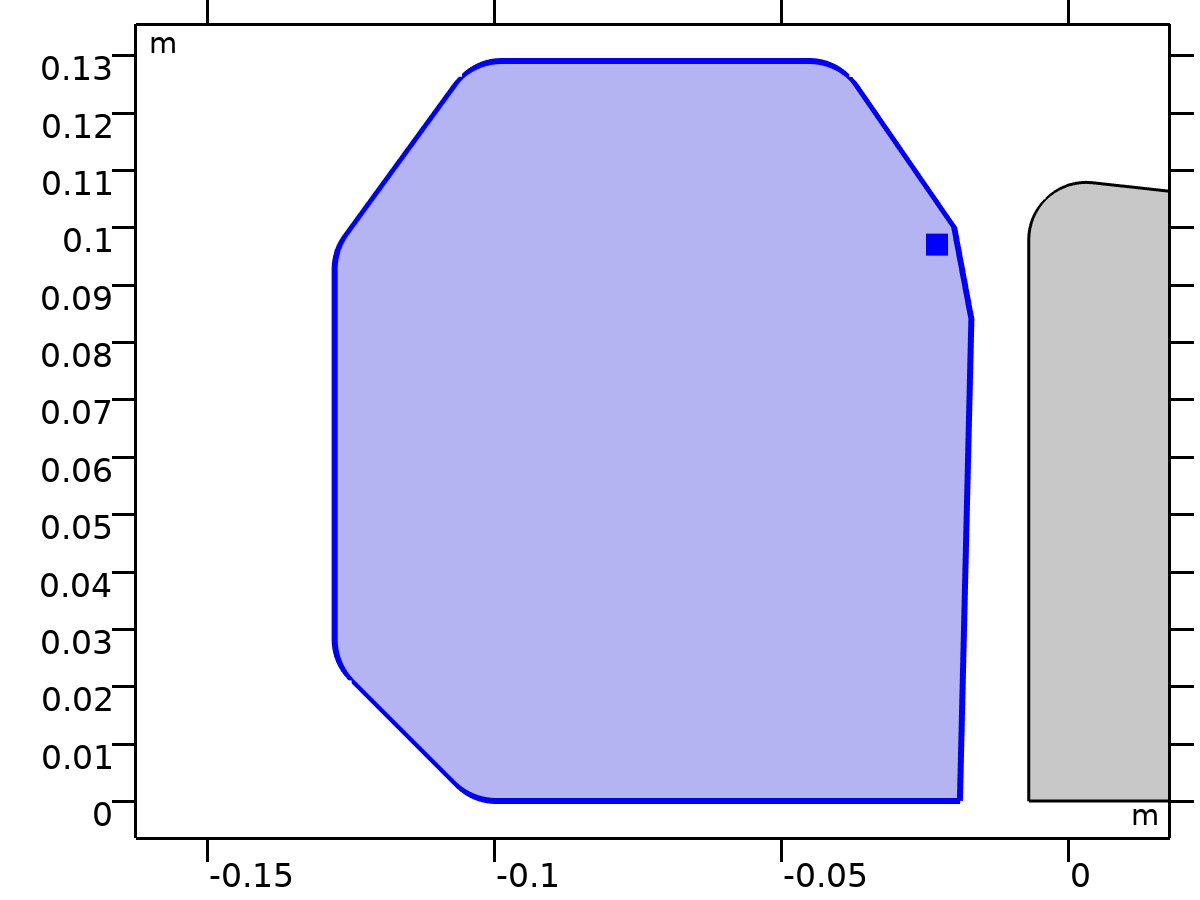
| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

### Pelvis



Pelvis

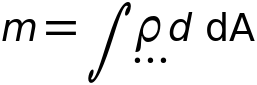
Selection

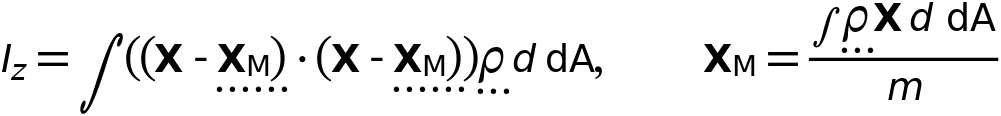
|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: Domain 1 |

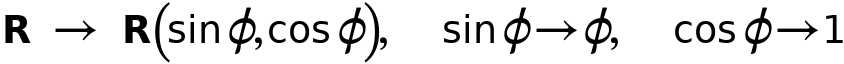
Equations





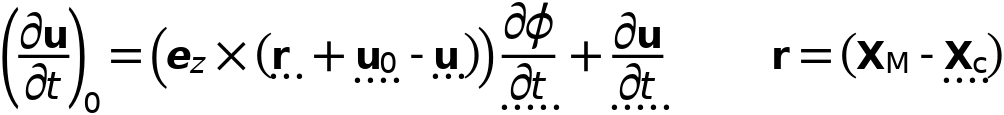




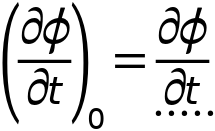












#### Density

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Density | User defined |  |
| Density | 0 | kg/m³ |

#### Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Center of rotation | Center of mass |
| Offset | Off |

#### Initial Values

Settings

| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| u | mbd.rd1.Udx | m | Displacement field, X-component | Domain 1 |  |
| v | mbd.rd1.Udy | m | Displacement field, Y-component | Domain 1 |  |
| w | mbd.rd1.Udz | m | Displacement field, Z-component | Domain 1 |  |
| mbd.Wk\_tot | 0.25\*(mbd.rd1.m\*(realdot(mbd.rd1.u\*mbd.iomega,mbd.rd1.u\*mbd.iomega)+realdot(mbd.rd1.v\*mbd.iomega,mbd.rd1.v\*mbd.iomega)+realdot(mbd.rd1.w\*mbd.iomega,mbd.rd1.w\*mbd.iomega))+realdot(mbd.rd1.Iz\*mbd.rd1.thx\*mbd.iomega,mbd.rd1.thx\*mbd.iomega)+realdot(mbd.rd1.Iz\*mbd.rd1.thy\*mbd.iomega,mbd.rd1.thy\*mbd.iomega)+realdot(mbd.rd1.Iz\*mbd.rd1.thz\*mbd.iomega,mbd.rd1.thz\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.RFtotalx | reacf(mbd.rd1.U) | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | reacf(mbd.rd1.V) | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | 0 | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | -reacf(mbd.rd1.V)\*mbd.rd1.RMmaz | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | reacf(mbd.rd1.U)\*mbd.rd1.RMmaz | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | reacf(mbd.rd1.V)\*mbd.rd1.RMmax-reacf(mbd.rd1.U)\*mbd.rd1.RMmay+reacf(mbd.rd1.Phi) | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.disp | sqrteps(real(u)^2+real(v)^2) | m | Displacement magnitude | Domain 1 |  |
| mbd.disp\_rms | sqrt(0.5\*(realdot(u,u)+realdot(v,v))) | m | Displacement, RMS | Domain 1 |  |
| mbd.gradUxX | -1+mbd.FdxX | 1 | Displacement gradient, xX-component | Domain 1 |  |
| mbd.gradUyX | mbd.FdyX | 1 | Displacement gradient, yX-component | Domain 1 |  |
| mbd.gradUzX | mbd.FdzX | 1 | Displacement gradient, zX-component | Domain 1 |  |
| mbd.gradUxY | mbd.FdxY | 1 | Displacement gradient, xY-component | Domain 1 |  |
| mbd.gradUyY | -1+mbd.FdyY | 1 | Displacement gradient, yY-component | Domain 1 |  |
| mbd.gradUzY | mbd.FdzY | 1 | Displacement gradient, zY-component | Domain 1 |  |
| mbd.gradUxZ | mbd.FdxZ | 1 | Displacement gradient, xZ-component | Domain 1 |  |
| mbd.gradUyZ | mbd.FdyZ | 1 | Displacement gradient, yZ-component | Domain 1 |  |
| mbd.gradUzZ | -1+mbd.FdzZ | 1 | Displacement gradient, zZ-component | Domain 1 |  |
| mbd.FdxX | mbd.rd1.rotxx | 1 | Deformation gradient, xX-component | Domain 1 |  |
| mbd.FdyX | mbd.rd1.rotyx | 1 | Deformation gradient, yX-component | Domain 1 |  |
| mbd.FdzX | mbd.rd1.rotzx | 1 | Deformation gradient, zX-component | Domain 1 |  |
| mbd.FdxY | mbd.rd1.rotxy | 1 | Deformation gradient, xY-component | Domain 1 |  |
| mbd.FdyY | mbd.rd1.rotyy | 1 | Deformation gradient, yY-component | Domain 1 |  |
| mbd.FdzY | mbd.rd1.rotzy | 1 | Deformation gradient, zY-component | Domain 1 |  |
| mbd.FdxZ | mbd.rd1.rotxz | 1 | Deformation gradient, xZ-component | Domain 1 |  |
| mbd.FdyZ | mbd.rd1.rotyz | 1 | Deformation gradient, yZ-component | Domain 1 |  |
| mbd.FdzZ | mbd.rd1.rotzz | 1 | Deformation gradient, zZ-component | Domain 1 |  |
| mbd.FdiXx | (mbd.FdyY\*mbd.FdzZ-mbd.FdyZ\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Xx-component | Domain 1 |  |
| mbd.FdiYx | (mbd.FdyZ\*mbd.FdzX-mbd.FdyX\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Yx-component | Domain 1 |  |
| mbd.FdiZx | (mbd.FdyX\*mbd.FdzY-mbd.FdyY\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Zx-component | Domain 1 |  |
| mbd.FdiXy | (mbd.FdxZ\*mbd.FdzY-mbd.FdxY\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Xy-component | Domain 1 |  |
| mbd.FdiYy | (mbd.FdxX\*mbd.FdzZ-mbd.FdxZ\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Yy-component | Domain 1 |  |
| mbd.FdiZy | (mbd.FdxY\*mbd.FdzX-mbd.FdxX\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Zy-component | Domain 1 |  |
| mbd.FdiXz | (mbd.FdxY\*mbd.FdyZ-mbd.FdxZ\*mbd.FdyY)/mbd.J | 1 | Deformation gradient inverse, Xz-component | Domain 1 |  |
| mbd.FdiYz | (mbd.FdxZ\*mbd.FdyX-mbd.FdxX\*mbd.FdyZ)/mbd.J | 1 | Deformation gradient inverse, Yz-component | Domain 1 |  |
| mbd.FdiZz | (mbd.FdxX\*mbd.FdyY-mbd.FdxY\*mbd.FdyX)/mbd.J | 1 | Deformation gradient inverse, Zz-component | Domain 1 |  |
| mbd.J | 1 | 1 | Volume ratio | Domain 1 |  |
| mbd.Ws | 0 | J/m³ | Elastic strain energy density | Domain 1 | + operation |
| mbd.Ws\_tot | 0 | J | Total elastic strain energy | Global | + operation |
| mbd.Wk | 0.25\*mbd.rho\*(realdot(u\*mbd.iomega,u\*mbd.iomega)+realdot(v\*mbd.iomega,v\*mbd.iomega)) | J/m³ | Kinetic energy density | Domain 1 | + operation |
| mbd.Eequ | Inf | Pa | Equivalent Young's modulus | Domain 1 |  |
| mbd.nuequ | 0 | 1 | Equivalent Poisson's ratio | Domain 1 |  |
| mbd.Eequtot | mbd.Eequ | Pa | Total equivalent Young's modulus | Domain 1 | + operation |
| mbd.rho | 0 | kg/m³ | Density | Domain 1 | \* operation |
| mbd.u\_ttX | material.dt(material.dt(mbd.rd1.Udx)) | m/s² | Acceleration, X-component | Domain 1 |  |
| mbd.u\_ttY | material.dt(material.dt(mbd.rd1.Udy)) | m/s² | Acceleration, Y-component | Domain 1 |  |
| mbd.u\_ttZ | material.dt(material.dt(mbd.rd1.Udz)) | m/s² | Acceleration, Z-component | Domain 1 |  |
| mbd.u\_tX | material.dt(mbd.rd1.Udx) | m/s | Velocity, X-component | Domain 1 |  |
| mbd.u\_tY | material.dt(mbd.rd1.Udy) | m/s | Velocity, Y-component | Domain 1 |  |
| mbd.u\_tZ | material.dt(mbd.rd1.Udz) | m/s | Velocity, Z-component | Domain 1 |  |
| mbd.vel\_rms | sqrt(0.5\*(realdot(mbd.u\_tX,mbd.u\_tX)+realdot(mbd.u\_tY,mbd.u\_tY)+realdot(mbd.u\_tZ,mbd.u\_tZ))) | m/s | Velocity magnitude, RMS | Domain 1 |  |
| mbd.acc\_rms | sqrt(0.5\*(realdot(mbd.u\_ttX,mbd.u\_ttX)+realdot(mbd.u\_ttY,mbd.u\_ttY)+realdot(mbd.u\_ttZ,mbd.u\_ttZ))) | m/s² | Acceleration magnitude, RMS | Domain 1 |  |
| mbd.afX | 0 | m/s² | Frame acceleration, X-component | Domain 1 | + operation |
| mbd.afY | 0 | m/s² | Frame acceleration, Y-component | Domain 1 | + operation |
| mbd.afZ | 0 | m/s² | Frame acceleration, Z-component | Domain 1 | + operation |
| mbd.accX | mbd.u\_ttX | m/s² | Effective acceleration, X-component | Domain 1 | + operation |
| mbd.accY | mbd.u\_ttY | m/s² | Effective acceleration, Y-component | Domain 1 | + operation |
| mbd.accZ | mbd.u\_ttZ | m/s² | Effective acceleration, Z-component | Domain 1 | + operation |
| mbd.vel | sqrteps(real(mbd.u\_tX)^2+real(mbd.u\_tY)^2+real(mbd.u\_tZ)^2) | m/s | Velocity magnitude | Domain 1 |  |
| mbd.acc | sqrteps(real(mbd.accX)^2+real(mbd.accY)^2+real(mbd.accZ)^2) | m/s² | Effective acceleration magnitude | Domain 1 |  |
| mbd.u\_tt | sqrteps(real(mbd.u\_ttX)^2+real(mbd.u\_ttY)^2+real(mbd.u\_ttZ)^2) | m/s² | Acceleration magnitude | Domain 1 |  |
| mbd.rd1.xcx | mbd.rd1.xmx | m | Center of rotation, x-component | Global | + operation |
| mbd.rd1.xcy | mbd.rd1.xmy | m | Center of rotation, y-component | Global | + operation |
| mbd.rd1.xcz | mbd.rd1.xmz | m | Center of rotation, z-component | Global | + operation |
| mbd.rd1.phi | mbd.rd1.Phi | rad | Rigid body rotation | Global |  |
| mbd.rd1.rotxx | 1 | 1 | Rotation matrix, xx-component | Global |  |
| mbd.rd1.rotyx | mbd.rd1.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, yx-component | Global |  |
| mbd.rd1.rotzx | 0 | 1 | Rotation matrix, zx-component | Global |  |
| mbd.rd1.rotxy | -mbd.rd1.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, xy-component | Global |  |
| mbd.rd1.rotyy | 1 | 1 | Rotation matrix, yy-component | Global |  |
| mbd.rd1.rotzy | 0 | 1 | Rotation matrix, zy-component | Global |  |
| mbd.rd1.rotxz | 0 | 1 | Rotation matrix, xz-component | Global |  |
| mbd.rd1.rotyz | 0 | 1 | Rotation matrix, yz-component | Global |  |
| mbd.rd1.rotzz | 1 | 1 | Rotation matrix, zz-component | Global |  |
| mbd.phase | if(isdefined(phase),phase,0) | 1 | Phase | Global |  |
| mbd.rd1.RMmax | mbd.rd1.xcx-mbd.refpntx | m | Moment arm, x-component | Global |  |
| mbd.rd1.RMmay | mbd.rd1.xcy-mbd.refpnty | m | Moment arm, y-component | Global |  |
| mbd.rd1.RMmaz | 0 | m | Moment arm, z-component | Global |  |
| mbd.rd1.u | mbd.rd1.U | m | Rigid body displacement, x-component | Global |  |
| mbd.rd1.v | mbd.rd1.V | m | Rigid body displacement, y-component | Global |  |
| mbd.rd1.w | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd1.xmx | mbd.rd1.int((mbd.rho+eps)\*mbd.d\*X)/mbd.rd1.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, x-component | Global |  |
| mbd.rd1.xmy | mbd.rd1.int((mbd.rho+eps)\*mbd.d\*Y)/mbd.rd1.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, y-component | Global |  |
| mbd.rd1.xmz | 0 | m | Center of mass, z-component | Global |  |
| mbd.rd1.Iz | mbd.rd1.int(((X-mbd.rd1.xmx)^2+(Y-mbd.rd1.xmy)^2+mbd.rd1.xmz^2)\*mbd.rho\*mbd.d) | kg·m² | Moment of inertia | Global |  |
| mbd.rd1.um | mbd.rd1.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd1.vm | mbd.rd1.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd1.wm | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd1.m | mbd.rd1.int(mbd.rho\*mbd.d) | kg | Mass | Global |  |
| mbd.rd1.Udx | (mbd.rd1.rotxx\*(X-mbd.rd1.xcx)+mbd.rd1.rotxy\*(Y-mbd.rd1.xcy)-mbd.rd1.rotxz\*mbd.rd1.xcz-X+mbd.rd1.xcx)\*exp(j\*mbd.phase)+mbd.rd1.u | m | Domain displacement, x-component | Domain 1 | + operation |
| mbd.rd1.Udy | (mbd.rd1.rotyx\*(X-mbd.rd1.xcx)+mbd.rd1.rotyy\*(Y-mbd.rd1.xcy)-mbd.rd1.rotyz\*mbd.rd1.xcz-Y+mbd.rd1.xcy)\*exp(j\*mbd.phase)+mbd.rd1.v | m | Domain displacement, y-component | Domain 1 | + operation |
| mbd.rd1.Udz | (mbd.rd1.rotzx\*(X-mbd.rd1.xcx)+mbd.rd1.rotzy\*(Y-mbd.rd1.xcy)-mbd.rd1.rotzz\*mbd.rd1.xcz+mbd.rd1.xcz)\*exp(j\*mbd.phase)+mbd.rd1.w | m | Domain displacement, z-component | Domain 1 | + operation |
| mbd.rd1.thx | 0 | rad | Rigid body rotation, x-component | Global |  |
| mbd.rd1.thy | 0 | rad | Rigid body rotation, y-component | Global |  |
| mbd.rd1.thz | mbd.rd1.phi | rad | Rigid body rotation, z-component | Global |  |
| mbd.rd1.u\_tx | mbd.iomega\*mbd.rd1.u | m/s | Rigid body velocity, x-component | Global |  |
| mbd.rd1.u\_ty | mbd.iomega\*mbd.rd1.v | m/s | Rigid body velocity, y-component | Global |  |
| mbd.rd1.u\_tz | mbd.iomega\*mbd.rd1.w | m/s | Rigid body velocity, z-component | Global |  |
| mbd.rd1.u\_ttx | mbd.iomega\*mbd.rd1.u\_tx | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd1.u\_tty | mbd.iomega\*mbd.rd1.u\_ty | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd1.u\_ttz | mbd.iomega\*mbd.rd1.u\_tz | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd1.um\_ttx | mbd.iomega^2\*mbd.rd1.um | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd1.um\_tty | mbd.iomega^2\*mbd.rd1.vm | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd1.um\_ttz | mbd.iomega^2\*mbd.rd1.wm | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd1.th\_tx | mbd.iomega\*mbd.rd1.thx | rad/s | Rigid body angular velocity, x-component | Global |  |
| mbd.rd1.th\_ty | mbd.iomega\*mbd.rd1.thy | rad/s | Rigid body angular velocity, y-component | Global |  |
| mbd.rd1.th\_tz | mbd.iomega\*mbd.rd1.thz | rad/s | Rigid body angular velocity, z-component | Global |  |
| mbd.rd1.th\_ttx | mbd.iomega\*mbd.rd1.th\_tx | rad/s² | Rigid body angular acceleration, x-component | Global |  |
| mbd.rd1.th\_tty | mbd.iomega\*mbd.rd1.th\_ty | rad/s² | Rigid body angular acceleration, y-component | Global |  |
| mbd.rd1.th\_ttz | mbd.iomega\*mbd.rd1.th\_tz | rad/s² | Rigid body angular acceleration, z-component | Global |  |
| mbd.rd1.FIx | -mbd.rd1.m\*mbd.rd1.um\_ttx | N | Inertial force, x-component | Global |  |
| mbd.rd1.FIy | -mbd.rd1.m\*mbd.rd1.um\_tty | N | Inertial force, y-component | Global |  |
| mbd.rd1.FIz | 0 | N | Inertial force, z-component | Global |  |
| mbd.rd1.MIz | -mbd.rd1.Iz\*mbd.iomega^2\*mbd.rd1.phi | N·m | Inertial moment | Global |  |
| mbd.rd1.i\_rot | 1 | 1 | Free rotation indicator | Global | \* operation |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd1.U | ODE | m | Rigid body displacement, x-component |  | Global |
| mbd.rd1.V | ODE | m | Rigid body displacement, y-component |  | Global |
| mbd.rd1.Phi | ODE | rad | Rigid body rotation |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd1.FIx\*test(mbd.rd1.um)+mbd.rd1.FIy\*test(mbd.rd1.vm)+mbd.rd1.FIz\*test(mbd.rd1.wm) | 2 |  | Global |
| mbd.rd1.MIz\*test(mbd.rd1.phi) | 2 |  | Global |

#### Constraints

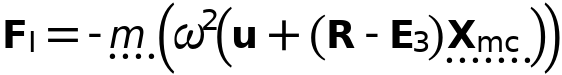
| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| up(u)-down(u) | test(up(u)-down(u)) | Lagrange (Linear) | No boundaries | Elemental |
| up(v)-down(v) | test(up(v)-down(v)) | Lagrange (Linear) | No boundaries | Elemental |
| 0 | 0 |  | No boundaries | Elemental |

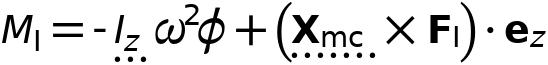
#### Mass and Moment of Inertia 1

Selection

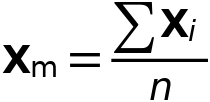
|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations









##### Center of Mass

Settings

| **Description** | **Value** |
| --- | --- |
| Center of mass | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

##### Mass and Moment of Inertia

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Mass | m\_pelvis | kg |
| Moment of inertia | I\_pelvis | kg·m² |

##### Frame Acceleration Forces

Settings

| **Description** | **Value** |
| --- | --- |
| Exclude contribution | Off |

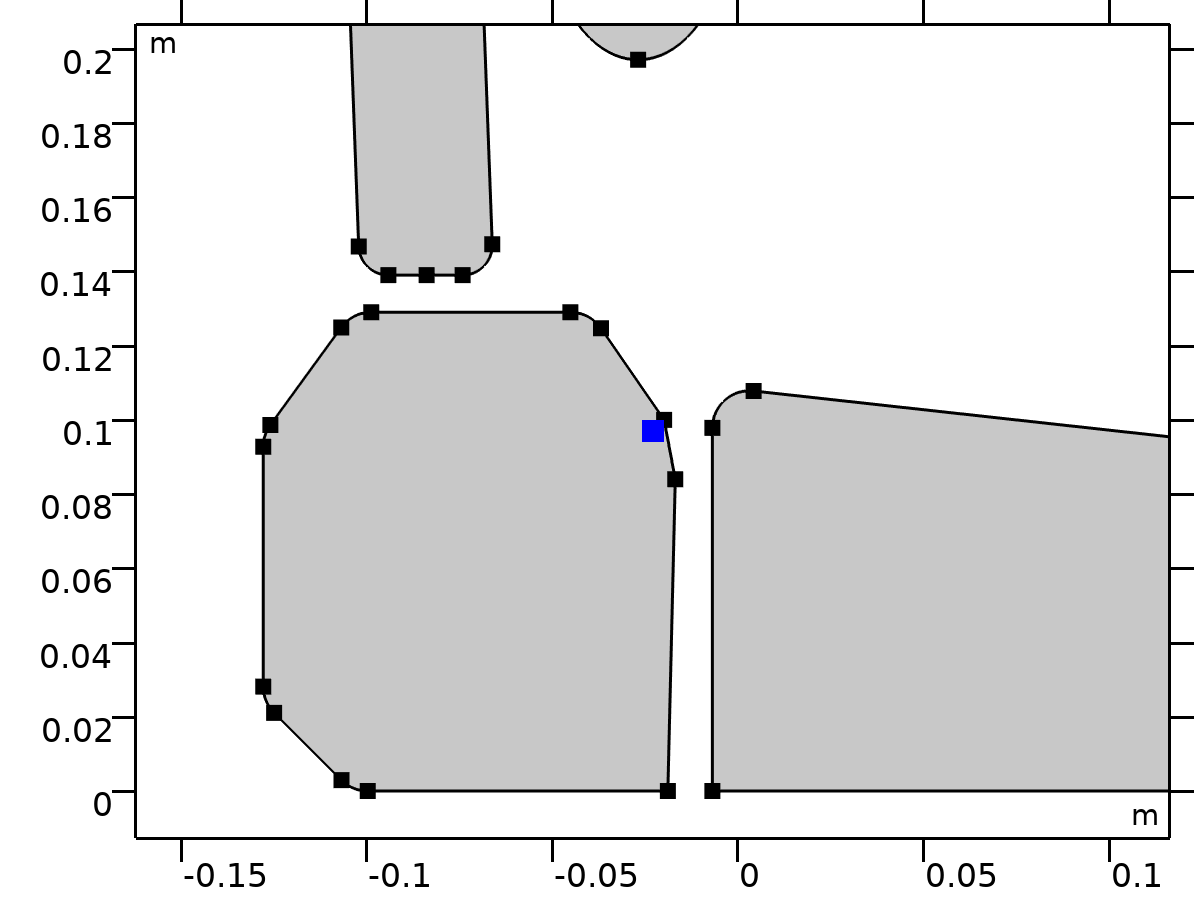
##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Wk\_tot | 0.25\*(mbd.rd1.mmi1.mt\*(realdot((mbd.rd1.u+mbd.rd1.mmi1.dMrotx-mbd.rd1.mmi1.dMx)\*mbd.iomega,(mbd.rd1.u+mbd.rd1.mmi1.dMrotx-mbd.rd1.mmi1.dMx)\*mbd.iomega)+realdot((mbd.rd1.v+mbd.rd1.mmi1.dMroty-mbd.rd1.mmi1.dMy)\*mbd.iomega,(mbd.rd1.v+mbd.rd1.mmi1.dMroty-mbd.rd1.mmi1.dMy)\*mbd.iomega)+realdot((mbd.rd1.w+mbd.rd1.mmi1.dMrotz-mbd.rd1.mmi1.dMz)\*mbd.iomega,(mbd.rd1.w+mbd.rd1.mmi1.dMrotz-mbd.rd1.mmi1.dMz)\*mbd.iomega))+mbd.rd1.mmi1.Iz\*realdot(mbd.rd1.phi\*mbd.iomega,mbd.rd1.phi\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.rd1.mmi1.mt | m\_pelvis | kg | Mass | Global |  |
| mbd.rd1.mmi1.Iz | I\_pelvis | kg·m² | Moment of inertia | Global |  |
| mbd.rd1.mmi1.xmsx | mbd.rd1.xcx+mbd.rd1.u+mbd.rd1.rotxx\*(mbd.rd1.mmi1.xmx-mbd.rd1.xcx)+mbd.rd1.rotxy\*(mbd.rd1.mmi1.xmy-mbd.rd1.xcy)+mbd.rd1.rotxz\*(mbd.rd1.mmi1.xmz-mbd.rd1.xcz) | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd1.mmi1.xmsy | mbd.rd1.xcy+mbd.rd1.v+mbd.rd1.rotyx\*(mbd.rd1.mmi1.xmx-mbd.rd1.xcx)+mbd.rd1.rotyy\*(mbd.rd1.mmi1.xmy-mbd.rd1.xcy)+mbd.rd1.rotyz\*(mbd.rd1.mmi1.xmz-mbd.rd1.xcz) | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd1.mmi1.xmsz | mbd.rd1.xcz+mbd.rd1.w+mbd.rd1.rotzx\*(mbd.rd1.mmi1.xmx-mbd.rd1.xcx)+mbd.rd1.rotzy\*(mbd.rd1.mmi1.xmy-mbd.rd1.xcy)+mbd.rd1.rotzz\*(mbd.rd1.mmi1.xmz-mbd.rd1.xcz) | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd1.mmi1.umx | mbd.rd1.u+mbd.rd1.rotxx\*(mbd.rd1.mmi1.xmx-mbd.rd1.xcx)+mbd.rd1.rotxy\*(mbd.rd1.mmi1.xmy-mbd.rd1.xcy)+mbd.rd1.rotxz\*(mbd.rd1.mmi1.xmz-mbd.rd1.xcz)-mbd.rd1.mmi1.xmx+mbd.rd1.xcx | m | Displacement at center of mass, x-component | Global |  |
| mbd.rd1.mmi1.umy | mbd.rd1.v+mbd.rd1.rotyx\*(mbd.rd1.mmi1.xmx-mbd.rd1.xcx)+mbd.rd1.rotyy\*(mbd.rd1.mmi1.xmy-mbd.rd1.xcy)+mbd.rd1.rotyz\*(mbd.rd1.mmi1.xmz-mbd.rd1.xcz)-mbd.rd1.mmi1.xmy+mbd.rd1.xcy | m | Displacement at center of mass, y-component | Global |  |
| mbd.rd1.mmi1.umz | mbd.rd1.w+mbd.rd1.rotzx\*(mbd.rd1.mmi1.xmx-mbd.rd1.xcx)+mbd.rd1.rotzy\*(mbd.rd1.mmi1.xmy-mbd.rd1.xcy)+mbd.rd1.rotzz\*(mbd.rd1.mmi1.xmz-mbd.rd1.xcz)-mbd.rd1.mmi1.xmz+mbd.rd1.xcz | m | Displacement at center of mass, z-component | Global |  |
| mbd.rd1.mmi1.FIx | -mbd.rd1.mmi1.mt\*mbd.iomega^2\*(mbd.rd1.u+mbd.rd1.mmi1.dMrotx-mbd.rd1.mmi1.dMx) | N | Inertial force, x-component | Global |  |
| mbd.rd1.mmi1.FIy | -mbd.rd1.mmi1.mt\*mbd.iomega^2\*(mbd.rd1.v+mbd.rd1.mmi1.dMroty-mbd.rd1.mmi1.dMy) | N | Inertial force, y-component | Global |  |
| mbd.rd1.mmi1.FIz | -mbd.rd1.mmi1.mt\*mbd.iomega^2\*(mbd.rd1.w+mbd.rd1.mmi1.dMrotz-mbd.rd1.mmi1.dMz) | N | Inertial force, z-component | Global |  |
| mbd.rd1.mmi1.MIz | -mbd.rd1.mmi1.Iz\*mbd.iomega^2\*mbd.rd1.phi | N·m | Inertial moment | Global |  |
| mbd.rd1.mmi1.dMx | mbd.rd1.mmi1.xmx-mbd.rd1.xcx | m | Mass offset from CoR, Original, x-component | Global |  |
| mbd.rd1.mmi1.dMy | mbd.rd1.mmi1.xmy-mbd.rd1.xcy | m | Mass offset from CoR, Original, y-component | Global |  |
| mbd.rd1.mmi1.dMz | mbd.rd1.mmi1.xmz-mbd.rd1.xcz | m | Mass offset from CoR, Original, z-component | Global |  |
| mbd.rd1.mmi1.dMrotx | mbd.rd1.rotxx\*mbd.rd1.mmi1.dMx+mbd.rd1.rotxy\*mbd.rd1.mmi1.dMy+mbd.rd1.rotxz\*mbd.rd1.mmi1.dMz | m | Mass offset from CoR, Rotated, x-component | Global |  |
| mbd.rd1.mmi1.dMroty | mbd.rd1.rotyx\*mbd.rd1.mmi1.dMx+mbd.rd1.rotyy\*mbd.rd1.mmi1.dMy+mbd.rd1.rotyz\*mbd.rd1.mmi1.dMz | m | Mass offset from CoR, Rotated, y-component | Global |  |
| mbd.rd1.mmi1.dMrotz | mbd.rd1.rotzx\*mbd.rd1.mmi1.dMx+mbd.rd1.rotzy\*mbd.rd1.mmi1.dMy+mbd.rd1.rotzz\*mbd.rd1.mmi1.dMz | m | Mass offset from CoR, Rotated, z-component | Global |  |
| mbd.rd1.mmi1.Fx | mbd.rd1.mmi1.FIx | N | Applied force, x-component | Global |  |
| mbd.rd1.mmi1.Fy | mbd.rd1.mmi1.FIy | N | Applied force, y-component | Global |  |
| mbd.rd1.mmi1.Fz | mbd.rd1.mmi1.FIz | N | Applied force, z-component | Global |  |
| mbd.rd1.mmi1.F\_Mag | sqrt(real(mbd.rd1.mmi1.Fx)^2+real(mbd.rd1.mmi1.Fy)^2+real(mbd.rd1.mmi1.Fz)^2) | N | Load magnitude | Global |  |
| mbd.rd1.mmi1.Mx | 0 | N·m | Applied moment, x-component | Global |  |
| mbd.rd1.mmi1.My | 0 | N·m | Applied moment, y-component | Global |  |
| mbd.rd1.mmi1.Mz | mbd.rd1.mmi1.MIz | N·m | Applied moment, z-component | Global |  |
| mbd.rd1.mmi1.M\_Mag | sqrt(real(mbd.rd1.mmi1.Mx)^2+real(mbd.rd1.mmi1.My)^2+real(mbd.rd1.mmi1.Mz)^2) | N·m | Moment magnitude | Global |  |
| mbd.rd1.mmi1.loadposx | mbd.rd1.mmi1.xmx | m | Load position, x-component | Global |  |
| mbd.rd1.mmi1.loadposy | mbd.rd1.mmi1.xmy | m | Load position, y-component | Global |  |
| mbd.rd1.mmi1.loadposz | mbd.rd1.mmi1.xmz | m | Load position, z-component | Global |  |
| mbd.rd1.mmi1.momposx | mbd.rd1.mmi1.xmx | m | Moment position, x-component | Global |  |
| mbd.rd1.mmi1.momposy | mbd.rd1.mmi1.xmy | m | Moment position, y-component | Global |  |
| mbd.rd1.mmi1.momposz | mbd.rd1.mmi1.xmz | m | Moment position, z-component | Global |  |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd1.mmi1.FIx\*test(mbd.rd1.u+mbd.rd1.mmi1.dMrotx)+mbd.rd1.mmi1.FIy\*test(mbd.rd1.v+mbd.rd1.mmi1.dMroty)+mbd.rd1.mmi1.FIz\*test(mbd.rd1.w+mbd.rd1.mmi1.dMrotz) | 2 |  | Global |
| mbd.rd1.mmi1.MIz\*test(mbd.rd1.phi) | 2 |  | Global |

##### Center of Mass: Point 1



Center of Mass: Point 1

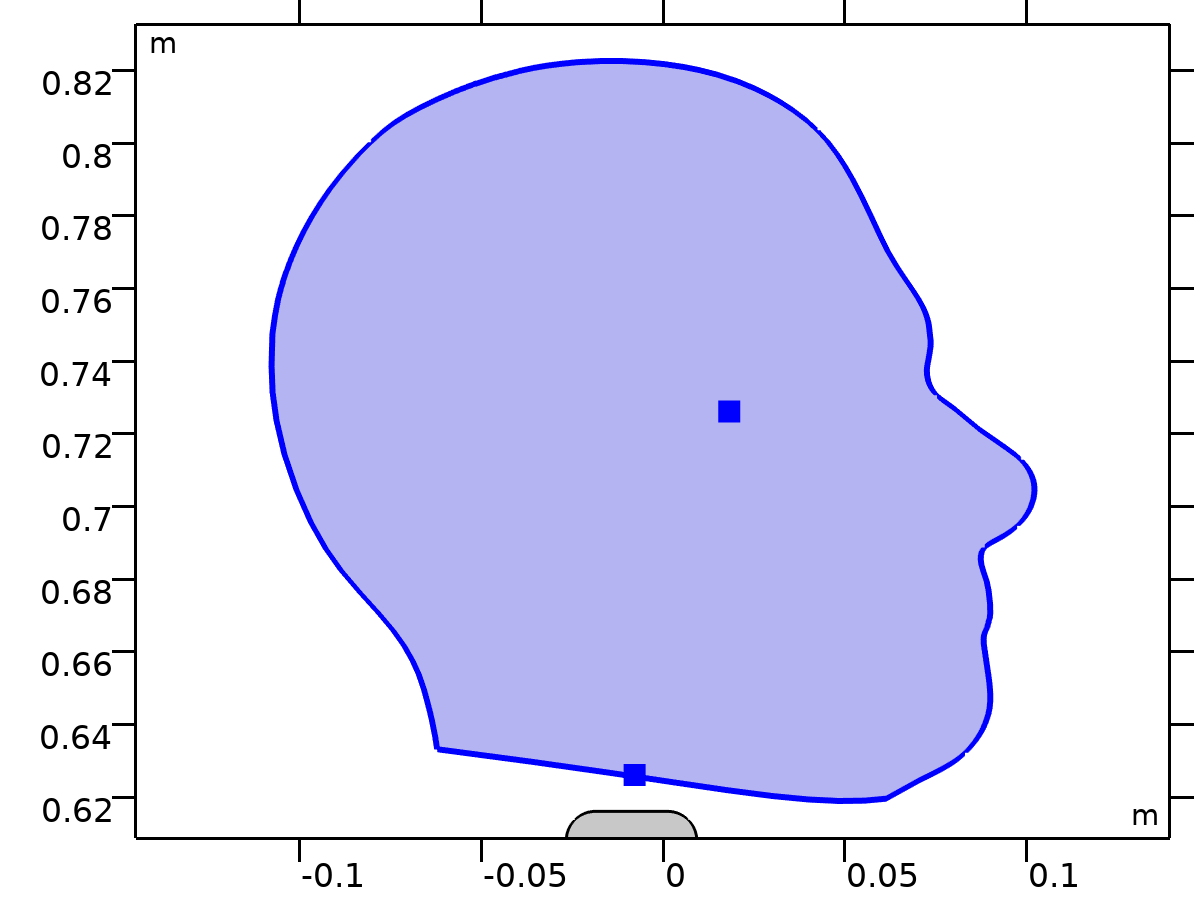
Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 11 |

###### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd1.mmi1.xmx | mbd.rd1.mmi1.cmp1.int(X)/mbd.rd1.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, x-component | Global | + operation |
| mbd.rd1.mmi1.xmy | mbd.rd1.mmi1.cmp1.int(Y)/mbd.rd1.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, y-component | Global | + operation |
| mbd.rd1.mmi1.xmz | mbd.rd1.mmi1.cmp1.int(0)/mbd.rd1.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, z-component | Global | + operation |

### Head

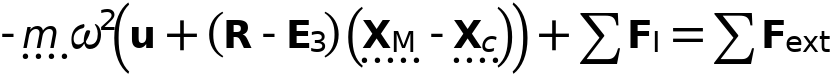


Head

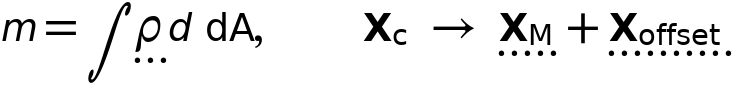
Selection

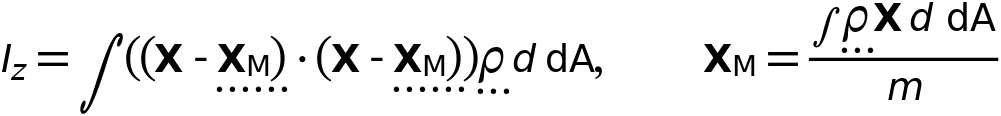
|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: Domain 2 |

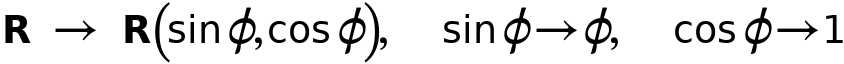
Equations





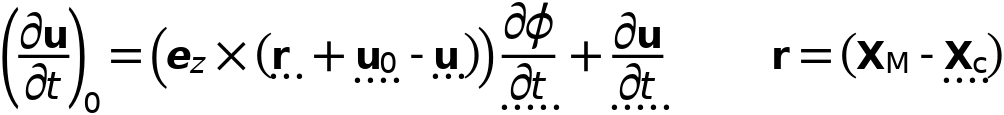




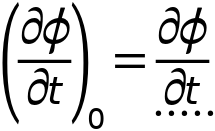












#### Density

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Density | User defined |  |
| Density | 0 | kg/m³ |

#### Center of Rotation

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Center of rotation | Center of mass |  |
| Offset | On |  |
| Offset coordinates, x-component | 0 | m |
| Offset coordinates, y-component | 0 | m |
| Offset coordinates, z-component | 0 | m |

#### Initial Values

Settings

| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| u | mbd.rd2.Udx | m | Displacement field, X-component | Domain 2 |  |
| v | mbd.rd2.Udy | m | Displacement field, Y-component | Domain 2 |  |
| w | mbd.rd2.Udz | m | Displacement field, Z-component | Domain 2 |  |
| mbd.Wk\_tot | 0.25\*(mbd.rd2.m\*(realdot(mbd.rd2.u\*mbd.iomega,mbd.rd2.u\*mbd.iomega)+realdot(mbd.rd2.v\*mbd.iomega,mbd.rd2.v\*mbd.iomega)+realdot(mbd.rd2.w\*mbd.iomega,mbd.rd2.w\*mbd.iomega))+realdot(mbd.rd2.Iz\*mbd.rd2.thx\*mbd.iomega,mbd.rd2.thx\*mbd.iomega)+realdot(mbd.rd2.Iz\*mbd.rd2.thy\*mbd.iomega,mbd.rd2.thy\*mbd.iomega)+realdot(mbd.rd2.Iz\*mbd.rd2.thz\*mbd.iomega,mbd.rd2.thz\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.RFtotalx | reacf(mbd.rd2.U) | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | reacf(mbd.rd2.V) | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | 0 | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | -reacf(mbd.rd2.V)\*mbd.rd2.RMmaz | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | reacf(mbd.rd2.U)\*mbd.rd2.RMmaz | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | reacf(mbd.rd2.V)\*mbd.rd2.RMmax-reacf(mbd.rd2.U)\*mbd.rd2.RMmay+reacf(mbd.rd2.Phi) | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.disp | sqrteps(real(u)^2+real(v)^2) | m | Displacement magnitude | Domain 2 |  |
| mbd.disp\_rms | sqrt(0.5\*(realdot(u,u)+realdot(v,v))) | m | Displacement, RMS | Domain 2 |  |
| mbd.gradUxX | -1+mbd.FdxX | 1 | Displacement gradient, xX-component | Domain 2 |  |
| mbd.gradUyX | mbd.FdyX | 1 | Displacement gradient, yX-component | Domain 2 |  |
| mbd.gradUzX | mbd.FdzX | 1 | Displacement gradient, zX-component | Domain 2 |  |
| mbd.gradUxY | mbd.FdxY | 1 | Displacement gradient, xY-component | Domain 2 |  |
| mbd.gradUyY | -1+mbd.FdyY | 1 | Displacement gradient, yY-component | Domain 2 |  |
| mbd.gradUzY | mbd.FdzY | 1 | Displacement gradient, zY-component | Domain 2 |  |
| mbd.gradUxZ | mbd.FdxZ | 1 | Displacement gradient, xZ-component | Domain 2 |  |
| mbd.gradUyZ | mbd.FdyZ | 1 | Displacement gradient, yZ-component | Domain 2 |  |
| mbd.gradUzZ | -1+mbd.FdzZ | 1 | Displacement gradient, zZ-component | Domain 2 |  |
| mbd.FdxX | mbd.rd2.rotxx | 1 | Deformation gradient, xX-component | Domain 2 |  |
| mbd.FdyX | mbd.rd2.rotyx | 1 | Deformation gradient, yX-component | Domain 2 |  |
| mbd.FdzX | mbd.rd2.rotzx | 1 | Deformation gradient, zX-component | Domain 2 |  |
| mbd.FdxY | mbd.rd2.rotxy | 1 | Deformation gradient, xY-component | Domain 2 |  |
| mbd.FdyY | mbd.rd2.rotyy | 1 | Deformation gradient, yY-component | Domain 2 |  |
| mbd.FdzY | mbd.rd2.rotzy | 1 | Deformation gradient, zY-component | Domain 2 |  |
| mbd.FdxZ | mbd.rd2.rotxz | 1 | Deformation gradient, xZ-component | Domain 2 |  |
| mbd.FdyZ | mbd.rd2.rotyz | 1 | Deformation gradient, yZ-component | Domain 2 |  |
| mbd.FdzZ | mbd.rd2.rotzz | 1 | Deformation gradient, zZ-component | Domain 2 |  |
| mbd.FdiXx | (mbd.FdyY\*mbd.FdzZ-mbd.FdyZ\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Xx-component | Domain 2 |  |
| mbd.FdiYx | (mbd.FdyZ\*mbd.FdzX-mbd.FdyX\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Yx-component | Domain 2 |  |
| mbd.FdiZx | (mbd.FdyX\*mbd.FdzY-mbd.FdyY\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Zx-component | Domain 2 |  |
| mbd.FdiXy | (mbd.FdxZ\*mbd.FdzY-mbd.FdxY\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Xy-component | Domain 2 |  |
| mbd.FdiYy | (mbd.FdxX\*mbd.FdzZ-mbd.FdxZ\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Yy-component | Domain 2 |  |
| mbd.FdiZy | (mbd.FdxY\*mbd.FdzX-mbd.FdxX\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Zy-component | Domain 2 |  |
| mbd.FdiXz | (mbd.FdxY\*mbd.FdyZ-mbd.FdxZ\*mbd.FdyY)/mbd.J | 1 | Deformation gradient inverse, Xz-component | Domain 2 |  |
| mbd.FdiYz | (mbd.FdxZ\*mbd.FdyX-mbd.FdxX\*mbd.FdyZ)/mbd.J | 1 | Deformation gradient inverse, Yz-component | Domain 2 |  |
| mbd.FdiZz | (mbd.FdxX\*mbd.FdyY-mbd.FdxY\*mbd.FdyX)/mbd.J | 1 | Deformation gradient inverse, Zz-component | Domain 2 |  |
| mbd.J | 1 | 1 | Volume ratio | Domain 2 |  |
| mbd.Ws | 0 | J/m³ | Elastic strain energy density | Domain 2 | + operation |
| mbd.Ws\_tot | 0 | J | Total elastic strain energy | Global | + operation |
| mbd.Wk | 0.25\*mbd.rho\*(realdot(u\*mbd.iomega,u\*mbd.iomega)+realdot(v\*mbd.iomega,v\*mbd.iomega)) | J/m³ | Kinetic energy density | Domain 2 | + operation |
| mbd.Eequ | Inf | Pa | Equivalent Young's modulus | Domain 2 |  |
| mbd.nuequ | 0 | 1 | Equivalent Poisson's ratio | Domain 2 |  |
| mbd.Eequtot | mbd.Eequ | Pa | Total equivalent Young's modulus | Domain 2 | + operation |
| mbd.rho | 0 | kg/m³ | Density | Domain 2 | \* operation |
| mbd.u\_ttX | material.dt(material.dt(mbd.rd2.Udx)) | m/s² | Acceleration, X-component | Domain 2 |  |
| mbd.u\_ttY | material.dt(material.dt(mbd.rd2.Udy)) | m/s² | Acceleration, Y-component | Domain 2 |  |
| mbd.u\_ttZ | material.dt(material.dt(mbd.rd2.Udz)) | m/s² | Acceleration, Z-component | Domain 2 |  |
| mbd.u\_tX | material.dt(mbd.rd2.Udx) | m/s | Velocity, X-component | Domain 2 |  |
| mbd.u\_tY | material.dt(mbd.rd2.Udy) | m/s | Velocity, Y-component | Domain 2 |  |
| mbd.u\_tZ | material.dt(mbd.rd2.Udz) | m/s | Velocity, Z-component | Domain 2 |  |
| mbd.vel\_rms | sqrt(0.5\*(realdot(mbd.u\_tX,mbd.u\_tX)+realdot(mbd.u\_tY,mbd.u\_tY)+realdot(mbd.u\_tZ,mbd.u\_tZ))) | m/s | Velocity magnitude, RMS | Domain 2 |  |
| mbd.acc\_rms | sqrt(0.5\*(realdot(mbd.u\_ttX,mbd.u\_ttX)+realdot(mbd.u\_ttY,mbd.u\_ttY)+realdot(mbd.u\_ttZ,mbd.u\_ttZ))) | m/s² | Acceleration magnitude, RMS | Domain 2 |  |
| mbd.afX | 0 | m/s² | Frame acceleration, X-component | Domain 2 | + operation |
| mbd.afY | 0 | m/s² | Frame acceleration, Y-component | Domain 2 | + operation |
| mbd.afZ | 0 | m/s² | Frame acceleration, Z-component | Domain 2 | + operation |
| mbd.accX | mbd.u\_ttX | m/s² | Effective acceleration, X-component | Domain 2 | + operation |
| mbd.accY | mbd.u\_ttY | m/s² | Effective acceleration, Y-component | Domain 2 | + operation |
| mbd.accZ | mbd.u\_ttZ | m/s² | Effective acceleration, Z-component | Domain 2 | + operation |
| mbd.vel | sqrteps(real(mbd.u\_tX)^2+real(mbd.u\_tY)^2+real(mbd.u\_tZ)^2) | m/s | Velocity magnitude | Domain 2 |  |
| mbd.acc | sqrteps(real(mbd.accX)^2+real(mbd.accY)^2+real(mbd.accZ)^2) | m/s² | Effective acceleration magnitude | Domain 2 |  |
| mbd.u\_tt | sqrteps(real(mbd.u\_ttX)^2+real(mbd.u\_ttY)^2+real(mbd.u\_ttZ)^2) | m/s² | Acceleration magnitude | Domain 2 |  |
| mbd.phase | if(isdefined(phase),phase,0) | 1 | Phase | Global |  |
| mbd.rd2.xcx | mbd.rd2.x\_offx+mbd.rd2.xmx | m | Center of rotation, x-component | Global | + operation |
| mbd.rd2.xcy | mbd.rd2.x\_offy+mbd.rd2.xmy | m | Center of rotation, y-component | Global | + operation |
| mbd.rd2.xcz | mbd.rd2.x\_offz+mbd.rd2.xmz | m | Center of rotation, z-component | Global | + operation |
| mbd.rd2.phi | mbd.rd2.Phi | rad | Rigid body rotation | Global |  |
| mbd.rd2.rotxx | 1 | 1 | Rotation matrix, xx-component | Global |  |
| mbd.rd2.rotyx | mbd.rd2.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, yx-component | Global |  |
| mbd.rd2.rotzx | 0 | 1 | Rotation matrix, zx-component | Global |  |
| mbd.rd2.rotxy | -mbd.rd2.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, xy-component | Global |  |
| mbd.rd2.rotyy | 1 | 1 | Rotation matrix, yy-component | Global |  |
| mbd.rd2.rotzy | 0 | 1 | Rotation matrix, zy-component | Global |  |
| mbd.rd2.rotxz | 0 | 1 | Rotation matrix, xz-component | Global |  |
| mbd.rd2.rotyz | 0 | 1 | Rotation matrix, yz-component | Global |  |
| mbd.rd2.rotzz | 1 | 1 | Rotation matrix, zz-component | Global |  |
| mbd.rd2.x\_offx | 0 | m | Offset coordinates, x-component | Global |  |
| mbd.rd2.x\_offy | 0 | m | Offset coordinates, y-component | Global |  |
| mbd.rd2.x\_offz | 0 | m | Offset coordinates, z-component | Global |  |
| mbd.rd2.RMmax | mbd.rd2.xcx-mbd.refpntx | m | Moment arm, x-component | Global |  |
| mbd.rd2.RMmay | mbd.rd2.xcy-mbd.refpnty | m | Moment arm, y-component | Global |  |
| mbd.rd2.RMmaz | 0 | m | Moment arm, z-component | Global |  |
| mbd.rd2.u | mbd.rd2.U | m | Rigid body displacement, x-component | Global |  |
| mbd.rd2.v | mbd.rd2.V | m | Rigid body displacement, y-component | Global |  |
| mbd.rd2.w | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd2.xmx | mbd.rd2.int((mbd.rho+eps)\*mbd.d\*X)/mbd.rd2.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, x-component | Global |  |
| mbd.rd2.xmy | mbd.rd2.int((mbd.rho+eps)\*mbd.d\*Y)/mbd.rd2.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, y-component | Global |  |
| mbd.rd2.xmz | 0 | m | Center of mass, z-component | Global |  |
| mbd.rd2.Iz | mbd.rd2.int(((X-mbd.rd2.xmx)^2+(Y-mbd.rd2.xmy)^2+mbd.rd2.xmz^2)\*mbd.rho\*mbd.d) | kg·m² | Moment of inertia | Global |  |
| mbd.rd2.um | mbd.rd2.rotxx\*(mbd.rd2.xmx-mbd.rd2.xcx)+mbd.rd2.rotxy\*(mbd.rd2.xmy-mbd.rd2.xcy)+mbd.rd2.rotxz\*(mbd.rd2.xmz-mbd.rd2.xcz)-mbd.rd2.xmx+mbd.rd2.xcx+mbd.rd2.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd2.vm | mbd.rd2.rotyx\*(mbd.rd2.xmx-mbd.rd2.xcx)+mbd.rd2.rotyy\*(mbd.rd2.xmy-mbd.rd2.xcy)+mbd.rd2.rotyz\*(mbd.rd2.xmz-mbd.rd2.xcz)-mbd.rd2.xmy+mbd.rd2.xcy+mbd.rd2.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd2.wm | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd2.m | mbd.rd2.int(mbd.rho\*mbd.d) | kg | Mass | Global |  |
| mbd.rd2.Udx | (mbd.rd2.rotxx\*(X-mbd.rd2.xcx)+mbd.rd2.rotxy\*(Y-mbd.rd2.xcy)-mbd.rd2.rotxz\*mbd.rd2.xcz-X+mbd.rd2.xcx)\*exp(j\*mbd.phase)+mbd.rd2.u | m | Domain displacement, x-component | Domain 2 | + operation |
| mbd.rd2.Udy | (mbd.rd2.rotyx\*(X-mbd.rd2.xcx)+mbd.rd2.rotyy\*(Y-mbd.rd2.xcy)-mbd.rd2.rotyz\*mbd.rd2.xcz-Y+mbd.rd2.xcy)\*exp(j\*mbd.phase)+mbd.rd2.v | m | Domain displacement, y-component | Domain 2 | + operation |
| mbd.rd2.Udz | (mbd.rd2.rotzx\*(X-mbd.rd2.xcx)+mbd.rd2.rotzy\*(Y-mbd.rd2.xcy)-mbd.rd2.rotzz\*mbd.rd2.xcz+mbd.rd2.xcz)\*exp(j\*mbd.phase)+mbd.rd2.w | m | Domain displacement, z-component | Domain 2 | + operation |
| mbd.rd2.thx | 0 | rad | Rigid body rotation, x-component | Global |  |
| mbd.rd2.thy | 0 | rad | Rigid body rotation, y-component | Global |  |
| mbd.rd2.thz | mbd.rd2.phi | rad | Rigid body rotation, z-component | Global |  |
| mbd.rd2.u\_tx | mbd.iomega\*mbd.rd2.u | m/s | Rigid body velocity, x-component | Global |  |
| mbd.rd2.u\_ty | mbd.iomega\*mbd.rd2.v | m/s | Rigid body velocity, y-component | Global |  |
| mbd.rd2.u\_tz | mbd.iomega\*mbd.rd2.w | m/s | Rigid body velocity, z-component | Global |  |
| mbd.rd2.u\_ttx | mbd.iomega\*mbd.rd2.u\_tx | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd2.u\_tty | mbd.iomega\*mbd.rd2.u\_ty | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd2.u\_ttz | mbd.iomega\*mbd.rd2.u\_tz | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd2.um\_ttx | mbd.iomega^2\*mbd.rd2.um | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd2.um\_tty | mbd.iomega^2\*mbd.rd2.vm | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd2.um\_ttz | mbd.iomega^2\*mbd.rd2.wm | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd2.th\_tx | mbd.iomega\*mbd.rd2.thx | rad/s | Rigid body angular velocity, x-component | Global |  |
| mbd.rd2.th\_ty | mbd.iomega\*mbd.rd2.thy | rad/s | Rigid body angular velocity, y-component | Global |  |
| mbd.rd2.th\_tz | mbd.iomega\*mbd.rd2.thz | rad/s | Rigid body angular velocity, z-component | Global |  |
| mbd.rd2.th\_ttx | mbd.iomega\*mbd.rd2.th\_tx | rad/s² | Rigid body angular acceleration, x-component | Global |  |
| mbd.rd2.th\_tty | mbd.iomega\*mbd.rd2.th\_ty | rad/s² | Rigid body angular acceleration, y-component | Global |  |
| mbd.rd2.th\_ttz | mbd.iomega\*mbd.rd2.th\_tz | rad/s² | Rigid body angular acceleration, z-component | Global |  |
| mbd.rd2.FIx | -mbd.rd2.m\*mbd.rd2.um\_ttx | N | Inertial force, x-component | Global |  |
| mbd.rd2.FIy | -mbd.rd2.m\*mbd.rd2.um\_tty | N | Inertial force, y-component | Global |  |
| mbd.rd2.FIz | 0 | N | Inertial force, z-component | Global |  |
| mbd.rd2.MIz | -mbd.rd2.Iz\*mbd.iomega^2\*mbd.rd2.phi | N·m | Inertial moment | Global |  |
| mbd.rd2.i\_rot | 1 | 1 | Free rotation indicator | Global | \* operation |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd2.U | ODE | m | Rigid body displacement, x-component |  | Global |
| mbd.rd2.V | ODE | m | Rigid body displacement, y-component |  | Global |
| mbd.rd2.Phi | ODE | rad | Rigid body rotation |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd2.FIx\*test(mbd.rd2.um)+mbd.rd2.FIy\*test(mbd.rd2.vm)+mbd.rd2.FIz\*test(mbd.rd2.wm) | 2 |  | Global |
| mbd.rd2.MIz\*test(mbd.rd2.phi) | 2 |  | Global |

#### Constraints

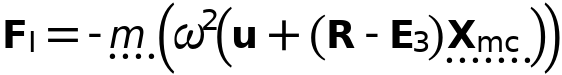
| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| up(u)-down(u) | test(up(u)-down(u)) | Lagrange (Linear) | No boundaries | Elemental |
| up(v)-down(v) | test(up(v)-down(v)) | Lagrange (Linear) | No boundaries | Elemental |
| 0 | 0 |  | No boundaries | Elemental |

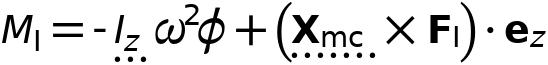
#### Mass and Moment of Inertia 2

Selection

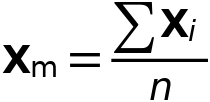
|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations









##### Center of Mass

Settings

| **Description** | **Value** |
| --- | --- |
| Center of mass | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

##### Mass and Moment of Inertia

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Mass | m\_head | kg |
| Moment of inertia | I\_head | kg·m² |

##### Frame Acceleration Forces

Settings

| **Description** | **Value** |
| --- | --- |
| Exclude contribution | Off |

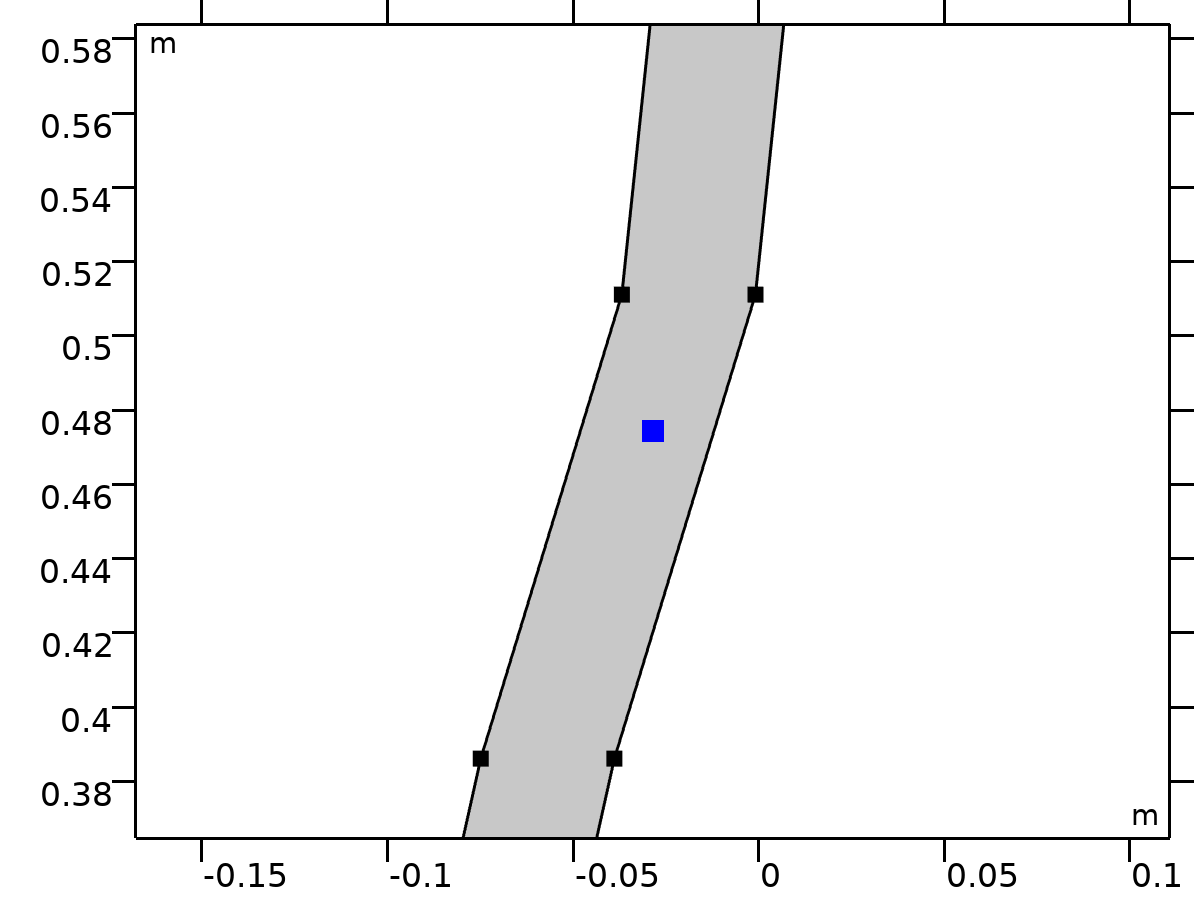
##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Wk\_tot | 0.25\*(mbd.rd2.mmi1.mt\*(realdot((mbd.rd2.u+mbd.rd2.mmi1.dMrotx-mbd.rd2.mmi1.dMx)\*mbd.iomega,(mbd.rd2.u+mbd.rd2.mmi1.dMrotx-mbd.rd2.mmi1.dMx)\*mbd.iomega)+realdot((mbd.rd2.v+mbd.rd2.mmi1.dMroty-mbd.rd2.mmi1.dMy)\*mbd.iomega,(mbd.rd2.v+mbd.rd2.mmi1.dMroty-mbd.rd2.mmi1.dMy)\*mbd.iomega)+realdot((mbd.rd2.w+mbd.rd2.mmi1.dMrotz-mbd.rd2.mmi1.dMz)\*mbd.iomega,(mbd.rd2.w+mbd.rd2.mmi1.dMrotz-mbd.rd2.mmi1.dMz)\*mbd.iomega))+mbd.rd2.mmi1.Iz\*realdot(mbd.rd2.phi\*mbd.iomega,mbd.rd2.phi\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.rd2.mmi1.mt | m\_head | kg | Mass | Global |  |
| mbd.rd2.mmi1.Iz | I\_head | kg·m² | Moment of inertia | Global |  |
| mbd.rd2.mmi1.xmsx | mbd.rd2.xcx+mbd.rd2.u+mbd.rd2.rotxx\*(mbd.rd2.mmi1.xmx-mbd.rd2.xcx)+mbd.rd2.rotxy\*(mbd.rd2.mmi1.xmy-mbd.rd2.xcy)+mbd.rd2.rotxz\*(mbd.rd2.mmi1.xmz-mbd.rd2.xcz) | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd2.mmi1.xmsy | mbd.rd2.xcy+mbd.rd2.v+mbd.rd2.rotyx\*(mbd.rd2.mmi1.xmx-mbd.rd2.xcx)+mbd.rd2.rotyy\*(mbd.rd2.mmi1.xmy-mbd.rd2.xcy)+mbd.rd2.rotyz\*(mbd.rd2.mmi1.xmz-mbd.rd2.xcz) | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd2.mmi1.xmsz | mbd.rd2.xcz+mbd.rd2.w+mbd.rd2.rotzx\*(mbd.rd2.mmi1.xmx-mbd.rd2.xcx)+mbd.rd2.rotzy\*(mbd.rd2.mmi1.xmy-mbd.rd2.xcy)+mbd.rd2.rotzz\*(mbd.rd2.mmi1.xmz-mbd.rd2.xcz) | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd2.mmi1.umx | mbd.rd2.u+mbd.rd2.rotxx\*(mbd.rd2.mmi1.xmx-mbd.rd2.xcx)+mbd.rd2.rotxy\*(mbd.rd2.mmi1.xmy-mbd.rd2.xcy)+mbd.rd2.rotxz\*(mbd.rd2.mmi1.xmz-mbd.rd2.xcz)-mbd.rd2.mmi1.xmx+mbd.rd2.xcx | m | Displacement at center of mass, x-component | Global |  |
| mbd.rd2.mmi1.umy | mbd.rd2.v+mbd.rd2.rotyx\*(mbd.rd2.mmi1.xmx-mbd.rd2.xcx)+mbd.rd2.rotyy\*(mbd.rd2.mmi1.xmy-mbd.rd2.xcy)+mbd.rd2.rotyz\*(mbd.rd2.mmi1.xmz-mbd.rd2.xcz)-mbd.rd2.mmi1.xmy+mbd.rd2.xcy | m | Displacement at center of mass, y-component | Global |  |
| mbd.rd2.mmi1.umz | mbd.rd2.w+mbd.rd2.rotzx\*(mbd.rd2.mmi1.xmx-mbd.rd2.xcx)+mbd.rd2.rotzy\*(mbd.rd2.mmi1.xmy-mbd.rd2.xcy)+mbd.rd2.rotzz\*(mbd.rd2.mmi1.xmz-mbd.rd2.xcz)-mbd.rd2.mmi1.xmz+mbd.rd2.xcz | m | Displacement at center of mass, z-component | Global |  |
| mbd.rd2.mmi1.FIx | -mbd.rd2.mmi1.mt\*mbd.iomega^2\*(mbd.rd2.u+mbd.rd2.mmi1.dMrotx-mbd.rd2.mmi1.dMx) | N | Inertial force, x-component | Global |  |
| mbd.rd2.mmi1.FIy | -mbd.rd2.mmi1.mt\*mbd.iomega^2\*(mbd.rd2.v+mbd.rd2.mmi1.dMroty-mbd.rd2.mmi1.dMy) | N | Inertial force, y-component | Global |  |
| mbd.rd2.mmi1.FIz | -mbd.rd2.mmi1.mt\*mbd.iomega^2\*(mbd.rd2.w+mbd.rd2.mmi1.dMrotz-mbd.rd2.mmi1.dMz) | N | Inertial force, z-component | Global |  |
| mbd.rd2.mmi1.MIz | -mbd.rd2.mmi1.Iz\*mbd.iomega^2\*mbd.rd2.phi | N·m | Inertial moment | Global |  |
| mbd.rd2.mmi1.dMx | mbd.rd2.mmi1.xmx-mbd.rd2.xcx | m | Mass offset from CoR, Original, x-component | Global |  |
| mbd.rd2.mmi1.dMy | mbd.rd2.mmi1.xmy-mbd.rd2.xcy | m | Mass offset from CoR, Original, y-component | Global |  |
| mbd.rd2.mmi1.dMz | mbd.rd2.mmi1.xmz-mbd.rd2.xcz | m | Mass offset from CoR, Original, z-component | Global |  |
| mbd.rd2.mmi1.dMrotx | mbd.rd2.rotxx\*mbd.rd2.mmi1.dMx+mbd.rd2.rotxy\*mbd.rd2.mmi1.dMy+mbd.rd2.rotxz\*mbd.rd2.mmi1.dMz | m | Mass offset from CoR, Rotated, x-component | Global |  |
| mbd.rd2.mmi1.dMroty | mbd.rd2.rotyx\*mbd.rd2.mmi1.dMx+mbd.rd2.rotyy\*mbd.rd2.mmi1.dMy+mbd.rd2.rotyz\*mbd.rd2.mmi1.dMz | m | Mass offset from CoR, Rotated, y-component | Global |  |
| mbd.rd2.mmi1.dMrotz | mbd.rd2.rotzx\*mbd.rd2.mmi1.dMx+mbd.rd2.rotzy\*mbd.rd2.mmi1.dMy+mbd.rd2.rotzz\*mbd.rd2.mmi1.dMz | m | Mass offset from CoR, Rotated, z-component | Global |  |
| mbd.rd2.mmi1.Fx | mbd.rd2.mmi1.FIx | N | Applied force, x-component | Global |  |
| mbd.rd2.mmi1.Fy | mbd.rd2.mmi1.FIy | N | Applied force, y-component | Global |  |
| mbd.rd2.mmi1.Fz | mbd.rd2.mmi1.FIz | N | Applied force, z-component | Global |  |
| mbd.rd2.mmi1.F\_Mag | sqrt(real(mbd.rd2.mmi1.Fx)^2+real(mbd.rd2.mmi1.Fy)^2+real(mbd.rd2.mmi1.Fz)^2) | N | Load magnitude | Global |  |
| mbd.rd2.mmi1.Mx | 0 | N·m | Applied moment, x-component | Global |  |
| mbd.rd2.mmi1.My | 0 | N·m | Applied moment, y-component | Global |  |
| mbd.rd2.mmi1.Mz | mbd.rd2.mmi1.MIz | N·m | Applied moment, z-component | Global |  |
| mbd.rd2.mmi1.M\_Mag | sqrt(real(mbd.rd2.mmi1.Mx)^2+real(mbd.rd2.mmi1.My)^2+real(mbd.rd2.mmi1.Mz)^2) | N·m | Moment magnitude | Global |  |
| mbd.rd2.mmi1.loadposx | mbd.rd2.mmi1.xmx | m | Load position, x-component | Global |  |
| mbd.rd2.mmi1.loadposy | mbd.rd2.mmi1.xmy | m | Load position, y-component | Global |  |
| mbd.rd2.mmi1.loadposz | mbd.rd2.mmi1.xmz | m | Load position, z-component | Global |  |
| mbd.rd2.mmi1.momposx | mbd.rd2.mmi1.xmx | m | Moment position, x-component | Global |  |
| mbd.rd2.mmi1.momposy | mbd.rd2.mmi1.xmy | m | Moment position, y-component | Global |  |
| mbd.rd2.mmi1.momposz | mbd.rd2.mmi1.xmz | m | Moment position, z-component | Global |  |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd2.mmi1.FIx\*test(mbd.rd2.u+mbd.rd2.mmi1.dMrotx)+mbd.rd2.mmi1.FIy\*test(mbd.rd2.v+mbd.rd2.mmi1.dMroty)+mbd.rd2.mmi1.FIz\*test(mbd.rd2.w+mbd.rd2.mmi1.dMrotz) | 2 |  | Global |
| mbd.rd2.mmi1.MIz\*test(mbd.rd2.phi) | 2 |  | Global |

##### Center of Mass: Point 2



Center of Mass: Point 2

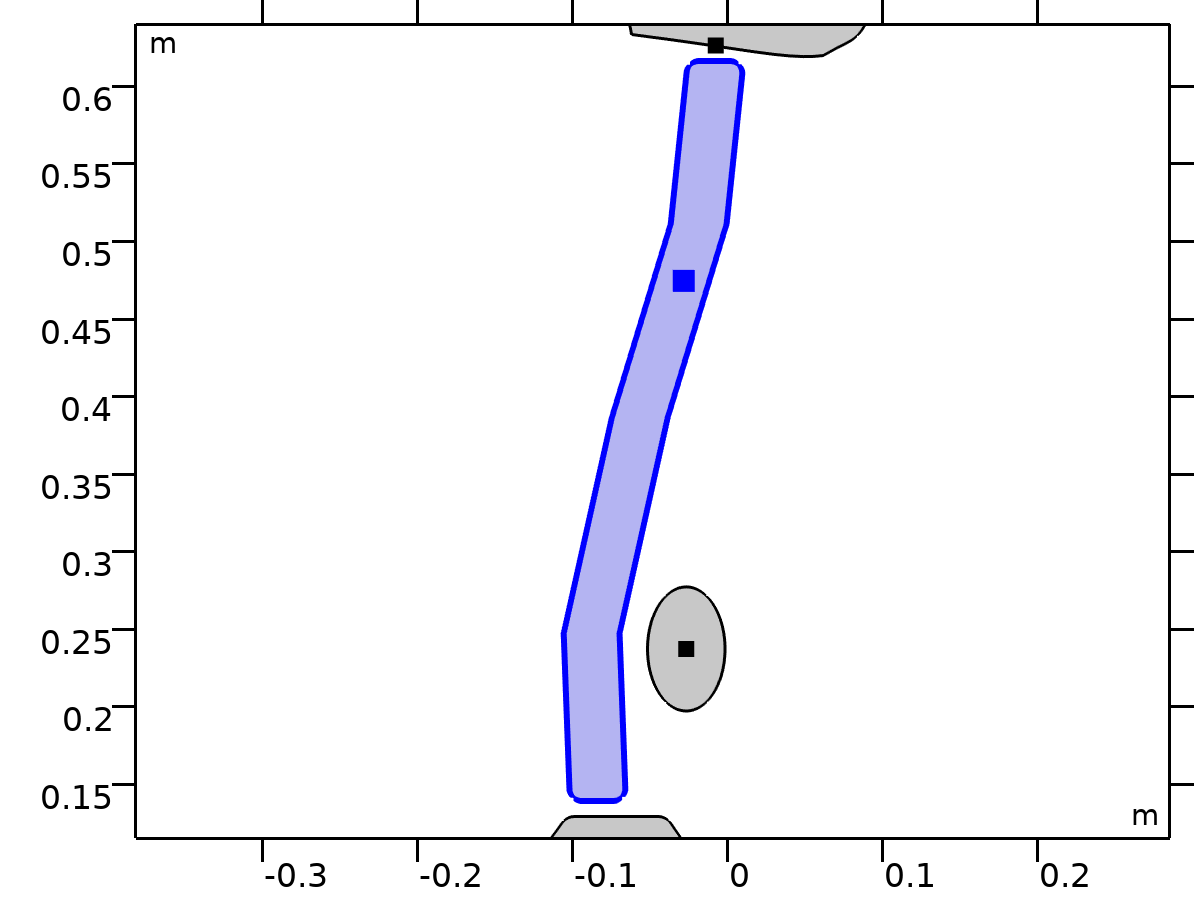
Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 46 |

###### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd2.mmi1.xmx | mbd.rd2.mmi1.cmp1.int(X)/mbd.rd2.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, x-component | Global | + operation |
| mbd.rd2.mmi1.xmy | mbd.rd2.mmi1.cmp1.int(Y)/mbd.rd2.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, y-component | Global | + operation |
| mbd.rd2.mmi1.xmz | mbd.rd2.mmi1.cmp1.int(0)/mbd.rd2.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, z-component | Global | + operation |

### Torso



Torso

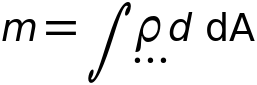
Selection

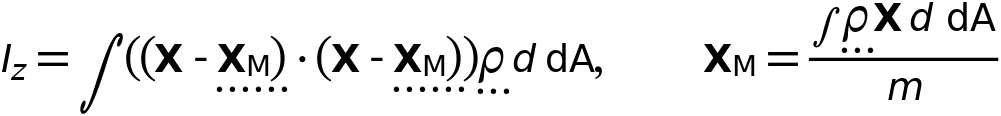
|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: Domain 3 |

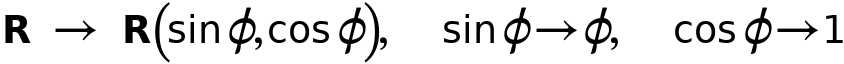
Equations





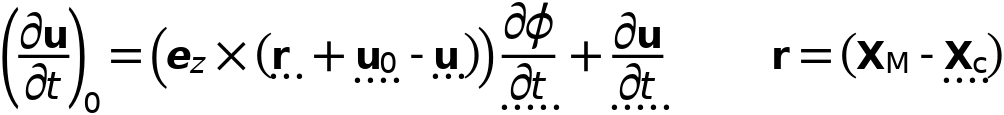




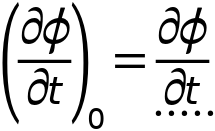












#### Density

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Density | User defined |  |
| Density | 0 | kg/m³ |

#### Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Center of rotation | Center of mass |
| Offset | Off |

#### Initial Values

Settings

| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| u | mbd.rd3.Udx | m | Displacement field, X-component | Domain 3 |  |
| v | mbd.rd3.Udy | m | Displacement field, Y-component | Domain 3 |  |
| w | mbd.rd3.Udz | m | Displacement field, Z-component | Domain 3 |  |
| mbd.Wk\_tot | 0.25\*(mbd.rd3.m\*(realdot(mbd.rd3.u\*mbd.iomega,mbd.rd3.u\*mbd.iomega)+realdot(mbd.rd3.v\*mbd.iomega,mbd.rd3.v\*mbd.iomega)+realdot(mbd.rd3.w\*mbd.iomega,mbd.rd3.w\*mbd.iomega))+realdot(mbd.rd3.Iz\*mbd.rd3.thx\*mbd.iomega,mbd.rd3.thx\*mbd.iomega)+realdot(mbd.rd3.Iz\*mbd.rd3.thy\*mbd.iomega,mbd.rd3.thy\*mbd.iomega)+realdot(mbd.rd3.Iz\*mbd.rd3.thz\*mbd.iomega,mbd.rd3.thz\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.RFtotalx | reacf(mbd.rd3.U) | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | reacf(mbd.rd3.V) | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | 0 | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | -reacf(mbd.rd3.V)\*mbd.rd3.RMmaz | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | reacf(mbd.rd3.U)\*mbd.rd3.RMmaz | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | reacf(mbd.rd3.V)\*mbd.rd3.RMmax-reacf(mbd.rd3.U)\*mbd.rd3.RMmay+reacf(mbd.rd3.Phi) | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.disp | sqrteps(real(u)^2+real(v)^2) | m | Displacement magnitude | Domain 3 |  |
| mbd.disp\_rms | sqrt(0.5\*(realdot(u,u)+realdot(v,v))) | m | Displacement, RMS | Domain 3 |  |
| mbd.gradUxX | -1+mbd.FdxX | 1 | Displacement gradient, xX-component | Domain 3 |  |
| mbd.gradUyX | mbd.FdyX | 1 | Displacement gradient, yX-component | Domain 3 |  |
| mbd.gradUzX | mbd.FdzX | 1 | Displacement gradient, zX-component | Domain 3 |  |
| mbd.gradUxY | mbd.FdxY | 1 | Displacement gradient, xY-component | Domain 3 |  |
| mbd.gradUyY | -1+mbd.FdyY | 1 | Displacement gradient, yY-component | Domain 3 |  |
| mbd.gradUzY | mbd.FdzY | 1 | Displacement gradient, zY-component | Domain 3 |  |
| mbd.gradUxZ | mbd.FdxZ | 1 | Displacement gradient, xZ-component | Domain 3 |  |
| mbd.gradUyZ | mbd.FdyZ | 1 | Displacement gradient, yZ-component | Domain 3 |  |
| mbd.gradUzZ | -1+mbd.FdzZ | 1 | Displacement gradient, zZ-component | Domain 3 |  |
| mbd.FdxX | mbd.rd3.rotxx | 1 | Deformation gradient, xX-component | Domain 3 |  |
| mbd.FdyX | mbd.rd3.rotyx | 1 | Deformation gradient, yX-component | Domain 3 |  |
| mbd.FdzX | mbd.rd3.rotzx | 1 | Deformation gradient, zX-component | Domain 3 |  |
| mbd.FdxY | mbd.rd3.rotxy | 1 | Deformation gradient, xY-component | Domain 3 |  |
| mbd.FdyY | mbd.rd3.rotyy | 1 | Deformation gradient, yY-component | Domain 3 |  |
| mbd.FdzY | mbd.rd3.rotzy | 1 | Deformation gradient, zY-component | Domain 3 |  |
| mbd.FdxZ | mbd.rd3.rotxz | 1 | Deformation gradient, xZ-component | Domain 3 |  |
| mbd.FdyZ | mbd.rd3.rotyz | 1 | Deformation gradient, yZ-component | Domain 3 |  |
| mbd.FdzZ | mbd.rd3.rotzz | 1 | Deformation gradient, zZ-component | Domain 3 |  |
| mbd.FdiXx | (mbd.FdyY\*mbd.FdzZ-mbd.FdyZ\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Xx-component | Domain 3 |  |
| mbd.FdiYx | (mbd.FdyZ\*mbd.FdzX-mbd.FdyX\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Yx-component | Domain 3 |  |
| mbd.FdiZx | (mbd.FdyX\*mbd.FdzY-mbd.FdyY\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Zx-component | Domain 3 |  |
| mbd.FdiXy | (mbd.FdxZ\*mbd.FdzY-mbd.FdxY\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Xy-component | Domain 3 |  |
| mbd.FdiYy | (mbd.FdxX\*mbd.FdzZ-mbd.FdxZ\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Yy-component | Domain 3 |  |
| mbd.FdiZy | (mbd.FdxY\*mbd.FdzX-mbd.FdxX\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Zy-component | Domain 3 |  |
| mbd.FdiXz | (mbd.FdxY\*mbd.FdyZ-mbd.FdxZ\*mbd.FdyY)/mbd.J | 1 | Deformation gradient inverse, Xz-component | Domain 3 |  |
| mbd.FdiYz | (mbd.FdxZ\*mbd.FdyX-mbd.FdxX\*mbd.FdyZ)/mbd.J | 1 | Deformation gradient inverse, Yz-component | Domain 3 |  |
| mbd.FdiZz | (mbd.FdxX\*mbd.FdyY-mbd.FdxY\*mbd.FdyX)/mbd.J | 1 | Deformation gradient inverse, Zz-component | Domain 3 |  |
| mbd.J | 1 | 1 | Volume ratio | Domain 3 |  |
| mbd.Ws | 0 | J/m³ | Elastic strain energy density | Domain 3 | + operation |
| mbd.Ws\_tot | 0 | J | Total elastic strain energy | Global | + operation |
| mbd.Wk | 0.25\*mbd.rho\*(realdot(u\*mbd.iomega,u\*mbd.iomega)+realdot(v\*mbd.iomega,v\*mbd.iomega)) | J/m³ | Kinetic energy density | Domain 3 | + operation |
| mbd.Eequ | Inf | Pa | Equivalent Young's modulus | Domain 3 |  |
| mbd.nuequ | 0 | 1 | Equivalent Poisson's ratio | Domain 3 |  |
| mbd.Eequtot | mbd.Eequ | Pa | Total equivalent Young's modulus | Domain 3 | + operation |
| mbd.rho | 0 | kg/m³ | Density | Domain 3 | \* operation |
| mbd.u\_ttX | material.dt(material.dt(mbd.rd3.Udx)) | m/s² | Acceleration, X-component | Domain 3 |  |
| mbd.u\_ttY | material.dt(material.dt(mbd.rd3.Udy)) | m/s² | Acceleration, Y-component | Domain 3 |  |
| mbd.u\_ttZ | material.dt(material.dt(mbd.rd3.Udz)) | m/s² | Acceleration, Z-component | Domain 3 |  |
| mbd.u\_tX | material.dt(mbd.rd3.Udx) | m/s | Velocity, X-component | Domain 3 |  |
| mbd.u\_tY | material.dt(mbd.rd3.Udy) | m/s | Velocity, Y-component | Domain 3 |  |
| mbd.u\_tZ | material.dt(mbd.rd3.Udz) | m/s | Velocity, Z-component | Domain 3 |  |
| mbd.vel\_rms | sqrt(0.5\*(realdot(mbd.u\_tX,mbd.u\_tX)+realdot(mbd.u\_tY,mbd.u\_tY)+realdot(mbd.u\_tZ,mbd.u\_tZ))) | m/s | Velocity magnitude, RMS | Domain 3 |  |
| mbd.acc\_rms | sqrt(0.5\*(realdot(mbd.u\_ttX,mbd.u\_ttX)+realdot(mbd.u\_ttY,mbd.u\_ttY)+realdot(mbd.u\_ttZ,mbd.u\_ttZ))) | m/s² | Acceleration magnitude, RMS | Domain 3 |  |
| mbd.afX | 0 | m/s² | Frame acceleration, X-component | Domain 3 | + operation |
| mbd.afY | 0 | m/s² | Frame acceleration, Y-component | Domain 3 | + operation |
| mbd.afZ | 0 | m/s² | Frame acceleration, Z-component | Domain 3 | + operation |
| mbd.accX | mbd.u\_ttX | m/s² | Effective acceleration, X-component | Domain 3 | + operation |
| mbd.accY | mbd.u\_ttY | m/s² | Effective acceleration, Y-component | Domain 3 | + operation |
| mbd.accZ | mbd.u\_ttZ | m/s² | Effective acceleration, Z-component | Domain 3 | + operation |
| mbd.vel | sqrteps(real(mbd.u\_tX)^2+real(mbd.u\_tY)^2+real(mbd.u\_tZ)^2) | m/s | Velocity magnitude | Domain 3 |  |
| mbd.acc | sqrteps(real(mbd.accX)^2+real(mbd.accY)^2+real(mbd.accZ)^2) | m/s² | Effective acceleration magnitude | Domain 3 |  |
| mbd.u\_tt | sqrteps(real(mbd.u\_ttX)^2+real(mbd.u\_ttY)^2+real(mbd.u\_ttZ)^2) | m/s² | Acceleration magnitude | Domain 3 |  |
| mbd.phase | if(isdefined(phase),phase,0) | 1 | Phase | Global |  |
| mbd.rd3.xcx | mbd.rd3.xmx | m | Center of rotation, x-component | Global | + operation |
| mbd.rd3.xcy | mbd.rd3.xmy | m | Center of rotation, y-component | Global | + operation |
| mbd.rd3.xcz | mbd.rd3.xmz | m | Center of rotation, z-component | Global | + operation |
| mbd.rd3.phi | mbd.rd3.Phi | rad | Rigid body rotation | Global |  |
| mbd.rd3.rotxx | 1 | 1 | Rotation matrix, xx-component | Global |  |
| mbd.rd3.rotyx | mbd.rd3.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, yx-component | Global |  |
| mbd.rd3.rotzx | 0 | 1 | Rotation matrix, zx-component | Global |  |
| mbd.rd3.rotxy | -mbd.rd3.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, xy-component | Global |  |
| mbd.rd3.rotyy | 1 | 1 | Rotation matrix, yy-component | Global |  |
| mbd.rd3.rotzy | 0 | 1 | Rotation matrix, zy-component | Global |  |
| mbd.rd3.rotxz | 0 | 1 | Rotation matrix, xz-component | Global |  |
| mbd.rd3.rotyz | 0 | 1 | Rotation matrix, yz-component | Global |  |
| mbd.rd3.rotzz | 1 | 1 | Rotation matrix, zz-component | Global |  |
| mbd.rd3.RMmax | mbd.rd3.xcx-mbd.refpntx | m | Moment arm, x-component | Global |  |
| mbd.rd3.RMmay | mbd.rd3.xcy-mbd.refpnty | m | Moment arm, y-component | Global |  |
| mbd.rd3.RMmaz | 0 | m | Moment arm, z-component | Global |  |
| mbd.rd3.u | mbd.rd3.U | m | Rigid body displacement, x-component | Global |  |
| mbd.rd3.v | mbd.rd3.V | m | Rigid body displacement, y-component | Global |  |
| mbd.rd3.w | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd3.xmx | mbd.rd3.int((mbd.rho+eps)\*mbd.d\*X)/mbd.rd3.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, x-component | Global |  |
| mbd.rd3.xmy | mbd.rd3.int((mbd.rho+eps)\*mbd.d\*Y)/mbd.rd3.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, y-component | Global |  |
| mbd.rd3.xmz | 0 | m | Center of mass, z-component | Global |  |
| mbd.rd3.Iz | mbd.rd3.int(((X-mbd.rd3.xmx)^2+(Y-mbd.rd3.xmy)^2+mbd.rd3.xmz^2)\*mbd.rho\*mbd.d) | kg·m² | Moment of inertia | Global |  |
| mbd.rd3.um | mbd.rd3.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd3.vm | mbd.rd3.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd3.wm | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd3.m | mbd.rd3.int(mbd.rho\*mbd.d) | kg | Mass | Global |  |
| mbd.rd3.Udx | (mbd.rd3.rotxx\*(X-mbd.rd3.xcx)+mbd.rd3.rotxy\*(Y-mbd.rd3.xcy)-mbd.rd3.rotxz\*mbd.rd3.xcz-X+mbd.rd3.xcx)\*exp(j\*mbd.phase)+mbd.rd3.u | m | Domain displacement, x-component | Domain 3 | + operation |
| mbd.rd3.Udy | (mbd.rd3.rotyx\*(X-mbd.rd3.xcx)+mbd.rd3.rotyy\*(Y-mbd.rd3.xcy)-mbd.rd3.rotyz\*mbd.rd3.xcz-Y+mbd.rd3.xcy)\*exp(j\*mbd.phase)+mbd.rd3.v | m | Domain displacement, y-component | Domain 3 | + operation |
| mbd.rd3.Udz | (mbd.rd3.rotzx\*(X-mbd.rd3.xcx)+mbd.rd3.rotzy\*(Y-mbd.rd3.xcy)-mbd.rd3.rotzz\*mbd.rd3.xcz+mbd.rd3.xcz)\*exp(j\*mbd.phase)+mbd.rd3.w | m | Domain displacement, z-component | Domain 3 | + operation |
| mbd.rd3.thx | 0 | rad | Rigid body rotation, x-component | Global |  |
| mbd.rd3.thy | 0 | rad | Rigid body rotation, y-component | Global |  |
| mbd.rd3.thz | mbd.rd3.phi | rad | Rigid body rotation, z-component | Global |  |
| mbd.rd3.u\_tx | mbd.iomega\*mbd.rd3.u | m/s | Rigid body velocity, x-component | Global |  |
| mbd.rd3.u\_ty | mbd.iomega\*mbd.rd3.v | m/s | Rigid body velocity, y-component | Global |  |
| mbd.rd3.u\_tz | mbd.iomega\*mbd.rd3.w | m/s | Rigid body velocity, z-component | Global |  |
| mbd.rd3.u\_ttx | mbd.iomega\*mbd.rd3.u\_tx | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd3.u\_tty | mbd.iomega\*mbd.rd3.u\_ty | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd3.u\_ttz | mbd.iomega\*mbd.rd3.u\_tz | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd3.um\_ttx | mbd.iomega^2\*mbd.rd3.um | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd3.um\_tty | mbd.iomega^2\*mbd.rd3.vm | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd3.um\_ttz | mbd.iomega^2\*mbd.rd3.wm | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd3.th\_tx | mbd.iomega\*mbd.rd3.thx | rad/s | Rigid body angular velocity, x-component | Global |  |
| mbd.rd3.th\_ty | mbd.iomega\*mbd.rd3.thy | rad/s | Rigid body angular velocity, y-component | Global |  |
| mbd.rd3.th\_tz | mbd.iomega\*mbd.rd3.thz | rad/s | Rigid body angular velocity, z-component | Global |  |
| mbd.rd3.th\_ttx | mbd.iomega\*mbd.rd3.th\_tx | rad/s² | Rigid body angular acceleration, x-component | Global |  |
| mbd.rd3.th\_tty | mbd.iomega\*mbd.rd3.th\_ty | rad/s² | Rigid body angular acceleration, y-component | Global |  |
| mbd.rd3.th\_ttz | mbd.iomega\*mbd.rd3.th\_tz | rad/s² | Rigid body angular acceleration, z-component | Global |  |
| mbd.rd3.FIx | -mbd.rd3.m\*mbd.rd3.um\_ttx | N | Inertial force, x-component | Global |  |
| mbd.rd3.FIy | -mbd.rd3.m\*mbd.rd3.um\_tty | N | Inertial force, y-component | Global |  |
| mbd.rd3.FIz | 0 | N | Inertial force, z-component | Global |  |
| mbd.rd3.MIz | -mbd.rd3.Iz\*mbd.iomega^2\*mbd.rd3.phi | N·m | Inertial moment | Global |  |
| mbd.rd3.i\_rot | 1 | 1 | Free rotation indicator | Global | \* operation |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd3.U | ODE | m | Rigid body displacement, x-component |  | Global |
| mbd.rd3.V | ODE | m | Rigid body displacement, y-component |  | Global |
| mbd.rd3.Phi | ODE | rad | Rigid body rotation |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd3.FIx\*test(mbd.rd3.um)+mbd.rd3.FIy\*test(mbd.rd3.vm)+mbd.rd3.FIz\*test(mbd.rd3.wm) | 2 |  | Global |
| mbd.rd3.MIz\*test(mbd.rd3.phi) | 2 |  | Global |

#### Constraints

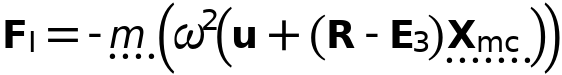
| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| up(u)-down(u) | test(up(u)-down(u)) | Lagrange (Linear) | No boundaries | Elemental |
| up(v)-down(v) | test(up(v)-down(v)) | Lagrange (Linear) | No boundaries | Elemental |
| 0 | 0 |  | No boundaries | Elemental |

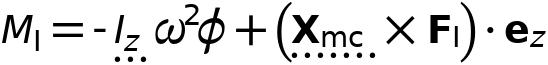
#### Mass and Moment of Inertia 3

Selection

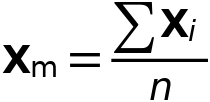
|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations









##### Center of Mass

Settings

| **Description** | **Value** |
| --- | --- |
| Center of mass | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

##### Mass and Moment of Inertia

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Mass | m\_torso | kg |
| Moment of inertia | I\_torso | kg·m² |

##### Frame Acceleration Forces

Settings

| **Description** | **Value** |
| --- | --- |
| Exclude contribution | Off |

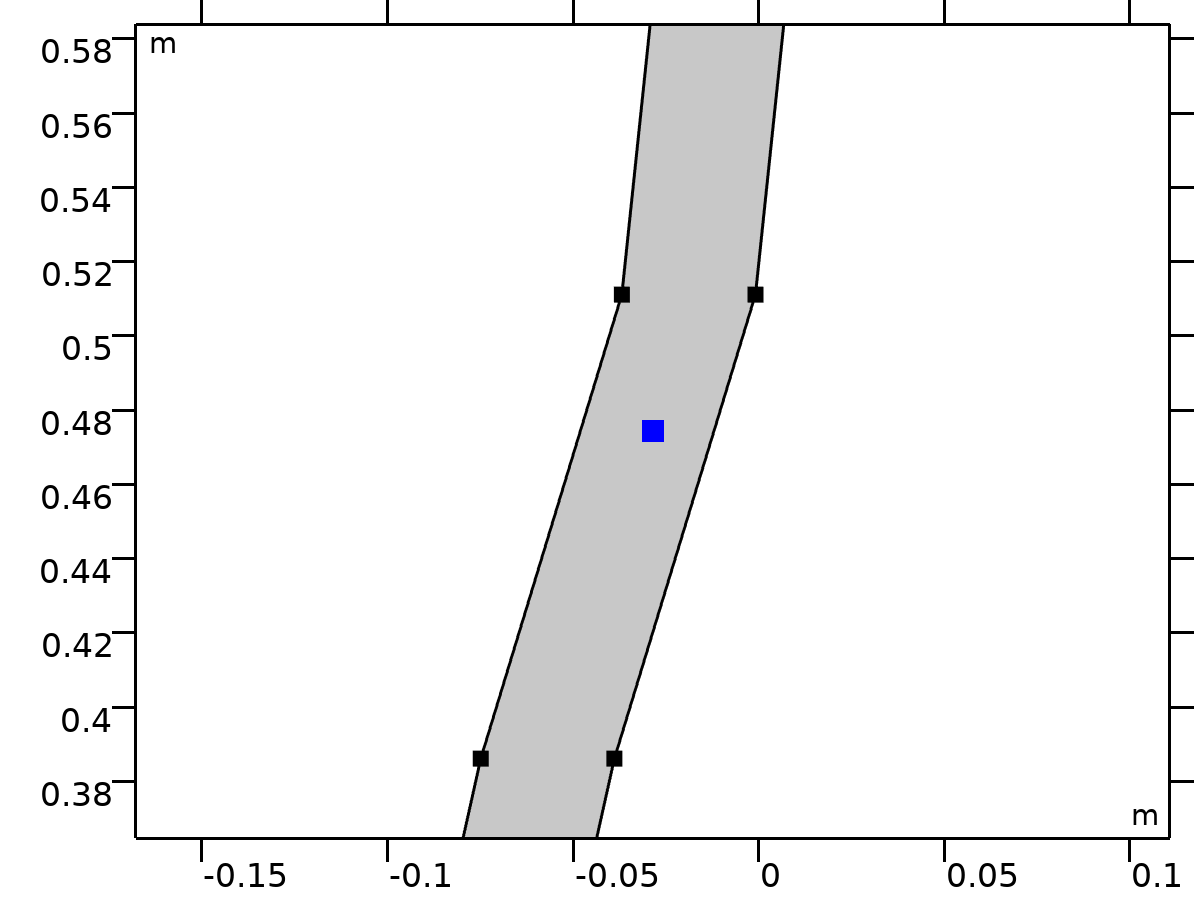
##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Wk\_tot | 0.25\*(mbd.rd3.mmi1.mt\*(realdot((mbd.rd3.u+mbd.rd3.mmi1.dMrotx-mbd.rd3.mmi1.dMx)\*mbd.iomega,(mbd.rd3.u+mbd.rd3.mmi1.dMrotx-mbd.rd3.mmi1.dMx)\*mbd.iomega)+realdot((mbd.rd3.v+mbd.rd3.mmi1.dMroty-mbd.rd3.mmi1.dMy)\*mbd.iomega,(mbd.rd3.v+mbd.rd3.mmi1.dMroty-mbd.rd3.mmi1.dMy)\*mbd.iomega)+realdot((mbd.rd3.w+mbd.rd3.mmi1.dMrotz-mbd.rd3.mmi1.dMz)\*mbd.iomega,(mbd.rd3.w+mbd.rd3.mmi1.dMrotz-mbd.rd3.mmi1.dMz)\*mbd.iomega))+mbd.rd3.mmi1.Iz\*realdot(mbd.rd3.phi\*mbd.iomega,mbd.rd3.phi\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.rd3.mmi1.mt | m\_torso | kg | Mass | Global |  |
| mbd.rd3.mmi1.Iz | I\_torso | kg·m² | Moment of inertia | Global |  |
| mbd.rd3.mmi1.xmsx | mbd.rd3.xcx+mbd.rd3.u+mbd.rd3.rotxx\*(mbd.rd3.mmi1.xmx-mbd.rd3.xcx)+mbd.rd3.rotxy\*(mbd.rd3.mmi1.xmy-mbd.rd3.xcy)+mbd.rd3.rotxz\*(mbd.rd3.mmi1.xmz-mbd.rd3.xcz) | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd3.mmi1.xmsy | mbd.rd3.xcy+mbd.rd3.v+mbd.rd3.rotyx\*(mbd.rd3.mmi1.xmx-mbd.rd3.xcx)+mbd.rd3.rotyy\*(mbd.rd3.mmi1.xmy-mbd.rd3.xcy)+mbd.rd3.rotyz\*(mbd.rd3.mmi1.xmz-mbd.rd3.xcz) | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd3.mmi1.xmsz | mbd.rd3.xcz+mbd.rd3.w+mbd.rd3.rotzx\*(mbd.rd3.mmi1.xmx-mbd.rd3.xcx)+mbd.rd3.rotzy\*(mbd.rd3.mmi1.xmy-mbd.rd3.xcy)+mbd.rd3.rotzz\*(mbd.rd3.mmi1.xmz-mbd.rd3.xcz) | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd3.mmi1.umx | mbd.rd3.u+mbd.rd3.rotxx\*(mbd.rd3.mmi1.xmx-mbd.rd3.xcx)+mbd.rd3.rotxy\*(mbd.rd3.mmi1.xmy-mbd.rd3.xcy)+mbd.rd3.rotxz\*(mbd.rd3.mmi1.xmz-mbd.rd3.xcz)-mbd.rd3.mmi1.xmx+mbd.rd3.xcx | m | Displacement at center of mass, x-component | Global |  |
| mbd.rd3.mmi1.umy | mbd.rd3.v+mbd.rd3.rotyx\*(mbd.rd3.mmi1.xmx-mbd.rd3.xcx)+mbd.rd3.rotyy\*(mbd.rd3.mmi1.xmy-mbd.rd3.xcy)+mbd.rd3.rotyz\*(mbd.rd3.mmi1.xmz-mbd.rd3.xcz)-mbd.rd3.mmi1.xmy+mbd.rd3.xcy | m | Displacement at center of mass, y-component | Global |  |
| mbd.rd3.mmi1.umz | mbd.rd3.w+mbd.rd3.rotzx\*(mbd.rd3.mmi1.xmx-mbd.rd3.xcx)+mbd.rd3.rotzy\*(mbd.rd3.mmi1.xmy-mbd.rd3.xcy)+mbd.rd3.rotzz\*(mbd.rd3.mmi1.xmz-mbd.rd3.xcz)-mbd.rd3.mmi1.xmz+mbd.rd3.xcz | m | Displacement at center of mass, z-component | Global |  |
| mbd.rd3.mmi1.FIx | -mbd.rd3.mmi1.mt\*mbd.iomega^2\*(mbd.rd3.u+mbd.rd3.mmi1.dMrotx-mbd.rd3.mmi1.dMx) | N | Inertial force, x-component | Global |  |
| mbd.rd3.mmi1.FIy | -mbd.rd3.mmi1.mt\*mbd.iomega^2\*(mbd.rd3.v+mbd.rd3.mmi1.dMroty-mbd.rd3.mmi1.dMy) | N | Inertial force, y-component | Global |  |
| mbd.rd3.mmi1.FIz | -mbd.rd3.mmi1.mt\*mbd.iomega^2\*(mbd.rd3.w+mbd.rd3.mmi1.dMrotz-mbd.rd3.mmi1.dMz) | N | Inertial force, z-component | Global |  |
| mbd.rd3.mmi1.MIz | -mbd.rd3.mmi1.Iz\*mbd.iomega^2\*mbd.rd3.phi | N·m | Inertial moment | Global |  |
| mbd.rd3.mmi1.dMx | mbd.rd3.mmi1.xmx-mbd.rd3.xcx | m | Mass offset from CoR, Original, x-component | Global |  |
| mbd.rd3.mmi1.dMy | mbd.rd3.mmi1.xmy-mbd.rd3.xcy | m | Mass offset from CoR, Original, y-component | Global |  |
| mbd.rd3.mmi1.dMz | mbd.rd3.mmi1.xmz-mbd.rd3.xcz | m | Mass offset from CoR, Original, z-component | Global |  |
| mbd.rd3.mmi1.dMrotx | mbd.rd3.rotxx\*mbd.rd3.mmi1.dMx+mbd.rd3.rotxy\*mbd.rd3.mmi1.dMy+mbd.rd3.rotxz\*mbd.rd3.mmi1.dMz | m | Mass offset from CoR, Rotated, x-component | Global |  |
| mbd.rd3.mmi1.dMroty | mbd.rd3.rotyx\*mbd.rd3.mmi1.dMx+mbd.rd3.rotyy\*mbd.rd3.mmi1.dMy+mbd.rd3.rotyz\*mbd.rd3.mmi1.dMz | m | Mass offset from CoR, Rotated, y-component | Global |  |
| mbd.rd3.mmi1.dMrotz | mbd.rd3.rotzx\*mbd.rd3.mmi1.dMx+mbd.rd3.rotzy\*mbd.rd3.mmi1.dMy+mbd.rd3.rotzz\*mbd.rd3.mmi1.dMz | m | Mass offset from CoR, Rotated, z-component | Global |  |
| mbd.rd3.mmi1.Fx | mbd.rd3.mmi1.FIx | N | Applied force, x-component | Global |  |
| mbd.rd3.mmi1.Fy | mbd.rd3.mmi1.FIy | N | Applied force, y-component | Global |  |
| mbd.rd3.mmi1.Fz | mbd.rd3.mmi1.FIz | N | Applied force, z-component | Global |  |
| mbd.rd3.mmi1.F\_Mag | sqrt(real(mbd.rd3.mmi1.Fx)^2+real(mbd.rd3.mmi1.Fy)^2+real(mbd.rd3.mmi1.Fz)^2) | N | Load magnitude | Global |  |
| mbd.rd3.mmi1.Mx | 0 | N·m | Applied moment, x-component | Global |  |
| mbd.rd3.mmi1.My | 0 | N·m | Applied moment, y-component | Global |  |
| mbd.rd3.mmi1.Mz | mbd.rd3.mmi1.MIz | N·m | Applied moment, z-component | Global |  |
| mbd.rd3.mmi1.M\_Mag | sqrt(real(mbd.rd3.mmi1.Mx)^2+real(mbd.rd3.mmi1.My)^2+real(mbd.rd3.mmi1.Mz)^2) | N·m | Moment magnitude | Global |  |
| mbd.rd3.mmi1.loadposx | mbd.rd3.mmi1.xmx | m | Load position, x-component | Global |  |
| mbd.rd3.mmi1.loadposy | mbd.rd3.mmi1.xmy | m | Load position, y-component | Global |  |
| mbd.rd3.mmi1.loadposz | mbd.rd3.mmi1.xmz | m | Load position, z-component | Global |  |
| mbd.rd3.mmi1.momposx | mbd.rd3.mmi1.xmx | m | Moment position, x-component | Global |  |
| mbd.rd3.mmi1.momposy | mbd.rd3.mmi1.xmy | m | Moment position, y-component | Global |  |
| mbd.rd3.mmi1.momposz | mbd.rd3.mmi1.xmz | m | Moment position, z-component | Global |  |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd3.mmi1.FIx\*test(mbd.rd3.u+mbd.rd3.mmi1.dMrotx)+mbd.rd3.mmi1.FIy\*test(mbd.rd3.v+mbd.rd3.mmi1.dMroty)+mbd.rd3.mmi1.FIz\*test(mbd.rd3.w+mbd.rd3.mmi1.dMrotz) | 2 |  | Global |
| mbd.rd3.mmi1.MIz\*test(mbd.rd3.phi) | 2 |  | Global |

##### Center of Mass: Point 3



Center of Mass: Point 3

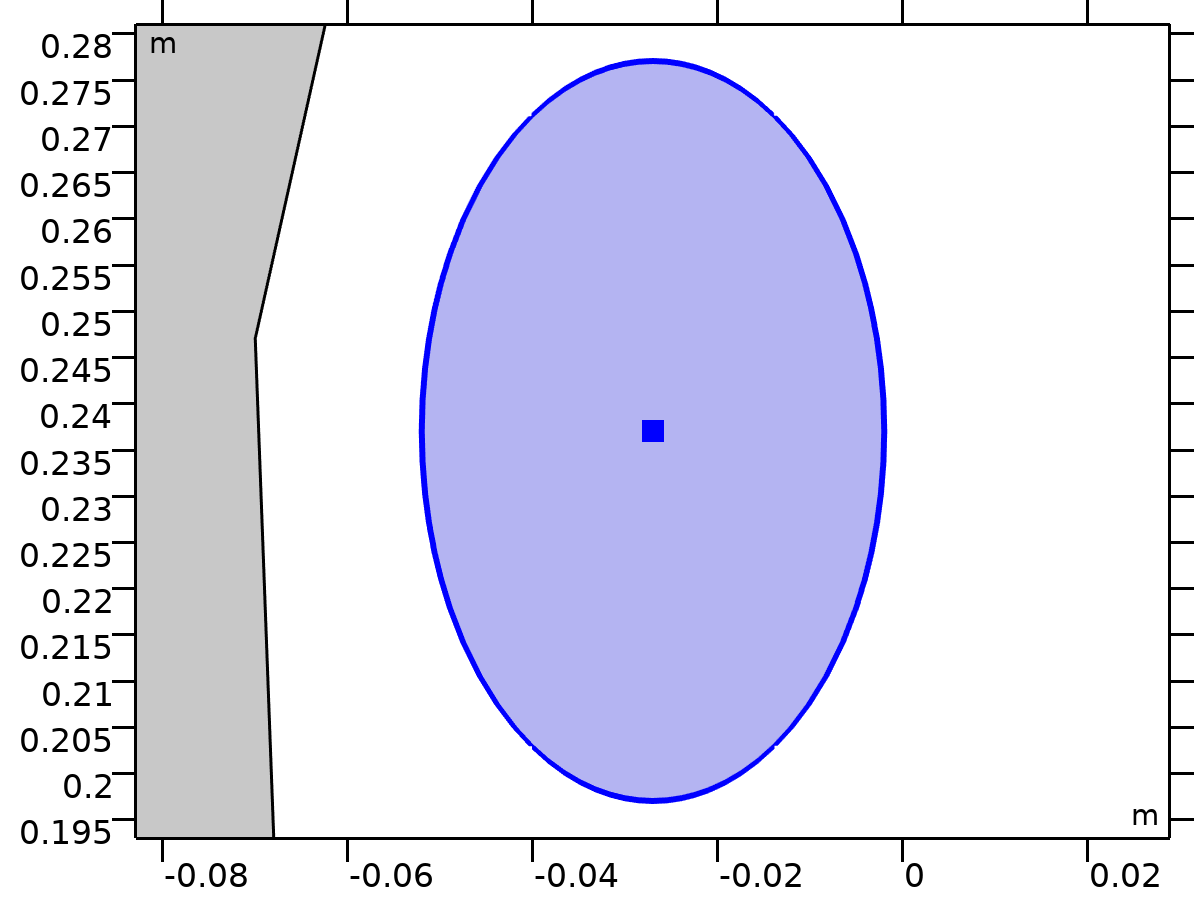
Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 46 |

###### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd3.mmi1.xmx | mbd.rd3.mmi1.cmp1.int(X)/mbd.rd3.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, x-component | Global | + operation |
| mbd.rd3.mmi1.xmy | mbd.rd3.mmi1.cmp1.int(Y)/mbd.rd3.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, y-component | Global | + operation |
| mbd.rd3.mmi1.xmz | mbd.rd3.mmi1.cmp1.int(0)/mbd.rd3.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, z-component | Global | + operation |

### Viscera



Viscera

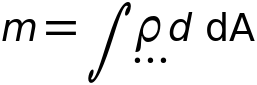
Selection

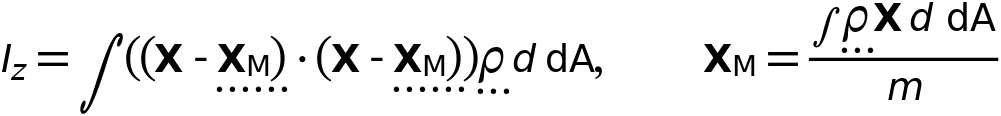
|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: Domain 4 |

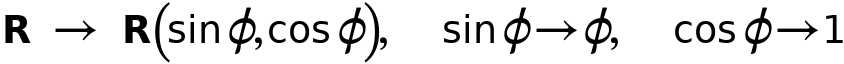
Equations





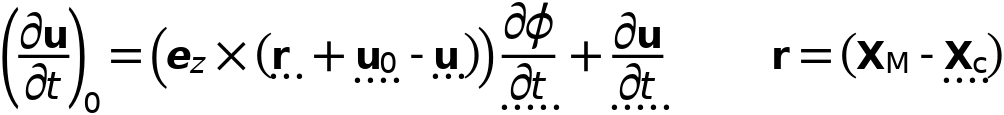




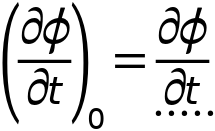












#### Density

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Density | User defined |  |
| Density | 0 | kg/m³ |

#### Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Center of rotation | Center of mass |
| Offset | Off |

#### Initial Values

Settings

| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| u | mbd.rd4.Udx | m | Displacement field, X-component | Domain 4 |  |
| v | mbd.rd4.Udy | m | Displacement field, Y-component | Domain 4 |  |
| w | mbd.rd4.Udz | m | Displacement field, Z-component | Domain 4 |  |
| mbd.Wk\_tot | 0.25\*(mbd.rd4.m\*(realdot(mbd.rd4.u\*mbd.iomega,mbd.rd4.u\*mbd.iomega)+realdot(mbd.rd4.v\*mbd.iomega,mbd.rd4.v\*mbd.iomega)+realdot(mbd.rd4.w\*mbd.iomega,mbd.rd4.w\*mbd.iomega))+realdot(mbd.rd4.Iz\*mbd.rd4.thx\*mbd.iomega,mbd.rd4.thx\*mbd.iomega)+realdot(mbd.rd4.Iz\*mbd.rd4.thy\*mbd.iomega,mbd.rd4.thy\*mbd.iomega)+realdot(mbd.rd4.Iz\*mbd.rd4.thz\*mbd.iomega,mbd.rd4.thz\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.RFtotalx | reacf(mbd.rd4.U) | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | reacf(mbd.rd4.V) | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | 0 | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | -reacf(mbd.rd4.V)\*mbd.rd4.RMmaz | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | reacf(mbd.rd4.U)\*mbd.rd4.RMmaz | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | reacf(mbd.rd4.V)\*mbd.rd4.RMmax-reacf(mbd.rd4.U)\*mbd.rd4.RMmay+reacf(mbd.rd4.Phi) | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.disp | sqrteps(real(u)^2+real(v)^2) | m | Displacement magnitude | Domain 4 |  |
| mbd.disp\_rms | sqrt(0.5\*(realdot(u,u)+realdot(v,v))) | m | Displacement, RMS | Domain 4 |  |
| mbd.gradUxX | -1+mbd.FdxX | 1 | Displacement gradient, xX-component | Domain 4 |  |
| mbd.gradUyX | mbd.FdyX | 1 | Displacement gradient, yX-component | Domain 4 |  |
| mbd.gradUzX | mbd.FdzX | 1 | Displacement gradient, zX-component | Domain 4 |  |
| mbd.gradUxY | mbd.FdxY | 1 | Displacement gradient, xY-component | Domain 4 |  |
| mbd.gradUyY | -1+mbd.FdyY | 1 | Displacement gradient, yY-component | Domain 4 |  |
| mbd.gradUzY | mbd.FdzY | 1 | Displacement gradient, zY-component | Domain 4 |  |
| mbd.gradUxZ | mbd.FdxZ | 1 | Displacement gradient, xZ-component | Domain 4 |  |
| mbd.gradUyZ | mbd.FdyZ | 1 | Displacement gradient, yZ-component | Domain 4 |  |
| mbd.gradUzZ | -1+mbd.FdzZ | 1 | Displacement gradient, zZ-component | Domain 4 |  |
| mbd.FdxX | mbd.rd4.rotxx | 1 | Deformation gradient, xX-component | Domain 4 |  |
| mbd.FdyX | mbd.rd4.rotyx | 1 | Deformation gradient, yX-component | Domain 4 |  |
| mbd.FdzX | mbd.rd4.rotzx | 1 | Deformation gradient, zX-component | Domain 4 |  |
| mbd.FdxY | mbd.rd4.rotxy | 1 | Deformation gradient, xY-component | Domain 4 |  |
| mbd.FdyY | mbd.rd4.rotyy | 1 | Deformation gradient, yY-component | Domain 4 |  |
| mbd.FdzY | mbd.rd4.rotzy | 1 | Deformation gradient, zY-component | Domain 4 |  |
| mbd.FdxZ | mbd.rd4.rotxz | 1 | Deformation gradient, xZ-component | Domain 4 |  |
| mbd.FdyZ | mbd.rd4.rotyz | 1 | Deformation gradient, yZ-component | Domain 4 |  |
| mbd.FdzZ | mbd.rd4.rotzz | 1 | Deformation gradient, zZ-component | Domain 4 |  |
| mbd.FdiXx | (mbd.FdyY\*mbd.FdzZ-mbd.FdyZ\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Xx-component | Domain 4 |  |
| mbd.FdiYx | (mbd.FdyZ\*mbd.FdzX-mbd.FdyX\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Yx-component | Domain 4 |  |
| mbd.FdiZx | (mbd.FdyX\*mbd.FdzY-mbd.FdyY\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Zx-component | Domain 4 |  |
| mbd.FdiXy | (mbd.FdxZ\*mbd.FdzY-mbd.FdxY\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Xy-component | Domain 4 |  |
| mbd.FdiYy | (mbd.FdxX\*mbd.FdzZ-mbd.FdxZ\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Yy-component | Domain 4 |  |
| mbd.FdiZy | (mbd.FdxY\*mbd.FdzX-mbd.FdxX\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Zy-component | Domain 4 |  |
| mbd.FdiXz | (mbd.FdxY\*mbd.FdyZ-mbd.FdxZ\*mbd.FdyY)/mbd.J | 1 | Deformation gradient inverse, Xz-component | Domain 4 |  |
| mbd.FdiYz | (mbd.FdxZ\*mbd.FdyX-mbd.FdxX\*mbd.FdyZ)/mbd.J | 1 | Deformation gradient inverse, Yz-component | Domain 4 |  |
| mbd.FdiZz | (mbd.FdxX\*mbd.FdyY-mbd.FdxY\*mbd.FdyX)/mbd.J | 1 | Deformation gradient inverse, Zz-component | Domain 4 |  |
| mbd.J | 1 | 1 | Volume ratio | Domain 4 |  |
| mbd.Ws | 0 | J/m³ | Elastic strain energy density | Domain 4 | + operation |
| mbd.Ws\_tot | 0 | J | Total elastic strain energy | Global | + operation |
| mbd.Wk | 0.25\*mbd.rho\*(realdot(u\*mbd.iomega,u\*mbd.iomega)+realdot(v\*mbd.iomega,v\*mbd.iomega)) | J/m³ | Kinetic energy density | Domain 4 | + operation |
| mbd.Eequ | Inf | Pa | Equivalent Young's modulus | Domain 4 |  |
| mbd.nuequ | 0 | 1 | Equivalent Poisson's ratio | Domain 4 |  |
| mbd.Eequtot | mbd.Eequ | Pa | Total equivalent Young's modulus | Domain 4 | + operation |
| mbd.rho | 0 | kg/m³ | Density | Domain 4 | \* operation |
| mbd.u\_ttX | material.dt(material.dt(mbd.rd4.Udx)) | m/s² | Acceleration, X-component | Domain 4 |  |
| mbd.u\_ttY | material.dt(material.dt(mbd.rd4.Udy)) | m/s² | Acceleration, Y-component | Domain 4 |  |
| mbd.u\_ttZ | material.dt(material.dt(mbd.rd4.Udz)) | m/s² | Acceleration, Z-component | Domain 4 |  |
| mbd.u\_tX | material.dt(mbd.rd4.Udx) | m/s | Velocity, X-component | Domain 4 |  |
| mbd.u\_tY | material.dt(mbd.rd4.Udy) | m/s | Velocity, Y-component | Domain 4 |  |
| mbd.u\_tZ | material.dt(mbd.rd4.Udz) | m/s | Velocity, Z-component | Domain 4 |  |
| mbd.vel\_rms | sqrt(0.5\*(realdot(mbd.u\_tX,mbd.u\_tX)+realdot(mbd.u\_tY,mbd.u\_tY)+realdot(mbd.u\_tZ,mbd.u\_tZ))) | m/s | Velocity magnitude, RMS | Domain 4 |  |
| mbd.acc\_rms | sqrt(0.5\*(realdot(mbd.u\_ttX,mbd.u\_ttX)+realdot(mbd.u\_ttY,mbd.u\_ttY)+realdot(mbd.u\_ttZ,mbd.u\_ttZ))) | m/s² | Acceleration magnitude, RMS | Domain 4 |  |
| mbd.afX | 0 | m/s² | Frame acceleration, X-component | Domain 4 | + operation |
| mbd.afY | 0 | m/s² | Frame acceleration, Y-component | Domain 4 | + operation |
| mbd.afZ | 0 | m/s² | Frame acceleration, Z-component | Domain 4 | + operation |
| mbd.accX | mbd.u\_ttX | m/s² | Effective acceleration, X-component | Domain 4 | + operation |
| mbd.accY | mbd.u\_ttY | m/s² | Effective acceleration, Y-component | Domain 4 | + operation |
| mbd.accZ | mbd.u\_ttZ | m/s² | Effective acceleration, Z-component | Domain 4 | + operation |
| mbd.vel | sqrteps(real(mbd.u\_tX)^2+real(mbd.u\_tY)^2+real(mbd.u\_tZ)^2) | m/s | Velocity magnitude | Domain 4 |  |
| mbd.acc | sqrteps(real(mbd.accX)^2+real(mbd.accY)^2+real(mbd.accZ)^2) | m/s² | Effective acceleration magnitude | Domain 4 |  |
| mbd.u\_tt | sqrteps(real(mbd.u\_ttX)^2+real(mbd.u\_ttY)^2+real(mbd.u\_ttZ)^2) | m/s² | Acceleration magnitude | Domain 4 |  |
| mbd.phase | if(isdefined(phase),phase,0) | 1 | Phase | Global |  |
| mbd.rd4.xcx | mbd.rd4.xmx | m | Center of rotation, x-component | Global | + operation |
| mbd.rd4.xcy | mbd.rd4.xmy | m | Center of rotation, y-component | Global | + operation |
| mbd.rd4.xcz | mbd.rd4.xmz | m | Center of rotation, z-component | Global | + operation |
| mbd.rd4.phi | mbd.rd4.Phi | rad | Rigid body rotation | Global |  |
| mbd.rd4.rotxx | 1 | 1 | Rotation matrix, xx-component | Global |  |
| mbd.rd4.rotyx | mbd.rd4.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, yx-component | Global |  |
| mbd.rd4.rotzx | 0 | 1 | Rotation matrix, zx-component | Global |  |
| mbd.rd4.rotxy | -mbd.rd4.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, xy-component | Global |  |
| mbd.rd4.rotyy | 1 | 1 | Rotation matrix, yy-component | Global |  |
| mbd.rd4.rotzy | 0 | 1 | Rotation matrix, zy-component | Global |  |
| mbd.rd4.rotxz | 0 | 1 | Rotation matrix, xz-component | Global |  |
| mbd.rd4.rotyz | 0 | 1 | Rotation matrix, yz-component | Global |  |
| mbd.rd4.rotzz | 1 | 1 | Rotation matrix, zz-component | Global |  |
| mbd.rd4.RMmax | mbd.rd4.xcx-mbd.refpntx | m | Moment arm, x-component | Global |  |
| mbd.rd4.RMmay | mbd.rd4.xcy-mbd.refpnty | m | Moment arm, y-component | Global |  |
| mbd.rd4.RMmaz | 0 | m | Moment arm, z-component | Global |  |
| mbd.rd4.u | mbd.rd4.U | m | Rigid body displacement, x-component | Global |  |
| mbd.rd4.v | mbd.rd4.V | m | Rigid body displacement, y-component | Global |  |
| mbd.rd4.w | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd4.xmx | mbd.rd4.int((mbd.rho+eps)\*mbd.d\*X)/mbd.rd4.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, x-component | Global |  |
| mbd.rd4.xmy | mbd.rd4.int((mbd.rho+eps)\*mbd.d\*Y)/mbd.rd4.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, y-component | Global |  |
| mbd.rd4.xmz | 0 | m | Center of mass, z-component | Global |  |
| mbd.rd4.Iz | mbd.rd4.int(((X-mbd.rd4.xmx)^2+(Y-mbd.rd4.xmy)^2+mbd.rd4.xmz^2)\*mbd.rho\*mbd.d) | kg·m² | Moment of inertia | Global |  |
| mbd.rd4.um | mbd.rd4.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd4.vm | mbd.rd4.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd4.wm | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd4.m | mbd.rd4.int(mbd.rho\*mbd.d) | kg | Mass | Global |  |
| mbd.rd4.Udx | (mbd.rd4.rotxx\*(X-mbd.rd4.xcx)+mbd.rd4.rotxy\*(Y-mbd.rd4.xcy)-mbd.rd4.rotxz\*mbd.rd4.xcz-X+mbd.rd4.xcx)\*exp(j\*mbd.phase)+mbd.rd4.u | m | Domain displacement, x-component | Domain 4 | + operation |
| mbd.rd4.Udy | (mbd.rd4.rotyx\*(X-mbd.rd4.xcx)+mbd.rd4.rotyy\*(Y-mbd.rd4.xcy)-mbd.rd4.rotyz\*mbd.rd4.xcz-Y+mbd.rd4.xcy)\*exp(j\*mbd.phase)+mbd.rd4.v | m | Domain displacement, y-component | Domain 4 | + operation |
| mbd.rd4.Udz | (mbd.rd4.rotzx\*(X-mbd.rd4.xcx)+mbd.rd4.rotzy\*(Y-mbd.rd4.xcy)-mbd.rd4.rotzz\*mbd.rd4.xcz+mbd.rd4.xcz)\*exp(j\*mbd.phase)+mbd.rd4.w | m | Domain displacement, z-component | Domain 4 | + operation |
| mbd.rd4.thx | 0 | rad | Rigid body rotation, x-component | Global |  |
| mbd.rd4.thy | 0 | rad | Rigid body rotation, y-component | Global |  |
| mbd.rd4.thz | mbd.rd4.phi | rad | Rigid body rotation, z-component | Global |  |
| mbd.rd4.u\_tx | mbd.iomega\*mbd.rd4.u | m/s | Rigid body velocity, x-component | Global |  |
| mbd.rd4.u\_ty | mbd.iomega\*mbd.rd4.v | m/s | Rigid body velocity, y-component | Global |  |
| mbd.rd4.u\_tz | mbd.iomega\*mbd.rd4.w | m/s | Rigid body velocity, z-component | Global |  |
| mbd.rd4.u\_ttx | mbd.iomega\*mbd.rd4.u\_tx | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd4.u\_tty | mbd.iomega\*mbd.rd4.u\_ty | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd4.u\_ttz | mbd.iomega\*mbd.rd4.u\_tz | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd4.um\_ttx | mbd.iomega^2\*mbd.rd4.um | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd4.um\_tty | mbd.iomega^2\*mbd.rd4.vm | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd4.um\_ttz | mbd.iomega^2\*mbd.rd4.wm | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd4.th\_tx | mbd.iomega\*mbd.rd4.thx | rad/s | Rigid body angular velocity, x-component | Global |  |
| mbd.rd4.th\_ty | mbd.iomega\*mbd.rd4.thy | rad/s | Rigid body angular velocity, y-component | Global |  |
| mbd.rd4.th\_tz | mbd.iomega\*mbd.rd4.thz | rad/s | Rigid body angular velocity, z-component | Global |  |
| mbd.rd4.th\_ttx | mbd.iomega\*mbd.rd4.th\_tx | rad/s² | Rigid body angular acceleration, x-component | Global |  |
| mbd.rd4.th\_tty | mbd.iomega\*mbd.rd4.th\_ty | rad/s² | Rigid body angular acceleration, y-component | Global |  |
| mbd.rd4.th\_ttz | mbd.iomega\*mbd.rd4.th\_tz | rad/s² | Rigid body angular acceleration, z-component | Global |  |
| mbd.rd4.FIx | -mbd.rd4.m\*mbd.rd4.um\_ttx | N | Inertial force, x-component | Global |  |
| mbd.rd4.FIy | -mbd.rd4.m\*mbd.rd4.um\_tty | N | Inertial force, y-component | Global |  |
| mbd.rd4.FIz | 0 | N | Inertial force, z-component | Global |  |
| mbd.rd4.MIz | -mbd.rd4.Iz\*mbd.iomega^2\*mbd.rd4.phi | N·m | Inertial moment | Global |  |
| mbd.rd4.i\_rot | 1 | 1 | Free rotation indicator | Global | \* operation |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd4.U | ODE | m | Rigid body displacement, x-component |  | Global |
| mbd.rd4.V | ODE | m | Rigid body displacement, y-component |  | Global |
| mbd.rd4.Phi | ODE | rad | Rigid body rotation |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd4.FIx\*test(mbd.rd4.um)+mbd.rd4.FIy\*test(mbd.rd4.vm)+mbd.rd4.FIz\*test(mbd.rd4.wm) | 2 |  | Global |
| mbd.rd4.MIz\*test(mbd.rd4.phi) | 2 |  | Global |

#### Constraints

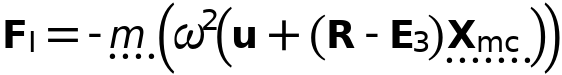
| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| up(u)-down(u) | test(up(u)-down(u)) | Lagrange (Linear) | No boundaries | Elemental |
| up(v)-down(v) | test(up(v)-down(v)) | Lagrange (Linear) | No boundaries | Elemental |
| 0 | 0 |  | No boundaries | Elemental |

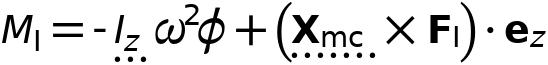
#### Mass and Moment of Inertia 4

Selection

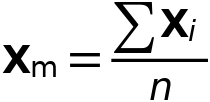
|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations









##### Center of Mass

Settings

| **Description** | **Value** |
| --- | --- |
| Center of mass | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

##### Mass and Moment of Inertia

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Mass | m\_viscera | kg |
| Moment of inertia | 0 | kg·m² |

##### Frame Acceleration Forces

Settings

| **Description** | **Value** |
| --- | --- |
| Exclude contribution | Off |

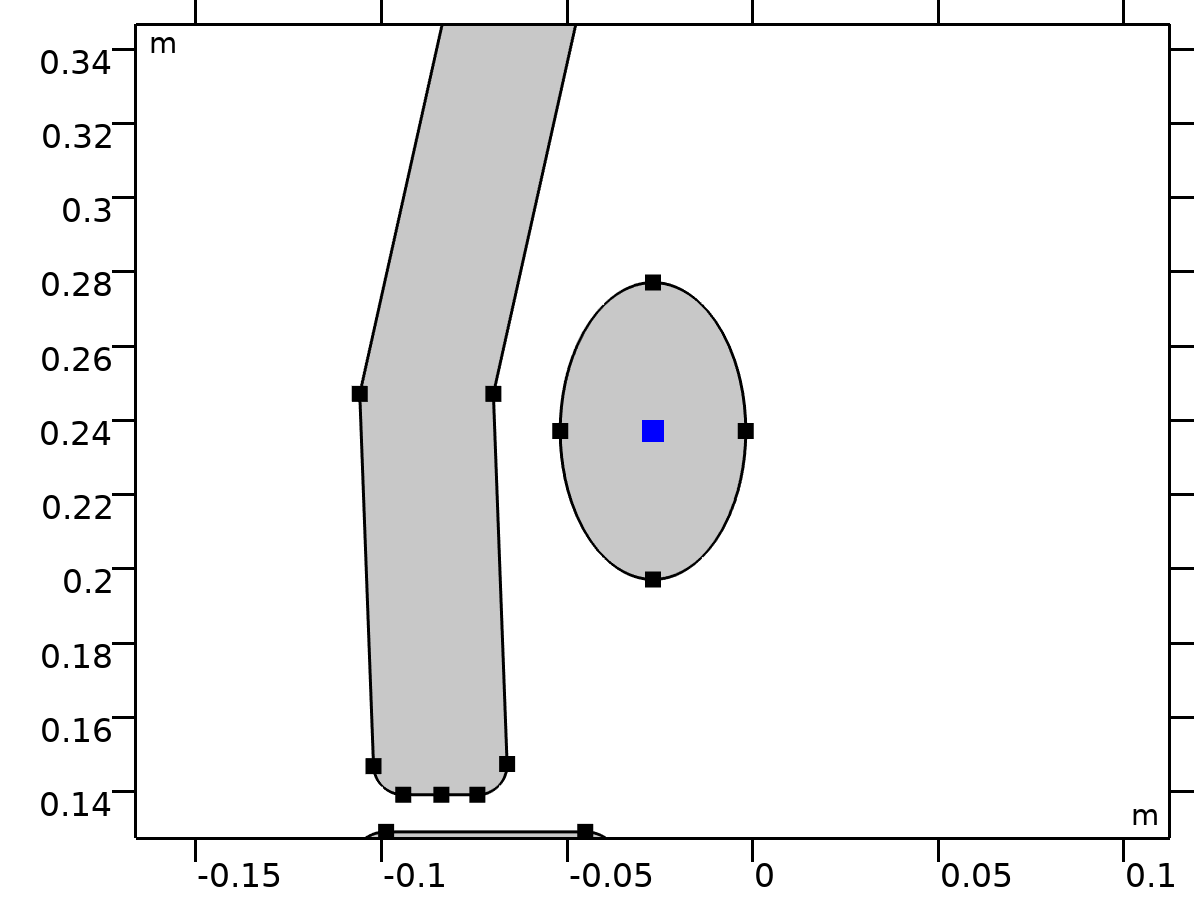
##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Wk\_tot | 0.25\*(mbd.rd4.mmi1.mt\*(realdot((mbd.rd4.u+mbd.rd4.mmi1.dMrotx-mbd.rd4.mmi1.dMx)\*mbd.iomega,(mbd.rd4.u+mbd.rd4.mmi1.dMrotx-mbd.rd4.mmi1.dMx)\*mbd.iomega)+realdot((mbd.rd4.v+mbd.rd4.mmi1.dMroty-mbd.rd4.mmi1.dMy)\*mbd.iomega,(mbd.rd4.v+mbd.rd4.mmi1.dMroty-mbd.rd4.mmi1.dMy)\*mbd.iomega)+realdot((mbd.rd4.w+mbd.rd4.mmi1.dMrotz-mbd.rd4.mmi1.dMz)\*mbd.iomega,(mbd.rd4.w+mbd.rd4.mmi1.dMrotz-mbd.rd4.mmi1.dMz)\*mbd.iomega))+mbd.rd4.mmi1.Iz\*realdot(mbd.rd4.phi\*mbd.iomega,mbd.rd4.phi\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.rd4.mmi1.mt | m\_viscera | kg | Mass | Global |  |
| mbd.rd4.mmi1.Iz | 0 | kg·m² | Moment of inertia | Global |  |
| mbd.rd4.mmi1.xmsx | mbd.rd4.xcx+mbd.rd4.u+mbd.rd4.rotxx\*(mbd.rd4.mmi1.xmx-mbd.rd4.xcx)+mbd.rd4.rotxy\*(mbd.rd4.mmi1.xmy-mbd.rd4.xcy)+mbd.rd4.rotxz\*(mbd.rd4.mmi1.xmz-mbd.rd4.xcz) | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd4.mmi1.xmsy | mbd.rd4.xcy+mbd.rd4.v+mbd.rd4.rotyx\*(mbd.rd4.mmi1.xmx-mbd.rd4.xcx)+mbd.rd4.rotyy\*(mbd.rd4.mmi1.xmy-mbd.rd4.xcy)+mbd.rd4.rotyz\*(mbd.rd4.mmi1.xmz-mbd.rd4.xcz) | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd4.mmi1.xmsz | mbd.rd4.xcz+mbd.rd4.w+mbd.rd4.rotzx\*(mbd.rd4.mmi1.xmx-mbd.rd4.xcx)+mbd.rd4.rotzy\*(mbd.rd4.mmi1.xmy-mbd.rd4.xcy)+mbd.rd4.rotzz\*(mbd.rd4.mmi1.xmz-mbd.rd4.xcz) | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd4.mmi1.umx | mbd.rd4.u+mbd.rd4.rotxx\*(mbd.rd4.mmi1.xmx-mbd.rd4.xcx)+mbd.rd4.rotxy\*(mbd.rd4.mmi1.xmy-mbd.rd4.xcy)+mbd.rd4.rotxz\*(mbd.rd4.mmi1.xmz-mbd.rd4.xcz)-mbd.rd4.mmi1.xmx+mbd.rd4.xcx | m | Displacement at center of mass, x-component | Global |  |
| mbd.rd4.mmi1.umy | mbd.rd4.v+mbd.rd4.rotyx\*(mbd.rd4.mmi1.xmx-mbd.rd4.xcx)+mbd.rd4.rotyy\*(mbd.rd4.mmi1.xmy-mbd.rd4.xcy)+mbd.rd4.rotyz\*(mbd.rd4.mmi1.xmz-mbd.rd4.xcz)-mbd.rd4.mmi1.xmy+mbd.rd4.xcy | m | Displacement at center of mass, y-component | Global |  |
| mbd.rd4.mmi1.umz | mbd.rd4.w+mbd.rd4.rotzx\*(mbd.rd4.mmi1.xmx-mbd.rd4.xcx)+mbd.rd4.rotzy\*(mbd.rd4.mmi1.xmy-mbd.rd4.xcy)+mbd.rd4.rotzz\*(mbd.rd4.mmi1.xmz-mbd.rd4.xcz)-mbd.rd4.mmi1.xmz+mbd.rd4.xcz | m | Displacement at center of mass, z-component | Global |  |
| mbd.rd4.mmi1.FIx | -mbd.rd4.mmi1.mt\*mbd.iomega^2\*(mbd.rd4.u+mbd.rd4.mmi1.dMrotx-mbd.rd4.mmi1.dMx) | N | Inertial force, x-component | Global |  |
| mbd.rd4.mmi1.FIy | -mbd.rd4.mmi1.mt\*mbd.iomega^2\*(mbd.rd4.v+mbd.rd4.mmi1.dMroty-mbd.rd4.mmi1.dMy) | N | Inertial force, y-component | Global |  |
| mbd.rd4.mmi1.FIz | -mbd.rd4.mmi1.mt\*mbd.iomega^2\*(mbd.rd4.w+mbd.rd4.mmi1.dMrotz-mbd.rd4.mmi1.dMz) | N | Inertial force, z-component | Global |  |
| mbd.rd4.mmi1.MIz | -mbd.rd4.mmi1.Iz\*mbd.iomega^2\*mbd.rd4.phi | N·m | Inertial moment | Global |  |
| mbd.rd4.mmi1.dMx | mbd.rd4.mmi1.xmx-mbd.rd4.xcx | m | Mass offset from CoR, Original, x-component | Global |  |
| mbd.rd4.mmi1.dMy | mbd.rd4.mmi1.xmy-mbd.rd4.xcy | m | Mass offset from CoR, Original, y-component | Global |  |
| mbd.rd4.mmi1.dMz | mbd.rd4.mmi1.xmz-mbd.rd4.xcz | m | Mass offset from CoR, Original, z-component | Global |  |
| mbd.rd4.mmi1.dMrotx | mbd.rd4.rotxx\*mbd.rd4.mmi1.dMx+mbd.rd4.rotxy\*mbd.rd4.mmi1.dMy+mbd.rd4.rotxz\*mbd.rd4.mmi1.dMz | m | Mass offset from CoR, Rotated, x-component | Global |  |
| mbd.rd4.mmi1.dMroty | mbd.rd4.rotyx\*mbd.rd4.mmi1.dMx+mbd.rd4.rotyy\*mbd.rd4.mmi1.dMy+mbd.rd4.rotyz\*mbd.rd4.mmi1.dMz | m | Mass offset from CoR, Rotated, y-component | Global |  |
| mbd.rd4.mmi1.dMrotz | mbd.rd4.rotzx\*mbd.rd4.mmi1.dMx+mbd.rd4.rotzy\*mbd.rd4.mmi1.dMy+mbd.rd4.rotzz\*mbd.rd4.mmi1.dMz | m | Mass offset from CoR, Rotated, z-component | Global |  |
| mbd.rd4.mmi1.Fx | mbd.rd4.mmi1.FIx | N | Applied force, x-component | Global |  |
| mbd.rd4.mmi1.Fy | mbd.rd4.mmi1.FIy | N | Applied force, y-component | Global |  |
| mbd.rd4.mmi1.Fz | mbd.rd4.mmi1.FIz | N | Applied force, z-component | Global |  |
| mbd.rd4.mmi1.F\_Mag | sqrt(real(mbd.rd4.mmi1.Fx)^2+real(mbd.rd4.mmi1.Fy)^2+real(mbd.rd4.mmi1.Fz)^2) | N | Load magnitude | Global |  |
| mbd.rd4.mmi1.Mx | 0 | N·m | Applied moment, x-component | Global |  |
| mbd.rd4.mmi1.My | 0 | N·m | Applied moment, y-component | Global |  |
| mbd.rd4.mmi1.Mz | mbd.rd4.mmi1.MIz | N·m | Applied moment, z-component | Global |  |
| mbd.rd4.mmi1.M\_Mag | sqrt(real(mbd.rd4.mmi1.Mx)^2+real(mbd.rd4.mmi1.My)^2+real(mbd.rd4.mmi1.Mz)^2) | N·m | Moment magnitude | Global |  |
| mbd.rd4.mmi1.loadposx | mbd.rd4.mmi1.xmx | m | Load position, x-component | Global |  |
| mbd.rd4.mmi1.loadposy | mbd.rd4.mmi1.xmy | m | Load position, y-component | Global |  |
| mbd.rd4.mmi1.loadposz | mbd.rd4.mmi1.xmz | m | Load position, z-component | Global |  |
| mbd.rd4.mmi1.momposx | mbd.rd4.mmi1.xmx | m | Moment position, x-component | Global |  |
| mbd.rd4.mmi1.momposy | mbd.rd4.mmi1.xmy | m | Moment position, y-component | Global |  |
| mbd.rd4.mmi1.momposz | mbd.rd4.mmi1.xmz | m | Moment position, z-component | Global |  |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd4.mmi1.FIx\*test(mbd.rd4.u+mbd.rd4.mmi1.dMrotx)+mbd.rd4.mmi1.FIy\*test(mbd.rd4.v+mbd.rd4.mmi1.dMroty)+mbd.rd4.mmi1.FIz\*test(mbd.rd4.w+mbd.rd4.mmi1.dMrotz) | 2 |  | Global |
| mbd.rd4.mmi1.MIz\*test(mbd.rd4.phi) | 2 |  | Global |

##### Center of Mass: Point 4



Center of Mass: Point 4

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 55 |

###### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd4.mmi1.xmx | mbd.rd4.mmi1.cmp1.int(X)/mbd.rd4.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, x-component | Global | + operation |
| mbd.rd4.mmi1.xmy | mbd.rd4.mmi1.cmp1.int(Y)/mbd.rd4.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, y-component | Global | + operation |
| mbd.rd4.mmi1.xmz | mbd.rd4.mmi1.cmp1.int(0)/mbd.rd4.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, z-component | Global | + operation |

#### Prescribed Displacement/Rotation 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations



##### Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Center of rotation | From parent |
| Offset | Off |

##### Prescribed Displacement at Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Prescribed in x direction | Off |
| Prescribed in y direction | Off |
| Prescribed in z direction | Off |

##### Prescribed Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| By | Constrained rotation |

##### Reaction Force Settings

Settings

| **Description** | **Value** |
| --- | --- |
| Evaluate reaction forces | Off |
| Apply reaction only on rigid body variables | Off |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

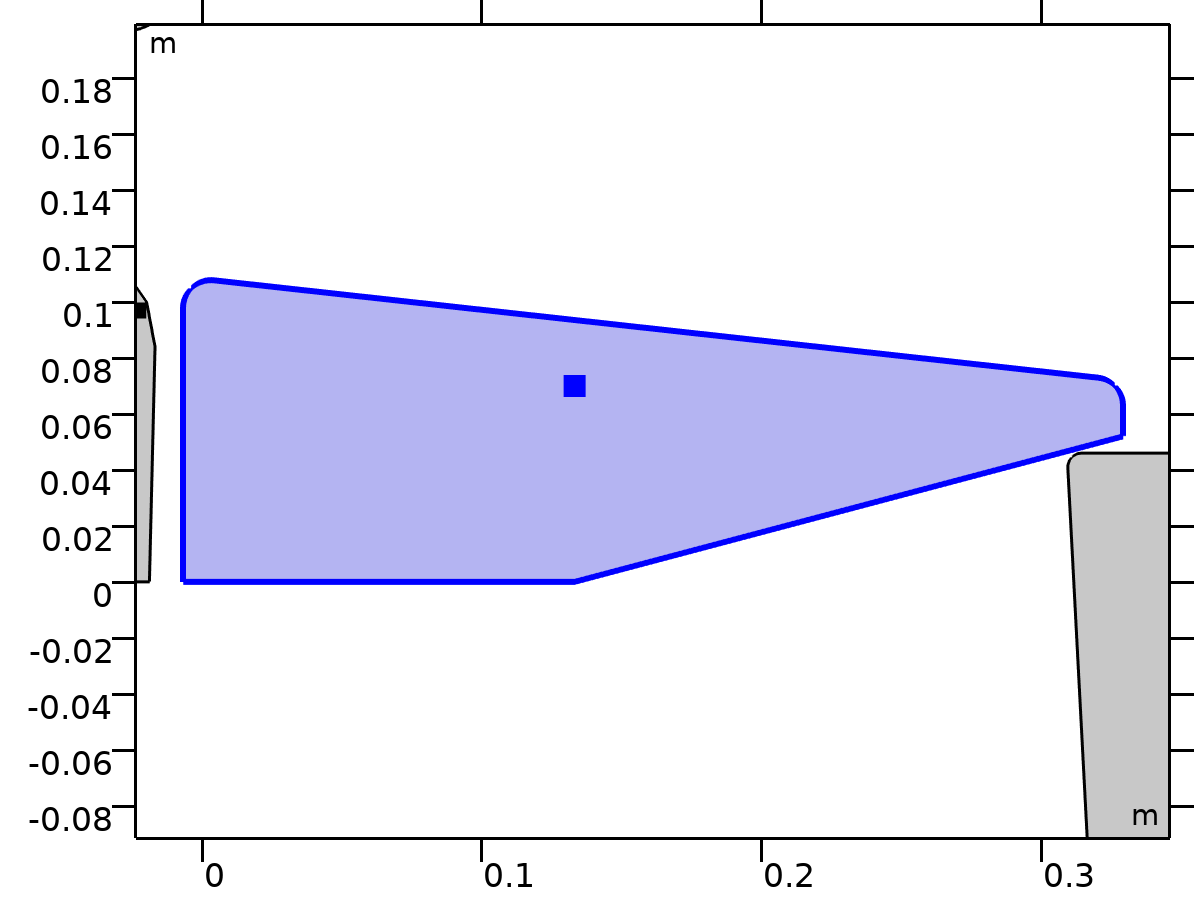
##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd4.pdr1.xcx | mbd.rd4.xcx | m | Global coordinates of center of rotation, x-component | Global | + operation |
| mbd.rd4.pdr1.xcy | mbd.rd4.xcy | m | Global coordinates of center of rotation, y-component | Global | + operation |
| mbd.rd4.pdr1.xcz | mbd.rd4.xcz | m | Global coordinates of center of rotation, z-component | Global | + operation |
| mbd.rd4.pdr1.u | mbd.rd4.rotxx\*(mbd.rd4.pdr1.xcx-mbd.rd4.xcx)+mbd.rd4.rotxy\*(mbd.rd4.pdr1.xcy-mbd.rd4.xcy)+mbd.rd4.rotxz\*(mbd.rd4.pdr1.xcz-mbd.rd4.xcz)-mbd.rd4.pdr1.xcx+mbd.rd4.xcx+mbd.rd4.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd4.pdr1.v | mbd.rd4.rotyx\*(mbd.rd4.pdr1.xcx-mbd.rd4.xcx)+mbd.rd4.rotyy\*(mbd.rd4.pdr1.xcy-mbd.rd4.xcy)+mbd.rd4.rotyz\*(mbd.rd4.pdr1.xcz-mbd.rd4.xcz)-mbd.rd4.pdr1.xcy+mbd.rd4.xcy+mbd.rd4.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd4.pdr1.w | mbd.rd4.rotzx\*(mbd.rd4.pdr1.xcx-mbd.rd4.xcx)+mbd.rd4.rotzy\*(mbd.rd4.pdr1.xcy-mbd.rd4.xcy)+mbd.rd4.rotzz\*(mbd.rd4.pdr1.xcz-mbd.rd4.xcz)-mbd.rd4.pdr1.xcz+mbd.rd4.xcz+mbd.rd4.w | m | Rigid body displacement, z-component | Global |  |
| mbd.rd4.pdr1.ul | mbd.rd4.pdr1.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd4.pdr1.vl | mbd.rd4.pdr1.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd4.pdr1.wl | mbd.rd4.pdr1.w | m | Rigid body displacement, z-component | Global |  |

##### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| -mbd.rd4.phi | test(-mbd.rd4.phi) |  | Global | Elemental |

### Thigh



Thigh

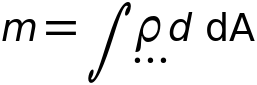
Selection

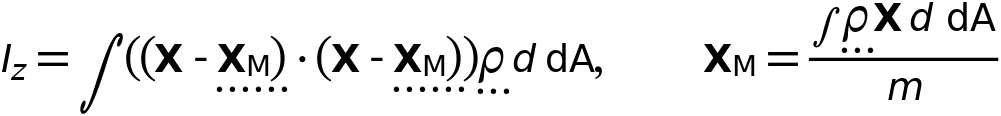
|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: Domain 5 |

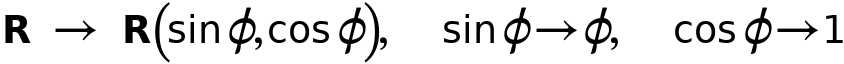
Equations





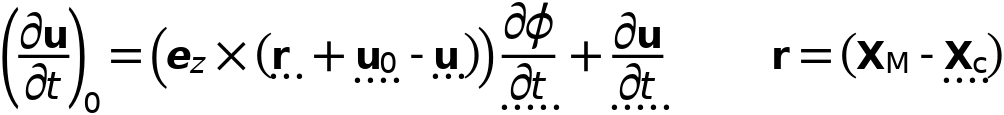




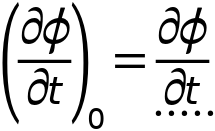












#### Density

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Density | User defined |  |
| Density | 0 | kg/m³ |

#### Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Center of rotation | Center of mass |
| Offset | Off |

#### Initial Values

Settings

| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| u | mbd.rd5.Udx | m | Displacement field, X-component | Domain 5 |  |
| v | mbd.rd5.Udy | m | Displacement field, Y-component | Domain 5 |  |
| w | mbd.rd5.Udz | m | Displacement field, Z-component | Domain 5 |  |
| mbd.Wk\_tot | 0.25\*(mbd.rd5.m\*(realdot(mbd.rd5.u\*mbd.iomega,mbd.rd5.u\*mbd.iomega)+realdot(mbd.rd5.v\*mbd.iomega,mbd.rd5.v\*mbd.iomega)+realdot(mbd.rd5.w\*mbd.iomega,mbd.rd5.w\*mbd.iomega))+realdot(mbd.rd5.Iz\*mbd.rd5.thx\*mbd.iomega,mbd.rd5.thx\*mbd.iomega)+realdot(mbd.rd5.Iz\*mbd.rd5.thy\*mbd.iomega,mbd.rd5.thy\*mbd.iomega)+realdot(mbd.rd5.Iz\*mbd.rd5.thz\*mbd.iomega,mbd.rd5.thz\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.RFtotalx | reacf(mbd.rd5.U) | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | reacf(mbd.rd5.V) | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | 0 | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | -reacf(mbd.rd5.V)\*mbd.rd5.RMmaz | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | reacf(mbd.rd5.U)\*mbd.rd5.RMmaz | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | reacf(mbd.rd5.V)\*mbd.rd5.RMmax-reacf(mbd.rd5.U)\*mbd.rd5.RMmay+reacf(mbd.rd5.Phi) | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.disp | sqrteps(real(u)^2+real(v)^2) | m | Displacement magnitude | Domain 5 |  |
| mbd.disp\_rms | sqrt(0.5\*(realdot(u,u)+realdot(v,v))) | m | Displacement, RMS | Domain 5 |  |
| mbd.gradUxX | -1+mbd.FdxX | 1 | Displacement gradient, xX-component | Domain 5 |  |
| mbd.gradUyX | mbd.FdyX | 1 | Displacement gradient, yX-component | Domain 5 |  |
| mbd.gradUzX | mbd.FdzX | 1 | Displacement gradient, zX-component | Domain 5 |  |
| mbd.gradUxY | mbd.FdxY | 1 | Displacement gradient, xY-component | Domain 5 |  |
| mbd.gradUyY | -1+mbd.FdyY | 1 | Displacement gradient, yY-component | Domain 5 |  |
| mbd.gradUzY | mbd.FdzY | 1 | Displacement gradient, zY-component | Domain 5 |  |
| mbd.gradUxZ | mbd.FdxZ | 1 | Displacement gradient, xZ-component | Domain 5 |  |
| mbd.gradUyZ | mbd.FdyZ | 1 | Displacement gradient, yZ-component | Domain 5 |  |
| mbd.gradUzZ | -1+mbd.FdzZ | 1 | Displacement gradient, zZ-component | Domain 5 |  |
| mbd.FdxX | mbd.rd5.rotxx | 1 | Deformation gradient, xX-component | Domain 5 |  |
| mbd.FdyX | mbd.rd5.rotyx | 1 | Deformation gradient, yX-component | Domain 5 |  |
| mbd.FdzX | mbd.rd5.rotzx | 1 | Deformation gradient, zX-component | Domain 5 |  |
| mbd.FdxY | mbd.rd5.rotxy | 1 | Deformation gradient, xY-component | Domain 5 |  |
| mbd.FdyY | mbd.rd5.rotyy | 1 | Deformation gradient, yY-component | Domain 5 |  |
| mbd.FdzY | mbd.rd5.rotzy | 1 | Deformation gradient, zY-component | Domain 5 |  |
| mbd.FdxZ | mbd.rd5.rotxz | 1 | Deformation gradient, xZ-component | Domain 5 |  |
| mbd.FdyZ | mbd.rd5.rotyz | 1 | Deformation gradient, yZ-component | Domain 5 |  |
| mbd.FdzZ | mbd.rd5.rotzz | 1 | Deformation gradient, zZ-component | Domain 5 |  |
| mbd.FdiXx | (mbd.FdyY\*mbd.FdzZ-mbd.FdyZ\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Xx-component | Domain 5 |  |
| mbd.FdiYx | (mbd.FdyZ\*mbd.FdzX-mbd.FdyX\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Yx-component | Domain 5 |  |
| mbd.FdiZx | (mbd.FdyX\*mbd.FdzY-mbd.FdyY\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Zx-component | Domain 5 |  |
| mbd.FdiXy | (mbd.FdxZ\*mbd.FdzY-mbd.FdxY\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Xy-component | Domain 5 |  |
| mbd.FdiYy | (mbd.FdxX\*mbd.FdzZ-mbd.FdxZ\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Yy-component | Domain 5 |  |
| mbd.FdiZy | (mbd.FdxY\*mbd.FdzX-mbd.FdxX\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Zy-component | Domain 5 |  |
| mbd.FdiXz | (mbd.FdxY\*mbd.FdyZ-mbd.FdxZ\*mbd.FdyY)/mbd.J | 1 | Deformation gradient inverse, Xz-component | Domain 5 |  |
| mbd.FdiYz | (mbd.FdxZ\*mbd.FdyX-mbd.FdxX\*mbd.FdyZ)/mbd.J | 1 | Deformation gradient inverse, Yz-component | Domain 5 |  |
| mbd.FdiZz | (mbd.FdxX\*mbd.FdyY-mbd.FdxY\*mbd.FdyX)/mbd.J | 1 | Deformation gradient inverse, Zz-component | Domain 5 |  |
| mbd.J | 1 | 1 | Volume ratio | Domain 5 |  |
| mbd.Ws | 0 | J/m³ | Elastic strain energy density | Domain 5 | + operation |
| mbd.Ws\_tot | 0 | J | Total elastic strain energy | Global | + operation |
| mbd.Wk | 0.25\*mbd.rho\*(realdot(u\*mbd.iomega,u\*mbd.iomega)+realdot(v\*mbd.iomega,v\*mbd.iomega)) | J/m³ | Kinetic energy density | Domain 5 | + operation |
| mbd.Eequ | Inf | Pa | Equivalent Young's modulus | Domain 5 |  |
| mbd.nuequ | 0 | 1 | Equivalent Poisson's ratio | Domain 5 |  |
| mbd.Eequtot | mbd.Eequ | Pa | Total equivalent Young's modulus | Domain 5 | + operation |
| mbd.rho | 0 | kg/m³ | Density | Domain 5 | \* operation |
| mbd.u\_ttX | material.dt(material.dt(mbd.rd5.Udx)) | m/s² | Acceleration, X-component | Domain 5 |  |
| mbd.u\_ttY | material.dt(material.dt(mbd.rd5.Udy)) | m/s² | Acceleration, Y-component | Domain 5 |  |
| mbd.u\_ttZ | material.dt(material.dt(mbd.rd5.Udz)) | m/s² | Acceleration, Z-component | Domain 5 |  |
| mbd.u\_tX | material.dt(mbd.rd5.Udx) | m/s | Velocity, X-component | Domain 5 |  |
| mbd.u\_tY | material.dt(mbd.rd5.Udy) | m/s | Velocity, Y-component | Domain 5 |  |
| mbd.u\_tZ | material.dt(mbd.rd5.Udz) | m/s | Velocity, Z-component | Domain 5 |  |
| mbd.vel\_rms | sqrt(0.5\*(realdot(mbd.u\_tX,mbd.u\_tX)+realdot(mbd.u\_tY,mbd.u\_tY)+realdot(mbd.u\_tZ,mbd.u\_tZ))) | m/s | Velocity magnitude, RMS | Domain 5 |  |
| mbd.acc\_rms | sqrt(0.5\*(realdot(mbd.u\_ttX,mbd.u\_ttX)+realdot(mbd.u\_ttY,mbd.u\_ttY)+realdot(mbd.u\_ttZ,mbd.u\_ttZ))) | m/s² | Acceleration magnitude, RMS | Domain 5 |  |
| mbd.afX | 0 | m/s² | Frame acceleration, X-component | Domain 5 | + operation |
| mbd.afY | 0 | m/s² | Frame acceleration, Y-component | Domain 5 | + operation |
| mbd.afZ | 0 | m/s² | Frame acceleration, Z-component | Domain 5 | + operation |
| mbd.accX | mbd.u\_ttX | m/s² | Effective acceleration, X-component | Domain 5 | + operation |
| mbd.accY | mbd.u\_ttY | m/s² | Effective acceleration, Y-component | Domain 5 | + operation |
| mbd.accZ | mbd.u\_ttZ | m/s² | Effective acceleration, Z-component | Domain 5 | + operation |
| mbd.vel | sqrteps(real(mbd.u\_tX)^2+real(mbd.u\_tY)^2+real(mbd.u\_tZ)^2) | m/s | Velocity magnitude | Domain 5 |  |
| mbd.acc | sqrteps(real(mbd.accX)^2+real(mbd.accY)^2+real(mbd.accZ)^2) | m/s² | Effective acceleration magnitude | Domain 5 |  |
| mbd.u\_tt | sqrteps(real(mbd.u\_ttX)^2+real(mbd.u\_ttY)^2+real(mbd.u\_ttZ)^2) | m/s² | Acceleration magnitude | Domain 5 |  |
| mbd.phase | if(isdefined(phase),phase,0) | 1 | Phase | Global |  |
| mbd.rd5.xcx | mbd.rd5.xmx | m | Center of rotation, x-component | Global | + operation |
| mbd.rd5.xcy | mbd.rd5.xmy | m | Center of rotation, y-component | Global | + operation |
| mbd.rd5.xcz | mbd.rd5.xmz | m | Center of rotation, z-component | Global | + operation |
| mbd.rd5.phi | mbd.rd5.Phi | rad | Rigid body rotation | Global |  |
| mbd.rd5.rotxx | 1 | 1 | Rotation matrix, xx-component | Global |  |
| mbd.rd5.rotyx | mbd.rd5.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, yx-component | Global |  |
| mbd.rd5.rotzx | 0 | 1 | Rotation matrix, zx-component | Global |  |
| mbd.rd5.rotxy | -mbd.rd5.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, xy-component | Global |  |
| mbd.rd5.rotyy | 1 | 1 | Rotation matrix, yy-component | Global |  |
| mbd.rd5.rotzy | 0 | 1 | Rotation matrix, zy-component | Global |  |
| mbd.rd5.rotxz | 0 | 1 | Rotation matrix, xz-component | Global |  |
| mbd.rd5.rotyz | 0 | 1 | Rotation matrix, yz-component | Global |  |
| mbd.rd5.rotzz | 1 | 1 | Rotation matrix, zz-component | Global |  |
| mbd.rd5.RMmax | mbd.rd5.xcx-mbd.refpntx | m | Moment arm, x-component | Global |  |
| mbd.rd5.RMmay | mbd.rd5.xcy-mbd.refpnty | m | Moment arm, y-component | Global |  |
| mbd.rd5.RMmaz | 0 | m | Moment arm, z-component | Global |  |
| mbd.rd5.u | mbd.rd5.U | m | Rigid body displacement, x-component | Global |  |
| mbd.rd5.v | mbd.rd5.V | m | Rigid body displacement, y-component | Global |  |
| mbd.rd5.w | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd5.xmx | mbd.rd5.int((mbd.rho+eps)\*mbd.d\*X)/mbd.rd5.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, x-component | Global |  |
| mbd.rd5.xmy | mbd.rd5.int((mbd.rho+eps)\*mbd.d\*Y)/mbd.rd5.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, y-component | Global |  |
| mbd.rd5.xmz | 0 | m | Center of mass, z-component | Global |  |
| mbd.rd5.Iz | mbd.rd5.int(((X-mbd.rd5.xmx)^2+(Y-mbd.rd5.xmy)^2+mbd.rd5.xmz^2)\*mbd.rho\*mbd.d) | kg·m² | Moment of inertia | Global |  |
| mbd.rd5.um | mbd.rd5.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd5.vm | mbd.rd5.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd5.wm | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd5.m | mbd.rd5.int(mbd.rho\*mbd.d) | kg | Mass | Global |  |
| mbd.rd5.Udx | (mbd.rd5.rotxx\*(X-mbd.rd5.xcx)+mbd.rd5.rotxy\*(Y-mbd.rd5.xcy)-mbd.rd5.rotxz\*mbd.rd5.xcz-X+mbd.rd5.xcx)\*exp(j\*mbd.phase)+mbd.rd5.u | m | Domain displacement, x-component | Domain 5 | + operation |
| mbd.rd5.Udy | (mbd.rd5.rotyx\*(X-mbd.rd5.xcx)+mbd.rd5.rotyy\*(Y-mbd.rd5.xcy)-mbd.rd5.rotyz\*mbd.rd5.xcz-Y+mbd.rd5.xcy)\*exp(j\*mbd.phase)+mbd.rd5.v | m | Domain displacement, y-component | Domain 5 | + operation |
| mbd.rd5.Udz | (mbd.rd5.rotzx\*(X-mbd.rd5.xcx)+mbd.rd5.rotzy\*(Y-mbd.rd5.xcy)-mbd.rd5.rotzz\*mbd.rd5.xcz+mbd.rd5.xcz)\*exp(j\*mbd.phase)+mbd.rd5.w | m | Domain displacement, z-component | Domain 5 | + operation |
| mbd.rd5.thx | 0 | rad | Rigid body rotation, x-component | Global |  |
| mbd.rd5.thy | 0 | rad | Rigid body rotation, y-component | Global |  |
| mbd.rd5.thz | mbd.rd5.phi | rad | Rigid body rotation, z-component | Global |  |
| mbd.rd5.u\_tx | mbd.iomega\*mbd.rd5.u | m/s | Rigid body velocity, x-component | Global |  |
| mbd.rd5.u\_ty | mbd.iomega\*mbd.rd5.v | m/s | Rigid body velocity, y-component | Global |  |
| mbd.rd5.u\_tz | mbd.iomega\*mbd.rd5.w | m/s | Rigid body velocity, z-component | Global |  |
| mbd.rd5.u\_ttx | mbd.iomega\*mbd.rd5.u\_tx | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd5.u\_tty | mbd.iomega\*mbd.rd5.u\_ty | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd5.u\_ttz | mbd.iomega\*mbd.rd5.u\_tz | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd5.um\_ttx | mbd.iomega^2\*mbd.rd5.um | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd5.um\_tty | mbd.iomega^2\*mbd.rd5.vm | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd5.um\_ttz | mbd.iomega^2\*mbd.rd5.wm | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd5.th\_tx | mbd.iomega\*mbd.rd5.thx | rad/s | Rigid body angular velocity, x-component | Global |  |
| mbd.rd5.th\_ty | mbd.iomega\*mbd.rd5.thy | rad/s | Rigid body angular velocity, y-component | Global |  |
| mbd.rd5.th\_tz | mbd.iomega\*mbd.rd5.thz | rad/s | Rigid body angular velocity, z-component | Global |  |
| mbd.rd5.th\_ttx | mbd.iomega\*mbd.rd5.th\_tx | rad/s² | Rigid body angular acceleration, x-component | Global |  |
| mbd.rd5.th\_tty | mbd.iomega\*mbd.rd5.th\_ty | rad/s² | Rigid body angular acceleration, y-component | Global |  |
| mbd.rd5.th\_ttz | mbd.iomega\*mbd.rd5.th\_tz | rad/s² | Rigid body angular acceleration, z-component | Global |  |
| mbd.rd5.FIx | -mbd.rd5.m\*mbd.rd5.um\_ttx | N | Inertial force, x-component | Global |  |
| mbd.rd5.FIy | -mbd.rd5.m\*mbd.rd5.um\_tty | N | Inertial force, y-component | Global |  |
| mbd.rd5.FIz | 0 | N | Inertial force, z-component | Global |  |
| mbd.rd5.MIz | -mbd.rd5.Iz\*mbd.iomega^2\*mbd.rd5.phi | N·m | Inertial moment | Global |  |
| mbd.rd5.i\_rot | 1 | 1 | Free rotation indicator | Global | \* operation |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd5.U | ODE | m | Rigid body displacement, x-component |  | Global |
| mbd.rd5.V | ODE | m | Rigid body displacement, y-component |  | Global |
| mbd.rd5.Phi | ODE | rad | Rigid body rotation |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd5.FIx\*test(mbd.rd5.um)+mbd.rd5.FIy\*test(mbd.rd5.vm)+mbd.rd5.FIz\*test(mbd.rd5.wm) | 2 |  | Global |
| mbd.rd5.MIz\*test(mbd.rd5.phi) | 2 |  | Global |

#### Constraints

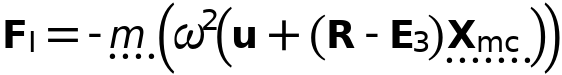
| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| up(u)-down(u) | test(up(u)-down(u)) | Lagrange (Linear) | No boundaries | Elemental |
| up(v)-down(v) | test(up(v)-down(v)) | Lagrange (Linear) | No boundaries | Elemental |
| 0 | 0 |  | No boundaries | Elemental |

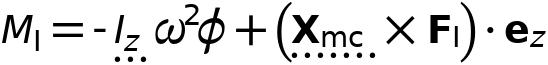
#### Mass and Moment of Inertia 5

Selection

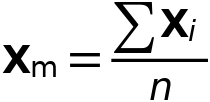
|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations









##### Center of Mass

Settings

| **Description** | **Value** |
| --- | --- |
| Center of mass | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

##### Mass and Moment of Inertia

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Mass | m\_thigh | kg |
| Moment of inertia | I\_thigh | kg·m² |

##### Frame Acceleration Forces

Settings

| **Description** | **Value** |
| --- | --- |
| Exclude contribution | Off |

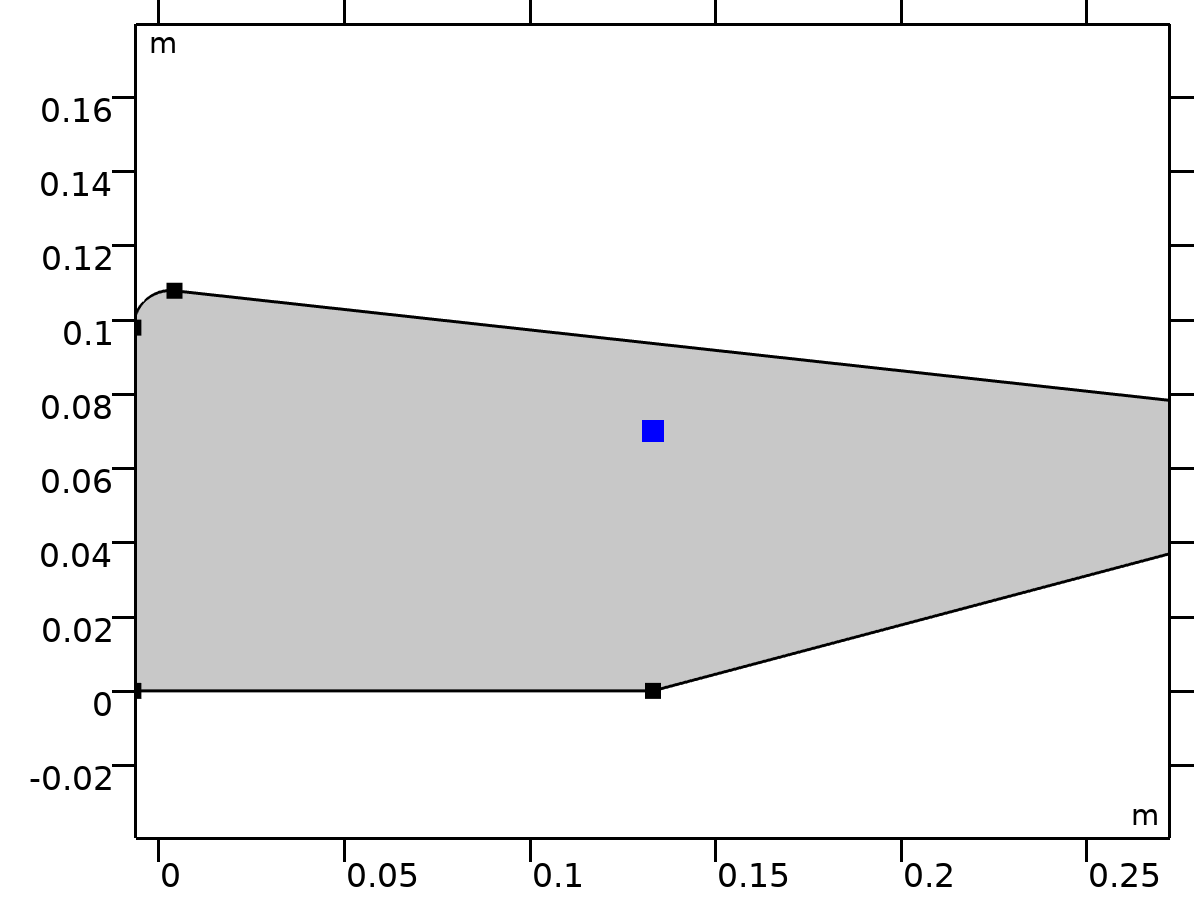
##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Wk\_tot | 0.25\*(mbd.rd5.mmi1.mt\*(realdot((mbd.rd5.u+mbd.rd5.mmi1.dMrotx-mbd.rd5.mmi1.dMx)\*mbd.iomega,(mbd.rd5.u+mbd.rd5.mmi1.dMrotx-mbd.rd5.mmi1.dMx)\*mbd.iomega)+realdot((mbd.rd5.v+mbd.rd5.mmi1.dMroty-mbd.rd5.mmi1.dMy)\*mbd.iomega,(mbd.rd5.v+mbd.rd5.mmi1.dMroty-mbd.rd5.mmi1.dMy)\*mbd.iomega)+realdot((mbd.rd5.w+mbd.rd5.mmi1.dMrotz-mbd.rd5.mmi1.dMz)\*mbd.iomega,(mbd.rd5.w+mbd.rd5.mmi1.dMrotz-mbd.rd5.mmi1.dMz)\*mbd.iomega))+mbd.rd5.mmi1.Iz\*realdot(mbd.rd5.phi\*mbd.iomega,mbd.rd5.phi\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.rd5.mmi1.mt | m\_thigh | kg | Mass | Global |  |
| mbd.rd5.mmi1.Iz | I\_thigh | kg·m² | Moment of inertia | Global |  |
| mbd.rd5.mmi1.xmsx | mbd.rd5.xcx+mbd.rd5.u+mbd.rd5.rotxx\*(mbd.rd5.mmi1.xmx-mbd.rd5.xcx)+mbd.rd5.rotxy\*(mbd.rd5.mmi1.xmy-mbd.rd5.xcy)+mbd.rd5.rotxz\*(mbd.rd5.mmi1.xmz-mbd.rd5.xcz) | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd5.mmi1.xmsy | mbd.rd5.xcy+mbd.rd5.v+mbd.rd5.rotyx\*(mbd.rd5.mmi1.xmx-mbd.rd5.xcx)+mbd.rd5.rotyy\*(mbd.rd5.mmi1.xmy-mbd.rd5.xcy)+mbd.rd5.rotyz\*(mbd.rd5.mmi1.xmz-mbd.rd5.xcz) | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd5.mmi1.xmsz | mbd.rd5.xcz+mbd.rd5.w+mbd.rd5.rotzx\*(mbd.rd5.mmi1.xmx-mbd.rd5.xcx)+mbd.rd5.rotzy\*(mbd.rd5.mmi1.xmy-mbd.rd5.xcy)+mbd.rd5.rotzz\*(mbd.rd5.mmi1.xmz-mbd.rd5.xcz) | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd5.mmi1.umx | mbd.rd5.u+mbd.rd5.rotxx\*(mbd.rd5.mmi1.xmx-mbd.rd5.xcx)+mbd.rd5.rotxy\*(mbd.rd5.mmi1.xmy-mbd.rd5.xcy)+mbd.rd5.rotxz\*(mbd.rd5.mmi1.xmz-mbd.rd5.xcz)-mbd.rd5.mmi1.xmx+mbd.rd5.xcx | m | Displacement at center of mass, x-component | Global |  |
| mbd.rd5.mmi1.umy | mbd.rd5.v+mbd.rd5.rotyx\*(mbd.rd5.mmi1.xmx-mbd.rd5.xcx)+mbd.rd5.rotyy\*(mbd.rd5.mmi1.xmy-mbd.rd5.xcy)+mbd.rd5.rotyz\*(mbd.rd5.mmi1.xmz-mbd.rd5.xcz)-mbd.rd5.mmi1.xmy+mbd.rd5.xcy | m | Displacement at center of mass, y-component | Global |  |
| mbd.rd5.mmi1.umz | mbd.rd5.w+mbd.rd5.rotzx\*(mbd.rd5.mmi1.xmx-mbd.rd5.xcx)+mbd.rd5.rotzy\*(mbd.rd5.mmi1.xmy-mbd.rd5.xcy)+mbd.rd5.rotzz\*(mbd.rd5.mmi1.xmz-mbd.rd5.xcz)-mbd.rd5.mmi1.xmz+mbd.rd5.xcz | m | Displacement at center of mass, z-component | Global |  |
| mbd.rd5.mmi1.FIx | -mbd.rd5.mmi1.mt\*mbd.iomega^2\*(mbd.rd5.u+mbd.rd5.mmi1.dMrotx-mbd.rd5.mmi1.dMx) | N | Inertial force, x-component | Global |  |
| mbd.rd5.mmi1.FIy | -mbd.rd5.mmi1.mt\*mbd.iomega^2\*(mbd.rd5.v+mbd.rd5.mmi1.dMroty-mbd.rd5.mmi1.dMy) | N | Inertial force, y-component | Global |  |
| mbd.rd5.mmi1.FIz | -mbd.rd5.mmi1.mt\*mbd.iomega^2\*(mbd.rd5.w+mbd.rd5.mmi1.dMrotz-mbd.rd5.mmi1.dMz) | N | Inertial force, z-component | Global |  |
| mbd.rd5.mmi1.MIz | -mbd.rd5.mmi1.Iz\*mbd.iomega^2\*mbd.rd5.phi | N·m | Inertial moment | Global |  |
| mbd.rd5.mmi1.dMx | mbd.rd5.mmi1.xmx-mbd.rd5.xcx | m | Mass offset from CoR, Original, x-component | Global |  |
| mbd.rd5.mmi1.dMy | mbd.rd5.mmi1.xmy-mbd.rd5.xcy | m | Mass offset from CoR, Original, y-component | Global |  |
| mbd.rd5.mmi1.dMz | mbd.rd5.mmi1.xmz-mbd.rd5.xcz | m | Mass offset from CoR, Original, z-component | Global |  |
| mbd.rd5.mmi1.dMrotx | mbd.rd5.rotxx\*mbd.rd5.mmi1.dMx+mbd.rd5.rotxy\*mbd.rd5.mmi1.dMy+mbd.rd5.rotxz\*mbd.rd5.mmi1.dMz | m | Mass offset from CoR, Rotated, x-component | Global |  |
| mbd.rd5.mmi1.dMroty | mbd.rd5.rotyx\*mbd.rd5.mmi1.dMx+mbd.rd5.rotyy\*mbd.rd5.mmi1.dMy+mbd.rd5.rotyz\*mbd.rd5.mmi1.dMz | m | Mass offset from CoR, Rotated, y-component | Global |  |
| mbd.rd5.mmi1.dMrotz | mbd.rd5.rotzx\*mbd.rd5.mmi1.dMx+mbd.rd5.rotzy\*mbd.rd5.mmi1.dMy+mbd.rd5.rotzz\*mbd.rd5.mmi1.dMz | m | Mass offset from CoR, Rotated, z-component | Global |  |
| mbd.rd5.mmi1.Fx | mbd.rd5.mmi1.FIx | N | Applied force, x-component | Global |  |
| mbd.rd5.mmi1.Fy | mbd.rd5.mmi1.FIy | N | Applied force, y-component | Global |  |
| mbd.rd5.mmi1.Fz | mbd.rd5.mmi1.FIz | N | Applied force, z-component | Global |  |
| mbd.rd5.mmi1.F\_Mag | sqrt(real(mbd.rd5.mmi1.Fx)^2+real(mbd.rd5.mmi1.Fy)^2+real(mbd.rd5.mmi1.Fz)^2) | N | Load magnitude | Global |  |
| mbd.rd5.mmi1.Mx | 0 | N·m | Applied moment, x-component | Global |  |
| mbd.rd5.mmi1.My | 0 | N·m | Applied moment, y-component | Global |  |
| mbd.rd5.mmi1.Mz | mbd.rd5.mmi1.MIz | N·m | Applied moment, z-component | Global |  |
| mbd.rd5.mmi1.M\_Mag | sqrt(real(mbd.rd5.mmi1.Mx)^2+real(mbd.rd5.mmi1.My)^2+real(mbd.rd5.mmi1.Mz)^2) | N·m | Moment magnitude | Global |  |
| mbd.rd5.mmi1.loadposx | mbd.rd5.mmi1.xmx | m | Load position, x-component | Global |  |
| mbd.rd5.mmi1.loadposy | mbd.rd5.mmi1.xmy | m | Load position, y-component | Global |  |
| mbd.rd5.mmi1.loadposz | mbd.rd5.mmi1.xmz | m | Load position, z-component | Global |  |
| mbd.rd5.mmi1.momposx | mbd.rd5.mmi1.xmx | m | Moment position, x-component | Global |  |
| mbd.rd5.mmi1.momposy | mbd.rd5.mmi1.xmy | m | Moment position, y-component | Global |  |
| mbd.rd5.mmi1.momposz | mbd.rd5.mmi1.xmz | m | Moment position, z-component | Global |  |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd5.mmi1.FIx\*test(mbd.rd5.u+mbd.rd5.mmi1.dMrotx)+mbd.rd5.mmi1.FIy\*test(mbd.rd5.v+mbd.rd5.mmi1.dMroty)+mbd.rd5.mmi1.FIz\*test(mbd.rd5.w+mbd.rd5.mmi1.dMrotz) | 2 |  | Global |
| mbd.rd5.mmi1.MIz\*test(mbd.rd5.phi) | 2 |  | Global |

##### Center of Mass: Point 5



Center of Mass: Point 5

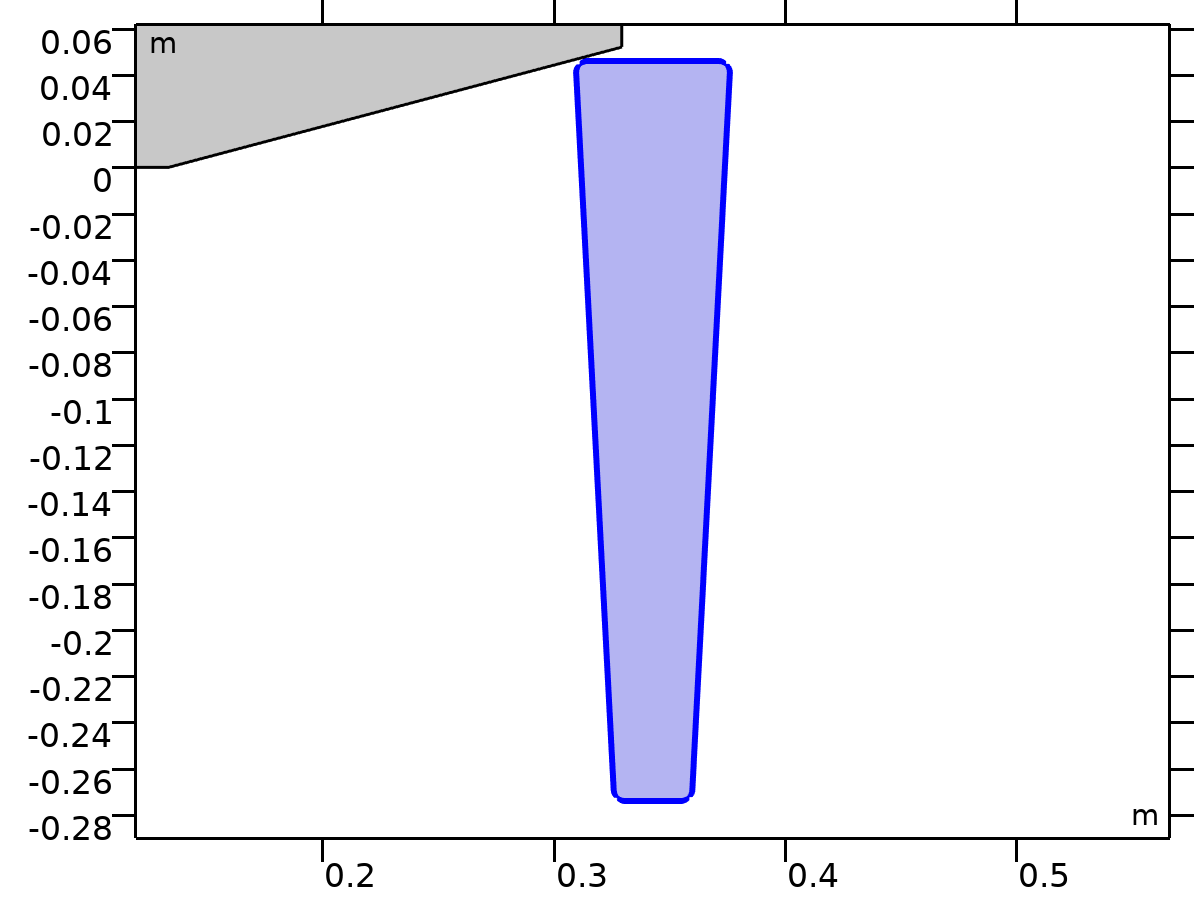
Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 62 |

###### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd5.mmi1.xmx | mbd.rd5.mmi1.cmp1.int(X)/mbd.rd5.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, x-component | Global | + operation |
| mbd.rd5.mmi1.xmy | mbd.rd5.mmi1.cmp1.int(Y)/mbd.rd5.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, y-component | Global | + operation |
| mbd.rd5.mmi1.xmz | mbd.rd5.mmi1.cmp1.int(0)/mbd.rd5.mmi1.cmp1.int(1) | m | Global coordinates of center of mass, z-component | Global | + operation |

### Leg



Leg

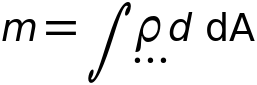
Selection

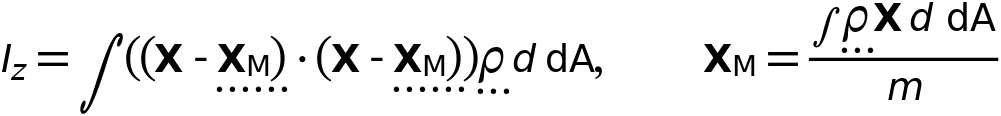
|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Geometry geom1: Dimension 2: Domain 6 |

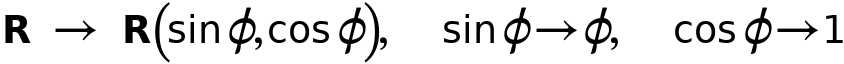
Equations





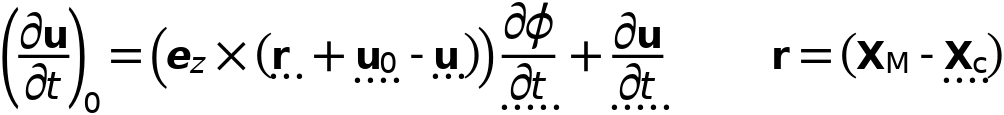




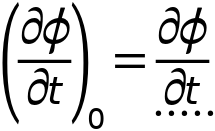












#### Density

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Density | User defined |  |
| Density | 0 | kg/m³ |

#### Center of Rotation

Settings

| **Description** | **Value** |
| --- | --- |
| Center of rotation | Center of mass |
| Offset | Off |

#### Initial Values

Settings

| **Description** | **Value** |
| --- | --- |
| Initial values | From physics interface node |
| Consistent initialization | Default |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| u | mbd.rd6.Udx | m | Displacement field, X-component | Domain 6 |  |
| v | mbd.rd6.Udy | m | Displacement field, Y-component | Domain 6 |  |
| w | mbd.rd6.Udz | m | Displacement field, Z-component | Domain 6 |  |
| mbd.Wk\_tot | 0.25\*(mbd.rd6.m\*(realdot(mbd.rd6.u\*mbd.iomega,mbd.rd6.u\*mbd.iomega)+realdot(mbd.rd6.v\*mbd.iomega,mbd.rd6.v\*mbd.iomega)+realdot(mbd.rd6.w\*mbd.iomega,mbd.rd6.w\*mbd.iomega))+realdot(mbd.rd6.Iz\*mbd.rd6.thx\*mbd.iomega,mbd.rd6.thx\*mbd.iomega)+realdot(mbd.rd6.Iz\*mbd.rd6.thy\*mbd.iomega,mbd.rd6.thy\*mbd.iomega)+realdot(mbd.rd6.Iz\*mbd.rd6.thz\*mbd.iomega,mbd.rd6.thz\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.RFtotalx | reacf(mbd.rd6.U) | N | Total reaction force, x-component | Global | + operation |
| mbd.RFtotaly | reacf(mbd.rd6.V) | N | Total reaction force, y-component | Global | + operation |
| mbd.RFtotalz | 0 | N | Total reaction force, z-component | Global | + operation |
| mbd.RMtotalx | -reacf(mbd.rd6.V)\*mbd.rd6.RMmaz | N·m | Total reaction moment, x-component | Global | + operation |
| mbd.RMtotaly | reacf(mbd.rd6.U)\*mbd.rd6.RMmaz | N·m | Total reaction moment, y-component | Global | + operation |
| mbd.RMtotalz | reacf(mbd.rd6.V)\*mbd.rd6.RMmax-reacf(mbd.rd6.U)\*mbd.rd6.RMmay+reacf(mbd.rd6.Phi) | N·m | Total reaction moment, z-component | Global | + operation |
| mbd.disp | sqrteps(real(u)^2+real(v)^2) | m | Displacement magnitude | Domain 6 |  |
| mbd.disp\_rms | sqrt(0.5\*(realdot(u,u)+realdot(v,v))) | m | Displacement, RMS | Domain 6 |  |
| mbd.gradUxX | -1+mbd.FdxX | 1 | Displacement gradient, xX-component | Domain 6 |  |
| mbd.gradUyX | mbd.FdyX | 1 | Displacement gradient, yX-component | Domain 6 |  |
| mbd.gradUzX | mbd.FdzX | 1 | Displacement gradient, zX-component | Domain 6 |  |
| mbd.gradUxY | mbd.FdxY | 1 | Displacement gradient, xY-component | Domain 6 |  |
| mbd.gradUyY | -1+mbd.FdyY | 1 | Displacement gradient, yY-component | Domain 6 |  |
| mbd.gradUzY | mbd.FdzY | 1 | Displacement gradient, zY-component | Domain 6 |  |
| mbd.gradUxZ | mbd.FdxZ | 1 | Displacement gradient, xZ-component | Domain 6 |  |
| mbd.gradUyZ | mbd.FdyZ | 1 | Displacement gradient, yZ-component | Domain 6 |  |
| mbd.gradUzZ | -1+mbd.FdzZ | 1 | Displacement gradient, zZ-component | Domain 6 |  |
| mbd.FdxX | mbd.rd6.rotxx | 1 | Deformation gradient, xX-component | Domain 6 |  |
| mbd.FdyX | mbd.rd6.rotyx | 1 | Deformation gradient, yX-component | Domain 6 |  |
| mbd.FdzX | mbd.rd6.rotzx | 1 | Deformation gradient, zX-component | Domain 6 |  |
| mbd.FdxY | mbd.rd6.rotxy | 1 | Deformation gradient, xY-component | Domain 6 |  |
| mbd.FdyY | mbd.rd6.rotyy | 1 | Deformation gradient, yY-component | Domain 6 |  |
| mbd.FdzY | mbd.rd6.rotzy | 1 | Deformation gradient, zY-component | Domain 6 |  |
| mbd.FdxZ | mbd.rd6.rotxz | 1 | Deformation gradient, xZ-component | Domain 6 |  |
| mbd.FdyZ | mbd.rd6.rotyz | 1 | Deformation gradient, yZ-component | Domain 6 |  |
| mbd.FdzZ | mbd.rd6.rotzz | 1 | Deformation gradient, zZ-component | Domain 6 |  |
| mbd.FdiXx | (mbd.FdyY\*mbd.FdzZ-mbd.FdyZ\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Xx-component | Domain 6 |  |
| mbd.FdiYx | (mbd.FdyZ\*mbd.FdzX-mbd.FdyX\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Yx-component | Domain 6 |  |
| mbd.FdiZx | (mbd.FdyX\*mbd.FdzY-mbd.FdyY\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Zx-component | Domain 6 |  |
| mbd.FdiXy | (mbd.FdxZ\*mbd.FdzY-mbd.FdxY\*mbd.FdzZ)/mbd.J | 1 | Deformation gradient inverse, Xy-component | Domain 6 |  |
| mbd.FdiYy | (mbd.FdxX\*mbd.FdzZ-mbd.FdxZ\*mbd.FdzX)/mbd.J | 1 | Deformation gradient inverse, Yy-component | Domain 6 |  |
| mbd.FdiZy | (mbd.FdxY\*mbd.FdzX-mbd.FdxX\*mbd.FdzY)/mbd.J | 1 | Deformation gradient inverse, Zy-component | Domain 6 |  |
| mbd.FdiXz | (mbd.FdxY\*mbd.FdyZ-mbd.FdxZ\*mbd.FdyY)/mbd.J | 1 | Deformation gradient inverse, Xz-component | Domain 6 |  |
| mbd.FdiYz | (mbd.FdxZ\*mbd.FdyX-mbd.FdxX\*mbd.FdyZ)/mbd.J | 1 | Deformation gradient inverse, Yz-component | Domain 6 |  |
| mbd.FdiZz | (mbd.FdxX\*mbd.FdyY-mbd.FdxY\*mbd.FdyX)/mbd.J | 1 | Deformation gradient inverse, Zz-component | Domain 6 |  |
| mbd.J | 1 | 1 | Volume ratio | Domain 6 |  |
| mbd.Ws | 0 | J/m³ | Elastic strain energy density | Domain 6 | + operation |
| mbd.Ws\_tot | 0 | J | Total elastic strain energy | Global | + operation |
| mbd.Wk | 0.25\*mbd.rho\*(realdot(u\*mbd.iomega,u\*mbd.iomega)+realdot(v\*mbd.iomega,v\*mbd.iomega)) | J/m³ | Kinetic energy density | Domain 6 | + operation |
| mbd.Eequ | Inf | Pa | Equivalent Young's modulus | Domain 6 |  |
| mbd.nuequ | 0 | 1 | Equivalent Poisson's ratio | Domain 6 |  |
| mbd.Eequtot | mbd.Eequ | Pa | Total equivalent Young's modulus | Domain 6 | + operation |
| mbd.rho | 0 | kg/m³ | Density | Domain 6 | \* operation |
| mbd.u\_ttX | material.dt(material.dt(mbd.rd6.Udx)) | m/s² | Acceleration, X-component | Domain 6 |  |
| mbd.u\_ttY | material.dt(material.dt(mbd.rd6.Udy)) | m/s² | Acceleration, Y-component | Domain 6 |  |
| mbd.u\_ttZ | material.dt(material.dt(mbd.rd6.Udz)) | m/s² | Acceleration, Z-component | Domain 6 |  |
| mbd.u\_tX | material.dt(mbd.rd6.Udx) | m/s | Velocity, X-component | Domain 6 |  |
| mbd.u\_tY | material.dt(mbd.rd6.Udy) | m/s | Velocity, Y-component | Domain 6 |  |
| mbd.u\_tZ | material.dt(mbd.rd6.Udz) | m/s | Velocity, Z-component | Domain 6 |  |
| mbd.vel\_rms | sqrt(0.5\*(realdot(mbd.u\_tX,mbd.u\_tX)+realdot(mbd.u\_tY,mbd.u\_tY)+realdot(mbd.u\_tZ,mbd.u\_tZ))) | m/s | Velocity magnitude, RMS | Domain 6 |  |
| mbd.acc\_rms | sqrt(0.5\*(realdot(mbd.u\_ttX,mbd.u\_ttX)+realdot(mbd.u\_ttY,mbd.u\_ttY)+realdot(mbd.u\_ttZ,mbd.u\_ttZ))) | m/s² | Acceleration magnitude, RMS | Domain 6 |  |
| mbd.afX | 0 | m/s² | Frame acceleration, X-component | Domain 6 | + operation |
| mbd.afY | 0 | m/s² | Frame acceleration, Y-component | Domain 6 | + operation |
| mbd.afZ | 0 | m/s² | Frame acceleration, Z-component | Domain 6 | + operation |
| mbd.accX | mbd.u\_ttX | m/s² | Effective acceleration, X-component | Domain 6 | + operation |
| mbd.accY | mbd.u\_ttY | m/s² | Effective acceleration, Y-component | Domain 6 | + operation |
| mbd.accZ | mbd.u\_ttZ | m/s² | Effective acceleration, Z-component | Domain 6 | + operation |
| mbd.vel | sqrteps(real(mbd.u\_tX)^2+real(mbd.u\_tY)^2+real(mbd.u\_tZ)^2) | m/s | Velocity magnitude | Domain 6 |  |
| mbd.acc | sqrteps(real(mbd.accX)^2+real(mbd.accY)^2+real(mbd.accZ)^2) | m/s² | Effective acceleration magnitude | Domain 6 |  |
| mbd.u\_tt | sqrteps(real(mbd.u\_ttX)^2+real(mbd.u\_ttY)^2+real(mbd.u\_ttZ)^2) | m/s² | Acceleration magnitude | Domain 6 |  |
| mbd.phase | if(isdefined(phase),phase,0) | 1 | Phase | Global |  |
| mbd.rd6.xcx | mbd.rd6.xmx | m | Center of rotation, x-component | Global | + operation |
| mbd.rd6.xcy | mbd.rd6.xmy | m | Center of rotation, y-component | Global | + operation |
| mbd.rd6.xcz | mbd.rd6.xmz | m | Center of rotation, z-component | Global | + operation |
| mbd.rd6.phi | mbd.rd6.Phi | rad | Rigid body rotation | Global |  |
| mbd.rd6.rotxx | 1 | 1 | Rotation matrix, xx-component | Global |  |
| mbd.rd6.rotyx | mbd.rd6.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, yx-component | Global |  |
| mbd.rd6.rotzx | 0 | 1 | Rotation matrix, zx-component | Global |  |
| mbd.rd6.rotxy | -mbd.rd6.phi\*exp(-(j\*mbd.phase)) | 1 | Rotation matrix, xy-component | Global |  |
| mbd.rd6.rotyy | 1 | 1 | Rotation matrix, yy-component | Global |  |
| mbd.rd6.rotzy | 0 | 1 | Rotation matrix, zy-component | Global |  |
| mbd.rd6.rotxz | 0 | 1 | Rotation matrix, xz-component | Global |  |
| mbd.rd6.rotyz | 0 | 1 | Rotation matrix, yz-component | Global |  |
| mbd.rd6.rotzz | 1 | 1 | Rotation matrix, zz-component | Global |  |
| mbd.rd6.RMmax | mbd.rd6.xcx-mbd.refpntx | m | Moment arm, x-component | Global |  |
| mbd.rd6.RMmay | mbd.rd6.xcy-mbd.refpnty | m | Moment arm, y-component | Global |  |
| mbd.rd6.RMmaz | 0 | m | Moment arm, z-component | Global |  |
| mbd.rd6.u | mbd.rd6.U | m | Rigid body displacement, x-component | Global |  |
| mbd.rd6.v | mbd.rd6.V | m | Rigid body displacement, y-component | Global |  |
| mbd.rd6.w | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd6.xmx | mbd.rd6.int((mbd.rho+eps)\*mbd.d\*X)/mbd.rd6.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, x-component | Global |  |
| mbd.rd6.xmy | mbd.rd6.int((mbd.rho+eps)\*mbd.d\*Y)/mbd.rd6.int((mbd.rho+eps)\*mbd.d) | m | Center of mass, y-component | Global |  |
| mbd.rd6.xmz | 0 | m | Center of mass, z-component | Global |  |
| mbd.rd6.Iz | mbd.rd6.int(((X-mbd.rd6.xmx)^2+(Y-mbd.rd6.xmy)^2+mbd.rd6.xmz^2)\*mbd.rho\*mbd.d) | kg·m² | Moment of inertia | Global |  |
| mbd.rd6.um | mbd.rd6.u | m | Rigid body displacement, x-component | Global |  |
| mbd.rd6.vm | mbd.rd6.v | m | Rigid body displacement, y-component | Global |  |
| mbd.rd6.wm | 0 | m | Rigid body displacement, z-component | Global |  |
| mbd.rd6.m | mbd.rd6.int(mbd.rho\*mbd.d) | kg | Mass | Global |  |
| mbd.rd6.Udx | (mbd.rd6.rotxx\*(X-mbd.rd6.xcx)+mbd.rd6.rotxy\*(Y-mbd.rd6.xcy)-mbd.rd6.rotxz\*mbd.rd6.xcz-X+mbd.rd6.xcx)\*exp(j\*mbd.phase)+mbd.rd6.u | m | Domain displacement, x-component | Domain 6 | + operation |
| mbd.rd6.Udy | (mbd.rd6.rotyx\*(X-mbd.rd6.xcx)+mbd.rd6.rotyy\*(Y-mbd.rd6.xcy)-mbd.rd6.rotyz\*mbd.rd6.xcz-Y+mbd.rd6.xcy)\*exp(j\*mbd.phase)+mbd.rd6.v | m | Domain displacement, y-component | Domain 6 | + operation |
| mbd.rd6.Udz | (mbd.rd6.rotzx\*(X-mbd.rd6.xcx)+mbd.rd6.rotzy\*(Y-mbd.rd6.xcy)-mbd.rd6.rotzz\*mbd.rd6.xcz+mbd.rd6.xcz)\*exp(j\*mbd.phase)+mbd.rd6.w | m | Domain displacement, z-component | Domain 6 | + operation |
| mbd.rd6.thx | 0 | rad | Rigid body rotation, x-component | Global |  |
| mbd.rd6.thy | 0 | rad | Rigid body rotation, y-component | Global |  |
| mbd.rd6.thz | mbd.rd6.phi | rad | Rigid body rotation, z-component | Global |  |
| mbd.rd6.u\_tx | mbd.iomega\*mbd.rd6.u | m/s | Rigid body velocity, x-component | Global |  |
| mbd.rd6.u\_ty | mbd.iomega\*mbd.rd6.v | m/s | Rigid body velocity, y-component | Global |  |
| mbd.rd6.u\_tz | mbd.iomega\*mbd.rd6.w | m/s | Rigid body velocity, z-component | Global |  |
| mbd.rd6.u\_ttx | mbd.iomega\*mbd.rd6.u\_tx | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd6.u\_tty | mbd.iomega\*mbd.rd6.u\_ty | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd6.u\_ttz | mbd.iomega\*mbd.rd6.u\_tz | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd6.um\_ttx | mbd.iomega^2\*mbd.rd6.um | m/s² | Rigid body acceleration, x-component | Global |  |
| mbd.rd6.um\_tty | mbd.iomega^2\*mbd.rd6.vm | m/s² | Rigid body acceleration, y-component | Global |  |
| mbd.rd6.um\_ttz | mbd.iomega^2\*mbd.rd6.wm | m/s² | Rigid body acceleration, z-component | Global |  |
| mbd.rd6.th\_tx | mbd.iomega\*mbd.rd6.thx | rad/s | Rigid body angular velocity, x-component | Global |  |
| mbd.rd6.th\_ty | mbd.iomega\*mbd.rd6.thy | rad/s | Rigid body angular velocity, y-component | Global |  |
| mbd.rd6.th\_tz | mbd.iomega\*mbd.rd6.thz | rad/s | Rigid body angular velocity, z-component | Global |  |
| mbd.rd6.th\_ttx | mbd.iomega\*mbd.rd6.th\_tx | rad/s² | Rigid body angular acceleration, x-component | Global |  |
| mbd.rd6.th\_tty | mbd.iomega\*mbd.rd6.th\_ty | rad/s² | Rigid body angular acceleration, y-component | Global |  |
| mbd.rd6.th\_ttz | mbd.iomega\*mbd.rd6.th\_tz | rad/s² | Rigid body angular acceleration, z-component | Global |  |
| mbd.rd6.FIx | -mbd.rd6.m\*mbd.rd6.um\_ttx | N | Inertial force, x-component | Global |  |
| mbd.rd6.FIy | -mbd.rd6.m\*mbd.rd6.um\_tty | N | Inertial force, y-component | Global |  |
| mbd.rd6.FIz | 0 | N | Inertial force, z-component | Global |  |
| mbd.rd6.MIz | -mbd.rd6.Iz\*mbd.iomega^2\*mbd.rd6.phi | N·m | Inertial moment | Global |  |
| mbd.rd6.i\_rot | 1 | 1 | Free rotation indicator | Global | \* operation |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.rd6.U | ODE | m | Rigid body displacement, x-component |  | Global |
| mbd.rd6.V | ODE | m | Rigid body displacement, y-component |  | Global |
| mbd.rd6.Phi | ODE | rad | Rigid body rotation |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd6.FIx\*test(mbd.rd6.um)+mbd.rd6.FIy\*test(mbd.rd6.vm)+mbd.rd6.FIz\*test(mbd.rd6.wm) | 2 |  | Global |
| mbd.rd6.MIz\*test(mbd.rd6.phi) | 2 |  | Global |

#### Constraints

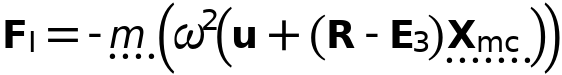
| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| up(u)-down(u) | test(up(u)-down(u)) | Lagrange (Linear) | No boundaries | Elemental |
| up(v)-down(v) | test(up(v)-down(v)) | Lagrange (Linear) | No boundaries | Elemental |
| 0 | 0 |  | No boundaries | Elemental |

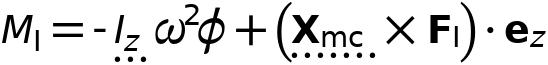
#### Mass and Moment of Inertia 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations







##### Center of Mass

Settings

| **Description** | **Value** |
| --- | --- |
| Center of mass | Center of rotation |
| Offset | Off |

##### Mass and Moment of Inertia

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Mass | 0 | kg |
| Moment of inertia | 0 | kg·m² |

##### Frame Acceleration Forces

Settings

| **Description** | **Value** |
| --- | --- |
| Exclude contribution | Off |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Wk\_tot | 0.25\*(mbd.rd6.mmi1.mt\*(realdot((mbd.rd6.u+mbd.rd6.mmi1.dMrotx-mbd.rd6.mmi1.dMx)\*mbd.iomega,(mbd.rd6.u+mbd.rd6.mmi1.dMrotx-mbd.rd6.mmi1.dMx)\*mbd.iomega)+realdot((mbd.rd6.v+mbd.rd6.mmi1.dMroty-mbd.rd6.mmi1.dMy)\*mbd.iomega,(mbd.rd6.v+mbd.rd6.mmi1.dMroty-mbd.rd6.mmi1.dMy)\*mbd.iomega)+realdot((mbd.rd6.w+mbd.rd6.mmi1.dMrotz-mbd.rd6.mmi1.dMz)\*mbd.iomega,(mbd.rd6.w+mbd.rd6.mmi1.dMrotz-mbd.rd6.mmi1.dMz)\*mbd.iomega))+mbd.rd6.mmi1.Iz\*realdot(mbd.rd6.phi\*mbd.iomega,mbd.rd6.phi\*mbd.iomega)) | J | Total kinetic energy | Global | + operation |
| mbd.rd6.mmi1.mt | 0 | kg | Mass | Global |  |
| mbd.rd6.mmi1.Iz | 0 | kg·m² | Moment of inertia | Global |  |
| mbd.rd6.mmi1.xmsx | mbd.rd6.xcx+mbd.rd6.u+mbd.rd6.rotxx\*(mbd.rd6.mmi1.xmx-mbd.rd6.xcx)+mbd.rd6.rotxy\*(mbd.rd6.mmi1.xmy-mbd.rd6.xcy)+mbd.rd6.rotxz\*(mbd.rd6.mmi1.xmz-mbd.rd6.xcz) | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd6.mmi1.xmsy | mbd.rd6.xcy+mbd.rd6.v+mbd.rd6.rotyx\*(mbd.rd6.mmi1.xmx-mbd.rd6.xcx)+mbd.rd6.rotyy\*(mbd.rd6.mmi1.xmy-mbd.rd6.xcy)+mbd.rd6.rotyz\*(mbd.rd6.mmi1.xmz-mbd.rd6.xcz) | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd6.mmi1.xmsz | mbd.rd6.xcz+mbd.rd6.w+mbd.rd6.rotzx\*(mbd.rd6.mmi1.xmx-mbd.rd6.xcx)+mbd.rd6.rotzy\*(mbd.rd6.mmi1.xmy-mbd.rd6.xcy)+mbd.rd6.rotzz\*(mbd.rd6.mmi1.xmz-mbd.rd6.xcz) | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd6.mmi1.umx | mbd.rd6.u+mbd.rd6.rotxx\*(mbd.rd6.mmi1.xmx-mbd.rd6.xcx)+mbd.rd6.rotxy\*(mbd.rd6.mmi1.xmy-mbd.rd6.xcy)+mbd.rd6.rotxz\*(mbd.rd6.mmi1.xmz-mbd.rd6.xcz)-mbd.rd6.mmi1.xmx+mbd.rd6.xcx | m | Displacement at center of mass, x-component | Global |  |
| mbd.rd6.mmi1.umy | mbd.rd6.v+mbd.rd6.rotyx\*(mbd.rd6.mmi1.xmx-mbd.rd6.xcx)+mbd.rd6.rotyy\*(mbd.rd6.mmi1.xmy-mbd.rd6.xcy)+mbd.rd6.rotyz\*(mbd.rd6.mmi1.xmz-mbd.rd6.xcz)-mbd.rd6.mmi1.xmy+mbd.rd6.xcy | m | Displacement at center of mass, y-component | Global |  |
| mbd.rd6.mmi1.umz | mbd.rd6.w+mbd.rd6.rotzx\*(mbd.rd6.mmi1.xmx-mbd.rd6.xcx)+mbd.rd6.rotzy\*(mbd.rd6.mmi1.xmy-mbd.rd6.xcy)+mbd.rd6.rotzz\*(mbd.rd6.mmi1.xmz-mbd.rd6.xcz)-mbd.rd6.mmi1.xmz+mbd.rd6.xcz | m | Displacement at center of mass, z-component | Global |  |
| mbd.rd6.mmi1.xmx | mbd.rd6.xcx | m | Global coordinates of center of mass, x-component | Global |  |
| mbd.rd6.mmi1.xmy | mbd.rd6.xcy | m | Global coordinates of center of mass, y-component | Global |  |
| mbd.rd6.mmi1.xmz | mbd.rd6.xcz | m | Global coordinates of center of mass, z-component | Global |  |
| mbd.rd6.mmi1.FIx | -mbd.rd6.mmi1.mt\*mbd.iomega^2\*(mbd.rd6.u+mbd.rd6.mmi1.dMrotx-mbd.rd6.mmi1.dMx) | N | Inertial force, x-component | Global |  |
| mbd.rd6.mmi1.FIy | -mbd.rd6.mmi1.mt\*mbd.iomega^2\*(mbd.rd6.v+mbd.rd6.mmi1.dMroty-mbd.rd6.mmi1.dMy) | N | Inertial force, y-component | Global |  |
| mbd.rd6.mmi1.FIz | -mbd.rd6.mmi1.mt\*mbd.iomega^2\*(mbd.rd6.w+mbd.rd6.mmi1.dMrotz-mbd.rd6.mmi1.dMz) | N | Inertial force, z-component | Global |  |
| mbd.rd6.mmi1.MIz | -mbd.rd6.mmi1.Iz\*mbd.iomega^2\*mbd.rd6.phi | N·m | Inertial moment | Global |  |
| mbd.rd6.mmi1.dMx | mbd.rd6.mmi1.xmx-mbd.rd6.xcx | m | Mass offset from CoR, Original, x-component | Global |  |
| mbd.rd6.mmi1.dMy | mbd.rd6.mmi1.xmy-mbd.rd6.xcy | m | Mass offset from CoR, Original, y-component | Global |  |
| mbd.rd6.mmi1.dMz | mbd.rd6.mmi1.xmz-mbd.rd6.xcz | m | Mass offset from CoR, Original, z-component | Global |  |
| mbd.rd6.mmi1.dMrotx | mbd.rd6.rotxx\*mbd.rd6.mmi1.dMx+mbd.rd6.rotxy\*mbd.rd6.mmi1.dMy+mbd.rd6.rotxz\*mbd.rd6.mmi1.dMz | m | Mass offset from CoR, Rotated, x-component | Global |  |
| mbd.rd6.mmi1.dMroty | mbd.rd6.rotyx\*mbd.rd6.mmi1.dMx+mbd.rd6.rotyy\*mbd.rd6.mmi1.dMy+mbd.rd6.rotyz\*mbd.rd6.mmi1.dMz | m | Mass offset from CoR, Rotated, y-component | Global |  |
| mbd.rd6.mmi1.dMrotz | mbd.rd6.rotzx\*mbd.rd6.mmi1.dMx+mbd.rd6.rotzy\*mbd.rd6.mmi1.dMy+mbd.rd6.rotzz\*mbd.rd6.mmi1.dMz | m | Mass offset from CoR, Rotated, z-component | Global |  |
| mbd.rd6.mmi1.Fx | mbd.rd6.mmi1.FIx | N | Applied force, x-component | Global |  |
| mbd.rd6.mmi1.Fy | mbd.rd6.mmi1.FIy | N | Applied force, y-component | Global |  |
| mbd.rd6.mmi1.Fz | mbd.rd6.mmi1.FIz | N | Applied force, z-component | Global |  |
| mbd.rd6.mmi1.F\_Mag | sqrt(real(mbd.rd6.mmi1.Fx)^2+real(mbd.rd6.mmi1.Fy)^2+real(mbd.rd6.mmi1.Fz)^2) | N | Load magnitude | Global |  |
| mbd.rd6.mmi1.Mx | 0 | N·m | Applied moment, x-component | Global |  |
| mbd.rd6.mmi1.My | 0 | N·m | Applied moment, y-component | Global |  |
| mbd.rd6.mmi1.Mz | mbd.rd6.mmi1.MIz | N·m | Applied moment, z-component | Global |  |
| mbd.rd6.mmi1.M\_Mag | sqrt(real(mbd.rd6.mmi1.Mx)^2+real(mbd.rd6.mmi1.My)^2+real(mbd.rd6.mmi1.Mz)^2) | N·m | Moment magnitude | Global |  |
| mbd.rd6.mmi1.loadposx | mbd.rd6.mmi1.xmx | m | Load position, x-component | Global |  |
| mbd.rd6.mmi1.loadposy | mbd.rd6.mmi1.xmy | m | Load position, y-component | Global |  |
| mbd.rd6.mmi1.loadposz | mbd.rd6.mmi1.xmz | m | Load position, z-component | Global |  |
| mbd.rd6.mmi1.momposx | mbd.rd6.mmi1.xmx | m | Moment position, x-component | Global |  |
| mbd.rd6.mmi1.momposy | mbd.rd6.mmi1.xmy | m | Moment position, y-component | Global |  |
| mbd.rd6.mmi1.momposz | mbd.rd6.mmi1.xmz | m | Moment position, z-component | Global |  |

##### Weak Expressions

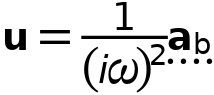
| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.rd6.mmi1.FIx\*test(mbd.rd6.u+mbd.rd6.mmi1.dMrotx)+mbd.rd6.mmi1.FIy\*test(mbd.rd6.v+mbd.rd6.mmi1.dMroty)+mbd.rd6.mmi1.FIz\*test(mbd.rd6.w+mbd.rd6.mmi1.dMrotz) | 2 |  | Global |
| mbd.rd6.mmi1.MIz\*test(mbd.rd6.phi) | 2 |  | Global |

### Seat

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations



#### Base Motion

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Base motion type | Acceleration |  |
| Base acceleration, x-component | 0 | m/s² |
| Base acceleration, y-component | vtt\_in | m/s² |
| Base acceleration, z-component | 0 | m/s² |

#### Initial Base Displacement

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Initial base displacement, x-component | 0 | m |
| Initial base displacement, y-component | 0 | m |
| Initial base displacement, z-component | 0 | m |

#### Initial Base Velocity

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Initial base velocity, x-component | 0 | m/s |
| Initial base velocity, y-component | 0 | m/s |
| Initial base velocity, z-component | 0 | m/s |

#### Coordinate System Selection

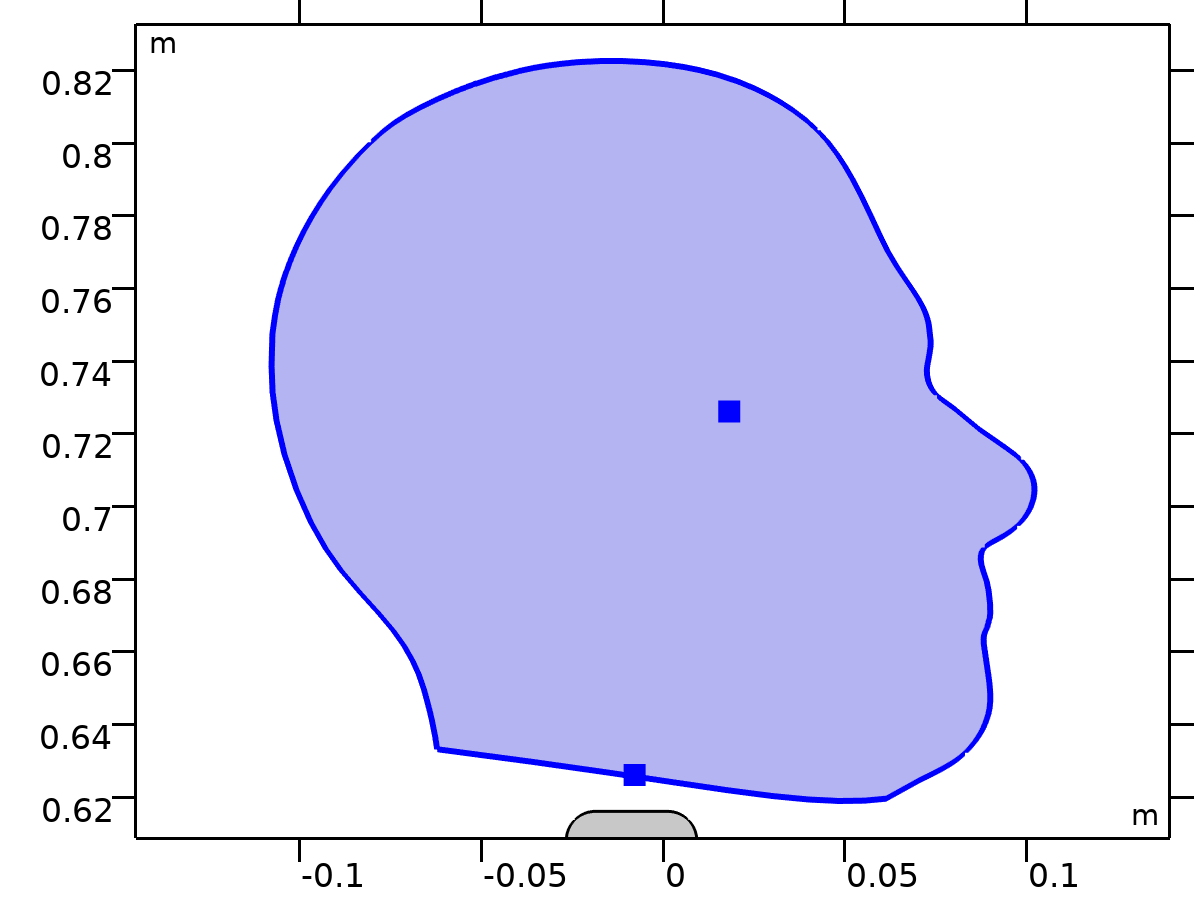
Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

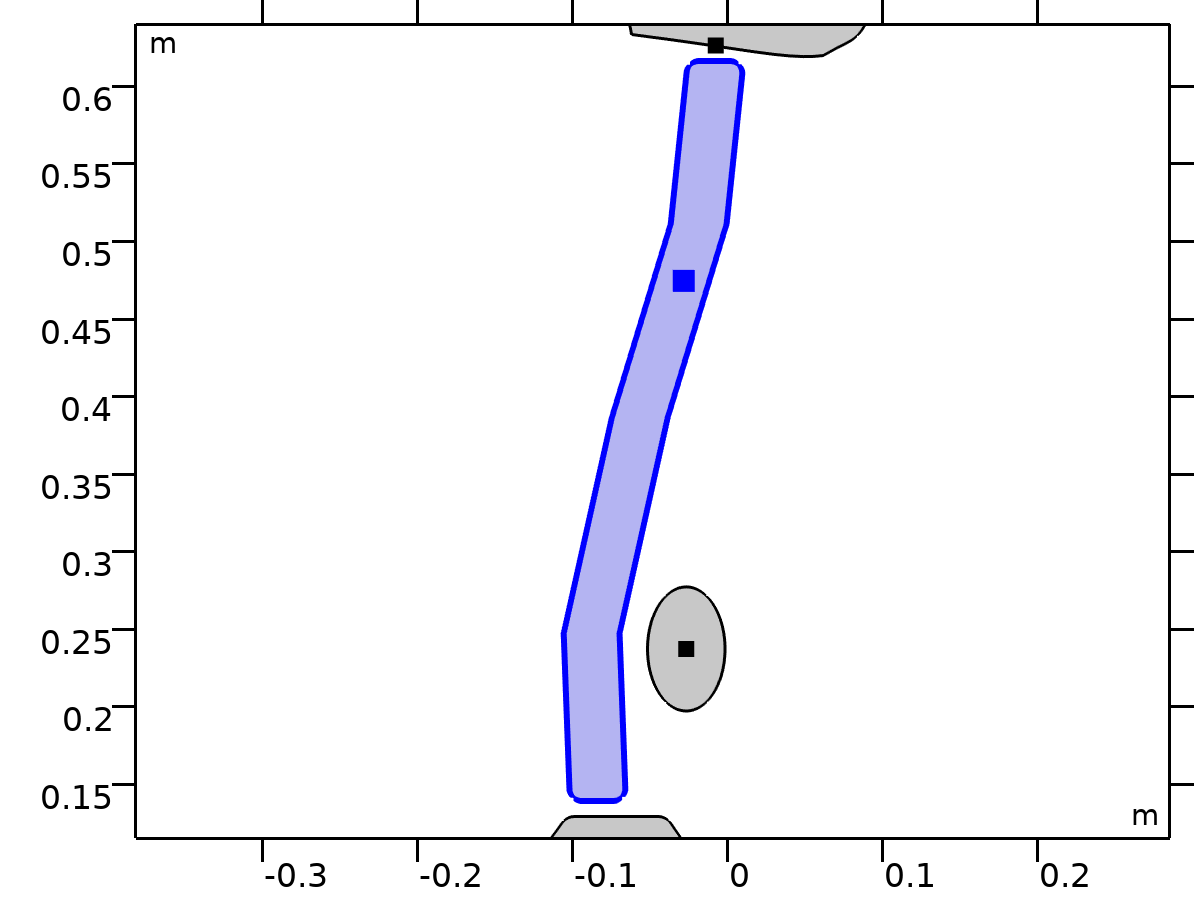
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.bsm1.abx | 0 | m/s² | Base acceleration, x-component | Global |
| mbd.bsm1.aby | vtt\_in | m/s² | Base acceleration, y-component | Global |
| mbd.bsm1.abz | 0 | m/s² | Base acceleration, z-component | Global |
| mbd.bsm1.ub0x | 0 | m | Initial base displacement, x-component | Global |
| mbd.bsm1.ub0y | 0 | m | Initial base displacement, y-component | Global |
| mbd.bsm1.ub0z | 0 | m | Initial base displacement, z-component | Global |
| mbd.bsm1.vb0x | 0 | m/s | Initial base velocity, x-component | Global |
| mbd.bsm1.vb0y | 0 | m/s | Initial base velocity, y-component | Global |
| mbd.bsm1.vb0z | 0 | m/s | Initial base velocity, z-component | Global |
| mbd.bsm1.u | mbd.bsm1.abx/mbd.iomega^2 | m | Base displacement, x-component | Global |
| mbd.bsm1.v | mbd.bsm1.aby/mbd.iomega^2 | m | Base displacement, y-component | Global |
| mbd.bsm1.w | mbd.bsm1.abz/mbd.iomega^2 | m | Base displacement, z-component | Global |

### Head-Torso



Head-Torso



Head-Torso

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

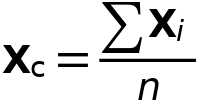
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Head |
| Destination | Torso |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

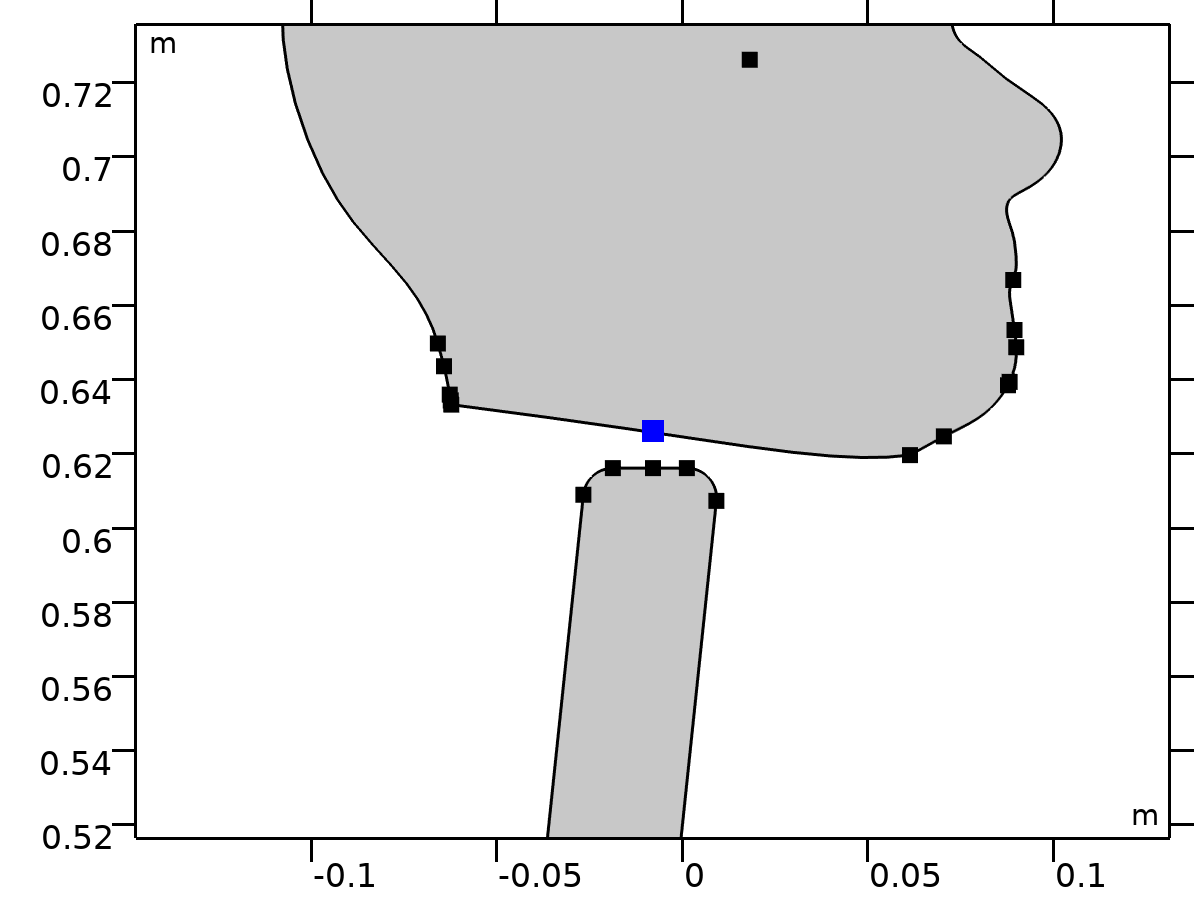
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj1.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj1.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj1.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj1.e20x | (mbd.fxj1.e10z\*mbd.fxj1.e30y-mbd.fxj1.e10y\*mbd.fxj1.e30z)/sqrt((mbd.fxj1.e10z\*mbd.fxj1.e30y-mbd.fxj1.e10y\*mbd.fxj1.e30z)^2+(-mbd.fxj1.e10z\*mbd.fxj1.e30x+mbd.fxj1.e10x\*mbd.fxj1.e30z)^2+(mbd.fxj1.e10y\*mbd.fxj1.e30x-mbd.fxj1.e10x\*mbd.fxj1.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj1.e20y | (-mbd.fxj1.e10z\*mbd.fxj1.e30x+mbd.fxj1.e10x\*mbd.fxj1.e30z)/sqrt((mbd.fxj1.e10z\*mbd.fxj1.e30y-mbd.fxj1.e10y\*mbd.fxj1.e30z)^2+(-mbd.fxj1.e10z\*mbd.fxj1.e30x+mbd.fxj1.e10x\*mbd.fxj1.e30z)^2+(mbd.fxj1.e10y\*mbd.fxj1.e30x-mbd.fxj1.e10x\*mbd.fxj1.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj1.e20z | (mbd.fxj1.e10y\*mbd.fxj1.e30x-mbd.fxj1.e10x\*mbd.fxj1.e30y)/sqrt((mbd.fxj1.e10z\*mbd.fxj1.e30y-mbd.fxj1.e10y\*mbd.fxj1.e30z)^2+(-mbd.fxj1.e10z\*mbd.fxj1.e30x+mbd.fxj1.e10x\*mbd.fxj1.e30z)^2+(mbd.fxj1.e10y\*mbd.fxj1.e30x-mbd.fxj1.e10x\*mbd.fxj1.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj1.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj1.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj1.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj1.e1x | mbd.rd2.rotxx\*mbd.fxj1.e10x+mbd.rd2.rotxy\*mbd.fxj1.e10y+mbd.rd2.rotxz\*mbd.fxj1.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj1.e1y | mbd.rd2.rotyx\*mbd.fxj1.e10x+mbd.rd2.rotyy\*mbd.fxj1.e10y+mbd.rd2.rotyz\*mbd.fxj1.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj1.e1z | mbd.rd2.rotzx\*mbd.fxj1.e10x+mbd.rd2.rotzy\*mbd.fxj1.e10y+mbd.rd2.rotzz\*mbd.fxj1.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj1.e2x | mbd.rd2.rotxx\*mbd.fxj1.e20x+mbd.rd2.rotxy\*mbd.fxj1.e20y+mbd.rd2.rotxz\*mbd.fxj1.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj1.e2y | mbd.rd2.rotyx\*mbd.fxj1.e20x+mbd.rd2.rotyy\*mbd.fxj1.e20y+mbd.rd2.rotyz\*mbd.fxj1.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj1.e2z | mbd.rd2.rotzx\*mbd.fxj1.e20x+mbd.rd2.rotzy\*mbd.fxj1.e20y+mbd.rd2.rotzz\*mbd.fxj1.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj1.e3x | mbd.rd2.rotxx\*mbd.fxj1.e30x+mbd.rd2.rotxy\*mbd.fxj1.e30y+mbd.rd2.rotxz\*mbd.fxj1.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj1.e3y | mbd.rd2.rotyx\*mbd.fxj1.e30x+mbd.rd2.rotyy\*mbd.fxj1.e30y+mbd.rd2.rotyz\*mbd.fxj1.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj1.e3z | mbd.rd2.rotzx\*mbd.fxj1.e30x+mbd.rd2.rotzy\*mbd.fxj1.e30y+mbd.rd2.rotzz\*mbd.fxj1.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj1.uc\_src | mbd.rd2.rotxx\*(mbd.fxj1.xcx-mbd.rd2.xcx)+mbd.rd2.rotxy\*(mbd.fxj1.xcy-mbd.rd2.xcy)+mbd.rd2.rotxz\*(mbd.fxj1.xcz-mbd.rd2.xcz)-mbd.fxj1.xcx+mbd.rd2.xcx+mbd.rd2.u+mbd.fxj1.u\_el | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj1.vc\_src | mbd.rd2.rotyx\*(mbd.fxj1.xcx-mbd.rd2.xcx)+mbd.rd2.rotyy\*(mbd.fxj1.xcy-mbd.rd2.xcy)+mbd.rd2.rotyz\*(mbd.fxj1.xcz-mbd.rd2.xcz)-mbd.fxj1.xcy+mbd.rd2.xcy+mbd.rd2.v+mbd.fxj1.v\_el | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj1.wc\_src | mbd.rd2.rotzx\*(mbd.fxj1.xcx-mbd.rd2.xcx)+mbd.rd2.rotzy\*(mbd.fxj1.xcy-mbd.rd2.xcy)+mbd.rd2.rotzz\*(mbd.fxj1.xcz-mbd.rd2.xcz)-mbd.fxj1.xcz+mbd.rd2.xcz+mbd.fxj1.w\_el | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj1.uc\_dest | mbd.rd3.rotxx\*(mbd.fxj1.xcx-mbd.rd3.xcx)+mbd.rd3.rotxy\*(mbd.fxj1.xcy-mbd.rd3.xcy)+mbd.rd3.rotxz\*(mbd.fxj1.xcz-mbd.rd3.xcz)-mbd.fxj1.xcx+mbd.rd3.xcx+mbd.rd3.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj1.vc\_dest | mbd.rd3.rotyx\*(mbd.fxj1.xcx-mbd.rd3.xcx)+mbd.rd3.rotyy\*(mbd.fxj1.xcy-mbd.rd3.xcy)+mbd.rd3.rotyz\*(mbd.fxj1.xcz-mbd.rd3.xcz)-mbd.fxj1.xcy+mbd.rd3.xcy+mbd.rd3.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj1.wc\_dest | mbd.rd3.rotzx\*(mbd.fxj1.xcx-mbd.rd3.xcx)+mbd.rd3.rotzy\*(mbd.fxj1.xcy-mbd.rd3.xcy)+mbd.rd3.rotzz\*(mbd.fxj1.xcz-mbd.rd3.xcz)-mbd.fxj1.xcz+mbd.rd3.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj1.phi\_src | mbd.rd2.phi+mbd.fxj1.th\_el | rad | Source rotation | Global |
| mbd.fxj1.phi\_dest | mbd.rd3.phi | rad | Destination rotation | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj1.uc\_src-mbd.fxj1.uc\_dest | test(mbd.fxj1.uc\_src-mbd.fxj1.uc\_dest) |  | Global | Elemental |
| mbd.fxj1.vc\_src-mbd.fxj1.vc\_dest | test(mbd.fxj1.vc\_src-mbd.fxj1.vc\_dest) |  | Global | Elemental |
| mbd.fxj1.phi\_src-mbd.fxj1.phi\_dest | test(mbd.fxj1.phi\_src-mbd.fxj1.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 1



Center of Joint: Point 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 24 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj1.xcx | mbd.fxj1.cjp1.int(X)/mbd.fxj1.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj1.xcy | mbd.fxj1.cjp1.int(Y)/mbd.fxj1.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj1.xcz | mbd.fxj1.cjp1.int(0)/mbd.fxj1.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

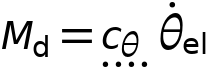












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {k1, k1, 0} | N/m |
| Spring constant | kr1 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | {if(i\_c==1, c1, 0), if(i\_c==1, c1, 0), 0} | N·s/m |
| Damping coefficient | if(i\_c==1, cr1, 0) | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj1.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj1.u\_el | mbd.fxj1.u1\*mbd.fxj1.e1x+mbd.fxj1.u2\*mbd.fxj1.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj1.v\_el | mbd.fxj1.u1\*mbd.fxj1.e1y+mbd.fxj1.u2\*mbd.fxj1.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj1.w\_el | mbd.fxj1.u1\*mbd.fxj1.e1z+mbd.fxj1.u2\*mbd.fxj1.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj1.th\_el | mbd.fxj1.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj1.je1.k\_u11 | k1 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj1.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj1.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj1.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj1.je1.k\_u22 | k1 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj1.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj1.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj1.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj1.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj1.je1.k\_th | kr1 | N·m/rad | Spring constant | Global |  |
| mbd.fxj1.je1.c\_u11 | if(i\_c==1,c1,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj1.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj1.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj1.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj1.je1.c\_u22 | if(i\_c==1,c1,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj1.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj1.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj1.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj1.je1.c\_u33 | 0 | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj1.je1.c\_th | if(i\_c==1,cr1,0) | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj1.u1 | mbd.fxj1.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj1.u2 | mbd.fxj1.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj1.th | mbd.fxj1.Th | rad | Relative rotation | Global |  |
| mbd.fxj1.kl\_u11 | mbd.fxj1.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj1.kl\_u21 | mbd.fxj1.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj1.kl\_u31 | mbd.fxj1.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj1.kl\_u12 | mbd.fxj1.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj1.kl\_u22 | mbd.fxj1.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj1.kl\_u32 | mbd.fxj1.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj1.kl\_u13 | mbd.fxj1.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj1.kl\_u23 | mbd.fxj1.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj1.kl\_u33 | mbd.fxj1.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj1.cl\_u11 | mbd.fxj1.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj1.cl\_u21 | mbd.fxj1.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj1.cl\_u31 | mbd.fxj1.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj1.cl\_u12 | mbd.fxj1.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj1.cl\_u22 | mbd.fxj1.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj1.cl\_u32 | mbd.fxj1.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj1.cl\_u13 | mbd.fxj1.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj1.cl\_u23 | mbd.fxj1.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj1.cl\_u33 | mbd.fxj1.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj1.ul\_el | mbd.fxj1.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj1.vl\_el | mbd.fxj1.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj1.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj1.Fs\_el1 | mbd.fxj1.kl\_u11\*mbd.fxj1.ul\_el+mbd.fxj1.kl\_u12\*mbd.fxj1.vl\_el+mbd.fxj1.kl\_u13\*mbd.fxj1.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj1.Fs\_el2 | mbd.fxj1.kl\_u21\*mbd.fxj1.ul\_el+mbd.fxj1.kl\_u22\*mbd.fxj1.vl\_el+mbd.fxj1.kl\_u23\*mbd.fxj1.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj1.Fs\_el3 | mbd.fxj1.kl\_u31\*mbd.fxj1.ul\_el+mbd.fxj1.kl\_u32\*mbd.fxj1.vl\_el+mbd.fxj1.kl\_u33\*mbd.fxj1.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj1.Ms\_el | mbd.fxj1.je1.k\_th\*mbd.fxj1.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj1.Fd\_el1 | (mbd.fxj1.cl\_u11\*mbd.fxj1.ul\_el+mbd.fxj1.cl\_u12\*mbd.fxj1.vl\_el+mbd.fxj1.cl\_u13\*mbd.fxj1.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj1.Fd\_el2 | (mbd.fxj1.cl\_u21\*mbd.fxj1.ul\_el+mbd.fxj1.cl\_u22\*mbd.fxj1.vl\_el+mbd.fxj1.cl\_u23\*mbd.fxj1.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj1.Fd\_el3 | (mbd.fxj1.cl\_u31\*mbd.fxj1.ul\_el+mbd.fxj1.cl\_u32\*mbd.fxj1.vl\_el+mbd.fxj1.cl\_u33\*mbd.fxj1.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj1.Md\_el | mbd.fxj1.je1.c\_th\*mbd.fxj1.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj1.Fl\_el1 | -mbd.fxj1.Fd\_el1-mbd.fxj1.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj1.Fl\_el2 | -mbd.fxj1.Fd\_el2-mbd.fxj1.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj1.Fl\_el3 | -mbd.fxj1.Fd\_el3-mbd.fxj1.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj1.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj1.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj1.Ml\_el3 | -mbd.fxj1.Md\_el-mbd.fxj1.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj1.F\_elx | mbd.fxj1.e1x\*mbd.fxj1.Fl\_el1+mbd.fxj1.e2x\*mbd.fxj1.Fl\_el2+mbd.fxj1.e3x\*mbd.fxj1.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj1.F\_ely | mbd.fxj1.e1y\*mbd.fxj1.Fl\_el1+mbd.fxj1.e2y\*mbd.fxj1.Fl\_el2+mbd.fxj1.e3y\*mbd.fxj1.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj1.F\_elz | mbd.fxj1.e1z\*mbd.fxj1.Fl\_el1+mbd.fxj1.e2z\*mbd.fxj1.Fl\_el2+mbd.fxj1.e3z\*mbd.fxj1.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj1.M\_elx | mbd.fxj1.e1x\*mbd.fxj1.Ml\_el1+mbd.fxj1.e2x\*mbd.fxj1.Ml\_el2+mbd.fxj1.e3x\*mbd.fxj1.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj1.M\_ely | mbd.fxj1.e1y\*mbd.fxj1.Ml\_el1+mbd.fxj1.e2y\*mbd.fxj1.Ml\_el2+mbd.fxj1.e3y\*mbd.fxj1.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj1.M\_elz | mbd.fxj1.e1z\*mbd.fxj1.Ml\_el1+mbd.fxj1.e2z\*mbd.fxj1.Ml\_el2+mbd.fxj1.e3z\*mbd.fxj1.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj1.Ws\_el | 0.25\*(realdot(mbd.fxj1.Fs\_el1,mbd.fxj1.ul\_el)+realdot(mbd.fxj1.Fs\_el2,mbd.fxj1.vl\_el)+realdot(mbd.fxj1.Fs\_el3,mbd.fxj1.wl\_el)+realdot(mbd.fxj1.Ms\_el,mbd.fxj1.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj1.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj1.Fd\_el1/mbd.iomega,mbd.fxj1.ul\_el)+realdot(mbd.fxj1.Fd\_el2/mbd.iomega,mbd.fxj1.vl\_el)+realdot(mbd.fxj1.Fd\_el3/mbd.iomega,mbd.fxj1.wl\_el)+realdot(mbd.fxj1.Md\_el/mbd.iomega,mbd.fxj1.th\_el)) | W | Energy dissipation rate in damper | Global |  |

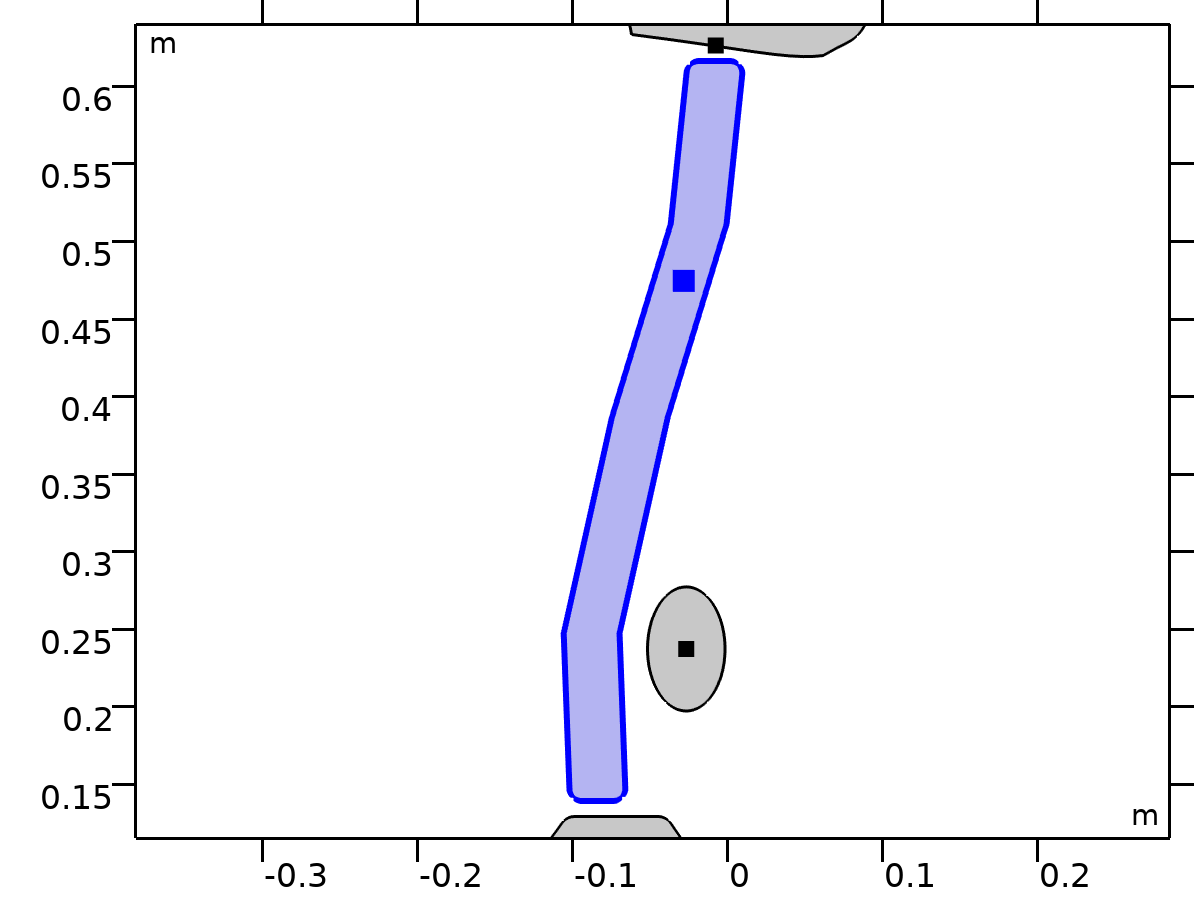
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj1.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj1.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj1.Th | ODE | rad | Relative rotation |  | Global |

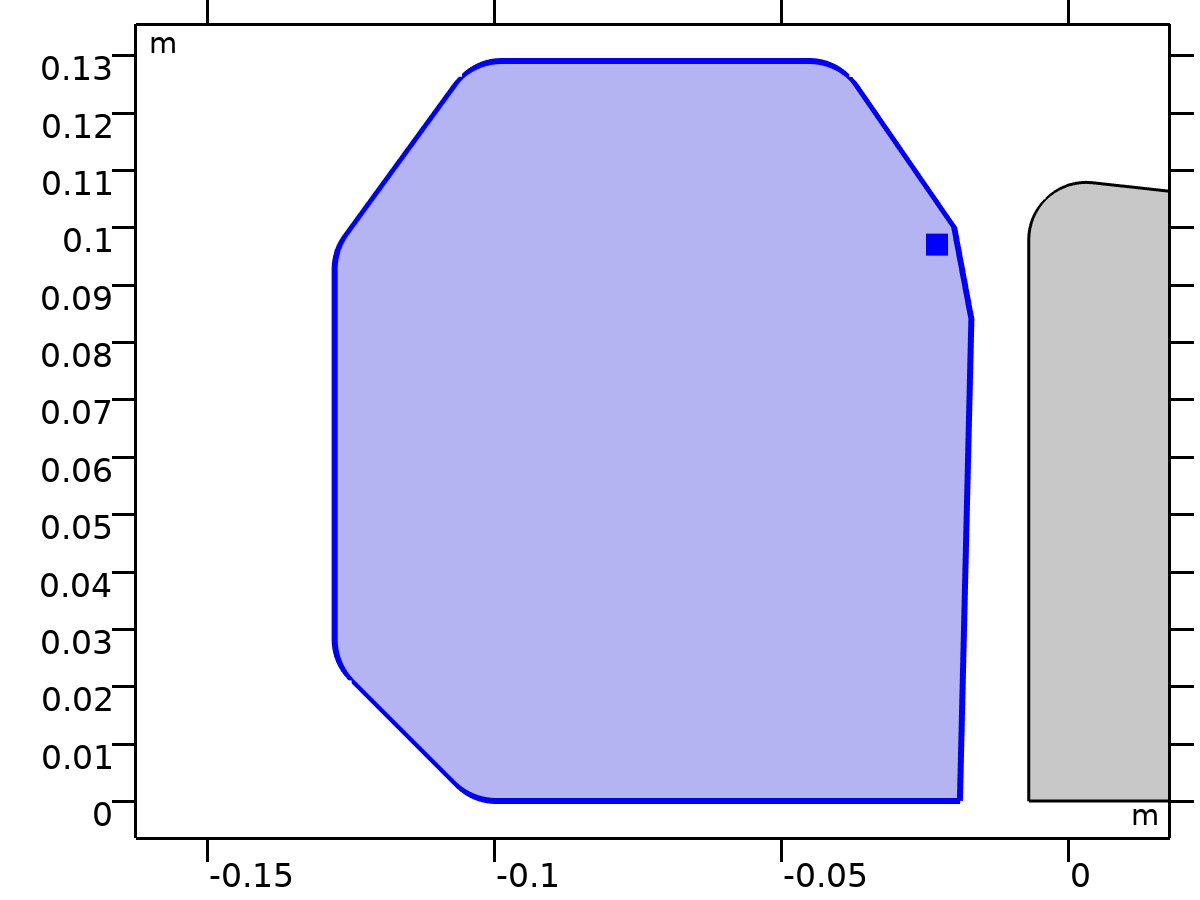
##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj1.Fl\_el1\*test(mbd.fxj1.ul\_el)+mbd.fxj1.Fl\_el2\*test(mbd.fxj1.vl\_el)+mbd.fxj1.Fl\_el3\*test(mbd.fxj1.wl\_el) | 2 |  | Global |
| mbd.fxj1.Ml\_el3\*test(mbd.fxj1.th\_el) | 2 |  | Global |

### Torso-Pelvis



Torso-Pelvis



Torso-Pelvis

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

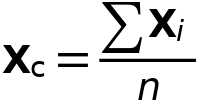
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Torso |
| Destination | Pelvis |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

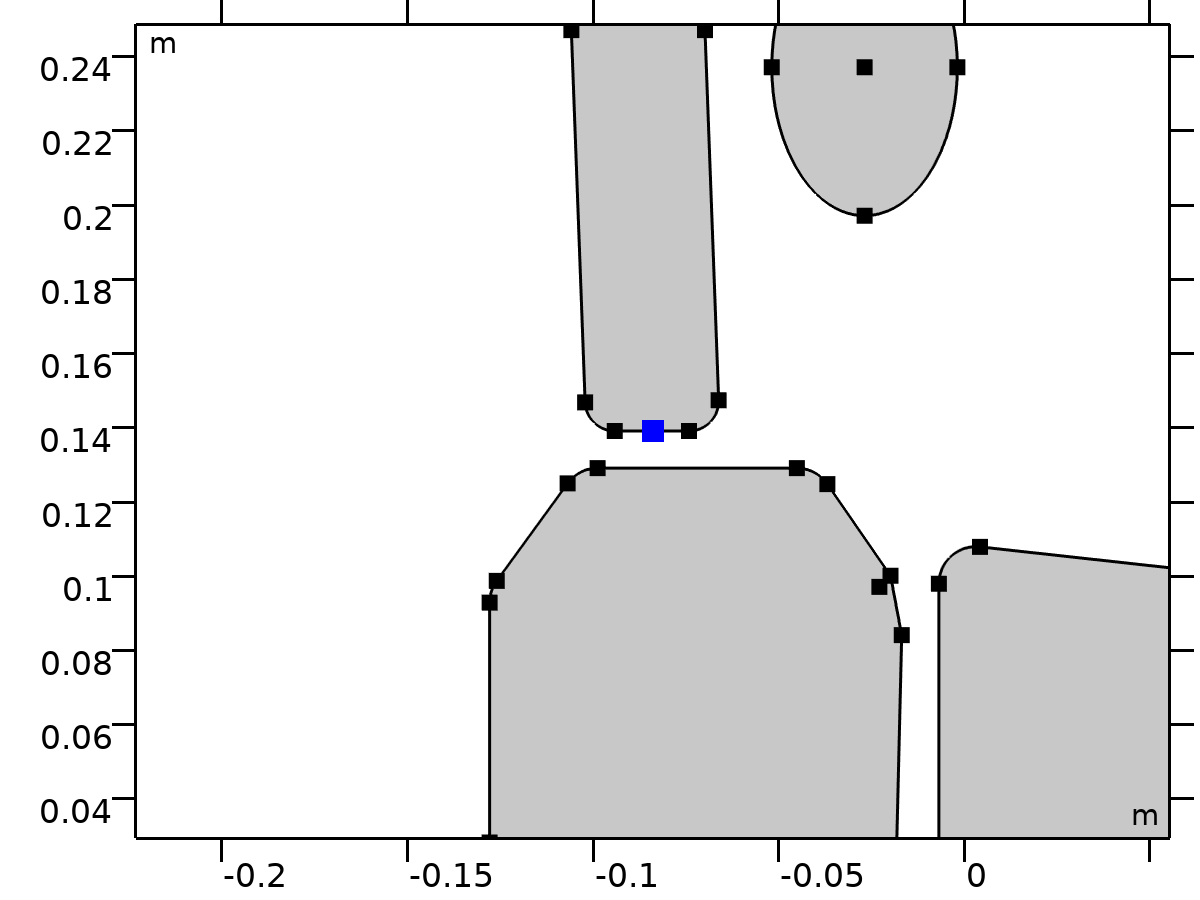
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj2.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj2.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj2.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj2.e20x | (mbd.fxj2.e10z\*mbd.fxj2.e30y-mbd.fxj2.e10y\*mbd.fxj2.e30z)/sqrt((mbd.fxj2.e10z\*mbd.fxj2.e30y-mbd.fxj2.e10y\*mbd.fxj2.e30z)^2+(-mbd.fxj2.e10z\*mbd.fxj2.e30x+mbd.fxj2.e10x\*mbd.fxj2.e30z)^2+(mbd.fxj2.e10y\*mbd.fxj2.e30x-mbd.fxj2.e10x\*mbd.fxj2.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj2.e20y | (-mbd.fxj2.e10z\*mbd.fxj2.e30x+mbd.fxj2.e10x\*mbd.fxj2.e30z)/sqrt((mbd.fxj2.e10z\*mbd.fxj2.e30y-mbd.fxj2.e10y\*mbd.fxj2.e30z)^2+(-mbd.fxj2.e10z\*mbd.fxj2.e30x+mbd.fxj2.e10x\*mbd.fxj2.e30z)^2+(mbd.fxj2.e10y\*mbd.fxj2.e30x-mbd.fxj2.e10x\*mbd.fxj2.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj2.e20z | (mbd.fxj2.e10y\*mbd.fxj2.e30x-mbd.fxj2.e10x\*mbd.fxj2.e30y)/sqrt((mbd.fxj2.e10z\*mbd.fxj2.e30y-mbd.fxj2.e10y\*mbd.fxj2.e30z)^2+(-mbd.fxj2.e10z\*mbd.fxj2.e30x+mbd.fxj2.e10x\*mbd.fxj2.e30z)^2+(mbd.fxj2.e10y\*mbd.fxj2.e30x-mbd.fxj2.e10x\*mbd.fxj2.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj2.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj2.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj2.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj2.e1x | mbd.rd3.rotxx\*mbd.fxj2.e10x+mbd.rd3.rotxy\*mbd.fxj2.e10y+mbd.rd3.rotxz\*mbd.fxj2.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj2.e1y | mbd.rd3.rotyx\*mbd.fxj2.e10x+mbd.rd3.rotyy\*mbd.fxj2.e10y+mbd.rd3.rotyz\*mbd.fxj2.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj2.e1z | mbd.rd3.rotzx\*mbd.fxj2.e10x+mbd.rd3.rotzy\*mbd.fxj2.e10y+mbd.rd3.rotzz\*mbd.fxj2.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj2.e2x | mbd.rd3.rotxx\*mbd.fxj2.e20x+mbd.rd3.rotxy\*mbd.fxj2.e20y+mbd.rd3.rotxz\*mbd.fxj2.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj2.e2y | mbd.rd3.rotyx\*mbd.fxj2.e20x+mbd.rd3.rotyy\*mbd.fxj2.e20y+mbd.rd3.rotyz\*mbd.fxj2.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj2.e2z | mbd.rd3.rotzx\*mbd.fxj2.e20x+mbd.rd3.rotzy\*mbd.fxj2.e20y+mbd.rd3.rotzz\*mbd.fxj2.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj2.e3x | mbd.rd3.rotxx\*mbd.fxj2.e30x+mbd.rd3.rotxy\*mbd.fxj2.e30y+mbd.rd3.rotxz\*mbd.fxj2.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj2.e3y | mbd.rd3.rotyx\*mbd.fxj2.e30x+mbd.rd3.rotyy\*mbd.fxj2.e30y+mbd.rd3.rotyz\*mbd.fxj2.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj2.e3z | mbd.rd3.rotzx\*mbd.fxj2.e30x+mbd.rd3.rotzy\*mbd.fxj2.e30y+mbd.rd3.rotzz\*mbd.fxj2.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj2.uc\_src | mbd.rd3.rotxx\*(mbd.fxj2.xcx-mbd.rd3.xcx)+mbd.rd3.rotxy\*(mbd.fxj2.xcy-mbd.rd3.xcy)+mbd.rd3.rotxz\*(mbd.fxj2.xcz-mbd.rd3.xcz)-mbd.fxj2.xcx+mbd.rd3.xcx+mbd.rd3.u+mbd.fxj2.u\_el | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj2.vc\_src | mbd.rd3.rotyx\*(mbd.fxj2.xcx-mbd.rd3.xcx)+mbd.rd3.rotyy\*(mbd.fxj2.xcy-mbd.rd3.xcy)+mbd.rd3.rotyz\*(mbd.fxj2.xcz-mbd.rd3.xcz)-mbd.fxj2.xcy+mbd.rd3.xcy+mbd.rd3.v+mbd.fxj2.v\_el | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj2.wc\_src | mbd.rd3.rotzx\*(mbd.fxj2.xcx-mbd.rd3.xcx)+mbd.rd3.rotzy\*(mbd.fxj2.xcy-mbd.rd3.xcy)+mbd.rd3.rotzz\*(mbd.fxj2.xcz-mbd.rd3.xcz)-mbd.fxj2.xcz+mbd.rd3.xcz+mbd.fxj2.w\_el | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj2.uc\_dest | mbd.rd1.rotxx\*(mbd.fxj2.xcx-mbd.rd1.xcx)+mbd.rd1.rotxy\*(mbd.fxj2.xcy-mbd.rd1.xcy)+mbd.rd1.rotxz\*(mbd.fxj2.xcz-mbd.rd1.xcz)-mbd.fxj2.xcx+mbd.rd1.xcx+mbd.rd1.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj2.vc\_dest | mbd.rd1.rotyx\*(mbd.fxj2.xcx-mbd.rd1.xcx)+mbd.rd1.rotyy\*(mbd.fxj2.xcy-mbd.rd1.xcy)+mbd.rd1.rotyz\*(mbd.fxj2.xcz-mbd.rd1.xcz)-mbd.fxj2.xcy+mbd.rd1.xcy+mbd.rd1.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj2.wc\_dest | mbd.rd1.rotzx\*(mbd.fxj2.xcx-mbd.rd1.xcx)+mbd.rd1.rotzy\*(mbd.fxj2.xcy-mbd.rd1.xcy)+mbd.rd1.rotzz\*(mbd.fxj2.xcz-mbd.rd1.xcz)-mbd.fxj2.xcz+mbd.rd1.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj2.phi\_src | mbd.rd3.phi+mbd.fxj2.th\_el | rad | Source rotation | Global |
| mbd.fxj2.phi\_dest | mbd.rd1.phi | rad | Destination rotation | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj2.uc\_src-mbd.fxj2.uc\_dest | test(mbd.fxj2.uc\_src-mbd.fxj2.uc\_dest) |  | Global | Elemental |
| mbd.fxj2.vc\_src-mbd.fxj2.vc\_dest | test(mbd.fxj2.vc\_src-mbd.fxj2.vc\_dest) |  | Global | Elemental |
| mbd.fxj2.phi\_src-mbd.fxj2.phi\_dest | test(mbd.fxj2.phi\_src-mbd.fxj2.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 2



Center of Joint: Point 2

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 39 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj2.xcx | mbd.fxj2.cjp1.int(X)/mbd.fxj2.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj2.xcy | mbd.fxj2.cjp1.int(Y)/mbd.fxj2.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj2.xcz | mbd.fxj2.cjp1.int(0)/mbd.fxj2.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 2

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

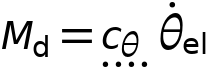












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {k2, k2, 0} | N/m |
| Spring constant | kr2 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | if(i\_c==1, c2, 0) | N·s/m |
| Damping coefficient | if(i\_c==1, cr2, 0) | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj2.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj2.u\_el | mbd.fxj2.u1\*mbd.fxj2.e1x+mbd.fxj2.u2\*mbd.fxj2.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj2.v\_el | mbd.fxj2.u1\*mbd.fxj2.e1y+mbd.fxj2.u2\*mbd.fxj2.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj2.w\_el | mbd.fxj2.u1\*mbd.fxj2.e1z+mbd.fxj2.u2\*mbd.fxj2.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj2.th\_el | mbd.fxj2.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj2.je1.k\_u11 | k2 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj2.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj2.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj2.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj2.je1.k\_u22 | k2 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj2.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj2.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj2.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj2.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj2.je1.k\_th | kr2 | N·m/rad | Spring constant | Global |  |
| mbd.fxj2.je1.c\_u11 | if(i\_c==1,c2,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj2.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj2.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj2.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj2.je1.c\_u22 | if(i\_c==1,c2,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj2.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj2.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj2.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj2.je1.c\_u33 | if(i\_c==1,c2,0) | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj2.je1.c\_th | if(i\_c==1,cr2,0) | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj2.u1 | mbd.fxj2.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj2.u2 | mbd.fxj2.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj2.th | mbd.fxj2.Th | rad | Relative rotation | Global |  |
| mbd.fxj2.kl\_u11 | mbd.fxj2.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj2.kl\_u21 | mbd.fxj2.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj2.kl\_u31 | mbd.fxj2.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj2.kl\_u12 | mbd.fxj2.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj2.kl\_u22 | mbd.fxj2.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj2.kl\_u32 | mbd.fxj2.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj2.kl\_u13 | mbd.fxj2.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj2.kl\_u23 | mbd.fxj2.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj2.kl\_u33 | mbd.fxj2.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj2.cl\_u11 | mbd.fxj2.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj2.cl\_u21 | mbd.fxj2.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj2.cl\_u31 | mbd.fxj2.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj2.cl\_u12 | mbd.fxj2.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj2.cl\_u22 | mbd.fxj2.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj2.cl\_u32 | mbd.fxj2.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj2.cl\_u13 | mbd.fxj2.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj2.cl\_u23 | mbd.fxj2.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj2.cl\_u33 | mbd.fxj2.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj2.ul\_el | mbd.fxj2.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj2.vl\_el | mbd.fxj2.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj2.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj2.Fs\_el1 | mbd.fxj2.kl\_u11\*mbd.fxj2.ul\_el+mbd.fxj2.kl\_u12\*mbd.fxj2.vl\_el+mbd.fxj2.kl\_u13\*mbd.fxj2.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj2.Fs\_el2 | mbd.fxj2.kl\_u21\*mbd.fxj2.ul\_el+mbd.fxj2.kl\_u22\*mbd.fxj2.vl\_el+mbd.fxj2.kl\_u23\*mbd.fxj2.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj2.Fs\_el3 | mbd.fxj2.kl\_u31\*mbd.fxj2.ul\_el+mbd.fxj2.kl\_u32\*mbd.fxj2.vl\_el+mbd.fxj2.kl\_u33\*mbd.fxj2.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj2.Ms\_el | mbd.fxj2.je1.k\_th\*mbd.fxj2.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj2.Fd\_el1 | (mbd.fxj2.cl\_u11\*mbd.fxj2.ul\_el+mbd.fxj2.cl\_u12\*mbd.fxj2.vl\_el+mbd.fxj2.cl\_u13\*mbd.fxj2.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj2.Fd\_el2 | (mbd.fxj2.cl\_u21\*mbd.fxj2.ul\_el+mbd.fxj2.cl\_u22\*mbd.fxj2.vl\_el+mbd.fxj2.cl\_u23\*mbd.fxj2.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj2.Fd\_el3 | (mbd.fxj2.cl\_u31\*mbd.fxj2.ul\_el+mbd.fxj2.cl\_u32\*mbd.fxj2.vl\_el+mbd.fxj2.cl\_u33\*mbd.fxj2.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj2.Md\_el | mbd.fxj2.je1.c\_th\*mbd.fxj2.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj2.Fl\_el1 | -mbd.fxj2.Fd\_el1-mbd.fxj2.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj2.Fl\_el2 | -mbd.fxj2.Fd\_el2-mbd.fxj2.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj2.Fl\_el3 | -mbd.fxj2.Fd\_el3-mbd.fxj2.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj2.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj2.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj2.Ml\_el3 | -mbd.fxj2.Md\_el-mbd.fxj2.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj2.F\_elx | mbd.fxj2.e1x\*mbd.fxj2.Fl\_el1+mbd.fxj2.e2x\*mbd.fxj2.Fl\_el2+mbd.fxj2.e3x\*mbd.fxj2.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj2.F\_ely | mbd.fxj2.e1y\*mbd.fxj2.Fl\_el1+mbd.fxj2.e2y\*mbd.fxj2.Fl\_el2+mbd.fxj2.e3y\*mbd.fxj2.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj2.F\_elz | mbd.fxj2.e1z\*mbd.fxj2.Fl\_el1+mbd.fxj2.e2z\*mbd.fxj2.Fl\_el2+mbd.fxj2.e3z\*mbd.fxj2.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj2.M\_elx | mbd.fxj2.e1x\*mbd.fxj2.Ml\_el1+mbd.fxj2.e2x\*mbd.fxj2.Ml\_el2+mbd.fxj2.e3x\*mbd.fxj2.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj2.M\_ely | mbd.fxj2.e1y\*mbd.fxj2.Ml\_el1+mbd.fxj2.e2y\*mbd.fxj2.Ml\_el2+mbd.fxj2.e3y\*mbd.fxj2.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj2.M\_elz | mbd.fxj2.e1z\*mbd.fxj2.Ml\_el1+mbd.fxj2.e2z\*mbd.fxj2.Ml\_el2+mbd.fxj2.e3z\*mbd.fxj2.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj2.Ws\_el | 0.25\*(realdot(mbd.fxj2.Fs\_el1,mbd.fxj2.ul\_el)+realdot(mbd.fxj2.Fs\_el2,mbd.fxj2.vl\_el)+realdot(mbd.fxj2.Fs\_el3,mbd.fxj2.wl\_el)+realdot(mbd.fxj2.Ms\_el,mbd.fxj2.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj2.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj2.Fd\_el1/mbd.iomega,mbd.fxj2.ul\_el)+realdot(mbd.fxj2.Fd\_el2/mbd.iomega,mbd.fxj2.vl\_el)+realdot(mbd.fxj2.Fd\_el3/mbd.iomega,mbd.fxj2.wl\_el)+realdot(mbd.fxj2.Md\_el/mbd.iomega,mbd.fxj2.th\_el)) | W | Energy dissipation rate in damper | Global |  |

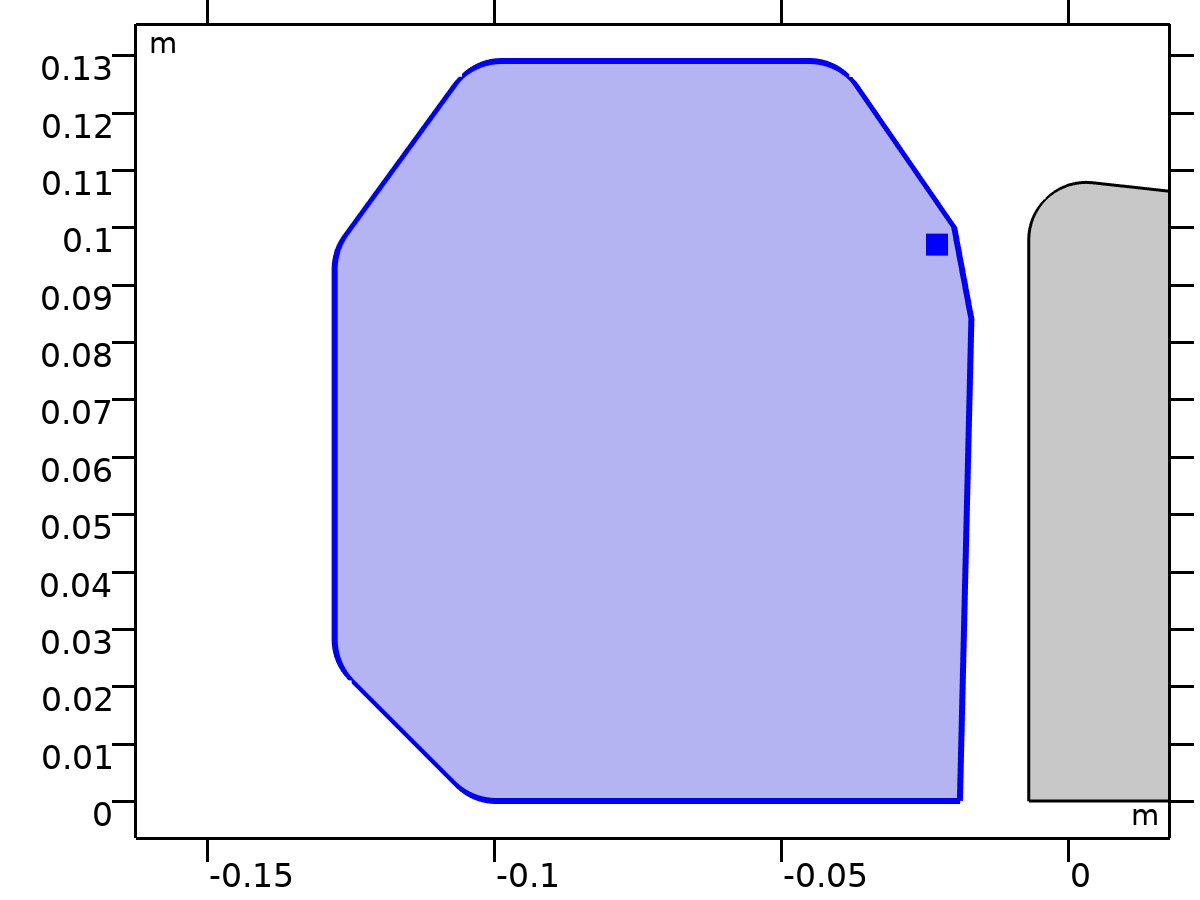
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj2.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj2.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj2.Th | ODE | rad | Relative rotation |  | Global |

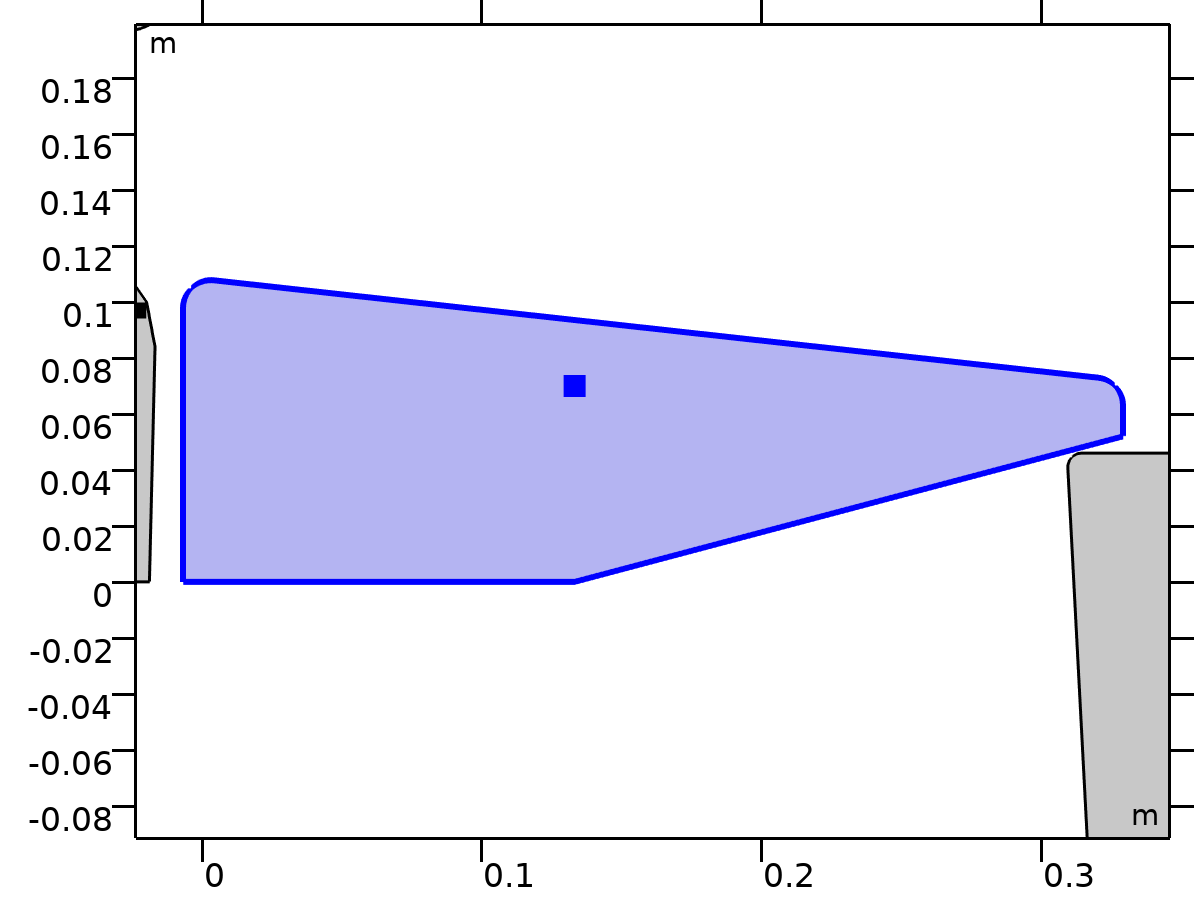
##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj2.Fl\_el1\*test(mbd.fxj2.ul\_el)+mbd.fxj2.Fl\_el2\*test(mbd.fxj2.vl\_el)+mbd.fxj2.Fl\_el3\*test(mbd.fxj2.wl\_el) | 2 |  | Global |
| mbd.fxj2.Ml\_el3\*test(mbd.fxj2.th\_el) | 2 |  | Global |

### Pelvis-Thigh



Pelvis-Thigh



Pelvis-Thigh

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

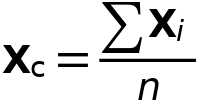
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Pelvis |
| Destination | Thigh |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

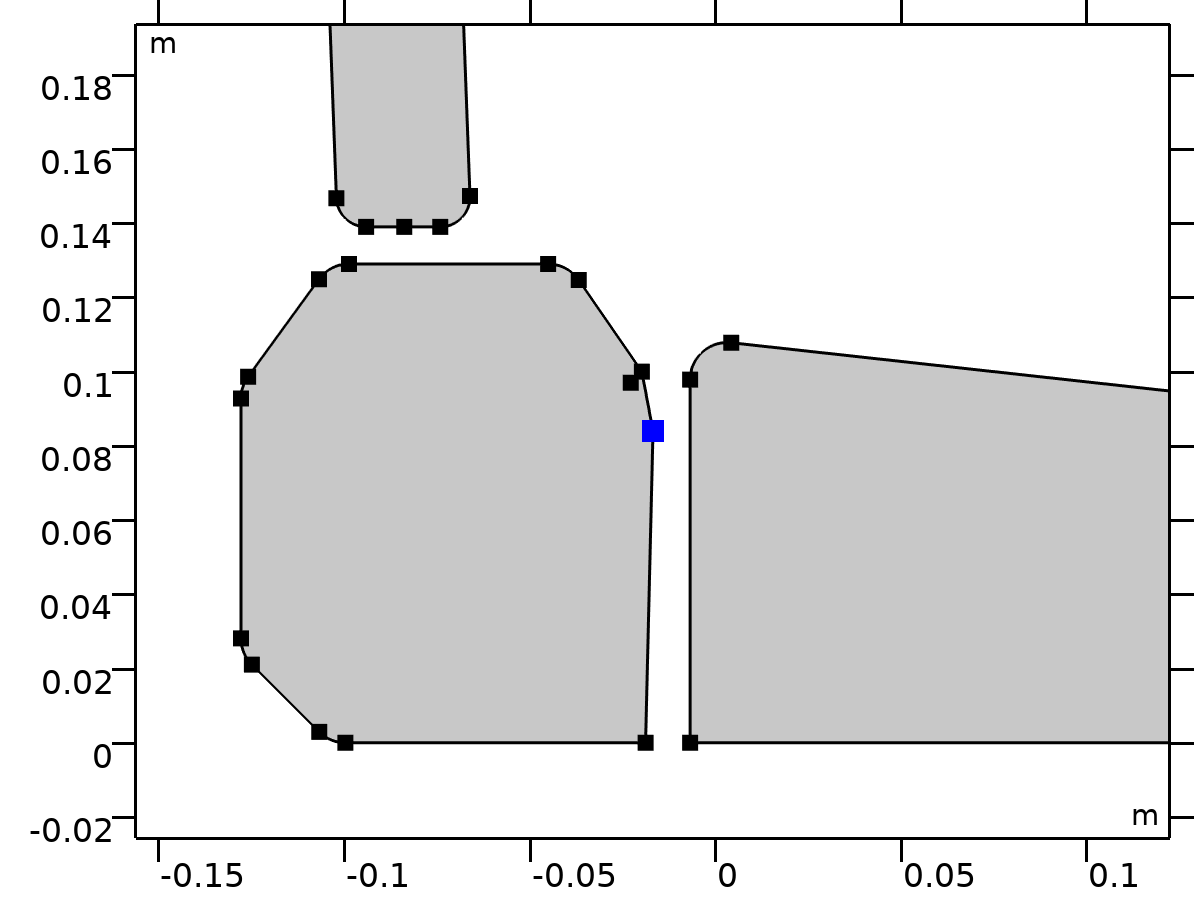
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj3.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj3.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj3.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj3.e20x | (mbd.fxj3.e10z\*mbd.fxj3.e30y-mbd.fxj3.e10y\*mbd.fxj3.e30z)/sqrt((mbd.fxj3.e10z\*mbd.fxj3.e30y-mbd.fxj3.e10y\*mbd.fxj3.e30z)^2+(-mbd.fxj3.e10z\*mbd.fxj3.e30x+mbd.fxj3.e10x\*mbd.fxj3.e30z)^2+(mbd.fxj3.e10y\*mbd.fxj3.e30x-mbd.fxj3.e10x\*mbd.fxj3.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj3.e20y | (-mbd.fxj3.e10z\*mbd.fxj3.e30x+mbd.fxj3.e10x\*mbd.fxj3.e30z)/sqrt((mbd.fxj3.e10z\*mbd.fxj3.e30y-mbd.fxj3.e10y\*mbd.fxj3.e30z)^2+(-mbd.fxj3.e10z\*mbd.fxj3.e30x+mbd.fxj3.e10x\*mbd.fxj3.e30z)^2+(mbd.fxj3.e10y\*mbd.fxj3.e30x-mbd.fxj3.e10x\*mbd.fxj3.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj3.e20z | (mbd.fxj3.e10y\*mbd.fxj3.e30x-mbd.fxj3.e10x\*mbd.fxj3.e30y)/sqrt((mbd.fxj3.e10z\*mbd.fxj3.e30y-mbd.fxj3.e10y\*mbd.fxj3.e30z)^2+(-mbd.fxj3.e10z\*mbd.fxj3.e30x+mbd.fxj3.e10x\*mbd.fxj3.e30z)^2+(mbd.fxj3.e10y\*mbd.fxj3.e30x-mbd.fxj3.e10x\*mbd.fxj3.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj3.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj3.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj3.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj3.e1x | mbd.rd1.rotxx\*mbd.fxj3.e10x+mbd.rd1.rotxy\*mbd.fxj3.e10y+mbd.rd1.rotxz\*mbd.fxj3.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj3.e1y | mbd.rd1.rotyx\*mbd.fxj3.e10x+mbd.rd1.rotyy\*mbd.fxj3.e10y+mbd.rd1.rotyz\*mbd.fxj3.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj3.e1z | mbd.rd1.rotzx\*mbd.fxj3.e10x+mbd.rd1.rotzy\*mbd.fxj3.e10y+mbd.rd1.rotzz\*mbd.fxj3.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj3.e2x | mbd.rd1.rotxx\*mbd.fxj3.e20x+mbd.rd1.rotxy\*mbd.fxj3.e20y+mbd.rd1.rotxz\*mbd.fxj3.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj3.e2y | mbd.rd1.rotyx\*mbd.fxj3.e20x+mbd.rd1.rotyy\*mbd.fxj3.e20y+mbd.rd1.rotyz\*mbd.fxj3.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj3.e2z | mbd.rd1.rotzx\*mbd.fxj3.e20x+mbd.rd1.rotzy\*mbd.fxj3.e20y+mbd.rd1.rotzz\*mbd.fxj3.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj3.e3x | mbd.rd1.rotxx\*mbd.fxj3.e30x+mbd.rd1.rotxy\*mbd.fxj3.e30y+mbd.rd1.rotxz\*mbd.fxj3.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj3.e3y | mbd.rd1.rotyx\*mbd.fxj3.e30x+mbd.rd1.rotyy\*mbd.fxj3.e30y+mbd.rd1.rotyz\*mbd.fxj3.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj3.e3z | mbd.rd1.rotzx\*mbd.fxj3.e30x+mbd.rd1.rotzy\*mbd.fxj3.e30y+mbd.rd1.rotzz\*mbd.fxj3.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj3.uc\_src | mbd.rd1.rotxx\*(mbd.fxj3.xcx-mbd.rd1.xcx)+mbd.rd1.rotxy\*(mbd.fxj3.xcy-mbd.rd1.xcy)+mbd.rd1.rotxz\*(mbd.fxj3.xcz-mbd.rd1.xcz)-mbd.fxj3.xcx+mbd.rd1.xcx+mbd.rd1.u+mbd.fxj3.u\_el | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj3.vc\_src | mbd.rd1.rotyx\*(mbd.fxj3.xcx-mbd.rd1.xcx)+mbd.rd1.rotyy\*(mbd.fxj3.xcy-mbd.rd1.xcy)+mbd.rd1.rotyz\*(mbd.fxj3.xcz-mbd.rd1.xcz)-mbd.fxj3.xcy+mbd.rd1.xcy+mbd.rd1.v+mbd.fxj3.v\_el | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj3.wc\_src | mbd.rd1.rotzx\*(mbd.fxj3.xcx-mbd.rd1.xcx)+mbd.rd1.rotzy\*(mbd.fxj3.xcy-mbd.rd1.xcy)+mbd.rd1.rotzz\*(mbd.fxj3.xcz-mbd.rd1.xcz)-mbd.fxj3.xcz+mbd.rd1.xcz+mbd.fxj3.w\_el | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj3.uc\_dest | mbd.rd5.rotxx\*(mbd.fxj3.xcx-mbd.rd5.xcx)+mbd.rd5.rotxy\*(mbd.fxj3.xcy-mbd.rd5.xcy)+mbd.rd5.rotxz\*(mbd.fxj3.xcz-mbd.rd5.xcz)-mbd.fxj3.xcx+mbd.rd5.xcx+mbd.rd5.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj3.vc\_dest | mbd.rd5.rotyx\*(mbd.fxj3.xcx-mbd.rd5.xcx)+mbd.rd5.rotyy\*(mbd.fxj3.xcy-mbd.rd5.xcy)+mbd.rd5.rotyz\*(mbd.fxj3.xcz-mbd.rd5.xcz)-mbd.fxj3.xcy+mbd.rd5.xcy+mbd.rd5.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj3.wc\_dest | mbd.rd5.rotzx\*(mbd.fxj3.xcx-mbd.rd5.xcx)+mbd.rd5.rotzy\*(mbd.fxj3.xcy-mbd.rd5.xcy)+mbd.rd5.rotzz\*(mbd.fxj3.xcz-mbd.rd5.xcz)-mbd.fxj3.xcz+mbd.rd5.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj3.phi\_src | mbd.rd1.phi+mbd.fxj3.th\_el | rad | Source rotation | Global |
| mbd.fxj3.phi\_dest | mbd.rd5.phi | rad | Destination rotation | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj3.uc\_src-mbd.fxj3.uc\_dest | test(mbd.fxj3.uc\_src-mbd.fxj3.uc\_dest) |  | Global | Elemental |
| mbd.fxj3.vc\_src-mbd.fxj3.vc\_dest | test(mbd.fxj3.vc\_src-mbd.fxj3.vc\_dest) |  | Global | Elemental |
| mbd.fxj3.phi\_src-mbd.fxj3.phi\_dest | test(mbd.fxj3.phi\_src-mbd.fxj3.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 3



Center of Joint: Point 3

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 14 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj3.xcx | mbd.fxj3.cjp1.int(X)/mbd.fxj3.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj3.xcy | mbd.fxj3.cjp1.int(Y)/mbd.fxj3.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj3.xcz | mbd.fxj3.cjp1.int(0)/mbd.fxj3.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 3

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

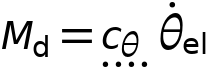












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {k3, k3, 0} | N/m |
| Spring constant | kr3 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | {if(i\_c==1, c3, 0), if(i\_c==1, c3, 0), 0} | N·s/m |
| Damping coefficient | if(i\_c==1, cr3, 0) | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj3.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj3.u\_el | mbd.fxj3.u1\*mbd.fxj3.e1x+mbd.fxj3.u2\*mbd.fxj3.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj3.v\_el | mbd.fxj3.u1\*mbd.fxj3.e1y+mbd.fxj3.u2\*mbd.fxj3.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj3.w\_el | mbd.fxj3.u1\*mbd.fxj3.e1z+mbd.fxj3.u2\*mbd.fxj3.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj3.th\_el | mbd.fxj3.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj3.je1.k\_u11 | k3 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj3.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj3.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj3.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj3.je1.k\_u22 | k3 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj3.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj3.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj3.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj3.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj3.je1.k\_th | kr3 | N·m/rad | Spring constant | Global |  |
| mbd.fxj3.je1.c\_u11 | if(i\_c==1,c3,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj3.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj3.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj3.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj3.je1.c\_u22 | if(i\_c==1,c3,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj3.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj3.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj3.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj3.je1.c\_u33 | 0 | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj3.je1.c\_th | if(i\_c==1,cr3,0) | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj3.u1 | mbd.fxj3.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj3.u2 | mbd.fxj3.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj3.th | mbd.fxj3.Th | rad | Relative rotation | Global |  |
| mbd.fxj3.kl\_u11 | mbd.fxj3.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj3.kl\_u21 | mbd.fxj3.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj3.kl\_u31 | mbd.fxj3.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj3.kl\_u12 | mbd.fxj3.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj3.kl\_u22 | mbd.fxj3.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj3.kl\_u32 | mbd.fxj3.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj3.kl\_u13 | mbd.fxj3.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj3.kl\_u23 | mbd.fxj3.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj3.kl\_u33 | mbd.fxj3.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj3.cl\_u11 | mbd.fxj3.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj3.cl\_u21 | mbd.fxj3.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj3.cl\_u31 | mbd.fxj3.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj3.cl\_u12 | mbd.fxj3.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj3.cl\_u22 | mbd.fxj3.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj3.cl\_u32 | mbd.fxj3.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj3.cl\_u13 | mbd.fxj3.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj3.cl\_u23 | mbd.fxj3.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj3.cl\_u33 | mbd.fxj3.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj3.ul\_el | mbd.fxj3.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj3.vl\_el | mbd.fxj3.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj3.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj3.Fs\_el1 | mbd.fxj3.kl\_u11\*mbd.fxj3.ul\_el+mbd.fxj3.kl\_u12\*mbd.fxj3.vl\_el+mbd.fxj3.kl\_u13\*mbd.fxj3.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj3.Fs\_el2 | mbd.fxj3.kl\_u21\*mbd.fxj3.ul\_el+mbd.fxj3.kl\_u22\*mbd.fxj3.vl\_el+mbd.fxj3.kl\_u23\*mbd.fxj3.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj3.Fs\_el3 | mbd.fxj3.kl\_u31\*mbd.fxj3.ul\_el+mbd.fxj3.kl\_u32\*mbd.fxj3.vl\_el+mbd.fxj3.kl\_u33\*mbd.fxj3.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj3.Ms\_el | mbd.fxj3.je1.k\_th\*mbd.fxj3.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj3.Fd\_el1 | (mbd.fxj3.cl\_u11\*mbd.fxj3.ul\_el+mbd.fxj3.cl\_u12\*mbd.fxj3.vl\_el+mbd.fxj3.cl\_u13\*mbd.fxj3.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj3.Fd\_el2 | (mbd.fxj3.cl\_u21\*mbd.fxj3.ul\_el+mbd.fxj3.cl\_u22\*mbd.fxj3.vl\_el+mbd.fxj3.cl\_u23\*mbd.fxj3.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj3.Fd\_el3 | (mbd.fxj3.cl\_u31\*mbd.fxj3.ul\_el+mbd.fxj3.cl\_u32\*mbd.fxj3.vl\_el+mbd.fxj3.cl\_u33\*mbd.fxj3.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj3.Md\_el | mbd.fxj3.je1.c\_th\*mbd.fxj3.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj3.Fl\_el1 | -mbd.fxj3.Fd\_el1-mbd.fxj3.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj3.Fl\_el2 | -mbd.fxj3.Fd\_el2-mbd.fxj3.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj3.Fl\_el3 | -mbd.fxj3.Fd\_el3-mbd.fxj3.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj3.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj3.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj3.Ml\_el3 | -mbd.fxj3.Md\_el-mbd.fxj3.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj3.F\_elx | mbd.fxj3.e1x\*mbd.fxj3.Fl\_el1+mbd.fxj3.e2x\*mbd.fxj3.Fl\_el2+mbd.fxj3.e3x\*mbd.fxj3.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj3.F\_ely | mbd.fxj3.e1y\*mbd.fxj3.Fl\_el1+mbd.fxj3.e2y\*mbd.fxj3.Fl\_el2+mbd.fxj3.e3y\*mbd.fxj3.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj3.F\_elz | mbd.fxj3.e1z\*mbd.fxj3.Fl\_el1+mbd.fxj3.e2z\*mbd.fxj3.Fl\_el2+mbd.fxj3.e3z\*mbd.fxj3.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj3.M\_elx | mbd.fxj3.e1x\*mbd.fxj3.Ml\_el1+mbd.fxj3.e2x\*mbd.fxj3.Ml\_el2+mbd.fxj3.e3x\*mbd.fxj3.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj3.M\_ely | mbd.fxj3.e1y\*mbd.fxj3.Ml\_el1+mbd.fxj3.e2y\*mbd.fxj3.Ml\_el2+mbd.fxj3.e3y\*mbd.fxj3.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj3.M\_elz | mbd.fxj3.e1z\*mbd.fxj3.Ml\_el1+mbd.fxj3.e2z\*mbd.fxj3.Ml\_el2+mbd.fxj3.e3z\*mbd.fxj3.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj3.Ws\_el | 0.25\*(realdot(mbd.fxj3.Fs\_el1,mbd.fxj3.ul\_el)+realdot(mbd.fxj3.Fs\_el2,mbd.fxj3.vl\_el)+realdot(mbd.fxj3.Fs\_el3,mbd.fxj3.wl\_el)+realdot(mbd.fxj3.Ms\_el,mbd.fxj3.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj3.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj3.Fd\_el1/mbd.iomega,mbd.fxj3.ul\_el)+realdot(mbd.fxj3.Fd\_el2/mbd.iomega,mbd.fxj3.vl\_el)+realdot(mbd.fxj3.Fd\_el3/mbd.iomega,mbd.fxj3.wl\_el)+realdot(mbd.fxj3.Md\_el/mbd.iomega,mbd.fxj3.th\_el)) | W | Energy dissipation rate in damper | Global |  |

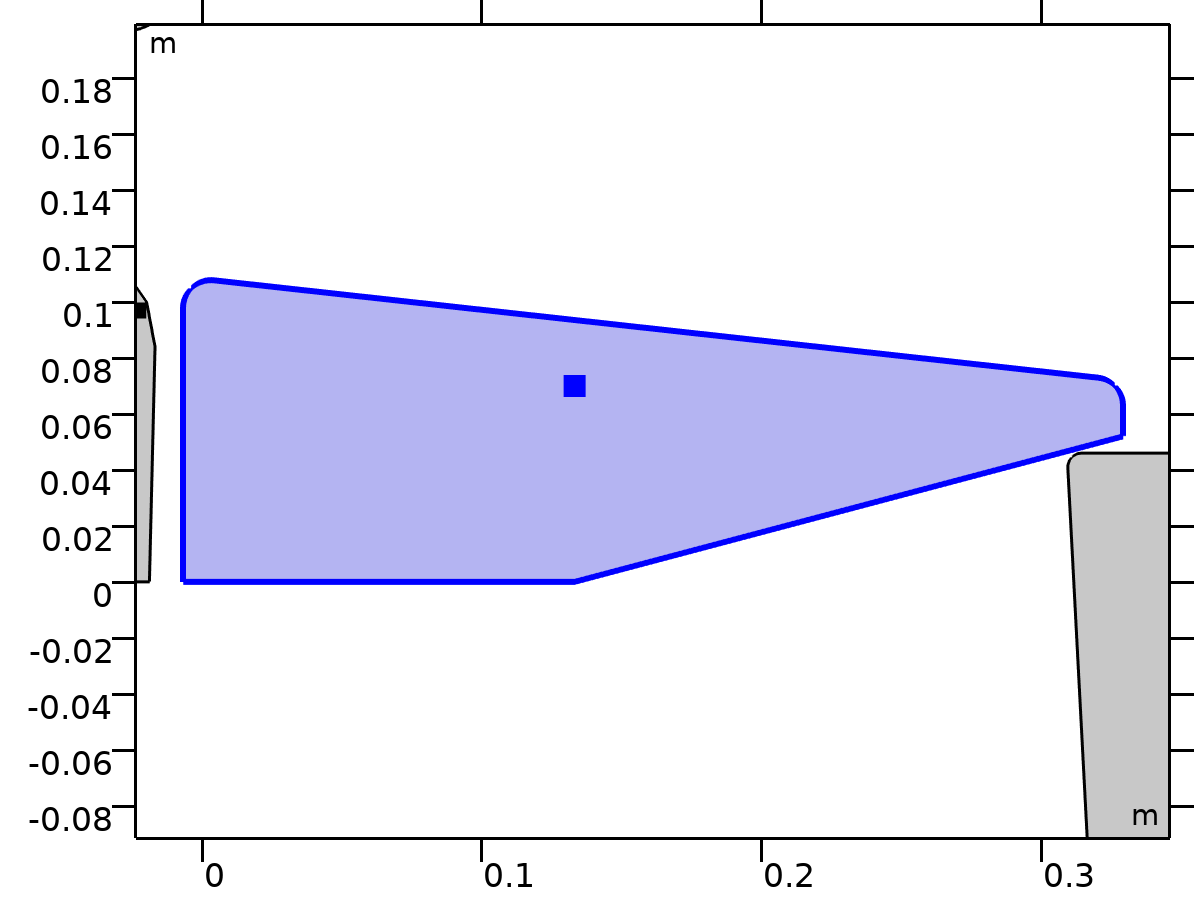
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj3.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj3.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj3.Th | ODE | rad | Relative rotation |  | Global |

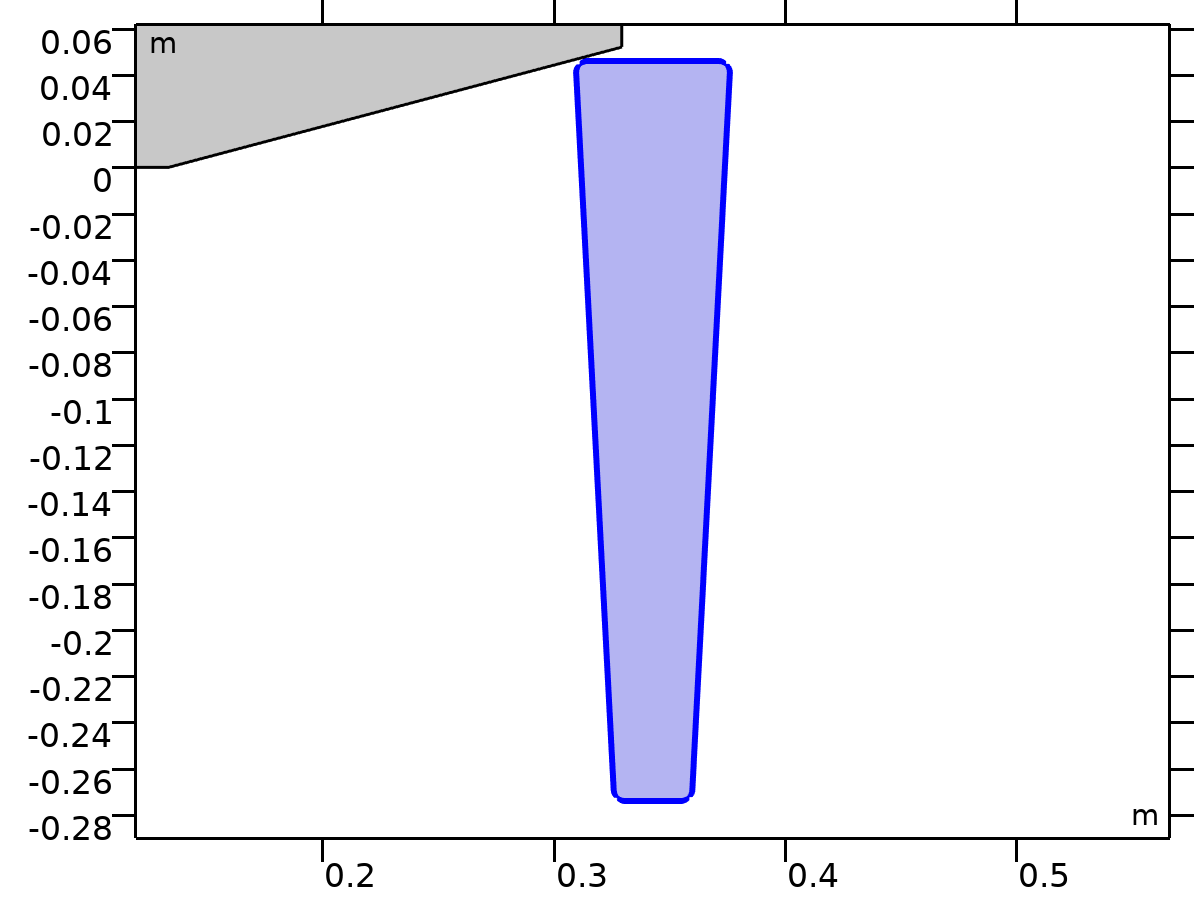
##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj3.Fl\_el1\*test(mbd.fxj3.ul\_el)+mbd.fxj3.Fl\_el2\*test(mbd.fxj3.vl\_el)+mbd.fxj3.Fl\_el3\*test(mbd.fxj3.wl\_el) | 2 |  | Global |
| mbd.fxj3.Ml\_el3\*test(mbd.fxj3.th\_el) | 2 |  | Global |

### Thigh-Leg



Thigh-Leg



Thigh-Leg

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

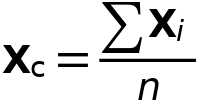
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Thigh |
| Destination | Leg |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

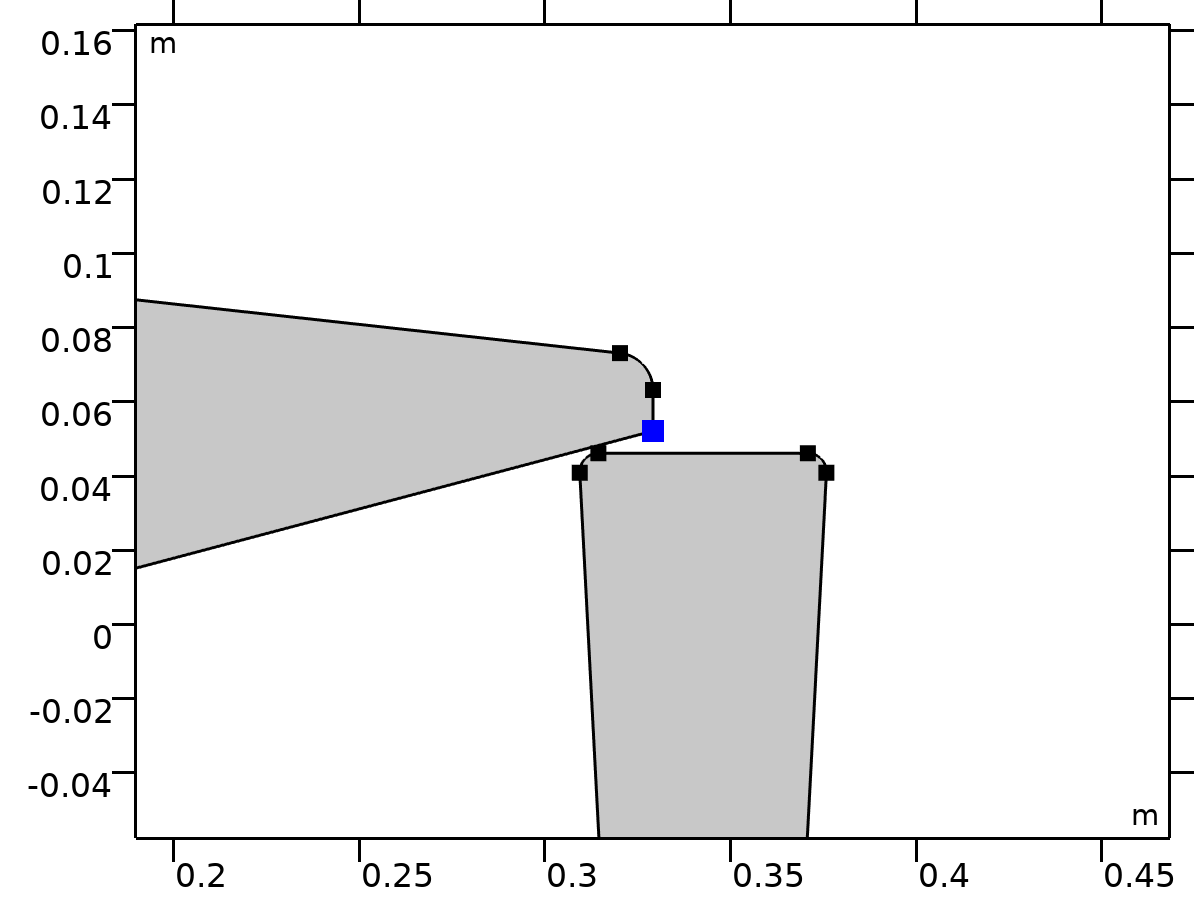
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj4.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj4.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj4.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj4.e20x | (mbd.fxj4.e10z\*mbd.fxj4.e30y-mbd.fxj4.e10y\*mbd.fxj4.e30z)/sqrt((mbd.fxj4.e10z\*mbd.fxj4.e30y-mbd.fxj4.e10y\*mbd.fxj4.e30z)^2+(-mbd.fxj4.e10z\*mbd.fxj4.e30x+mbd.fxj4.e10x\*mbd.fxj4.e30z)^2+(mbd.fxj4.e10y\*mbd.fxj4.e30x-mbd.fxj4.e10x\*mbd.fxj4.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj4.e20y | (-mbd.fxj4.e10z\*mbd.fxj4.e30x+mbd.fxj4.e10x\*mbd.fxj4.e30z)/sqrt((mbd.fxj4.e10z\*mbd.fxj4.e30y-mbd.fxj4.e10y\*mbd.fxj4.e30z)^2+(-mbd.fxj4.e10z\*mbd.fxj4.e30x+mbd.fxj4.e10x\*mbd.fxj4.e30z)^2+(mbd.fxj4.e10y\*mbd.fxj4.e30x-mbd.fxj4.e10x\*mbd.fxj4.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj4.e20z | (mbd.fxj4.e10y\*mbd.fxj4.e30x-mbd.fxj4.e10x\*mbd.fxj4.e30y)/sqrt((mbd.fxj4.e10z\*mbd.fxj4.e30y-mbd.fxj4.e10y\*mbd.fxj4.e30z)^2+(-mbd.fxj4.e10z\*mbd.fxj4.e30x+mbd.fxj4.e10x\*mbd.fxj4.e30z)^2+(mbd.fxj4.e10y\*mbd.fxj4.e30x-mbd.fxj4.e10x\*mbd.fxj4.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj4.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj4.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj4.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj4.e1x | mbd.rd5.rotxx\*mbd.fxj4.e10x+mbd.rd5.rotxy\*mbd.fxj4.e10y+mbd.rd5.rotxz\*mbd.fxj4.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj4.e1y | mbd.rd5.rotyx\*mbd.fxj4.e10x+mbd.rd5.rotyy\*mbd.fxj4.e10y+mbd.rd5.rotyz\*mbd.fxj4.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj4.e1z | mbd.rd5.rotzx\*mbd.fxj4.e10x+mbd.rd5.rotzy\*mbd.fxj4.e10y+mbd.rd5.rotzz\*mbd.fxj4.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj4.e2x | mbd.rd5.rotxx\*mbd.fxj4.e20x+mbd.rd5.rotxy\*mbd.fxj4.e20y+mbd.rd5.rotxz\*mbd.fxj4.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj4.e2y | mbd.rd5.rotyx\*mbd.fxj4.e20x+mbd.rd5.rotyy\*mbd.fxj4.e20y+mbd.rd5.rotyz\*mbd.fxj4.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj4.e2z | mbd.rd5.rotzx\*mbd.fxj4.e20x+mbd.rd5.rotzy\*mbd.fxj4.e20y+mbd.rd5.rotzz\*mbd.fxj4.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj4.e3x | mbd.rd5.rotxx\*mbd.fxj4.e30x+mbd.rd5.rotxy\*mbd.fxj4.e30y+mbd.rd5.rotxz\*mbd.fxj4.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj4.e3y | mbd.rd5.rotyx\*mbd.fxj4.e30x+mbd.rd5.rotyy\*mbd.fxj4.e30y+mbd.rd5.rotyz\*mbd.fxj4.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj4.e3z | mbd.rd5.rotzx\*mbd.fxj4.e30x+mbd.rd5.rotzy\*mbd.fxj4.e30y+mbd.rd5.rotzz\*mbd.fxj4.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj4.uc\_src | mbd.rd5.rotxx\*(mbd.fxj4.xcx-mbd.rd5.xcx)+mbd.rd5.rotxy\*(mbd.fxj4.xcy-mbd.rd5.xcy)+mbd.rd5.rotxz\*(mbd.fxj4.xcz-mbd.rd5.xcz)-mbd.fxj4.xcx+mbd.rd5.xcx+mbd.rd5.u+mbd.fxj4.u\_el | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj4.vc\_src | mbd.rd5.rotyx\*(mbd.fxj4.xcx-mbd.rd5.xcx)+mbd.rd5.rotyy\*(mbd.fxj4.xcy-mbd.rd5.xcy)+mbd.rd5.rotyz\*(mbd.fxj4.xcz-mbd.rd5.xcz)-mbd.fxj4.xcy+mbd.rd5.xcy+mbd.rd5.v+mbd.fxj4.v\_el | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj4.wc\_src | mbd.rd5.rotzx\*(mbd.fxj4.xcx-mbd.rd5.xcx)+mbd.rd5.rotzy\*(mbd.fxj4.xcy-mbd.rd5.xcy)+mbd.rd5.rotzz\*(mbd.fxj4.xcz-mbd.rd5.xcz)-mbd.fxj4.xcz+mbd.rd5.xcz+mbd.fxj4.w\_el | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj4.uc\_dest | mbd.rd6.rotxx\*(mbd.fxj4.xcx-mbd.rd6.xcx)+mbd.rd6.rotxy\*(mbd.fxj4.xcy-mbd.rd6.xcy)+mbd.rd6.rotxz\*(mbd.fxj4.xcz-mbd.rd6.xcz)-mbd.fxj4.xcx+mbd.rd6.xcx+mbd.rd6.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj4.vc\_dest | mbd.rd6.rotyx\*(mbd.fxj4.xcx-mbd.rd6.xcx)+mbd.rd6.rotyy\*(mbd.fxj4.xcy-mbd.rd6.xcy)+mbd.rd6.rotyz\*(mbd.fxj4.xcz-mbd.rd6.xcz)-mbd.fxj4.xcy+mbd.rd6.xcy+mbd.rd6.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj4.wc\_dest | mbd.rd6.rotzx\*(mbd.fxj4.xcx-mbd.rd6.xcx)+mbd.rd6.rotzy\*(mbd.fxj4.xcy-mbd.rd6.xcy)+mbd.rd6.rotzz\*(mbd.fxj4.xcz-mbd.rd6.xcz)-mbd.fxj4.xcz+mbd.rd6.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj4.phi\_src | mbd.rd5.phi+mbd.fxj4.th\_el | rad | Source rotation | Global |
| mbd.fxj4.phi\_dest | mbd.rd6.phi | rad | Destination rotation | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj4.uc\_src-mbd.fxj4.uc\_dest | test(mbd.fxj4.uc\_src-mbd.fxj4.uc\_dest) |  | Global | Elemental |
| mbd.fxj4.vc\_src-mbd.fxj4.vc\_dest | test(mbd.fxj4.vc\_src-mbd.fxj4.vc\_dest) |  | Global | Elemental |
| mbd.fxj4.phi\_src-mbd.fxj4.phi\_dest | test(mbd.fxj4.phi\_src-mbd.fxj4.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 4



Center of Joint: Point 4

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 64 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj4.xcx | mbd.fxj4.cjp1.int(X)/mbd.fxj4.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj4.xcy | mbd.fxj4.cjp1.int(Y)/mbd.fxj4.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj4.xcz | mbd.fxj4.cjp1.int(0)/mbd.fxj4.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 4

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

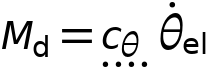












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {k4, k4, 0} | N/m |
| Spring constant | kr4 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | if(i\_c==1, c4, 0) | N·s/m |
| Damping coefficient | if(i\_c==1, cr4, 0) | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj4.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj4.u\_el | mbd.fxj4.u1\*mbd.fxj4.e1x+mbd.fxj4.u2\*mbd.fxj4.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj4.v\_el | mbd.fxj4.u1\*mbd.fxj4.e1y+mbd.fxj4.u2\*mbd.fxj4.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj4.w\_el | mbd.fxj4.u1\*mbd.fxj4.e1z+mbd.fxj4.u2\*mbd.fxj4.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj4.th\_el | mbd.fxj4.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj4.je1.k\_u11 | k4 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj4.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj4.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj4.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj4.je1.k\_u22 | k4 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj4.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj4.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj4.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj4.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj4.je1.k\_th | kr4 | N·m/rad | Spring constant | Global |  |
| mbd.fxj4.je1.c\_u11 | if(i\_c==1,c4,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj4.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj4.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj4.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj4.je1.c\_u22 | if(i\_c==1,c4,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj4.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj4.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj4.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj4.je1.c\_u33 | if(i\_c==1,c4,0) | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj4.je1.c\_th | if(i\_c==1,cr4,0) | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj4.u1 | mbd.fxj4.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj4.u2 | mbd.fxj4.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj4.th | mbd.fxj4.Th | rad | Relative rotation | Global |  |
| mbd.fxj4.kl\_u11 | mbd.fxj4.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj4.kl\_u21 | mbd.fxj4.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj4.kl\_u31 | mbd.fxj4.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj4.kl\_u12 | mbd.fxj4.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj4.kl\_u22 | mbd.fxj4.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj4.kl\_u32 | mbd.fxj4.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj4.kl\_u13 | mbd.fxj4.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj4.kl\_u23 | mbd.fxj4.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj4.kl\_u33 | mbd.fxj4.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj4.cl\_u11 | mbd.fxj4.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj4.cl\_u21 | mbd.fxj4.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj4.cl\_u31 | mbd.fxj4.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj4.cl\_u12 | mbd.fxj4.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj4.cl\_u22 | mbd.fxj4.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj4.cl\_u32 | mbd.fxj4.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj4.cl\_u13 | mbd.fxj4.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj4.cl\_u23 | mbd.fxj4.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj4.cl\_u33 | mbd.fxj4.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj4.ul\_el | mbd.fxj4.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj4.vl\_el | mbd.fxj4.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj4.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj4.Fs\_el1 | mbd.fxj4.kl\_u11\*mbd.fxj4.ul\_el+mbd.fxj4.kl\_u12\*mbd.fxj4.vl\_el+mbd.fxj4.kl\_u13\*mbd.fxj4.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj4.Fs\_el2 | mbd.fxj4.kl\_u21\*mbd.fxj4.ul\_el+mbd.fxj4.kl\_u22\*mbd.fxj4.vl\_el+mbd.fxj4.kl\_u23\*mbd.fxj4.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj4.Fs\_el3 | mbd.fxj4.kl\_u31\*mbd.fxj4.ul\_el+mbd.fxj4.kl\_u32\*mbd.fxj4.vl\_el+mbd.fxj4.kl\_u33\*mbd.fxj4.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj4.Ms\_el | mbd.fxj4.je1.k\_th\*mbd.fxj4.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj4.Fd\_el1 | (mbd.fxj4.cl\_u11\*mbd.fxj4.ul\_el+mbd.fxj4.cl\_u12\*mbd.fxj4.vl\_el+mbd.fxj4.cl\_u13\*mbd.fxj4.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj4.Fd\_el2 | (mbd.fxj4.cl\_u21\*mbd.fxj4.ul\_el+mbd.fxj4.cl\_u22\*mbd.fxj4.vl\_el+mbd.fxj4.cl\_u23\*mbd.fxj4.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj4.Fd\_el3 | (mbd.fxj4.cl\_u31\*mbd.fxj4.ul\_el+mbd.fxj4.cl\_u32\*mbd.fxj4.vl\_el+mbd.fxj4.cl\_u33\*mbd.fxj4.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj4.Md\_el | mbd.fxj4.je1.c\_th\*mbd.fxj4.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj4.Fl\_el1 | -mbd.fxj4.Fd\_el1-mbd.fxj4.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj4.Fl\_el2 | -mbd.fxj4.Fd\_el2-mbd.fxj4.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj4.Fl\_el3 | -mbd.fxj4.Fd\_el3-mbd.fxj4.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj4.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj4.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj4.Ml\_el3 | -mbd.fxj4.Md\_el-mbd.fxj4.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj4.F\_elx | mbd.fxj4.e1x\*mbd.fxj4.Fl\_el1+mbd.fxj4.e2x\*mbd.fxj4.Fl\_el2+mbd.fxj4.e3x\*mbd.fxj4.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj4.F\_ely | mbd.fxj4.e1y\*mbd.fxj4.Fl\_el1+mbd.fxj4.e2y\*mbd.fxj4.Fl\_el2+mbd.fxj4.e3y\*mbd.fxj4.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj4.F\_elz | mbd.fxj4.e1z\*mbd.fxj4.Fl\_el1+mbd.fxj4.e2z\*mbd.fxj4.Fl\_el2+mbd.fxj4.e3z\*mbd.fxj4.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj4.M\_elx | mbd.fxj4.e1x\*mbd.fxj4.Ml\_el1+mbd.fxj4.e2x\*mbd.fxj4.Ml\_el2+mbd.fxj4.e3x\*mbd.fxj4.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj4.M\_ely | mbd.fxj4.e1y\*mbd.fxj4.Ml\_el1+mbd.fxj4.e2y\*mbd.fxj4.Ml\_el2+mbd.fxj4.e3y\*mbd.fxj4.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj4.M\_elz | mbd.fxj4.e1z\*mbd.fxj4.Ml\_el1+mbd.fxj4.e2z\*mbd.fxj4.Ml\_el2+mbd.fxj4.e3z\*mbd.fxj4.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj4.Ws\_el | 0.25\*(realdot(mbd.fxj4.Fs\_el1,mbd.fxj4.ul\_el)+realdot(mbd.fxj4.Fs\_el2,mbd.fxj4.vl\_el)+realdot(mbd.fxj4.Fs\_el3,mbd.fxj4.wl\_el)+realdot(mbd.fxj4.Ms\_el,mbd.fxj4.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj4.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj4.Fd\_el1/mbd.iomega,mbd.fxj4.ul\_el)+realdot(mbd.fxj4.Fd\_el2/mbd.iomega,mbd.fxj4.vl\_el)+realdot(mbd.fxj4.Fd\_el3/mbd.iomega,mbd.fxj4.wl\_el)+realdot(mbd.fxj4.Md\_el/mbd.iomega,mbd.fxj4.th\_el)) | W | Energy dissipation rate in damper | Global |  |

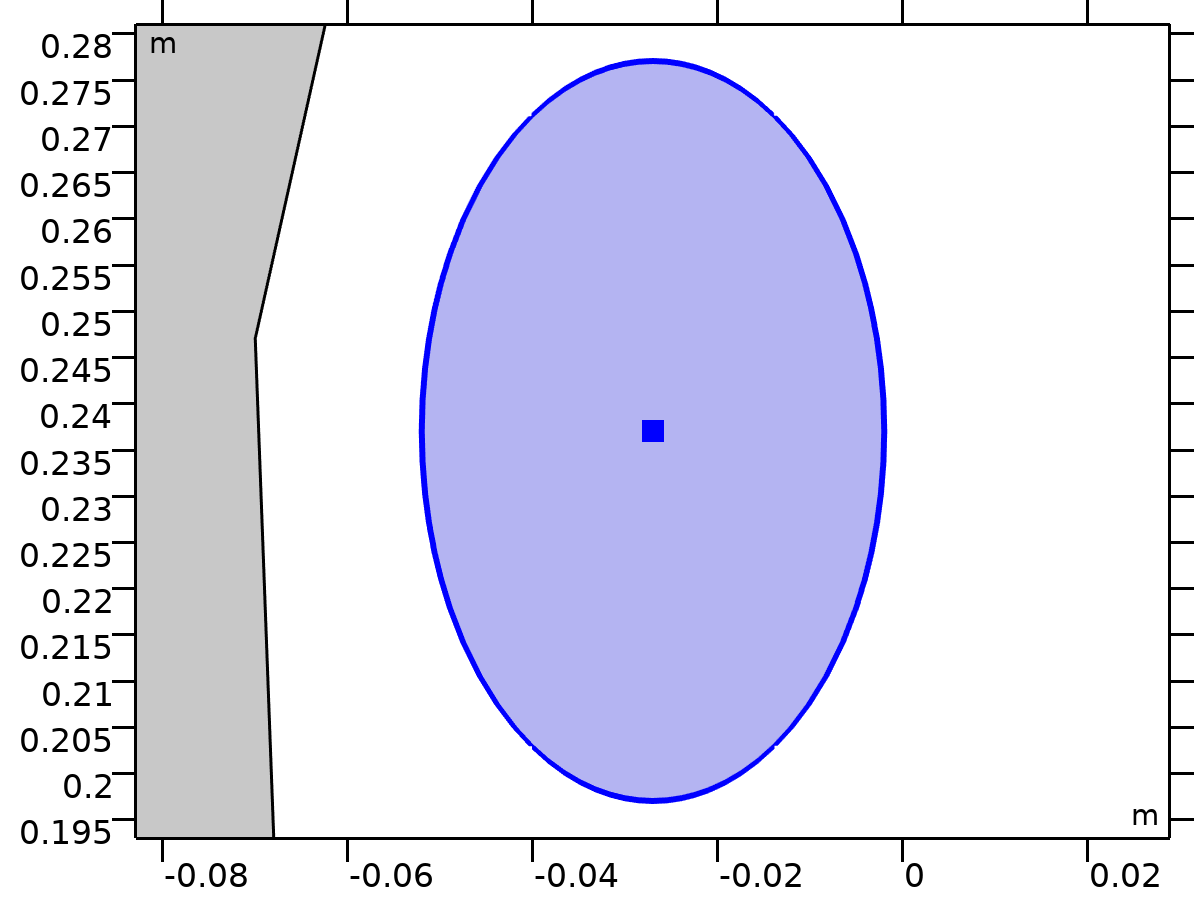
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj4.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj4.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj4.Th | ODE | rad | Relative rotation |  | Global |

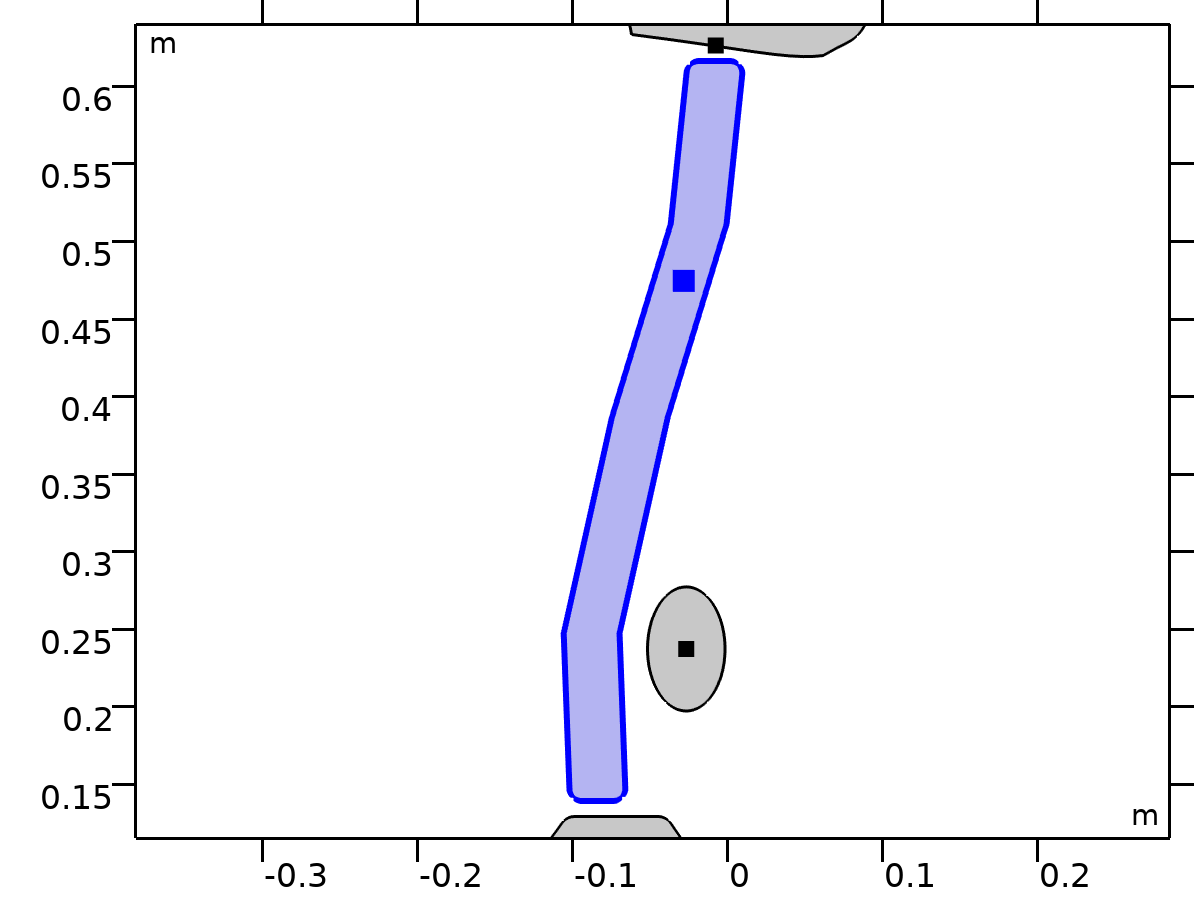
##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj4.Fl\_el1\*test(mbd.fxj4.ul\_el)+mbd.fxj4.Fl\_el2\*test(mbd.fxj4.vl\_el)+mbd.fxj4.Fl\_el3\*test(mbd.fxj4.wl\_el) | 2 |  | Global |
| mbd.fxj4.Ml\_el3\*test(mbd.fxj4.th\_el) | 2 |  | Global |

### Viscera-Torso



Viscera-Torso



Viscera-Torso

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

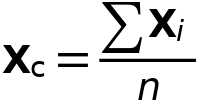
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Viscera |
| Destination | Torso |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

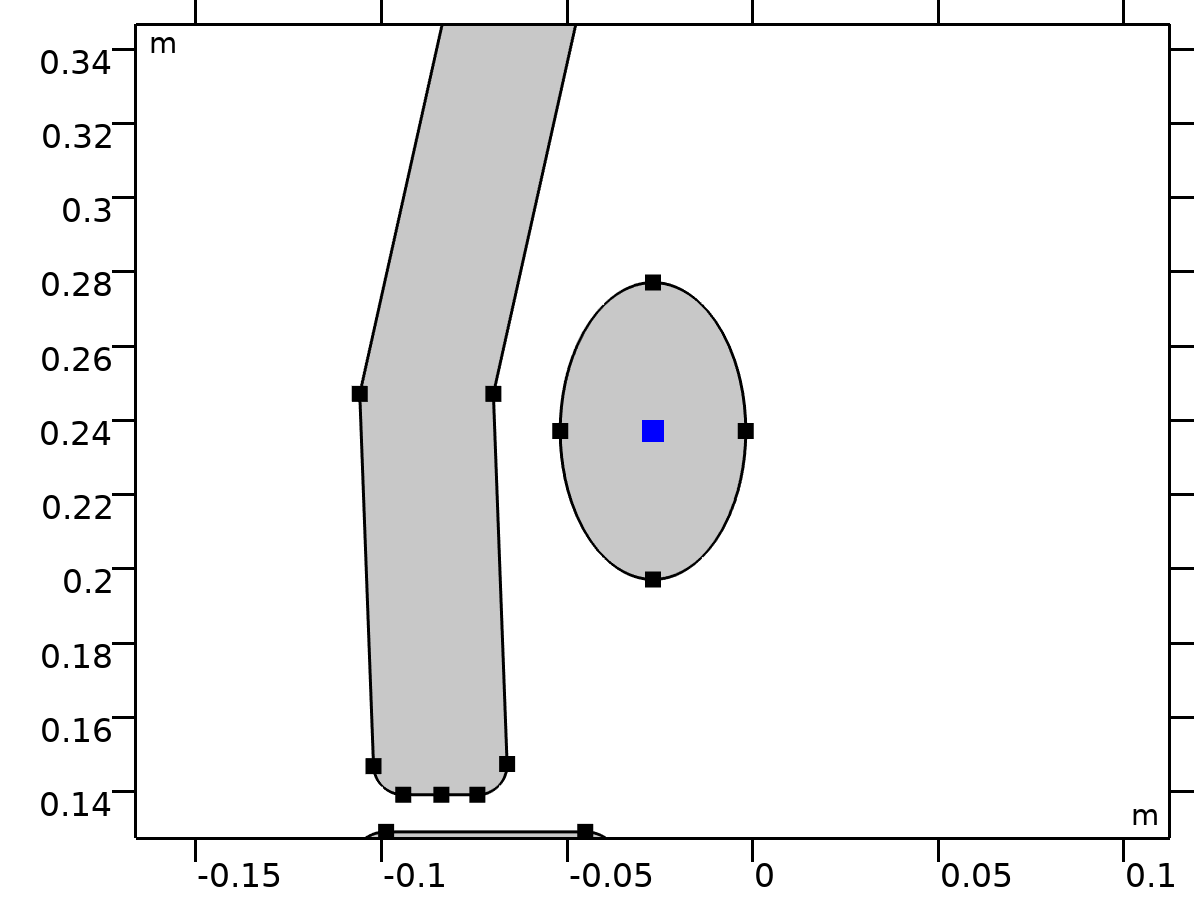
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj5.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj5.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj5.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj5.e20x | (mbd.fxj5.e10z\*mbd.fxj5.e30y-mbd.fxj5.e10y\*mbd.fxj5.e30z)/sqrt((mbd.fxj5.e10z\*mbd.fxj5.e30y-mbd.fxj5.e10y\*mbd.fxj5.e30z)^2+(-mbd.fxj5.e10z\*mbd.fxj5.e30x+mbd.fxj5.e10x\*mbd.fxj5.e30z)^2+(mbd.fxj5.e10y\*mbd.fxj5.e30x-mbd.fxj5.e10x\*mbd.fxj5.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj5.e20y | (-mbd.fxj5.e10z\*mbd.fxj5.e30x+mbd.fxj5.e10x\*mbd.fxj5.e30z)/sqrt((mbd.fxj5.e10z\*mbd.fxj5.e30y-mbd.fxj5.e10y\*mbd.fxj5.e30z)^2+(-mbd.fxj5.e10z\*mbd.fxj5.e30x+mbd.fxj5.e10x\*mbd.fxj5.e30z)^2+(mbd.fxj5.e10y\*mbd.fxj5.e30x-mbd.fxj5.e10x\*mbd.fxj5.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj5.e20z | (mbd.fxj5.e10y\*mbd.fxj5.e30x-mbd.fxj5.e10x\*mbd.fxj5.e30y)/sqrt((mbd.fxj5.e10z\*mbd.fxj5.e30y-mbd.fxj5.e10y\*mbd.fxj5.e30z)^2+(-mbd.fxj5.e10z\*mbd.fxj5.e30x+mbd.fxj5.e10x\*mbd.fxj5.e30z)^2+(mbd.fxj5.e10y\*mbd.fxj5.e30x-mbd.fxj5.e10x\*mbd.fxj5.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj5.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj5.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj5.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj5.e1x | mbd.rd4.rotxx\*mbd.fxj5.e10x+mbd.rd4.rotxy\*mbd.fxj5.e10y+mbd.rd4.rotxz\*mbd.fxj5.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj5.e1y | mbd.rd4.rotyx\*mbd.fxj5.e10x+mbd.rd4.rotyy\*mbd.fxj5.e10y+mbd.rd4.rotyz\*mbd.fxj5.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj5.e1z | mbd.rd4.rotzx\*mbd.fxj5.e10x+mbd.rd4.rotzy\*mbd.fxj5.e10y+mbd.rd4.rotzz\*mbd.fxj5.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj5.e2x | mbd.rd4.rotxx\*mbd.fxj5.e20x+mbd.rd4.rotxy\*mbd.fxj5.e20y+mbd.rd4.rotxz\*mbd.fxj5.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj5.e2y | mbd.rd4.rotyx\*mbd.fxj5.e20x+mbd.rd4.rotyy\*mbd.fxj5.e20y+mbd.rd4.rotyz\*mbd.fxj5.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj5.e2z | mbd.rd4.rotzx\*mbd.fxj5.e20x+mbd.rd4.rotzy\*mbd.fxj5.e20y+mbd.rd4.rotzz\*mbd.fxj5.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj5.e3x | mbd.rd4.rotxx\*mbd.fxj5.e30x+mbd.rd4.rotxy\*mbd.fxj5.e30y+mbd.rd4.rotxz\*mbd.fxj5.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj5.e3y | mbd.rd4.rotyx\*mbd.fxj5.e30x+mbd.rd4.rotyy\*mbd.fxj5.e30y+mbd.rd4.rotyz\*mbd.fxj5.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj5.e3z | mbd.rd4.rotzx\*mbd.fxj5.e30x+mbd.rd4.rotzy\*mbd.fxj5.e30y+mbd.rd4.rotzz\*mbd.fxj5.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj5.uc\_src | mbd.rd4.rotxx\*(mbd.fxj5.xcx-mbd.rd4.xcx)+mbd.rd4.rotxy\*(mbd.fxj5.xcy-mbd.rd4.xcy)+mbd.rd4.rotxz\*(mbd.fxj5.xcz-mbd.rd4.xcz)-mbd.fxj5.xcx+mbd.rd4.xcx+mbd.rd4.u+mbd.fxj5.u\_el | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj5.vc\_src | mbd.rd4.rotyx\*(mbd.fxj5.xcx-mbd.rd4.xcx)+mbd.rd4.rotyy\*(mbd.fxj5.xcy-mbd.rd4.xcy)+mbd.rd4.rotyz\*(mbd.fxj5.xcz-mbd.rd4.xcz)-mbd.fxj5.xcy+mbd.rd4.xcy+mbd.rd4.v+mbd.fxj5.v\_el | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj5.wc\_src | mbd.rd4.rotzx\*(mbd.fxj5.xcx-mbd.rd4.xcx)+mbd.rd4.rotzy\*(mbd.fxj5.xcy-mbd.rd4.xcy)+mbd.rd4.rotzz\*(mbd.fxj5.xcz-mbd.rd4.xcz)-mbd.fxj5.xcz+mbd.rd4.xcz+mbd.fxj5.w\_el | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj5.uc\_dest | mbd.rd3.rotxx\*(mbd.fxj5.xcx-mbd.rd3.xcx)+mbd.rd3.rotxy\*(mbd.fxj5.xcy-mbd.rd3.xcy)+mbd.rd3.rotxz\*(mbd.fxj5.xcz-mbd.rd3.xcz)-mbd.fxj5.xcx+mbd.rd3.xcx+mbd.rd3.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj5.vc\_dest | mbd.rd3.rotyx\*(mbd.fxj5.xcx-mbd.rd3.xcx)+mbd.rd3.rotyy\*(mbd.fxj5.xcy-mbd.rd3.xcy)+mbd.rd3.rotyz\*(mbd.fxj5.xcz-mbd.rd3.xcz)-mbd.fxj5.xcy+mbd.rd3.xcy+mbd.rd3.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj5.wc\_dest | mbd.rd3.rotzx\*(mbd.fxj5.xcx-mbd.rd3.xcx)+mbd.rd3.rotzy\*(mbd.fxj5.xcy-mbd.rd3.xcy)+mbd.rd3.rotzz\*(mbd.fxj5.xcz-mbd.rd3.xcz)-mbd.fxj5.xcz+mbd.rd3.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj5.phi\_src | mbd.rd4.phi+mbd.fxj5.th\_el | rad | Source rotation | Global |
| mbd.fxj5.phi\_dest | mbd.rd3.phi | rad | Destination rotation | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj5.uc\_src-mbd.fxj5.uc\_dest | test(mbd.fxj5.uc\_src-mbd.fxj5.uc\_dest) |  | Global | Elemental |
| mbd.fxj5.vc\_src-mbd.fxj5.vc\_dest | test(mbd.fxj5.vc\_src-mbd.fxj5.vc\_dest) |  | Global | Elemental |
| mbd.fxj5.phi\_src-mbd.fxj5.phi\_dest | test(mbd.fxj5.phi\_src-mbd.fxj5.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 5



Center of Joint: Point 5

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 55 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj5.xcx | mbd.fxj5.cjp1.int(X)/mbd.fxj5.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj5.xcy | mbd.fxj5.cjp1.int(Y)/mbd.fxj5.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj5.xcz | mbd.fxj5.cjp1.int(0)/mbd.fxj5.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 5

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

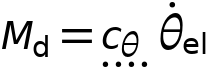












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {kh5, 0, 0} | N/m |
| Spring constant | 0 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | {if(i\_c==1, ch5, 0), 0, 0} | N·s/m |
| Damping coefficient | 0 | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj5.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj5.u\_el | mbd.fxj5.u1\*mbd.fxj5.e1x+mbd.fxj5.u2\*mbd.fxj5.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj5.v\_el | mbd.fxj5.u1\*mbd.fxj5.e1y+mbd.fxj5.u2\*mbd.fxj5.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj5.w\_el | mbd.fxj5.u1\*mbd.fxj5.e1z+mbd.fxj5.u2\*mbd.fxj5.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj5.th\_el | mbd.fxj5.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj5.je1.k\_u11 | kh5 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj5.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj5.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj5.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj5.je1.k\_u22 | 0 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj5.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj5.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj5.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj5.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj5.je1.k\_th | 0 | N·m/rad | Spring constant | Global |  |
| mbd.fxj5.je1.c\_u11 | if(i\_c==1,ch5,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj5.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj5.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj5.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj5.je1.c\_u22 | 0 | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj5.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj5.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj5.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj5.je1.c\_u33 | 0 | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj5.je1.c\_th | 0 | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj5.u1 | mbd.fxj5.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj5.u2 | mbd.fxj5.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj5.th | mbd.fxj5.Th | rad | Relative rotation | Global |  |
| mbd.fxj5.kl\_u11 | mbd.fxj5.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj5.kl\_u21 | mbd.fxj5.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj5.kl\_u31 | mbd.fxj5.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj5.kl\_u12 | mbd.fxj5.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj5.kl\_u22 | mbd.fxj5.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj5.kl\_u32 | mbd.fxj5.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj5.kl\_u13 | mbd.fxj5.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj5.kl\_u23 | mbd.fxj5.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj5.kl\_u33 | mbd.fxj5.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj5.cl\_u11 | mbd.fxj5.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj5.cl\_u21 | mbd.fxj5.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj5.cl\_u31 | mbd.fxj5.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj5.cl\_u12 | mbd.fxj5.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj5.cl\_u22 | mbd.fxj5.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj5.cl\_u32 | mbd.fxj5.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj5.cl\_u13 | mbd.fxj5.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj5.cl\_u23 | mbd.fxj5.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj5.cl\_u33 | mbd.fxj5.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj5.ul\_el | mbd.fxj5.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj5.vl\_el | mbd.fxj5.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj5.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj5.Fs\_el1 | mbd.fxj5.kl\_u11\*mbd.fxj5.ul\_el+mbd.fxj5.kl\_u12\*mbd.fxj5.vl\_el+mbd.fxj5.kl\_u13\*mbd.fxj5.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj5.Fs\_el2 | mbd.fxj5.kl\_u21\*mbd.fxj5.ul\_el+mbd.fxj5.kl\_u22\*mbd.fxj5.vl\_el+mbd.fxj5.kl\_u23\*mbd.fxj5.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj5.Fs\_el3 | mbd.fxj5.kl\_u31\*mbd.fxj5.ul\_el+mbd.fxj5.kl\_u32\*mbd.fxj5.vl\_el+mbd.fxj5.kl\_u33\*mbd.fxj5.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj5.Ms\_el | mbd.fxj5.je1.k\_th\*mbd.fxj5.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj5.Fd\_el1 | (mbd.fxj5.cl\_u11\*mbd.fxj5.ul\_el+mbd.fxj5.cl\_u12\*mbd.fxj5.vl\_el+mbd.fxj5.cl\_u13\*mbd.fxj5.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj5.Fd\_el2 | (mbd.fxj5.cl\_u21\*mbd.fxj5.ul\_el+mbd.fxj5.cl\_u22\*mbd.fxj5.vl\_el+mbd.fxj5.cl\_u23\*mbd.fxj5.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj5.Fd\_el3 | (mbd.fxj5.cl\_u31\*mbd.fxj5.ul\_el+mbd.fxj5.cl\_u32\*mbd.fxj5.vl\_el+mbd.fxj5.cl\_u33\*mbd.fxj5.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj5.Md\_el | mbd.fxj5.je1.c\_th\*mbd.fxj5.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj5.Fl\_el1 | -mbd.fxj5.Fd\_el1-mbd.fxj5.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj5.Fl\_el2 | -mbd.fxj5.Fd\_el2-mbd.fxj5.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj5.Fl\_el3 | -mbd.fxj5.Fd\_el3-mbd.fxj5.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj5.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj5.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj5.Ml\_el3 | -mbd.fxj5.Md\_el-mbd.fxj5.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj5.F\_elx | mbd.fxj5.e1x\*mbd.fxj5.Fl\_el1+mbd.fxj5.e2x\*mbd.fxj5.Fl\_el2+mbd.fxj5.e3x\*mbd.fxj5.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj5.F\_ely | mbd.fxj5.e1y\*mbd.fxj5.Fl\_el1+mbd.fxj5.e2y\*mbd.fxj5.Fl\_el2+mbd.fxj5.e3y\*mbd.fxj5.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj5.F\_elz | mbd.fxj5.e1z\*mbd.fxj5.Fl\_el1+mbd.fxj5.e2z\*mbd.fxj5.Fl\_el2+mbd.fxj5.e3z\*mbd.fxj5.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj5.M\_elx | mbd.fxj5.e1x\*mbd.fxj5.Ml\_el1+mbd.fxj5.e2x\*mbd.fxj5.Ml\_el2+mbd.fxj5.e3x\*mbd.fxj5.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj5.M\_ely | mbd.fxj5.e1y\*mbd.fxj5.Ml\_el1+mbd.fxj5.e2y\*mbd.fxj5.Ml\_el2+mbd.fxj5.e3y\*mbd.fxj5.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj5.M\_elz | mbd.fxj5.e1z\*mbd.fxj5.Ml\_el1+mbd.fxj5.e2z\*mbd.fxj5.Ml\_el2+mbd.fxj5.e3z\*mbd.fxj5.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj5.Ws\_el | 0.25\*(realdot(mbd.fxj5.Fs\_el1,mbd.fxj5.ul\_el)+realdot(mbd.fxj5.Fs\_el2,mbd.fxj5.vl\_el)+realdot(mbd.fxj5.Fs\_el3,mbd.fxj5.wl\_el)+realdot(mbd.fxj5.Ms\_el,mbd.fxj5.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj5.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj5.Fd\_el1/mbd.iomega,mbd.fxj5.ul\_el)+realdot(mbd.fxj5.Fd\_el2/mbd.iomega,mbd.fxj5.vl\_el)+realdot(mbd.fxj5.Fd\_el3/mbd.iomega,mbd.fxj5.wl\_el)+realdot(mbd.fxj5.Md\_el/mbd.iomega,mbd.fxj5.th\_el)) | W | Energy dissipation rate in damper | Global |  |

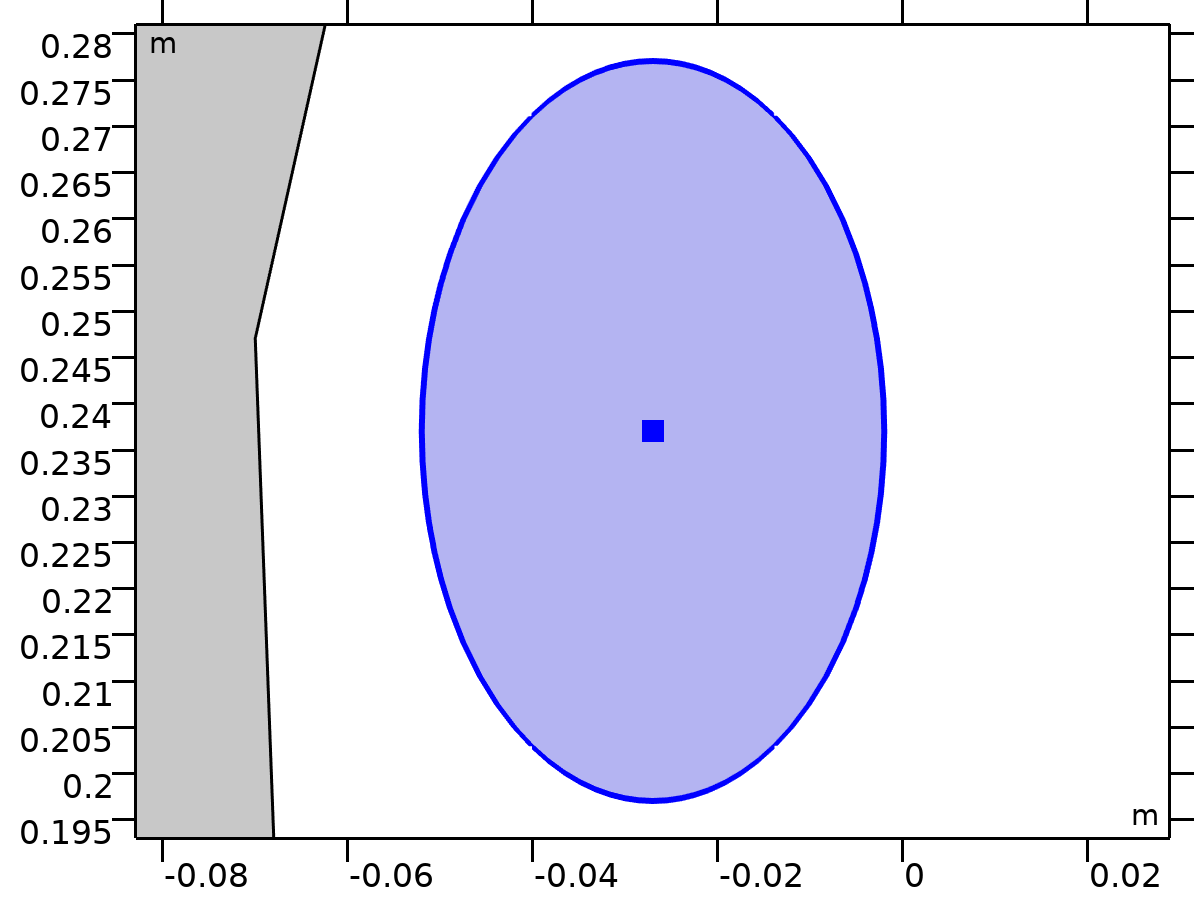
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj5.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj5.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj5.Th | ODE | rad | Relative rotation |  | Global |

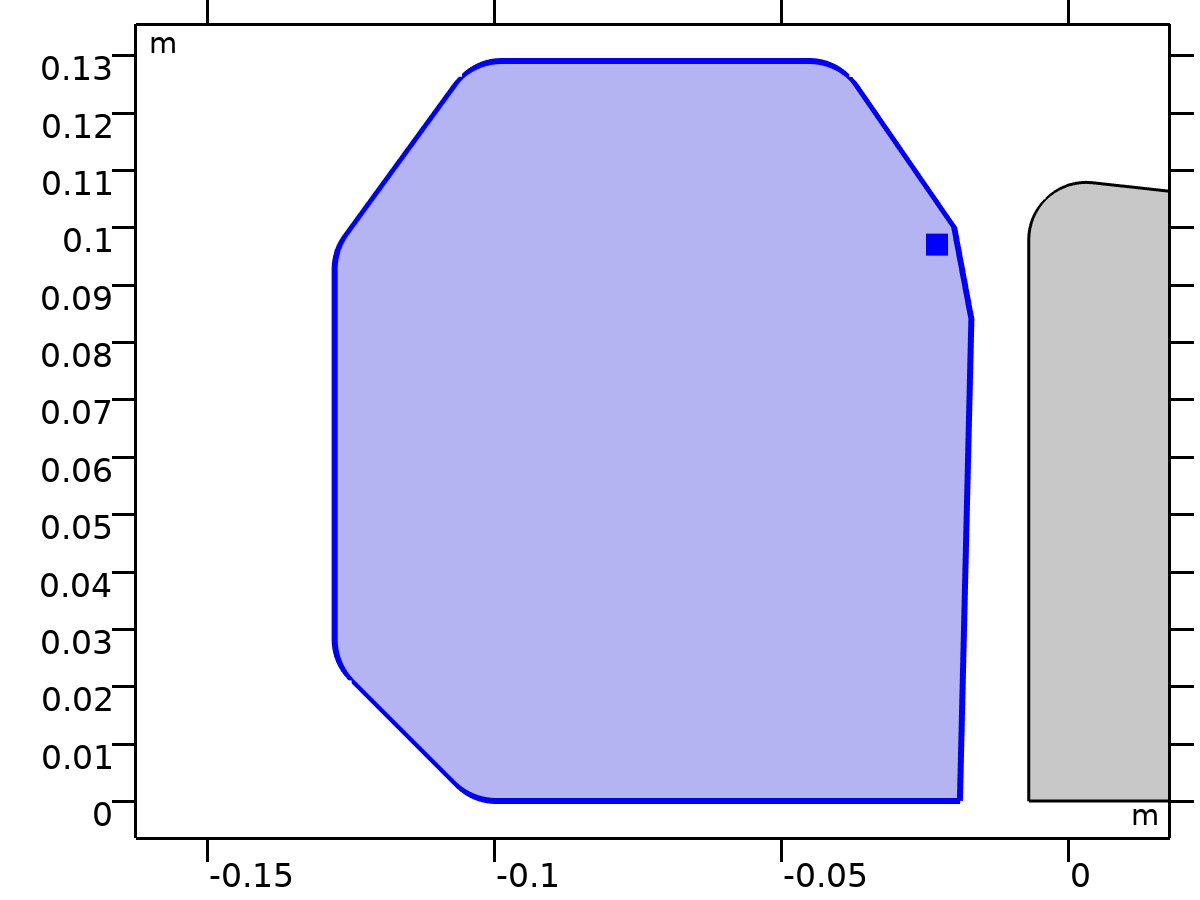
##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj5.Fl\_el1\*test(mbd.fxj5.ul\_el)+mbd.fxj5.Fl\_el2\*test(mbd.fxj5.vl\_el)+mbd.fxj5.Fl\_el3\*test(mbd.fxj5.wl\_el) | 2 |  | Global |
| mbd.fxj5.Ml\_el3\*test(mbd.fxj5.th\_el) | 2 |  | Global |

### Viscera-Pelvis



Viscera-Pelvis



Viscera-Pelvis

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

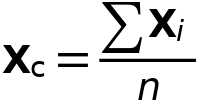
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Viscera |
| Destination | Pelvis |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

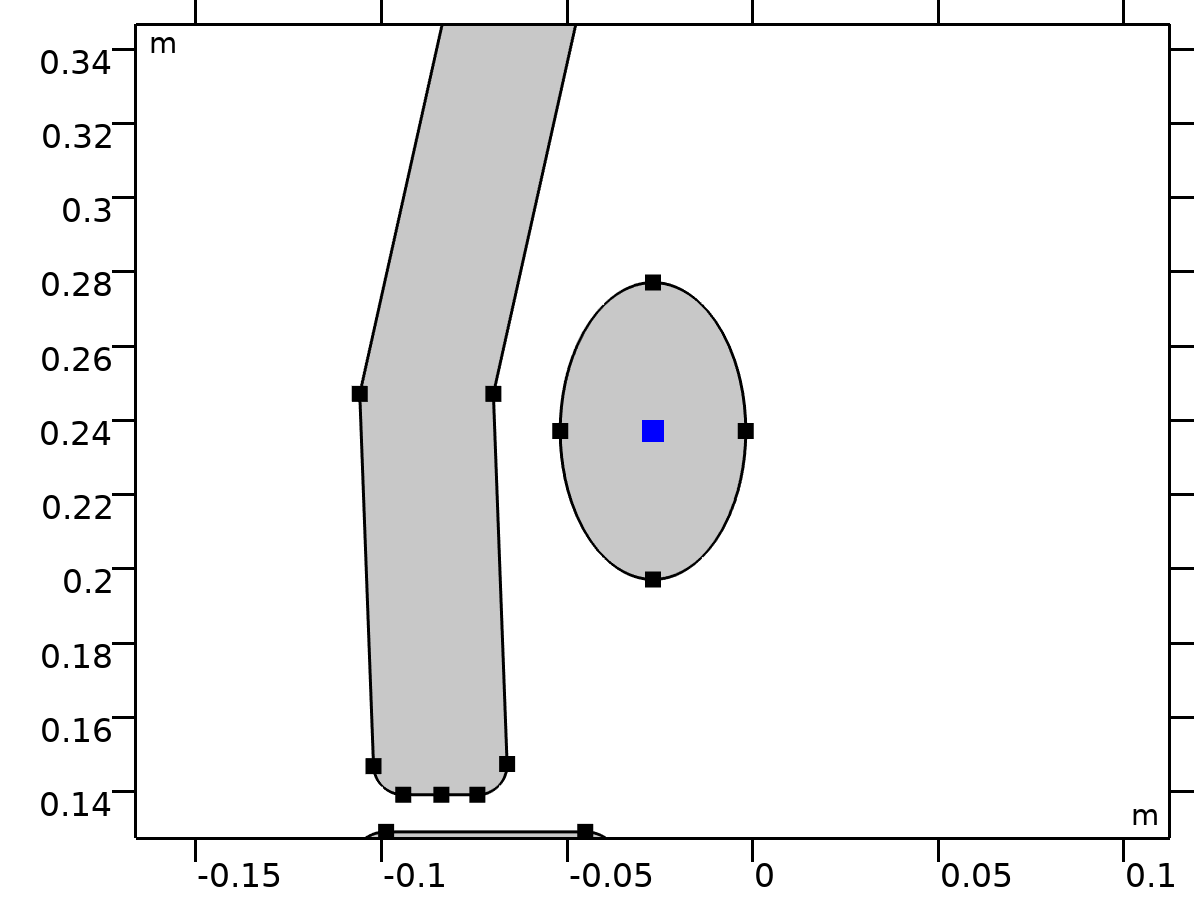
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj6.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj6.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj6.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj6.e20x | (mbd.fxj6.e10z\*mbd.fxj6.e30y-mbd.fxj6.e10y\*mbd.fxj6.e30z)/sqrt((mbd.fxj6.e10z\*mbd.fxj6.e30y-mbd.fxj6.e10y\*mbd.fxj6.e30z)^2+(-mbd.fxj6.e10z\*mbd.fxj6.e30x+mbd.fxj6.e10x\*mbd.fxj6.e30z)^2+(mbd.fxj6.e10y\*mbd.fxj6.e30x-mbd.fxj6.e10x\*mbd.fxj6.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj6.e20y | (-mbd.fxj6.e10z\*mbd.fxj6.e30x+mbd.fxj6.e10x\*mbd.fxj6.e30z)/sqrt((mbd.fxj6.e10z\*mbd.fxj6.e30y-mbd.fxj6.e10y\*mbd.fxj6.e30z)^2+(-mbd.fxj6.e10z\*mbd.fxj6.e30x+mbd.fxj6.e10x\*mbd.fxj6.e30z)^2+(mbd.fxj6.e10y\*mbd.fxj6.e30x-mbd.fxj6.e10x\*mbd.fxj6.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj6.e20z | (mbd.fxj6.e10y\*mbd.fxj6.e30x-mbd.fxj6.e10x\*mbd.fxj6.e30y)/sqrt((mbd.fxj6.e10z\*mbd.fxj6.e30y-mbd.fxj6.e10y\*mbd.fxj6.e30z)^2+(-mbd.fxj6.e10z\*mbd.fxj6.e30x+mbd.fxj6.e10x\*mbd.fxj6.e30z)^2+(mbd.fxj6.e10y\*mbd.fxj6.e30x-mbd.fxj6.e10x\*mbd.fxj6.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj6.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj6.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj6.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj6.e1x | mbd.rd4.rotxx\*mbd.fxj6.e10x+mbd.rd4.rotxy\*mbd.fxj6.e10y+mbd.rd4.rotxz\*mbd.fxj6.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj6.e1y | mbd.rd4.rotyx\*mbd.fxj6.e10x+mbd.rd4.rotyy\*mbd.fxj6.e10y+mbd.rd4.rotyz\*mbd.fxj6.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj6.e1z | mbd.rd4.rotzx\*mbd.fxj6.e10x+mbd.rd4.rotzy\*mbd.fxj6.e10y+mbd.rd4.rotzz\*mbd.fxj6.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj6.e2x | mbd.rd4.rotxx\*mbd.fxj6.e20x+mbd.rd4.rotxy\*mbd.fxj6.e20y+mbd.rd4.rotxz\*mbd.fxj6.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj6.e2y | mbd.rd4.rotyx\*mbd.fxj6.e20x+mbd.rd4.rotyy\*mbd.fxj6.e20y+mbd.rd4.rotyz\*mbd.fxj6.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj6.e2z | mbd.rd4.rotzx\*mbd.fxj6.e20x+mbd.rd4.rotzy\*mbd.fxj6.e20y+mbd.rd4.rotzz\*mbd.fxj6.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj6.e3x | mbd.rd4.rotxx\*mbd.fxj6.e30x+mbd.rd4.rotxy\*mbd.fxj6.e30y+mbd.rd4.rotxz\*mbd.fxj6.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj6.e3y | mbd.rd4.rotyx\*mbd.fxj6.e30x+mbd.rd4.rotyy\*mbd.fxj6.e30y+mbd.rd4.rotyz\*mbd.fxj6.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj6.e3z | mbd.rd4.rotzx\*mbd.fxj6.e30x+mbd.rd4.rotzy\*mbd.fxj6.e30y+mbd.rd4.rotzz\*mbd.fxj6.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj6.uc\_src | mbd.rd4.rotxx\*(mbd.fxj6.xcx-mbd.rd4.xcx)+mbd.rd4.rotxy\*(mbd.fxj6.xcy-mbd.rd4.xcy)+mbd.rd4.rotxz\*(mbd.fxj6.xcz-mbd.rd4.xcz)-mbd.fxj6.xcx+mbd.rd4.xcx+mbd.rd4.u+mbd.fxj6.u\_el | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj6.vc\_src | mbd.rd4.rotyx\*(mbd.fxj6.xcx-mbd.rd4.xcx)+mbd.rd4.rotyy\*(mbd.fxj6.xcy-mbd.rd4.xcy)+mbd.rd4.rotyz\*(mbd.fxj6.xcz-mbd.rd4.xcz)-mbd.fxj6.xcy+mbd.rd4.xcy+mbd.rd4.v+mbd.fxj6.v\_el | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj6.wc\_src | mbd.rd4.rotzx\*(mbd.fxj6.xcx-mbd.rd4.xcx)+mbd.rd4.rotzy\*(mbd.fxj6.xcy-mbd.rd4.xcy)+mbd.rd4.rotzz\*(mbd.fxj6.xcz-mbd.rd4.xcz)-mbd.fxj6.xcz+mbd.rd4.xcz+mbd.fxj6.w\_el | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj6.uc\_dest | mbd.rd1.rotxx\*(mbd.fxj6.xcx-mbd.rd1.xcx)+mbd.rd1.rotxy\*(mbd.fxj6.xcy-mbd.rd1.xcy)+mbd.rd1.rotxz\*(mbd.fxj6.xcz-mbd.rd1.xcz)-mbd.fxj6.xcx+mbd.rd1.xcx+mbd.rd1.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj6.vc\_dest | mbd.rd1.rotyx\*(mbd.fxj6.xcx-mbd.rd1.xcx)+mbd.rd1.rotyy\*(mbd.fxj6.xcy-mbd.rd1.xcy)+mbd.rd1.rotyz\*(mbd.fxj6.xcz-mbd.rd1.xcz)-mbd.fxj6.xcy+mbd.rd1.xcy+mbd.rd1.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj6.wc\_dest | mbd.rd1.rotzx\*(mbd.fxj6.xcx-mbd.rd1.xcx)+mbd.rd1.rotzy\*(mbd.fxj6.xcy-mbd.rd1.xcy)+mbd.rd1.rotzz\*(mbd.fxj6.xcz-mbd.rd1.xcz)-mbd.fxj6.xcz+mbd.rd1.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj6.phi\_src | mbd.rd4.phi+mbd.fxj6.th\_el | rad | Source rotation | Global |
| mbd.fxj6.phi\_dest | mbd.rd1.phi | rad | Destination rotation | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj6.uc\_src-mbd.fxj6.uc\_dest | test(mbd.fxj6.uc\_src-mbd.fxj6.uc\_dest) |  | Global | Elemental |
| mbd.fxj6.vc\_src-mbd.fxj6.vc\_dest | test(mbd.fxj6.vc\_src-mbd.fxj6.vc\_dest) |  | Global | Elemental |
| mbd.fxj6.phi\_src-mbd.fxj6.phi\_dest | test(mbd.fxj6.phi\_src-mbd.fxj6.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 6



Center of Joint: Point 6

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 55 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj6.xcx | mbd.fxj6.cjp1.int(X)/mbd.fxj6.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj6.xcy | mbd.fxj6.cjp1.int(Y)/mbd.fxj6.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj6.xcz | mbd.fxj6.cjp1.int(0)/mbd.fxj6.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 6

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

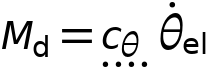












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {0, kv6, 0} | N/m |
| Spring constant | 0 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | {0, if(i\_c==1, cv6, 0), 0} | N·s/m |
| Damping coefficient | 0 | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj6.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj6.u\_el | mbd.fxj6.u1\*mbd.fxj6.e1x+mbd.fxj6.u2\*mbd.fxj6.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj6.v\_el | mbd.fxj6.u1\*mbd.fxj6.e1y+mbd.fxj6.u2\*mbd.fxj6.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj6.w\_el | mbd.fxj6.u1\*mbd.fxj6.e1z+mbd.fxj6.u2\*mbd.fxj6.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj6.th\_el | mbd.fxj6.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj6.je1.k\_u11 | 0 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj6.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj6.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj6.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj6.je1.k\_u22 | kv6 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj6.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj6.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj6.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj6.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj6.je1.k\_th | 0 | N·m/rad | Spring constant | Global |  |
| mbd.fxj6.je1.c\_u11 | 0 | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj6.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj6.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj6.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj6.je1.c\_u22 | if(i\_c==1,cv6,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj6.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj6.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj6.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj6.je1.c\_u33 | 0 | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj6.je1.c\_th | 0 | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj6.u1 | mbd.fxj6.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj6.u2 | mbd.fxj6.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj6.th | mbd.fxj6.Th | rad | Relative rotation | Global |  |
| mbd.fxj6.kl\_u11 | mbd.fxj6.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj6.kl\_u21 | mbd.fxj6.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj6.kl\_u31 | mbd.fxj6.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj6.kl\_u12 | mbd.fxj6.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj6.kl\_u22 | mbd.fxj6.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj6.kl\_u32 | mbd.fxj6.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj6.kl\_u13 | mbd.fxj6.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj6.kl\_u23 | mbd.fxj6.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj6.kl\_u33 | mbd.fxj6.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj6.cl\_u11 | mbd.fxj6.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj6.cl\_u21 | mbd.fxj6.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj6.cl\_u31 | mbd.fxj6.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj6.cl\_u12 | mbd.fxj6.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj6.cl\_u22 | mbd.fxj6.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj6.cl\_u32 | mbd.fxj6.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj6.cl\_u13 | mbd.fxj6.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj6.cl\_u23 | mbd.fxj6.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj6.cl\_u33 | mbd.fxj6.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj6.ul\_el | mbd.fxj6.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj6.vl\_el | mbd.fxj6.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj6.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj6.Fs\_el1 | mbd.fxj6.kl\_u11\*mbd.fxj6.ul\_el+mbd.fxj6.kl\_u12\*mbd.fxj6.vl\_el+mbd.fxj6.kl\_u13\*mbd.fxj6.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj6.Fs\_el2 | mbd.fxj6.kl\_u21\*mbd.fxj6.ul\_el+mbd.fxj6.kl\_u22\*mbd.fxj6.vl\_el+mbd.fxj6.kl\_u23\*mbd.fxj6.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj6.Fs\_el3 | mbd.fxj6.kl\_u31\*mbd.fxj6.ul\_el+mbd.fxj6.kl\_u32\*mbd.fxj6.vl\_el+mbd.fxj6.kl\_u33\*mbd.fxj6.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj6.Ms\_el | mbd.fxj6.je1.k\_th\*mbd.fxj6.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj6.Fd\_el1 | (mbd.fxj6.cl\_u11\*mbd.fxj6.ul\_el+mbd.fxj6.cl\_u12\*mbd.fxj6.vl\_el+mbd.fxj6.cl\_u13\*mbd.fxj6.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj6.Fd\_el2 | (mbd.fxj6.cl\_u21\*mbd.fxj6.ul\_el+mbd.fxj6.cl\_u22\*mbd.fxj6.vl\_el+mbd.fxj6.cl\_u23\*mbd.fxj6.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj6.Fd\_el3 | (mbd.fxj6.cl\_u31\*mbd.fxj6.ul\_el+mbd.fxj6.cl\_u32\*mbd.fxj6.vl\_el+mbd.fxj6.cl\_u33\*mbd.fxj6.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj6.Md\_el | mbd.fxj6.je1.c\_th\*mbd.fxj6.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj6.Fl\_el1 | -mbd.fxj6.Fd\_el1-mbd.fxj6.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj6.Fl\_el2 | -mbd.fxj6.Fd\_el2-mbd.fxj6.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj6.Fl\_el3 | -mbd.fxj6.Fd\_el3-mbd.fxj6.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj6.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj6.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj6.Ml\_el3 | -mbd.fxj6.Md\_el-mbd.fxj6.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj6.F\_elx | mbd.fxj6.e1x\*mbd.fxj6.Fl\_el1+mbd.fxj6.e2x\*mbd.fxj6.Fl\_el2+mbd.fxj6.e3x\*mbd.fxj6.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj6.F\_ely | mbd.fxj6.e1y\*mbd.fxj6.Fl\_el1+mbd.fxj6.e2y\*mbd.fxj6.Fl\_el2+mbd.fxj6.e3y\*mbd.fxj6.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj6.F\_elz | mbd.fxj6.e1z\*mbd.fxj6.Fl\_el1+mbd.fxj6.e2z\*mbd.fxj6.Fl\_el2+mbd.fxj6.e3z\*mbd.fxj6.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj6.M\_elx | mbd.fxj6.e1x\*mbd.fxj6.Ml\_el1+mbd.fxj6.e2x\*mbd.fxj6.Ml\_el2+mbd.fxj6.e3x\*mbd.fxj6.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj6.M\_ely | mbd.fxj6.e1y\*mbd.fxj6.Ml\_el1+mbd.fxj6.e2y\*mbd.fxj6.Ml\_el2+mbd.fxj6.e3y\*mbd.fxj6.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj6.M\_elz | mbd.fxj6.e1z\*mbd.fxj6.Ml\_el1+mbd.fxj6.e2z\*mbd.fxj6.Ml\_el2+mbd.fxj6.e3z\*mbd.fxj6.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj6.Ws\_el | 0.25\*(realdot(mbd.fxj6.Fs\_el1,mbd.fxj6.ul\_el)+realdot(mbd.fxj6.Fs\_el2,mbd.fxj6.vl\_el)+realdot(mbd.fxj6.Fs\_el3,mbd.fxj6.wl\_el)+realdot(mbd.fxj6.Ms\_el,mbd.fxj6.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj6.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj6.Fd\_el1/mbd.iomega,mbd.fxj6.ul\_el)+realdot(mbd.fxj6.Fd\_el2/mbd.iomega,mbd.fxj6.vl\_el)+realdot(mbd.fxj6.Fd\_el3/mbd.iomega,mbd.fxj6.wl\_el)+realdot(mbd.fxj6.Md\_el/mbd.iomega,mbd.fxj6.th\_el)) | W | Energy dissipation rate in damper | Global |  |

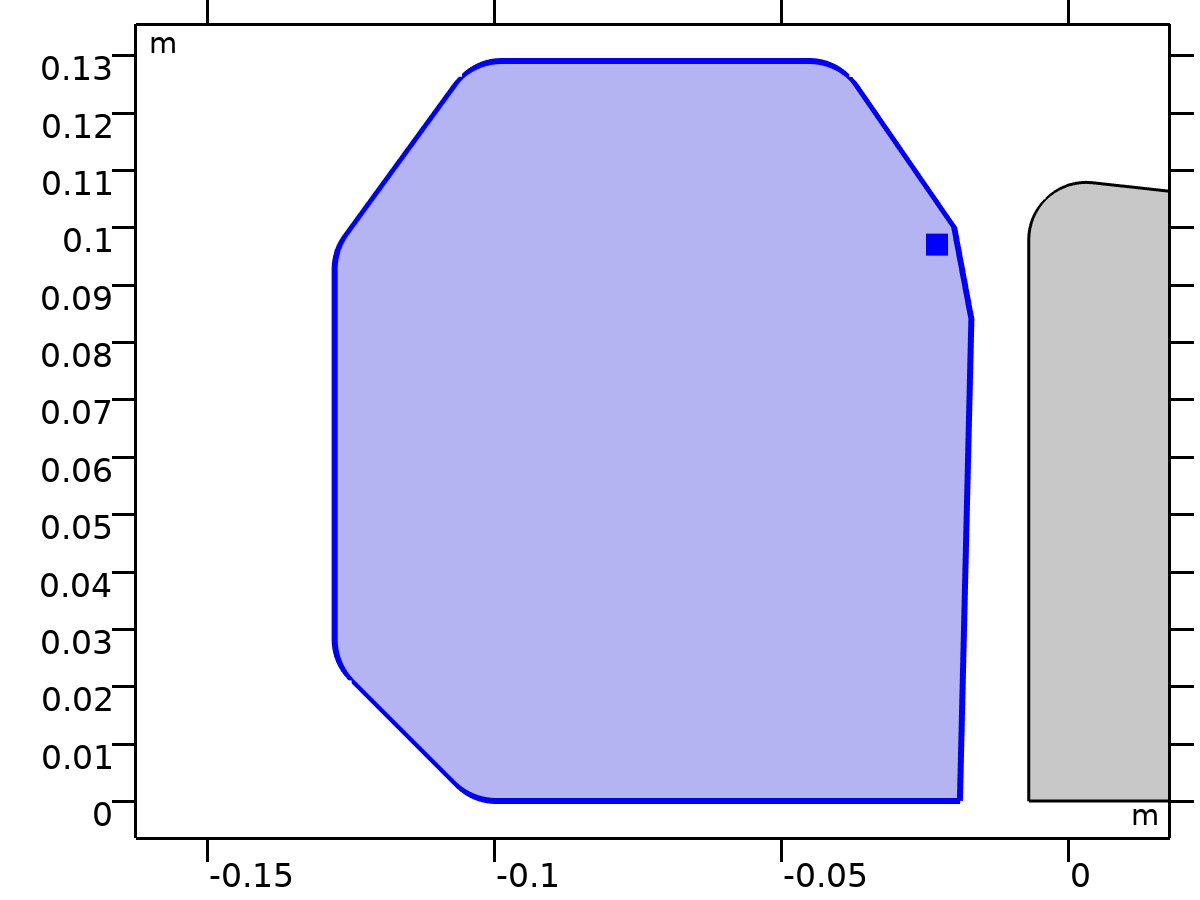
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj6.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj6.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj6.Th | ODE | rad | Relative rotation |  | Global |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj6.Fl\_el1\*test(mbd.fxj6.ul\_el)+mbd.fxj6.Fl\_el2\*test(mbd.fxj6.vl\_el)+mbd.fxj6.Fl\_el3\*test(mbd.fxj6.wl\_el) | 2 |  | Global |
| mbd.fxj6.Ml\_el3\*test(mbd.fxj6.th\_el) | 2 |  | Global |

### Seat-Pelvis



Seat-Pelvis

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

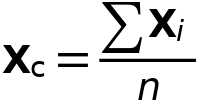
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Seat |
| Destination | Pelvis |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Computed using weak constraints |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj7.e10x | 1 | 1 | Initial joint axis, x-component | Global |  |
| mbd.fxj7.e10y | 0 | 1 | Initial joint axis, y-component | Global |  |
| mbd.fxj7.e10z | 0 | 1 | Initial joint axis, z-component | Global |  |
| mbd.fxj7.e20x | (mbd.fxj7.e10z\*mbd.fxj7.e30y-mbd.fxj7.e10y\*mbd.fxj7.e30z)/sqrt((mbd.fxj7.e10z\*mbd.fxj7.e30y-mbd.fxj7.e10y\*mbd.fxj7.e30z)^2+(-mbd.fxj7.e10z\*mbd.fxj7.e30x+mbd.fxj7.e10x\*mbd.fxj7.e30z)^2+(mbd.fxj7.e10y\*mbd.fxj7.e30x-mbd.fxj7.e10x\*mbd.fxj7.e30y)^2) | 1 | Initial second axis, x-component | Global |  |
| mbd.fxj7.e20y | (-mbd.fxj7.e10z\*mbd.fxj7.e30x+mbd.fxj7.e10x\*mbd.fxj7.e30z)/sqrt((mbd.fxj7.e10z\*mbd.fxj7.e30y-mbd.fxj7.e10y\*mbd.fxj7.e30z)^2+(-mbd.fxj7.e10z\*mbd.fxj7.e30x+mbd.fxj7.e10x\*mbd.fxj7.e30z)^2+(mbd.fxj7.e10y\*mbd.fxj7.e30x-mbd.fxj7.e10x\*mbd.fxj7.e30y)^2) | 1 | Initial second axis, y-component | Global |  |
| mbd.fxj7.e20z | (mbd.fxj7.e10y\*mbd.fxj7.e30x-mbd.fxj7.e10x\*mbd.fxj7.e30y)/sqrt((mbd.fxj7.e10z\*mbd.fxj7.e30y-mbd.fxj7.e10y\*mbd.fxj7.e30z)^2+(-mbd.fxj7.e10z\*mbd.fxj7.e30x+mbd.fxj7.e10x\*mbd.fxj7.e30z)^2+(mbd.fxj7.e10y\*mbd.fxj7.e30x-mbd.fxj7.e10x\*mbd.fxj7.e30y)^2) | 1 | Initial second axis, z-component | Global |  |
| mbd.fxj7.e30x | 0 | 1 | Initial third axis, x-component | Global |  |
| mbd.fxj7.e30y | 0 | 1 | Initial third axis, y-component | Global |  |
| mbd.fxj7.e30z | 1 | 1 | Initial third axis, z-component | Global |  |
| mbd.fxj7.e1x | mbd.fxj7.rot\_srcxx\*mbd.fxj7.e10x+mbd.fxj7.rot\_srcxy\*mbd.fxj7.e10y+mbd.fxj7.rot\_srcxz\*mbd.fxj7.e10z | 1 | Joint axis, x-component | Global |  |
| mbd.fxj7.e1y | mbd.fxj7.rot\_srcyx\*mbd.fxj7.e10x+mbd.fxj7.rot\_srcyy\*mbd.fxj7.e10y+mbd.fxj7.rot\_srcyz\*mbd.fxj7.e10z | 1 | Joint axis, y-component | Global |  |
| mbd.fxj7.e1z | mbd.fxj7.rot\_srczx\*mbd.fxj7.e10x+mbd.fxj7.rot\_srczy\*mbd.fxj7.e10y+mbd.fxj7.rot\_srczz\*mbd.fxj7.e10z | 1 | Joint axis, z-component | Global |  |
| mbd.fxj7.e2x | mbd.fxj7.rot\_srcxx\*mbd.fxj7.e20x+mbd.fxj7.rot\_srcxy\*mbd.fxj7.e20y+mbd.fxj7.rot\_srcxz\*mbd.fxj7.e20z | 1 | Second axis, x-component | Global |  |
| mbd.fxj7.e2y | mbd.fxj7.rot\_srcyx\*mbd.fxj7.e20x+mbd.fxj7.rot\_srcyy\*mbd.fxj7.e20y+mbd.fxj7.rot\_srcyz\*mbd.fxj7.e20z | 1 | Second axis, y-component | Global |  |
| mbd.fxj7.e2z | mbd.fxj7.rot\_srczx\*mbd.fxj7.e20x+mbd.fxj7.rot\_srczy\*mbd.fxj7.e20y+mbd.fxj7.rot\_srczz\*mbd.fxj7.e20z | 1 | Second axis, z-component | Global |  |
| mbd.fxj7.e3x | mbd.fxj7.rot\_srcxx\*mbd.fxj7.e30x+mbd.fxj7.rot\_srcxy\*mbd.fxj7.e30y+mbd.fxj7.rot\_srcxz\*mbd.fxj7.e30z | 1 | Third axis, x-component | Global |  |
| mbd.fxj7.e3y | mbd.fxj7.rot\_srcyx\*mbd.fxj7.e30x+mbd.fxj7.rot\_srcyy\*mbd.fxj7.e30y+mbd.fxj7.rot\_srcyz\*mbd.fxj7.e30z | 1 | Third axis, y-component | Global |  |
| mbd.fxj7.e3z | mbd.fxj7.rot\_srczx\*mbd.fxj7.e30x+mbd.fxj7.rot\_srczy\*mbd.fxj7.e30y+mbd.fxj7.rot\_srczz\*mbd.fxj7.e30z | 1 | Third axis, z-component | Global |  |
| mbd.fxj7.uc\_src | mbd.bsm1.u+mbd.fxj7.u\_el | m | Source displacement at center of joint, x-component | Global |  |
| mbd.fxj7.vc\_src | mbd.bsm1.v+mbd.fxj7.v\_el | m | Source displacement at center of joint, y-component | Global |  |
| mbd.fxj7.wc\_src | mbd.fxj7.w\_el | m | Source displacement at center of joint, z-component | Global |  |
| mbd.fxj7.uc\_dest | mbd.rd1.rotxx\*(mbd.fxj7.xcx-mbd.rd1.xcx)+mbd.rd1.rotxy\*(mbd.fxj7.xcy-mbd.rd1.xcy)+mbd.rd1.rotxz\*(mbd.fxj7.xcz-mbd.rd1.xcz)-mbd.fxj7.xcx+mbd.rd1.xcx+mbd.rd1.u | m | Destination displacement at center of joint, x-component | Global |  |
| mbd.fxj7.vc\_dest | mbd.rd1.rotyx\*(mbd.fxj7.xcx-mbd.rd1.xcx)+mbd.rd1.rotyy\*(mbd.fxj7.xcy-mbd.rd1.xcy)+mbd.rd1.rotyz\*(mbd.fxj7.xcz-mbd.rd1.xcz)-mbd.fxj7.xcy+mbd.rd1.xcy+mbd.rd1.v | m | Destination displacement at center of joint, y-component | Global |  |
| mbd.fxj7.wc\_dest | mbd.rd1.rotzx\*(mbd.fxj7.xcx-mbd.rd1.xcx)+mbd.rd1.rotzy\*(mbd.fxj7.xcy-mbd.rd1.xcy)+mbd.rd1.rotzz\*(mbd.fxj7.xcz-mbd.rd1.xcz)-mbd.fxj7.xcz+mbd.rd1.xcz | m | Destination displacement at center of joint, z-component | Global |  |
| mbd.fxj7.phi\_src | mbd.fxj7.th\_el | rad | Source rotation | Global |  |
| mbd.fxj7.phi\_dest | mbd.rd1.phi | rad | Destination rotation | Global |  |
| mbd.fxj7.rot\_srcxx | 1 | 1 | Source rotation matrix, xx-component | Global |  |
| mbd.fxj7.rot\_srcyx | 0 | 1 | Source rotation matrix, yx-component | Global |  |
| mbd.fxj7.rot\_srczx | 0 | 1 | Source rotation matrix, zx-component | Global |  |
| mbd.fxj7.rot\_srcxy | 0 | 1 | Source rotation matrix, xy-component | Global |  |
| mbd.fxj7.rot\_srcyy | 1 | 1 | Source rotation matrix, yy-component | Global |  |
| mbd.fxj7.rot\_srczy | 0 | 1 | Source rotation matrix, zy-component | Global |  |
| mbd.fxj7.rot\_srcxz | 0 | 1 | Source rotation matrix, xz-component | Global |  |
| mbd.fxj7.rot\_srcyz | 0 | 1 | Source rotation matrix, yz-component | Global |  |
| mbd.fxj7.rot\_srczz | 1 | 1 | Source rotation matrix, zz-component | Global |  |
| mbd.fxj7.Fx | mbd.fxj7.RFx | N | Joint force, x-component | Global | + operation |
| mbd.fxj7.Fy | mbd.fxj7.RFy | N | Joint force, y-component | Global | + operation |
| mbd.fxj7.Fz | 0 | N | Joint force, z-component | Global | + operation |
| mbd.fxj7.rx | mbd.fxj7.uc\_dest-mbd.fxj7.uc\_src+mbd.fxj7.u\_el | m | Joint moment arm, x-component | Global |  |
| mbd.fxj7.ry | mbd.fxj7.vc\_dest-mbd.fxj7.vc\_src+mbd.fxj7.v\_el | m | Joint moment arm, y-component | Global |  |
| mbd.fxj7.rz | mbd.fxj7.wc\_dest-mbd.fxj7.wc\_src+mbd.fxj7.w\_el | m | Joint moment arm, z-component | Global |  |
| mbd.fxj7.Mx | -mbd.fxj7.RFy\*mbd.fxj7.rz | N·m | Joint moment, x-component | Global | + operation |
| mbd.fxj7.My | mbd.fxj7.RFx\*mbd.fxj7.rz | N·m | Joint moment, y-component | Global | + operation |
| mbd.fxj7.Mz | mbd.fxj7.Rphi+mbd.fxj7.RFy\*mbd.fxj7.rx-mbd.fxj7.RFx\*mbd.fxj7.ry | N·m | Joint moment, z-component | Global | + operation |
| mbd.fxj7.Fl1 | mbd.fxj7.Fx\*mbd.fxj7.e1x+mbd.fxj7.Fy\*mbd.fxj7.e1y+mbd.fxj7.Fz\*mbd.fxj7.e1z | N | Joint force, local coordinate system, 1 component | Global |  |
| mbd.fxj7.Fl2 | mbd.fxj7.Fx\*mbd.fxj7.e2x+mbd.fxj7.Fy\*mbd.fxj7.e2y+mbd.fxj7.Fz\*mbd.fxj7.e2z | N | Joint force, local coordinate system, 2 component | Global |  |
| mbd.fxj7.Fl3 | mbd.fxj7.Fx\*mbd.fxj7.e3x+mbd.fxj7.Fy\*mbd.fxj7.e3y+mbd.fxj7.Fz\*mbd.fxj7.e3z | N | Joint force, local coordinate system, 3 component | Global |  |
| mbd.fxj7.Ml1 | mbd.fxj7.Mx\*mbd.fxj7.e1x+mbd.fxj7.My\*mbd.fxj7.e1y+mbd.fxj7.Mz\*mbd.fxj7.e1z | N·m | Joint moment, local coordinate system, 1 component | Global |  |
| mbd.fxj7.Ml2 | mbd.fxj7.Mx\*mbd.fxj7.e2x+mbd.fxj7.My\*mbd.fxj7.e2y+mbd.fxj7.Mz\*mbd.fxj7.e2z | N·m | Joint moment, local coordinate system, 2 component | Global |  |
| mbd.fxj7.Ml3 | mbd.fxj7.Mx\*mbd.fxj7.e3x+mbd.fxj7.My\*mbd.fxj7.e3y+mbd.fxj7.Mz\*mbd.fxj7.e3z | N·m | Joint moment, local coordinate system, 3 component | Global |  |

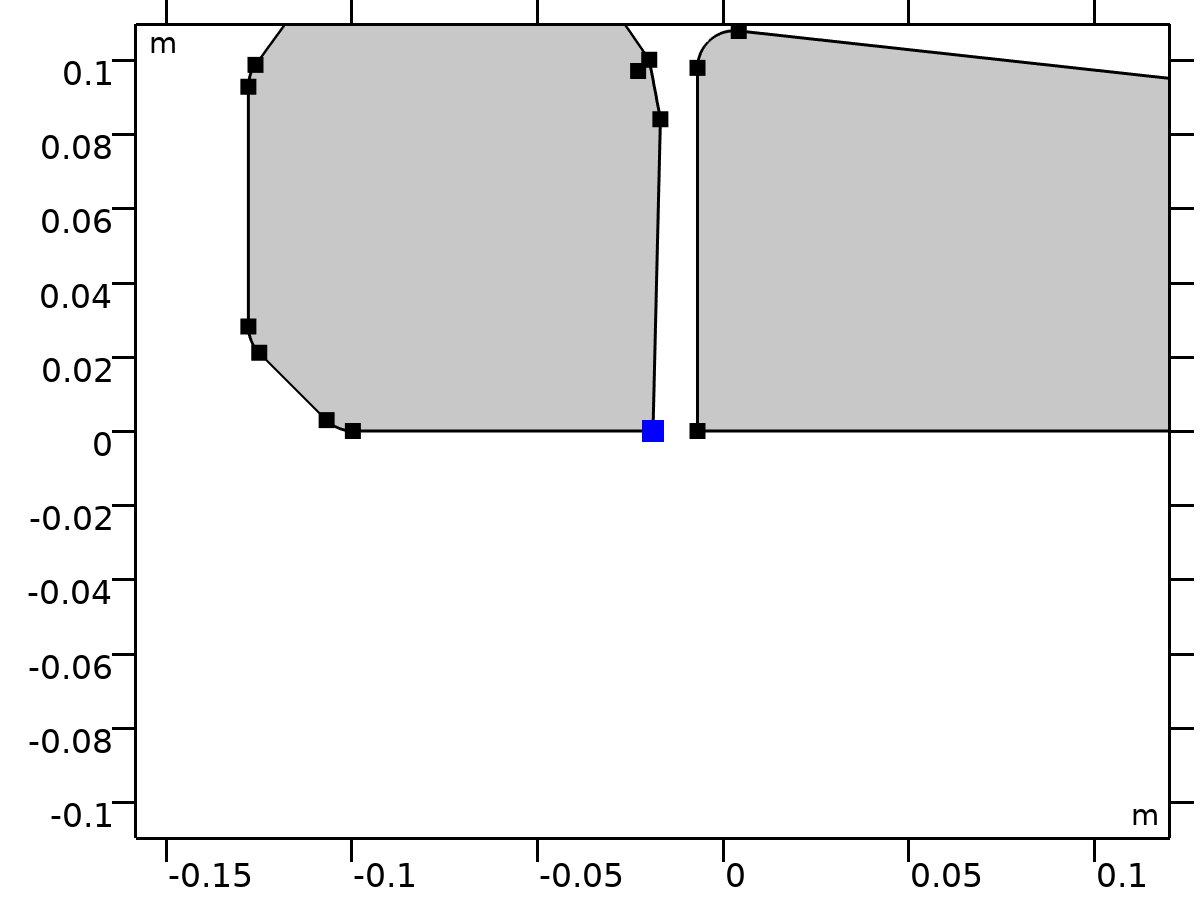
#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj7.RFx | ODE | N | Reaction force, x-component |  | Global |
| mbd.fxj7.RFy | ODE | N | Reaction force, y-component |  | Global |
| mbd.fxj7.Rphi | ODE | N·m | Reaction moment |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| (mbd.fxj7.uc\_src-mbd.fxj7.uc\_dest)\*test(-mbd.fxj7.RFx)-test(mbd.fxj7.u\_el-mbd.fxj7.uc\_dest)\*mbd.fxj7.RFx | 2 |  | Global |
| (mbd.fxj7.vc\_src-mbd.fxj7.vc\_dest)\*test(-mbd.fxj7.RFy)-test(mbd.fxj7.v\_el-mbd.fxj7.vc\_dest)\*mbd.fxj7.RFy | 2 |  | Global |
| (mbd.fxj7.phi\_src-mbd.fxj7.phi\_dest)\*test(-mbd.fxj7.Rphi)-test(mbd.fxj7.phi\_src-mbd.fxj7.phi\_dest)\*mbd.fxj7.Rphi | 2 |  | Global |

#### Center of Joint: Point 7



Center of Joint: Point 7

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 13 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj7.xcx | mbd.fxj7.cjp1.int(X)/mbd.fxj7.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj7.xcy | mbd.fxj7.cjp1.int(Y)/mbd.fxj7.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj7.xcz | mbd.fxj7.cjp1.int(0)/mbd.fxj7.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 7

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

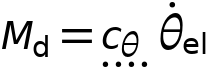












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {kh7, kv7, 0} | N/m |
| Spring constant | 0 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | {if(i\_c==1, ch7, 0), if(i\_c==1, cv7, 0), 0} | N·s/m |
| Damping coefficient | 0 | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj7.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj7.u\_el | mbd.fxj7.u1\*mbd.fxj7.e1x+mbd.fxj7.u2\*mbd.fxj7.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj7.v\_el | mbd.fxj7.u1\*mbd.fxj7.e1y+mbd.fxj7.u2\*mbd.fxj7.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj7.w\_el | mbd.fxj7.u1\*mbd.fxj7.e1z+mbd.fxj7.u2\*mbd.fxj7.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj7.th\_el | mbd.fxj7.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj7.je1.k\_u11 | kh7 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj7.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj7.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj7.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj7.je1.k\_u22 | kv7 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj7.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj7.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj7.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj7.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj7.je1.k\_th | 0 | N·m/rad | Spring constant | Global |  |
| mbd.fxj7.je1.c\_u11 | if(i\_c==1,ch7,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj7.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj7.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj7.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj7.je1.c\_u22 | if(i\_c==1,cv7,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj7.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj7.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj7.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj7.je1.c\_u33 | 0 | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj7.je1.c\_th | 0 | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj7.u1 | mbd.fxj7.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj7.u2 | mbd.fxj7.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj7.th | mbd.fxj7.Th | rad | Relative rotation | Global |  |
| mbd.fxj7.kl\_u11 | mbd.fxj7.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj7.kl\_u21 | mbd.fxj7.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj7.kl\_u31 | mbd.fxj7.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj7.kl\_u12 | mbd.fxj7.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj7.kl\_u22 | mbd.fxj7.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj7.kl\_u32 | mbd.fxj7.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj7.kl\_u13 | mbd.fxj7.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj7.kl\_u23 | mbd.fxj7.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj7.kl\_u33 | mbd.fxj7.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj7.cl\_u11 | mbd.fxj7.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj7.cl\_u21 | mbd.fxj7.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj7.cl\_u31 | mbd.fxj7.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj7.cl\_u12 | mbd.fxj7.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj7.cl\_u22 | mbd.fxj7.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj7.cl\_u32 | mbd.fxj7.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj7.cl\_u13 | mbd.fxj7.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj7.cl\_u23 | mbd.fxj7.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj7.cl\_u33 | mbd.fxj7.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj7.ul\_el | mbd.fxj7.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj7.vl\_el | mbd.fxj7.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj7.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj7.Fs\_el1 | mbd.fxj7.kl\_u11\*mbd.fxj7.ul\_el+mbd.fxj7.kl\_u12\*mbd.fxj7.vl\_el+mbd.fxj7.kl\_u13\*mbd.fxj7.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj7.Fs\_el2 | mbd.fxj7.kl\_u21\*mbd.fxj7.ul\_el+mbd.fxj7.kl\_u22\*mbd.fxj7.vl\_el+mbd.fxj7.kl\_u23\*mbd.fxj7.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj7.Fs\_el3 | mbd.fxj7.kl\_u31\*mbd.fxj7.ul\_el+mbd.fxj7.kl\_u32\*mbd.fxj7.vl\_el+mbd.fxj7.kl\_u33\*mbd.fxj7.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj7.Ms\_el | mbd.fxj7.je1.k\_th\*mbd.fxj7.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj7.Fd\_el1 | (mbd.fxj7.cl\_u11\*mbd.fxj7.ul\_el+mbd.fxj7.cl\_u12\*mbd.fxj7.vl\_el+mbd.fxj7.cl\_u13\*mbd.fxj7.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj7.Fd\_el2 | (mbd.fxj7.cl\_u21\*mbd.fxj7.ul\_el+mbd.fxj7.cl\_u22\*mbd.fxj7.vl\_el+mbd.fxj7.cl\_u23\*mbd.fxj7.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj7.Fd\_el3 | (mbd.fxj7.cl\_u31\*mbd.fxj7.ul\_el+mbd.fxj7.cl\_u32\*mbd.fxj7.vl\_el+mbd.fxj7.cl\_u33\*mbd.fxj7.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj7.Md\_el | mbd.fxj7.je1.c\_th\*mbd.fxj7.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj7.Fl\_el1 | -mbd.fxj7.Fd\_el1-mbd.fxj7.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj7.Fl\_el2 | -mbd.fxj7.Fd\_el2-mbd.fxj7.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj7.Fl\_el3 | -mbd.fxj7.Fd\_el3-mbd.fxj7.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj7.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj7.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj7.Ml\_el3 | -mbd.fxj7.Md\_el-mbd.fxj7.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj7.F\_elx | mbd.fxj7.e1x\*mbd.fxj7.Fl\_el1+mbd.fxj7.e2x\*mbd.fxj7.Fl\_el2+mbd.fxj7.e3x\*mbd.fxj7.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj7.F\_ely | mbd.fxj7.e1y\*mbd.fxj7.Fl\_el1+mbd.fxj7.e2y\*mbd.fxj7.Fl\_el2+mbd.fxj7.e3y\*mbd.fxj7.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj7.F\_elz | mbd.fxj7.e1z\*mbd.fxj7.Fl\_el1+mbd.fxj7.e2z\*mbd.fxj7.Fl\_el2+mbd.fxj7.e3z\*mbd.fxj7.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj7.M\_elx | mbd.fxj7.e1x\*mbd.fxj7.Ml\_el1+mbd.fxj7.e2x\*mbd.fxj7.Ml\_el2+mbd.fxj7.e3x\*mbd.fxj7.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj7.M\_ely | mbd.fxj7.e1y\*mbd.fxj7.Ml\_el1+mbd.fxj7.e2y\*mbd.fxj7.Ml\_el2+mbd.fxj7.e3y\*mbd.fxj7.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj7.M\_elz | mbd.fxj7.e1z\*mbd.fxj7.Ml\_el1+mbd.fxj7.e2z\*mbd.fxj7.Ml\_el2+mbd.fxj7.e3z\*mbd.fxj7.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj7.Ws\_el | 0.25\*(realdot(mbd.fxj7.Fs\_el1,mbd.fxj7.ul\_el)+realdot(mbd.fxj7.Fs\_el2,mbd.fxj7.vl\_el)+realdot(mbd.fxj7.Fs\_el3,mbd.fxj7.wl\_el)+realdot(mbd.fxj7.Ms\_el,mbd.fxj7.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj7.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj7.Fd\_el1/mbd.iomega,mbd.fxj7.ul\_el)+realdot(mbd.fxj7.Fd\_el2/mbd.iomega,mbd.fxj7.vl\_el)+realdot(mbd.fxj7.Fd\_el3/mbd.iomega,mbd.fxj7.wl\_el)+realdot(mbd.fxj7.Md\_el/mbd.iomega,mbd.fxj7.th\_el)) | W | Energy dissipation rate in damper | Global |  |

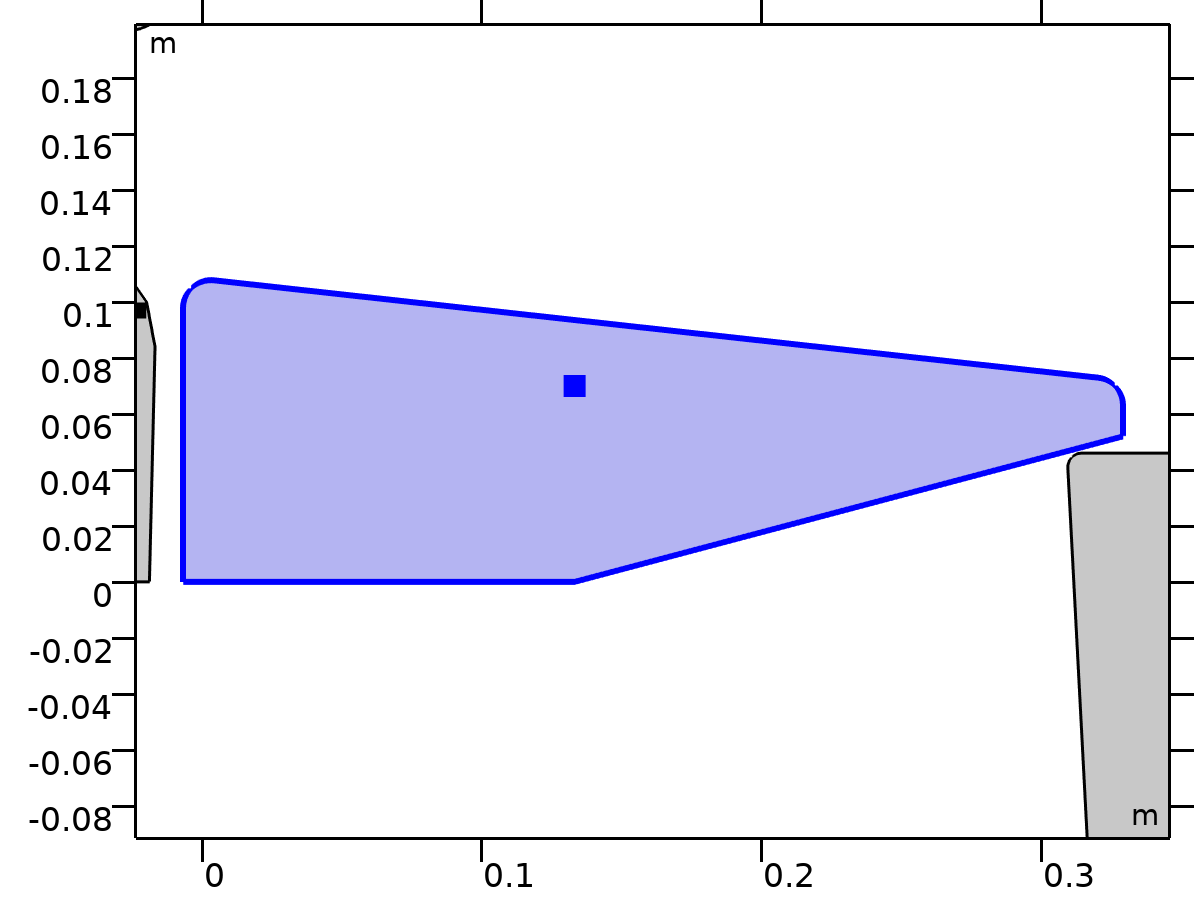
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj7.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj7.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj7.Th | ODE | rad | Relative rotation |  | Global |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj7.Fl\_el1\*test(mbd.fxj7.ul\_el)+mbd.fxj7.Fl\_el2\*test(mbd.fxj7.vl\_el)+mbd.fxj7.Fl\_el3\*test(mbd.fxj7.wl\_el) | 2 |  | Global |
| mbd.fxj7.Ml\_el3\*test(mbd.fxj7.th\_el) | 2 |  | Global |

### Seat-Thigh



Seat-Thigh

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

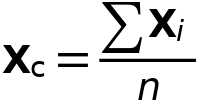
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Seat |
| Destination | Thigh |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Elastic joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Computed using weak constraints |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj8.e10x | 1 | 1 | Initial joint axis, x-component | Global |  |
| mbd.fxj8.e10y | 0 | 1 | Initial joint axis, y-component | Global |  |
| mbd.fxj8.e10z | 0 | 1 | Initial joint axis, z-component | Global |  |
| mbd.fxj8.e20x | (mbd.fxj8.e10z\*mbd.fxj8.e30y-mbd.fxj8.e10y\*mbd.fxj8.e30z)/sqrt((mbd.fxj8.e10z\*mbd.fxj8.e30y-mbd.fxj8.e10y\*mbd.fxj8.e30z)^2+(-mbd.fxj8.e10z\*mbd.fxj8.e30x+mbd.fxj8.e10x\*mbd.fxj8.e30z)^2+(mbd.fxj8.e10y\*mbd.fxj8.e30x-mbd.fxj8.e10x\*mbd.fxj8.e30y)^2) | 1 | Initial second axis, x-component | Global |  |
| mbd.fxj8.e20y | (-mbd.fxj8.e10z\*mbd.fxj8.e30x+mbd.fxj8.e10x\*mbd.fxj8.e30z)/sqrt((mbd.fxj8.e10z\*mbd.fxj8.e30y-mbd.fxj8.e10y\*mbd.fxj8.e30z)^2+(-mbd.fxj8.e10z\*mbd.fxj8.e30x+mbd.fxj8.e10x\*mbd.fxj8.e30z)^2+(mbd.fxj8.e10y\*mbd.fxj8.e30x-mbd.fxj8.e10x\*mbd.fxj8.e30y)^2) | 1 | Initial second axis, y-component | Global |  |
| mbd.fxj8.e20z | (mbd.fxj8.e10y\*mbd.fxj8.e30x-mbd.fxj8.e10x\*mbd.fxj8.e30y)/sqrt((mbd.fxj8.e10z\*mbd.fxj8.e30y-mbd.fxj8.e10y\*mbd.fxj8.e30z)^2+(-mbd.fxj8.e10z\*mbd.fxj8.e30x+mbd.fxj8.e10x\*mbd.fxj8.e30z)^2+(mbd.fxj8.e10y\*mbd.fxj8.e30x-mbd.fxj8.e10x\*mbd.fxj8.e30y)^2) | 1 | Initial second axis, z-component | Global |  |
| mbd.fxj8.e30x | 0 | 1 | Initial third axis, x-component | Global |  |
| mbd.fxj8.e30y | 0 | 1 | Initial third axis, y-component | Global |  |
| mbd.fxj8.e30z | 1 | 1 | Initial third axis, z-component | Global |  |
| mbd.fxj8.e1x | mbd.fxj8.rot\_srcxx\*mbd.fxj8.e10x+mbd.fxj8.rot\_srcxy\*mbd.fxj8.e10y+mbd.fxj8.rot\_srcxz\*mbd.fxj8.e10z | 1 | Joint axis, x-component | Global |  |
| mbd.fxj8.e1y | mbd.fxj8.rot\_srcyx\*mbd.fxj8.e10x+mbd.fxj8.rot\_srcyy\*mbd.fxj8.e10y+mbd.fxj8.rot\_srcyz\*mbd.fxj8.e10z | 1 | Joint axis, y-component | Global |  |
| mbd.fxj8.e1z | mbd.fxj8.rot\_srczx\*mbd.fxj8.e10x+mbd.fxj8.rot\_srczy\*mbd.fxj8.e10y+mbd.fxj8.rot\_srczz\*mbd.fxj8.e10z | 1 | Joint axis, z-component | Global |  |
| mbd.fxj8.e2x | mbd.fxj8.rot\_srcxx\*mbd.fxj8.e20x+mbd.fxj8.rot\_srcxy\*mbd.fxj8.e20y+mbd.fxj8.rot\_srcxz\*mbd.fxj8.e20z | 1 | Second axis, x-component | Global |  |
| mbd.fxj8.e2y | mbd.fxj8.rot\_srcyx\*mbd.fxj8.e20x+mbd.fxj8.rot\_srcyy\*mbd.fxj8.e20y+mbd.fxj8.rot\_srcyz\*mbd.fxj8.e20z | 1 | Second axis, y-component | Global |  |
| mbd.fxj8.e2z | mbd.fxj8.rot\_srczx\*mbd.fxj8.e20x+mbd.fxj8.rot\_srczy\*mbd.fxj8.e20y+mbd.fxj8.rot\_srczz\*mbd.fxj8.e20z | 1 | Second axis, z-component | Global |  |
| mbd.fxj8.e3x | mbd.fxj8.rot\_srcxx\*mbd.fxj8.e30x+mbd.fxj8.rot\_srcxy\*mbd.fxj8.e30y+mbd.fxj8.rot\_srcxz\*mbd.fxj8.e30z | 1 | Third axis, x-component | Global |  |
| mbd.fxj8.e3y | mbd.fxj8.rot\_srcyx\*mbd.fxj8.e30x+mbd.fxj8.rot\_srcyy\*mbd.fxj8.e30y+mbd.fxj8.rot\_srcyz\*mbd.fxj8.e30z | 1 | Third axis, y-component | Global |  |
| mbd.fxj8.e3z | mbd.fxj8.rot\_srczx\*mbd.fxj8.e30x+mbd.fxj8.rot\_srczy\*mbd.fxj8.e30y+mbd.fxj8.rot\_srczz\*mbd.fxj8.e30z | 1 | Third axis, z-component | Global |  |
| mbd.fxj8.uc\_src | mbd.bsm1.u+mbd.fxj8.u\_el | m | Source displacement at center of joint, x-component | Global |  |
| mbd.fxj8.vc\_src | mbd.bsm1.v+mbd.fxj8.v\_el | m | Source displacement at center of joint, y-component | Global |  |
| mbd.fxj8.wc\_src | mbd.fxj8.w\_el | m | Source displacement at center of joint, z-component | Global |  |
| mbd.fxj8.uc\_dest | mbd.rd5.rotxx\*(mbd.fxj8.xcx-mbd.rd5.xcx)+mbd.rd5.rotxy\*(mbd.fxj8.xcy-mbd.rd5.xcy)+mbd.rd5.rotxz\*(mbd.fxj8.xcz-mbd.rd5.xcz)-mbd.fxj8.xcx+mbd.rd5.xcx+mbd.rd5.u | m | Destination displacement at center of joint, x-component | Global |  |
| mbd.fxj8.vc\_dest | mbd.rd5.rotyx\*(mbd.fxj8.xcx-mbd.rd5.xcx)+mbd.rd5.rotyy\*(mbd.fxj8.xcy-mbd.rd5.xcy)+mbd.rd5.rotyz\*(mbd.fxj8.xcz-mbd.rd5.xcz)-mbd.fxj8.xcy+mbd.rd5.xcy+mbd.rd5.v | m | Destination displacement at center of joint, y-component | Global |  |
| mbd.fxj8.wc\_dest | mbd.rd5.rotzx\*(mbd.fxj8.xcx-mbd.rd5.xcx)+mbd.rd5.rotzy\*(mbd.fxj8.xcy-mbd.rd5.xcy)+mbd.rd5.rotzz\*(mbd.fxj8.xcz-mbd.rd5.xcz)-mbd.fxj8.xcz+mbd.rd5.xcz | m | Destination displacement at center of joint, z-component | Global |  |
| mbd.fxj8.phi\_src | mbd.fxj8.th\_el | rad | Source rotation | Global |  |
| mbd.fxj8.phi\_dest | mbd.rd5.phi | rad | Destination rotation | Global |  |
| mbd.fxj8.rot\_srcxx | 1 | 1 | Source rotation matrix, xx-component | Global |  |
| mbd.fxj8.rot\_srcyx | 0 | 1 | Source rotation matrix, yx-component | Global |  |
| mbd.fxj8.rot\_srczx | 0 | 1 | Source rotation matrix, zx-component | Global |  |
| mbd.fxj8.rot\_srcxy | 0 | 1 | Source rotation matrix, xy-component | Global |  |
| mbd.fxj8.rot\_srcyy | 1 | 1 | Source rotation matrix, yy-component | Global |  |
| mbd.fxj8.rot\_srczy | 0 | 1 | Source rotation matrix, zy-component | Global |  |
| mbd.fxj8.rot\_srcxz | 0 | 1 | Source rotation matrix, xz-component | Global |  |
| mbd.fxj8.rot\_srcyz | 0 | 1 | Source rotation matrix, yz-component | Global |  |
| mbd.fxj8.rot\_srczz | 1 | 1 | Source rotation matrix, zz-component | Global |  |
| mbd.fxj8.Fx | mbd.fxj8.RFx | N | Joint force, x-component | Global | + operation |
| mbd.fxj8.Fy | mbd.fxj8.RFy | N | Joint force, y-component | Global | + operation |
| mbd.fxj8.Fz | 0 | N | Joint force, z-component | Global | + operation |
| mbd.fxj8.rx | mbd.fxj8.uc\_dest-mbd.fxj8.uc\_src+mbd.fxj8.u\_el | m | Joint moment arm, x-component | Global |  |
| mbd.fxj8.ry | mbd.fxj8.vc\_dest-mbd.fxj8.vc\_src+mbd.fxj8.v\_el | m | Joint moment arm, y-component | Global |  |
| mbd.fxj8.rz | mbd.fxj8.wc\_dest-mbd.fxj8.wc\_src+mbd.fxj8.w\_el | m | Joint moment arm, z-component | Global |  |
| mbd.fxj8.Mx | -mbd.fxj8.RFy\*mbd.fxj8.rz | N·m | Joint moment, x-component | Global | + operation |
| mbd.fxj8.My | mbd.fxj8.RFx\*mbd.fxj8.rz | N·m | Joint moment, y-component | Global | + operation |
| mbd.fxj8.Mz | mbd.fxj8.Rphi+mbd.fxj8.RFy\*mbd.fxj8.rx-mbd.fxj8.RFx\*mbd.fxj8.ry | N·m | Joint moment, z-component | Global | + operation |
| mbd.fxj8.Fl1 | mbd.fxj8.Fx\*mbd.fxj8.e1x+mbd.fxj8.Fy\*mbd.fxj8.e1y+mbd.fxj8.Fz\*mbd.fxj8.e1z | N | Joint force, local coordinate system, 1 component | Global |  |
| mbd.fxj8.Fl2 | mbd.fxj8.Fx\*mbd.fxj8.e2x+mbd.fxj8.Fy\*mbd.fxj8.e2y+mbd.fxj8.Fz\*mbd.fxj8.e2z | N | Joint force, local coordinate system, 2 component | Global |  |
| mbd.fxj8.Fl3 | mbd.fxj8.Fx\*mbd.fxj8.e3x+mbd.fxj8.Fy\*mbd.fxj8.e3y+mbd.fxj8.Fz\*mbd.fxj8.e3z | N | Joint force, local coordinate system, 3 component | Global |  |
| mbd.fxj8.Ml1 | mbd.fxj8.Mx\*mbd.fxj8.e1x+mbd.fxj8.My\*mbd.fxj8.e1y+mbd.fxj8.Mz\*mbd.fxj8.e1z | N·m | Joint moment, local coordinate system, 1 component | Global |  |
| mbd.fxj8.Ml2 | mbd.fxj8.Mx\*mbd.fxj8.e2x+mbd.fxj8.My\*mbd.fxj8.e2y+mbd.fxj8.Mz\*mbd.fxj8.e2z | N·m | Joint moment, local coordinate system, 2 component | Global |  |
| mbd.fxj8.Ml3 | mbd.fxj8.Mx\*mbd.fxj8.e3x+mbd.fxj8.My\*mbd.fxj8.e3y+mbd.fxj8.Mz\*mbd.fxj8.e3z | N·m | Joint moment, local coordinate system, 3 component | Global |  |

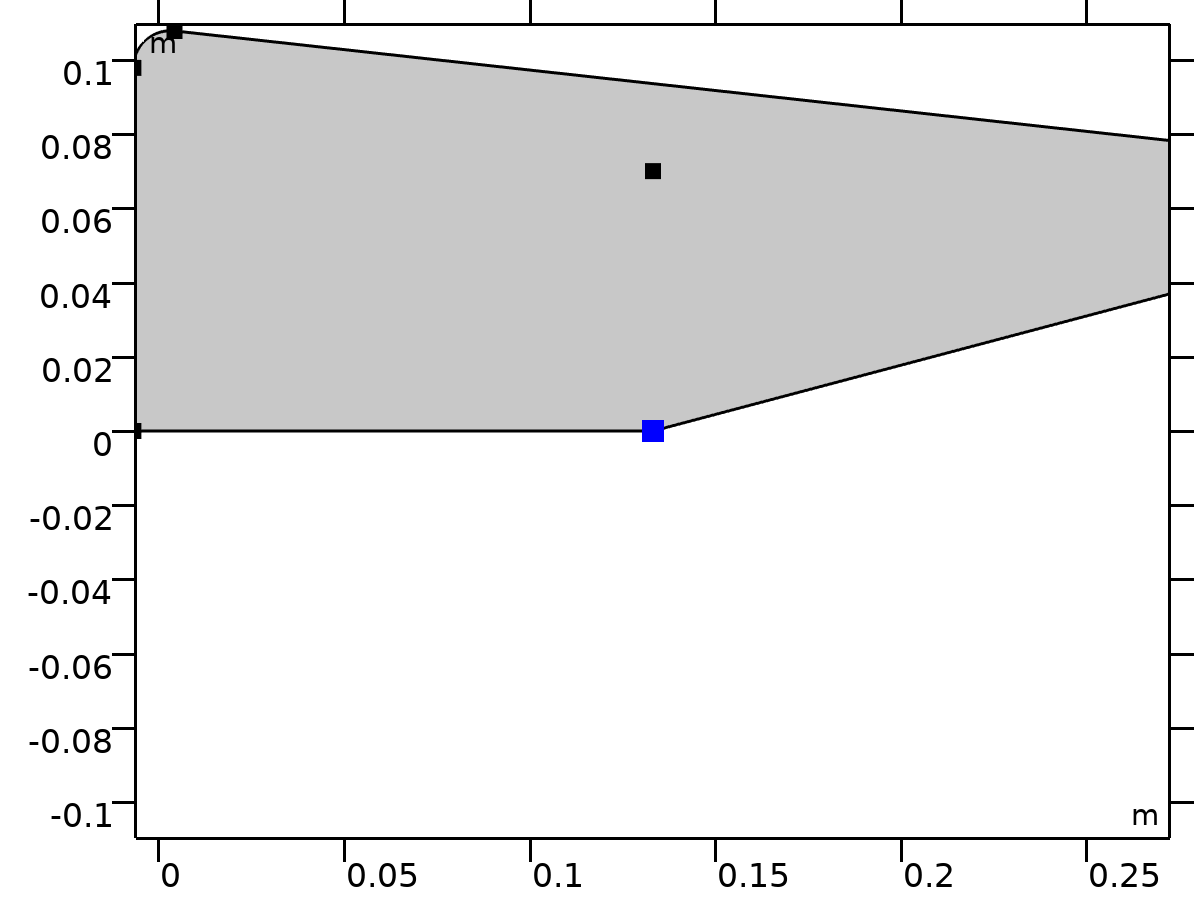
#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj8.RFx | ODE | N | Reaction force, x-component |  | Global |
| mbd.fxj8.RFy | ODE | N | Reaction force, y-component |  | Global |
| mbd.fxj8.Rphi | ODE | N·m | Reaction moment |  | Global |

#### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| (mbd.fxj8.uc\_src-mbd.fxj8.uc\_dest)\*test(-mbd.fxj8.RFx)-test(mbd.fxj8.u\_el-mbd.fxj8.uc\_dest)\*mbd.fxj8.RFx | 2 |  | Global |
| (mbd.fxj8.vc\_src-mbd.fxj8.vc\_dest)\*test(-mbd.fxj8.RFy)-test(mbd.fxj8.v\_el-mbd.fxj8.vc\_dest)\*mbd.fxj8.RFy | 2 |  | Global |
| (mbd.fxj8.phi\_src-mbd.fxj8.phi\_dest)\*test(-mbd.fxj8.Rphi)-test(mbd.fxj8.phi\_src-mbd.fxj8.phi\_dest)\*mbd.fxj8.Rphi | 2 |  | Global |

#### Center of Joint: Point 8



Center of Joint: Point 8

Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Point 61 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj8.xcx | mbd.fxj8.cjp1.int(X)/mbd.fxj8.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj8.xcy | mbd.fxj8.cjp1.int(Y)/mbd.fxj8.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj8.xcz | mbd.fxj8.cjp1.int(0)/mbd.fxj8.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

#### Joint Elasticity 8

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

Equations

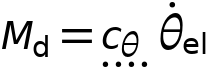












##### Elastic Degrees of Freedom

Settings

| **Description** | **Value** |
| --- | --- |
| First axis | On |
| Second axis | On |
| Third axis | On |

##### Spring

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Spring constant, xx-component | {kh8, kv8, 0} | N/m |
| Spring constant | 0 | N·m/rad |

##### Viscous Damping

Settings

| **Description** | **Value** | **Unit** |
| --- | --- | --- |
| Translational-rotational coupling | Off |  |
| Damping coefficient, xx-component | if(i\_c==1, cv8, 0) | N·s/m |
| Damping coefficient | 0 | N·m·s/rad |

##### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Joint coordinate system |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.Ws\_tot | mbd.fxj8.Ws\_el | J | Total elastic strain energy | Global | + operation |
| mbd.fxj8.u\_el | mbd.fxj8.u1\*mbd.fxj8.e1x+mbd.fxj8.u2\*mbd.fxj8.e2x | m | Relative displacement (elastic), x-component | Global | + operation |
| mbd.fxj8.v\_el | mbd.fxj8.u1\*mbd.fxj8.e1y+mbd.fxj8.u2\*mbd.fxj8.e2y | m | Relative displacement (elastic), y-component | Global | + operation |
| mbd.fxj8.w\_el | mbd.fxj8.u1\*mbd.fxj8.e1z+mbd.fxj8.u2\*mbd.fxj8.e2z | m | Relative displacement (elastic), z-component | Global | + operation |
| mbd.fxj8.th\_el | mbd.fxj8.th | rad | Relative rotation (elastic) | Global | + operation |
| mbd.fxj8.je1.k\_u11 | kh8 | N/m | Spring constant, xx-component | Global |  |
| mbd.fxj8.je1.k\_u21 | 0 | N/m | Spring constant, yx-component | Global |  |
| mbd.fxj8.je1.k\_u31 | 0 | N/m | Spring constant, zx-component | Global |  |
| mbd.fxj8.je1.k\_u12 | 0 | N/m | Spring constant, xy-component | Global |  |
| mbd.fxj8.je1.k\_u22 | kv8 | N/m | Spring constant, yy-component | Global |  |
| mbd.fxj8.je1.k\_u32 | 0 | N/m | Spring constant, zy-component | Global |  |
| mbd.fxj8.je1.k\_u13 | 0 | N/m | Spring constant, xz-component | Global |  |
| mbd.fxj8.je1.k\_u23 | 0 | N/m | Spring constant, yz-component | Global |  |
| mbd.fxj8.je1.k\_u33 | 0 | N/m | Spring constant, zz-component | Global |  |
| mbd.fxj8.je1.k\_th | 0 | N·m/rad | Spring constant | Global |  |
| mbd.fxj8.je1.c\_u11 | if(i\_c==1,cv8,0) | N·s/m | Damping coefficient, xx-component | Global |  |
| mbd.fxj8.je1.c\_u21 | 0 | N·s/m | Damping coefficient, yx-component | Global |  |
| mbd.fxj8.je1.c\_u31 | 0 | N·s/m | Damping coefficient, zx-component | Global |  |
| mbd.fxj8.je1.c\_u12 | 0 | N·s/m | Damping coefficient, xy-component | Global |  |
| mbd.fxj8.je1.c\_u22 | if(i\_c==1,cv8,0) | N·s/m | Damping coefficient, yy-component | Global |  |
| mbd.fxj8.je1.c\_u32 | 0 | N·s/m | Damping coefficient, zy-component | Global |  |
| mbd.fxj8.je1.c\_u13 | 0 | N·s/m | Damping coefficient, xz-component | Global |  |
| mbd.fxj8.je1.c\_u23 | 0 | N·s/m | Damping coefficient, yz-component | Global |  |
| mbd.fxj8.je1.c\_u33 | if(i\_c==1,cv8,0) | N·s/m | Damping coefficient, zz-component | Global |  |
| mbd.fxj8.je1.c\_th | 0 | N·m·s/rad | Damping coefficient | Global |  |
| mbd.fxj8.u1 | mbd.fxj8.U1 | m | Relative displacement along joint axis | Global |  |
| mbd.fxj8.u2 | mbd.fxj8.U2 | m | Relative displacement along second axis | Global |  |
| mbd.fxj8.th | mbd.fxj8.Th | rad | Relative rotation | Global |  |
| mbd.fxj8.kl\_u11 | mbd.fxj8.je1.k\_u11 | N/m | Spring constant, joint coordinate system, 11-component | Global |  |
| mbd.fxj8.kl\_u21 | mbd.fxj8.je1.k\_u21 | N/m | Spring constant, joint coordinate system, 21-component | Global |  |
| mbd.fxj8.kl\_u31 | mbd.fxj8.je1.k\_u31 | N/m | Spring constant, joint coordinate system, 31-component | Global |  |
| mbd.fxj8.kl\_u12 | mbd.fxj8.je1.k\_u12 | N/m | Spring constant, joint coordinate system, 12-component | Global |  |
| mbd.fxj8.kl\_u22 | mbd.fxj8.je1.k\_u22 | N/m | Spring constant, joint coordinate system, 22-component | Global |  |
| mbd.fxj8.kl\_u32 | mbd.fxj8.je1.k\_u32 | N/m | Spring constant, joint coordinate system, 32-component | Global |  |
| mbd.fxj8.kl\_u13 | mbd.fxj8.je1.k\_u13 | N/m | Spring constant, joint coordinate system, 13-component | Global |  |
| mbd.fxj8.kl\_u23 | mbd.fxj8.je1.k\_u23 | N/m | Spring constant, joint coordinate system, 23-component | Global |  |
| mbd.fxj8.kl\_u33 | mbd.fxj8.je1.k\_u33 | N/m | Spring constant, joint coordinate system, 33-component | Global |  |
| mbd.fxj8.cl\_u11 | mbd.fxj8.je1.c\_u11 | N·s/m | Damping coefficient, joint coordinate system, 11-component | Global |  |
| mbd.fxj8.cl\_u21 | mbd.fxj8.je1.c\_u21 | N·s/m | Damping coefficient, joint coordinate system, 21-component | Global |  |
| mbd.fxj8.cl\_u31 | mbd.fxj8.je1.c\_u31 | N·s/m | Damping coefficient, joint coordinate system, 31-component | Global |  |
| mbd.fxj8.cl\_u12 | mbd.fxj8.je1.c\_u12 | N·s/m | Damping coefficient, joint coordinate system, 12-component | Global |  |
| mbd.fxj8.cl\_u22 | mbd.fxj8.je1.c\_u22 | N·s/m | Damping coefficient, joint coordinate system, 22-component | Global |  |
| mbd.fxj8.cl\_u32 | mbd.fxj8.je1.c\_u32 | N·s/m | Damping coefficient, joint coordinate system, 32-component | Global |  |
| mbd.fxj8.cl\_u13 | mbd.fxj8.je1.c\_u13 | N·s/m | Damping coefficient, joint coordinate system, 13-component | Global |  |
| mbd.fxj8.cl\_u23 | mbd.fxj8.je1.c\_u23 | N·s/m | Damping coefficient, joint coordinate system, 23-component | Global |  |
| mbd.fxj8.cl\_u33 | mbd.fxj8.je1.c\_u33 | N·s/m | Damping coefficient, joint coordinate system, 33-component | Global |  |
| mbd.fxj8.ul\_el | mbd.fxj8.u1 | m | Relative displacement (elastic), joint coordinate system, 1-component | Global | + operation |
| mbd.fxj8.vl\_el | mbd.fxj8.u2 | m | Relative displacement (elastic), joint coordinate system, 2-component | Global | + operation |
| mbd.fxj8.wl\_el | 0 | m | Relative displacement (elastic), joint coordinate system, 3-component | Global | + operation |
| mbd.fxj8.Fs\_el1 | mbd.fxj8.kl\_u11\*mbd.fxj8.ul\_el+mbd.fxj8.kl\_u12\*mbd.fxj8.vl\_el+mbd.fxj8.kl\_u13\*mbd.fxj8.wl\_el | N | Spring force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj8.Fs\_el2 | mbd.fxj8.kl\_u21\*mbd.fxj8.ul\_el+mbd.fxj8.kl\_u22\*mbd.fxj8.vl\_el+mbd.fxj8.kl\_u23\*mbd.fxj8.wl\_el | N | Spring force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj8.Fs\_el3 | mbd.fxj8.kl\_u31\*mbd.fxj8.ul\_el+mbd.fxj8.kl\_u32\*mbd.fxj8.vl\_el+mbd.fxj8.kl\_u33\*mbd.fxj8.wl\_el | N | Spring force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj8.Ms\_el | mbd.fxj8.je1.k\_th\*mbd.fxj8.th\_el | N·m | Spring moment, joint coordinate system | Global | + operation |
| mbd.fxj8.Fd\_el1 | (mbd.fxj8.cl\_u11\*mbd.fxj8.ul\_el+mbd.fxj8.cl\_u12\*mbd.fxj8.vl\_el+mbd.fxj8.cl\_u13\*mbd.fxj8.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 1-component | Global | + operation |
| mbd.fxj8.Fd\_el2 | (mbd.fxj8.cl\_u21\*mbd.fxj8.ul\_el+mbd.fxj8.cl\_u22\*mbd.fxj8.vl\_el+mbd.fxj8.cl\_u23\*mbd.fxj8.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 2-component | Global | + operation |
| mbd.fxj8.Fd\_el3 | (mbd.fxj8.cl\_u31\*mbd.fxj8.ul\_el+mbd.fxj8.cl\_u32\*mbd.fxj8.vl\_el+mbd.fxj8.cl\_u33\*mbd.fxj8.wl\_el)\*mbd.iomega | N | Damping force, joint coordinate system, 3-component | Global | + operation |
| mbd.fxj8.Md\_el | mbd.fxj8.je1.c\_th\*mbd.fxj8.th\_el\*mbd.iomega | N·m | Damping moment, joint coordinate system | Global | + operation |
| mbd.fxj8.Fl\_el1 | -mbd.fxj8.Fd\_el1-mbd.fxj8.Fs\_el1 | N | Joint force (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj8.Fl\_el2 | -mbd.fxj8.Fd\_el2-mbd.fxj8.Fs\_el2 | N | Joint force (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj8.Fl\_el3 | -mbd.fxj8.Fd\_el3-mbd.fxj8.Fs\_el3 | N | Joint force (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj8.Ml\_el1 | 0 | N·m | Joint moment (elastic), local coordinate system, 1-component | Global | + operation |
| mbd.fxj8.Ml\_el2 | 0 | N·m | Joint moment (elastic), local coordinate system, 2-component | Global | + operation |
| mbd.fxj8.Ml\_el3 | -mbd.fxj8.Md\_el-mbd.fxj8.Ms\_el | N·m | Joint moment (elastic), local coordinate system, 3-component | Global | + operation |
| mbd.fxj8.F\_elx | mbd.fxj8.e1x\*mbd.fxj8.Fl\_el1+mbd.fxj8.e2x\*mbd.fxj8.Fl\_el2+mbd.fxj8.e3x\*mbd.fxj8.Fl\_el3 | N | Joint force (elastic), x-component | Global |  |
| mbd.fxj8.F\_ely | mbd.fxj8.e1y\*mbd.fxj8.Fl\_el1+mbd.fxj8.e2y\*mbd.fxj8.Fl\_el2+mbd.fxj8.e3y\*mbd.fxj8.Fl\_el3 | N | Joint force (elastic), y-component | Global |  |
| mbd.fxj8.F\_elz | mbd.fxj8.e1z\*mbd.fxj8.Fl\_el1+mbd.fxj8.e2z\*mbd.fxj8.Fl\_el2+mbd.fxj8.e3z\*mbd.fxj8.Fl\_el3 | N | Joint force (elastic), z-component | Global |  |
| mbd.fxj8.M\_elx | mbd.fxj8.e1x\*mbd.fxj8.Ml\_el1+mbd.fxj8.e2x\*mbd.fxj8.Ml\_el2+mbd.fxj8.e3x\*mbd.fxj8.Ml\_el3 | N·m | Joint moment (elastic), x-component | Global |  |
| mbd.fxj8.M\_ely | mbd.fxj8.e1y\*mbd.fxj8.Ml\_el1+mbd.fxj8.e2y\*mbd.fxj8.Ml\_el2+mbd.fxj8.e3y\*mbd.fxj8.Ml\_el3 | N·m | Joint moment (elastic), y-component | Global |  |
| mbd.fxj8.M\_elz | mbd.fxj8.e1z\*mbd.fxj8.Ml\_el1+mbd.fxj8.e2z\*mbd.fxj8.Ml\_el2+mbd.fxj8.e3z\*mbd.fxj8.Ml\_el3 | N·m | Joint moment (elastic), z-component | Global |  |
| mbd.fxj8.Ws\_el | 0.25\*(realdot(mbd.fxj8.Fs\_el1,mbd.fxj8.ul\_el)+realdot(mbd.fxj8.Fs\_el2,mbd.fxj8.vl\_el)+realdot(mbd.fxj8.Fs\_el3,mbd.fxj8.wl\_el)+realdot(mbd.fxj8.Ms\_el,mbd.fxj8.th\_el)) | J | Energy stored in spring | Global |  |
| mbd.fxj8.Qd\_el | 0.5\*mbd.omega^2\*(realdot(mbd.fxj8.Fd\_el1/mbd.iomega,mbd.fxj8.ul\_el)+realdot(mbd.fxj8.Fd\_el2/mbd.iomega,mbd.fxj8.vl\_el)+realdot(mbd.fxj8.Fd\_el3/mbd.iomega,mbd.fxj8.wl\_el)+realdot(mbd.fxj8.Md\_el/mbd.iomega,mbd.fxj8.th\_el)) | W | Energy dissipation rate in damper | Global |  |

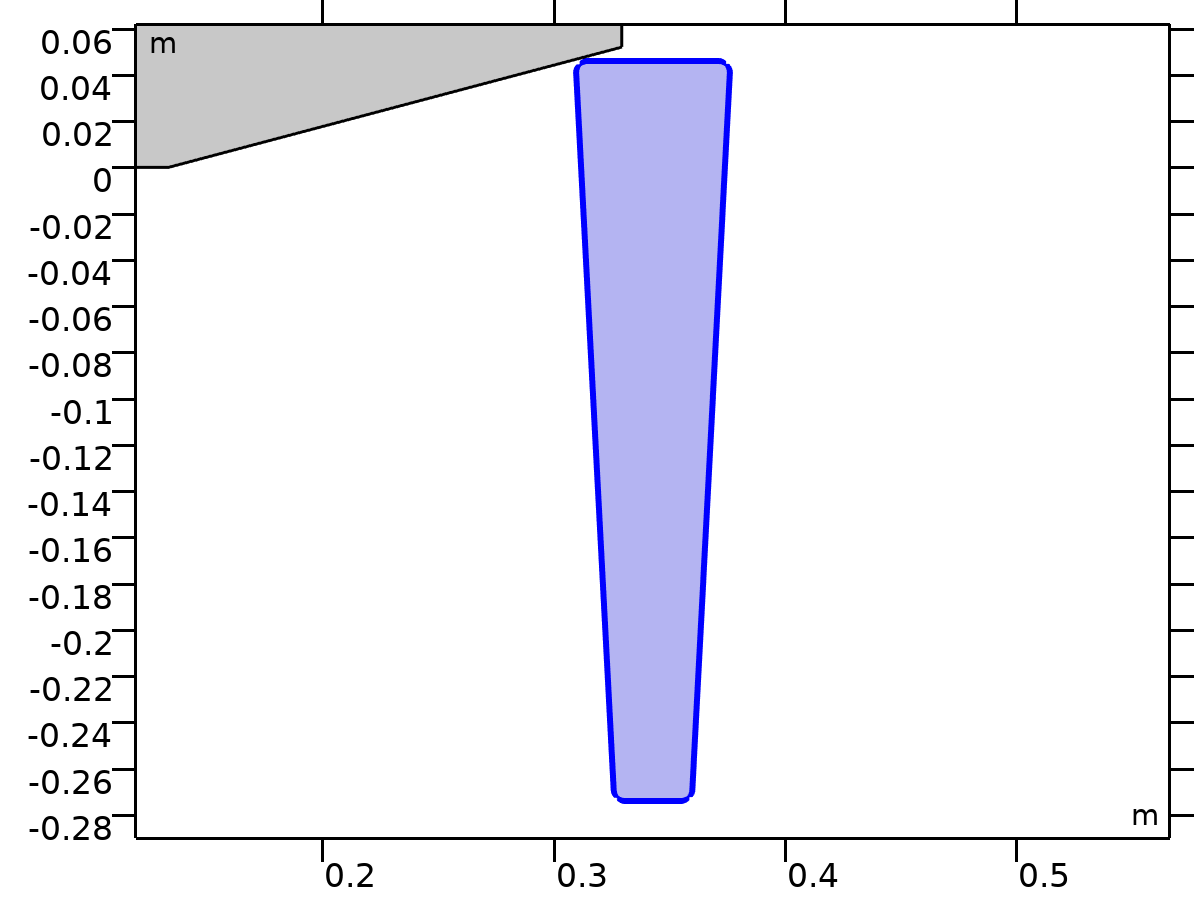
##### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj8.U1 | ODE | m | Relative displacement along joint axis |  | Global |
| mbd.fxj8.U2 | ODE | m | Relative displacement along second axis |  | Global |
| mbd.fxj8.Th | ODE | rad | Relative rotation |  | Global |

##### Weak Expressions

| **Weak expression** | **Integration order** | **Integration frame** | **Selection** |
| --- | --- | --- | --- |
| mbd.fxj8.Fl\_el1\*test(mbd.fxj8.ul\_el)+mbd.fxj8.Fl\_el2\*test(mbd.fxj8.vl\_el)+mbd.fxj8.Fl\_el3\*test(mbd.fxj8.wl\_el) | 2 |  | Global |
| mbd.fxj8.Ml\_el3\*test(mbd.fxj8.th\_el) | 2 |  | Global |

### Seat-Leg



Seat-Leg

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

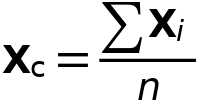
Equations











#### Attachment Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Source | Seat |
| Destination | Leg |
| Use selection filter | Off |

#### Center of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Center of joint | Centroid of selected entities |
| Entity level | Point |
| Offset | Off |

#### Axis of Joint

Settings

| **Description** | **Value** |
| --- | --- |
| Axis of joint | Specify direction |
| Axis of joint, x-component | 1 |
| Axis of joint, y-component | 0 |
| Axis of joint, z-component | 0 |

#### Joint Elasticity

Settings

| **Description** | **Value** |
| --- | --- |
| Joint elasticity | Rigid joint |

#### Joint Forces and Moments

Settings

| **Description** | **Value** |
| --- | --- |
| Joint forces and moments | Do not compute |

#### Coordinate System Selection

Settings

| **Description** | **Value** |
| --- | --- |
| Coordinate system | Global coordinate system |

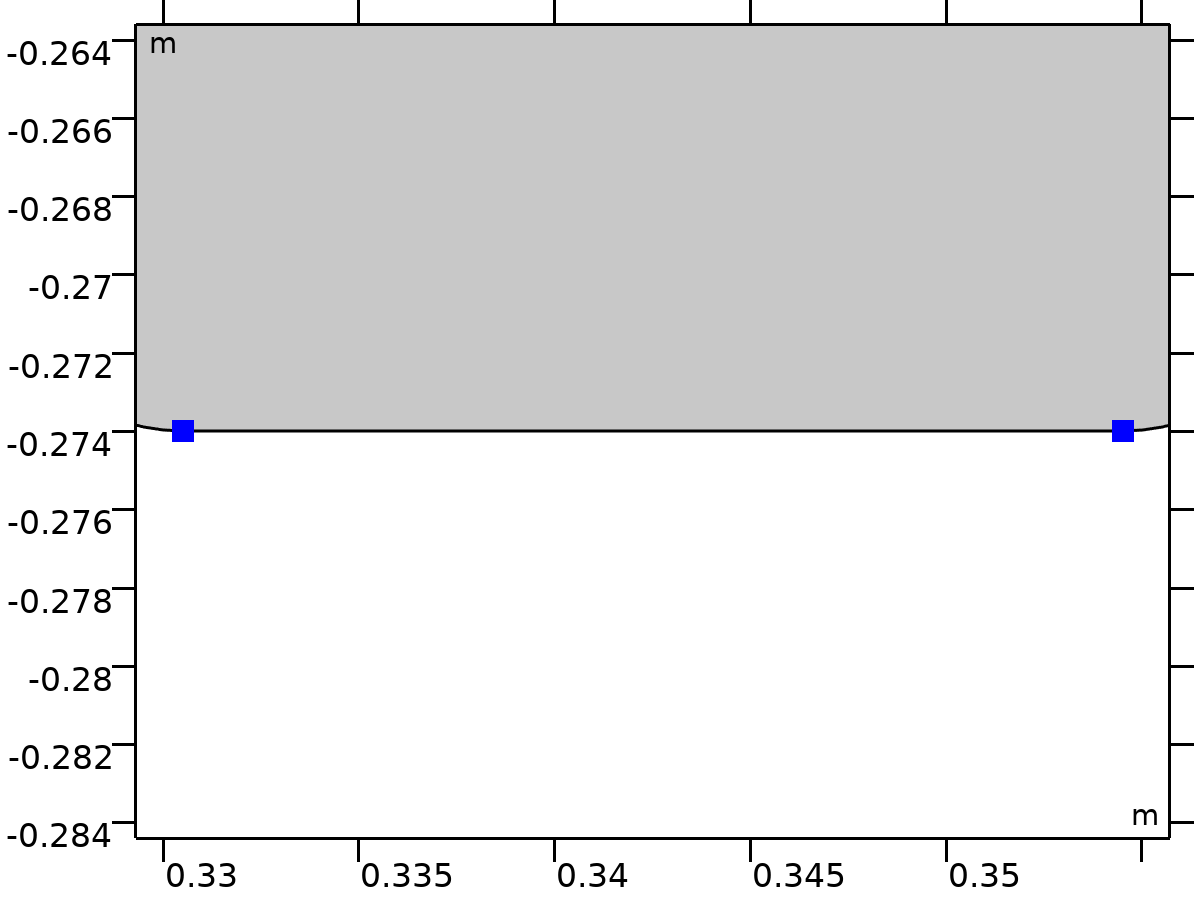
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| mbd.fxj9.e10x | 1 | 1 | Initial joint axis, x-component | Global |
| mbd.fxj9.e10y | 0 | 1 | Initial joint axis, y-component | Global |
| mbd.fxj9.e10z | 0 | 1 | Initial joint axis, z-component | Global |
| mbd.fxj9.e20x | (mbd.fxj9.e10z\*mbd.fxj9.e30y-mbd.fxj9.e10y\*mbd.fxj9.e30z)/sqrt((mbd.fxj9.e10z\*mbd.fxj9.e30y-mbd.fxj9.e10y\*mbd.fxj9.e30z)^2+(-mbd.fxj9.e10z\*mbd.fxj9.e30x+mbd.fxj9.e10x\*mbd.fxj9.e30z)^2+(mbd.fxj9.e10y\*mbd.fxj9.e30x-mbd.fxj9.e10x\*mbd.fxj9.e30y)^2) | 1 | Initial second axis, x-component | Global |
| mbd.fxj9.e20y | (-mbd.fxj9.e10z\*mbd.fxj9.e30x+mbd.fxj9.e10x\*mbd.fxj9.e30z)/sqrt((mbd.fxj9.e10z\*mbd.fxj9.e30y-mbd.fxj9.e10y\*mbd.fxj9.e30z)^2+(-mbd.fxj9.e10z\*mbd.fxj9.e30x+mbd.fxj9.e10x\*mbd.fxj9.e30z)^2+(mbd.fxj9.e10y\*mbd.fxj9.e30x-mbd.fxj9.e10x\*mbd.fxj9.e30y)^2) | 1 | Initial second axis, y-component | Global |
| mbd.fxj9.e20z | (mbd.fxj9.e10y\*mbd.fxj9.e30x-mbd.fxj9.e10x\*mbd.fxj9.e30y)/sqrt((mbd.fxj9.e10z\*mbd.fxj9.e30y-mbd.fxj9.e10y\*mbd.fxj9.e30z)^2+(-mbd.fxj9.e10z\*mbd.fxj9.e30x+mbd.fxj9.e10x\*mbd.fxj9.e30z)^2+(mbd.fxj9.e10y\*mbd.fxj9.e30x-mbd.fxj9.e10x\*mbd.fxj9.e30y)^2) | 1 | Initial second axis, z-component | Global |
| mbd.fxj9.e30x | 0 | 1 | Initial third axis, x-component | Global |
| mbd.fxj9.e30y | 0 | 1 | Initial third axis, y-component | Global |
| mbd.fxj9.e30z | 1 | 1 | Initial third axis, z-component | Global |
| mbd.fxj9.e1x | mbd.fxj9.rot\_srcxx\*mbd.fxj9.e10x+mbd.fxj9.rot\_srcxy\*mbd.fxj9.e10y+mbd.fxj9.rot\_srcxz\*mbd.fxj9.e10z | 1 | Joint axis, x-component | Global |
| mbd.fxj9.e1y | mbd.fxj9.rot\_srcyx\*mbd.fxj9.e10x+mbd.fxj9.rot\_srcyy\*mbd.fxj9.e10y+mbd.fxj9.rot\_srcyz\*mbd.fxj9.e10z | 1 | Joint axis, y-component | Global |
| mbd.fxj9.e1z | mbd.fxj9.rot\_srczx\*mbd.fxj9.e10x+mbd.fxj9.rot\_srczy\*mbd.fxj9.e10y+mbd.fxj9.rot\_srczz\*mbd.fxj9.e10z | 1 | Joint axis, z-component | Global |
| mbd.fxj9.e2x | mbd.fxj9.rot\_srcxx\*mbd.fxj9.e20x+mbd.fxj9.rot\_srcxy\*mbd.fxj9.e20y+mbd.fxj9.rot\_srcxz\*mbd.fxj9.e20z | 1 | Second axis, x-component | Global |
| mbd.fxj9.e2y | mbd.fxj9.rot\_srcyx\*mbd.fxj9.e20x+mbd.fxj9.rot\_srcyy\*mbd.fxj9.e20y+mbd.fxj9.rot\_srcyz\*mbd.fxj9.e20z | 1 | Second axis, y-component | Global |
| mbd.fxj9.e2z | mbd.fxj9.rot\_srczx\*mbd.fxj9.e20x+mbd.fxj9.rot\_srczy\*mbd.fxj9.e20y+mbd.fxj9.rot\_srczz\*mbd.fxj9.e20z | 1 | Second axis, z-component | Global |
| mbd.fxj9.e3x | mbd.fxj9.rot\_srcxx\*mbd.fxj9.e30x+mbd.fxj9.rot\_srcxy\*mbd.fxj9.e30y+mbd.fxj9.rot\_srcxz\*mbd.fxj9.e30z | 1 | Third axis, x-component | Global |
| mbd.fxj9.e3y | mbd.fxj9.rot\_srcyx\*mbd.fxj9.e30x+mbd.fxj9.rot\_srcyy\*mbd.fxj9.e30y+mbd.fxj9.rot\_srcyz\*mbd.fxj9.e30z | 1 | Third axis, y-component | Global |
| mbd.fxj9.e3z | mbd.fxj9.rot\_srczx\*mbd.fxj9.e30x+mbd.fxj9.rot\_srczy\*mbd.fxj9.e30y+mbd.fxj9.rot\_srczz\*mbd.fxj9.e30z | 1 | Third axis, z-component | Global |
| mbd.fxj9.uc\_src | mbd.bsm1.u | m | Source displacement at center of joint, x-component | Global |
| mbd.fxj9.vc\_src | mbd.bsm1.v | m | Source displacement at center of joint, y-component | Global |
| mbd.fxj9.wc\_src | 0 | m | Source displacement at center of joint, z-component | Global |
| mbd.fxj9.uc\_dest | mbd.rd6.rotxx\*(mbd.fxj9.xcx-mbd.rd6.xcx)+mbd.rd6.rotxy\*(mbd.fxj9.xcy-mbd.rd6.xcy)+mbd.rd6.rotxz\*(mbd.fxj9.xcz-mbd.rd6.xcz)-mbd.fxj9.xcx+mbd.rd6.xcx+mbd.rd6.u | m | Destination displacement at center of joint, x-component | Global |
| mbd.fxj9.vc\_dest | mbd.rd6.rotyx\*(mbd.fxj9.xcx-mbd.rd6.xcx)+mbd.rd6.rotyy\*(mbd.fxj9.xcy-mbd.rd6.xcy)+mbd.rd6.rotyz\*(mbd.fxj9.xcz-mbd.rd6.xcz)-mbd.fxj9.xcy+mbd.rd6.xcy+mbd.rd6.v | m | Destination displacement at center of joint, y-component | Global |
| mbd.fxj9.wc\_dest | mbd.rd6.rotzx\*(mbd.fxj9.xcx-mbd.rd6.xcx)+mbd.rd6.rotzy\*(mbd.fxj9.xcy-mbd.rd6.xcy)+mbd.rd6.rotzz\*(mbd.fxj9.xcz-mbd.rd6.xcz)-mbd.fxj9.xcz+mbd.rd6.xcz | m | Destination displacement at center of joint, z-component | Global |
| mbd.fxj9.phi\_src | 0 | rad | Source rotation | Global |
| mbd.fxj9.phi\_dest | mbd.rd6.phi | rad | Destination rotation | Global |
| mbd.fxj9.rot\_srcxx | 1 | 1 | Source rotation matrix, xx-component | Global |
| mbd.fxj9.rot\_srcyx | 0 | 1 | Source rotation matrix, yx-component | Global |
| mbd.fxj9.rot\_srczx | 0 | 1 | Source rotation matrix, zx-component | Global |
| mbd.fxj9.rot\_srcxy | 0 | 1 | Source rotation matrix, xy-component | Global |
| mbd.fxj9.rot\_srcyy | 1 | 1 | Source rotation matrix, yy-component | Global |
| mbd.fxj9.rot\_srczy | 0 | 1 | Source rotation matrix, zy-component | Global |
| mbd.fxj9.rot\_srcxz | 0 | 1 | Source rotation matrix, xz-component | Global |
| mbd.fxj9.rot\_srcyz | 0 | 1 | Source rotation matrix, yz-component | Global |
| mbd.fxj9.rot\_srczz | 1 | 1 | Source rotation matrix, zz-component | Global |

#### Constraints

| **Constraint** | **Constraint force** | **Shape function** | **Selection** | **Details** |
| --- | --- | --- | --- | --- |
| mbd.fxj9.uc\_src-mbd.fxj9.uc\_dest | test(-mbd.fxj9.uc\_dest) |  | Global | Elemental |
| mbd.fxj9.vc\_src-mbd.fxj9.vc\_dest | test(-mbd.fxj9.vc\_dest) |  | Global | Elemental |
| mbd.fxj9.phi\_src-mbd.fxj9.phi\_dest | test(mbd.fxj9.phi\_src-mbd.fxj9.phi\_dest) |  | Global | Elemental |

#### Center of Joint: Point 9



Center of Joint: Point 9

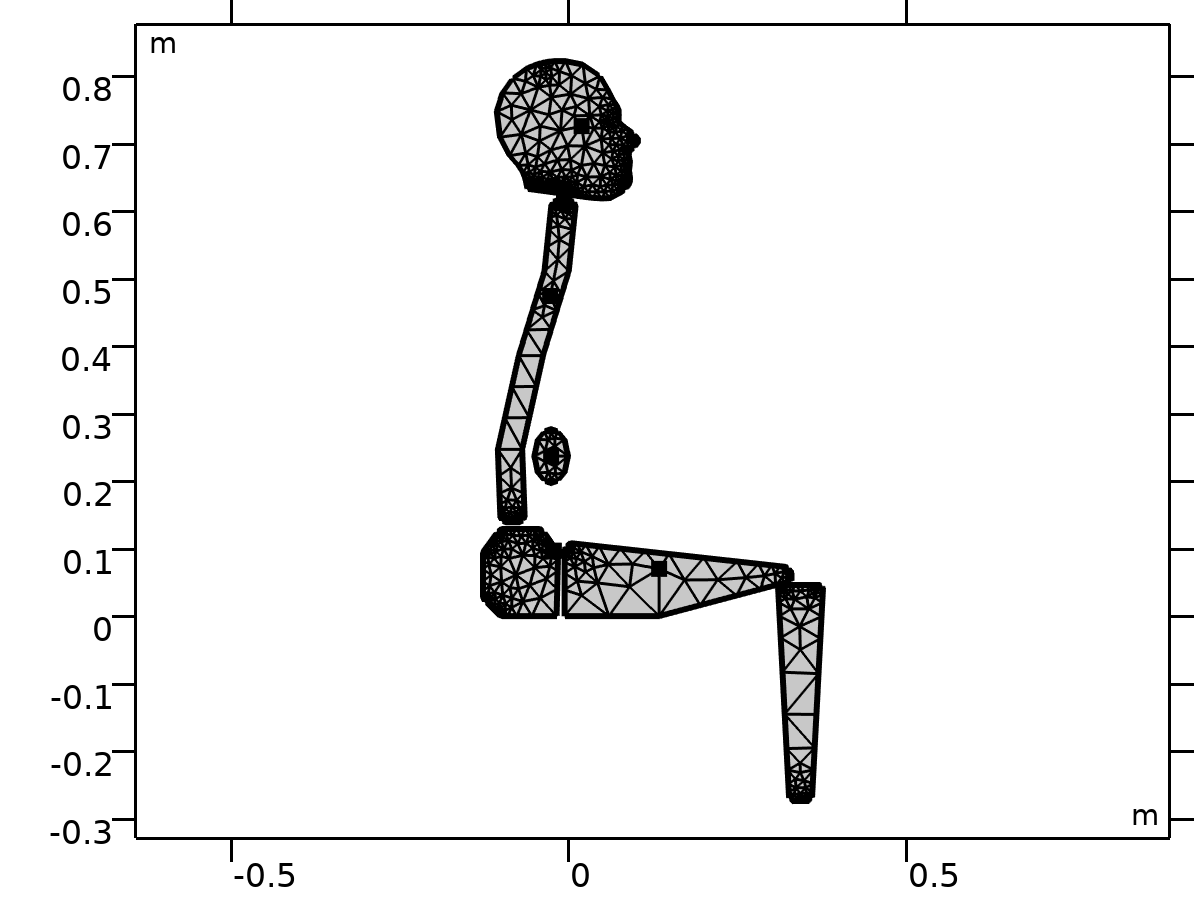
Selection

|  |  |
| --- | --- |
| Geometric entity level | Point |
| Selection | Geometry geom1: Dimension 0: Points 69–70 |

##### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** | **Details** |
| --- | --- | --- | --- | --- | --- |
| mbd.fxj9.xcx | mbd.fxj9.cjp1.int(X)/mbd.fxj9.cjp1.int(1) | m | Center of joint, x-component | Global | + operation |
| mbd.fxj9.xcy | mbd.fxj9.cjp1.int(Y)/mbd.fxj9.cjp1.int(1) | m | Center of joint, y-component | Global | + operation |
| mbd.fxj9.xcz | mbd.fxj9.cjp1.int(0)/mbd.fxj9.cjp1.int(1) | m | Center of joint, z-component | Global | + operation |

## Mesh 1



Mesh 1

Mesh statistics

| **Description** | **Value** |
| --- | --- |
| Status | Complete mesh |
| Mesh vertices | 873 |
| Triangles | 1451 |
| Edge elements | 283 |
| Vertex elements | 73 |
| Number of elements | 1451 |
| Minimum element quality | 0.5466 |
| Average element quality | 0.7928 |
| Element area ratio | 5.6069E-5 |
| Mesh area | 0.1061 m² |

### Size (size)

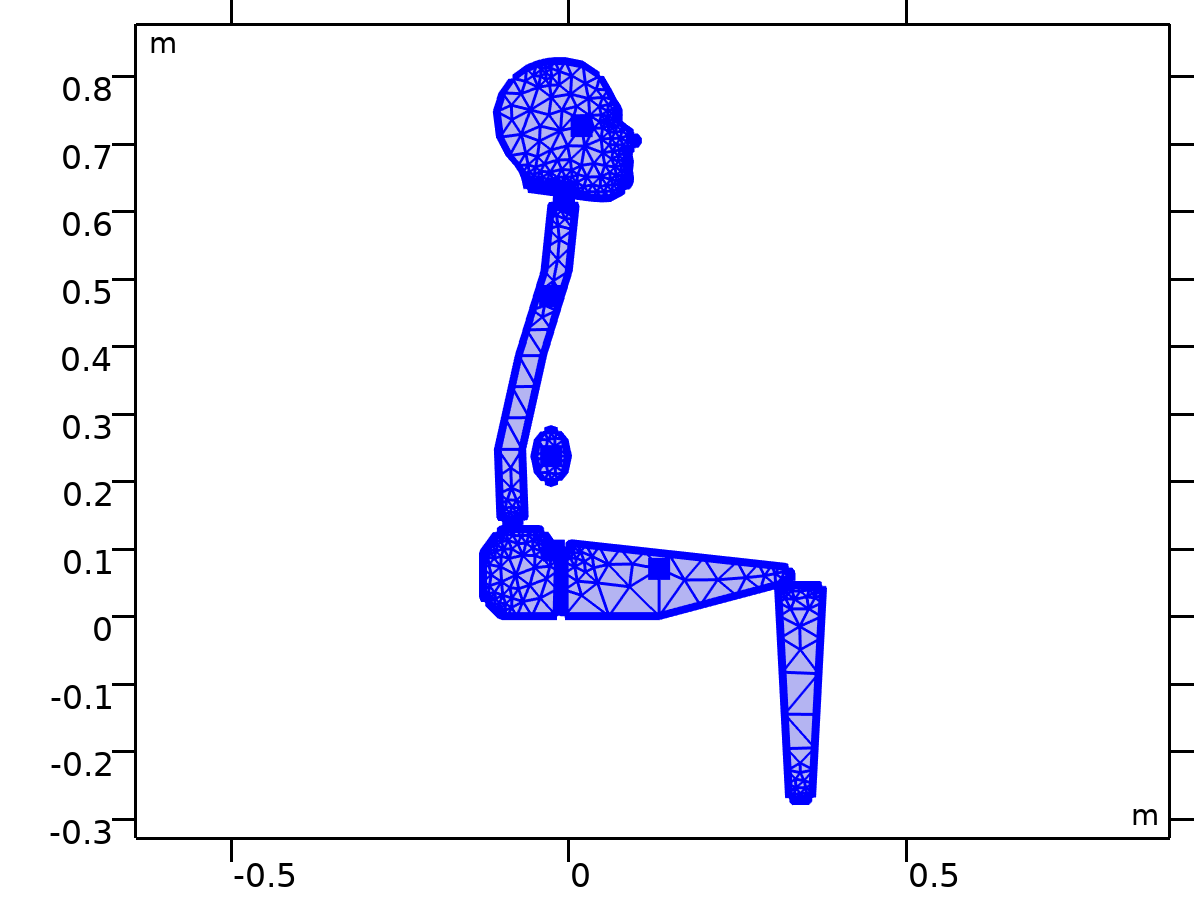
Settings

| **Description** | **Value** |
| --- | --- |
| Maximum element size | 0.143 |
| Minimum element size | 0.00658 |
| Curvature factor | 0.6 |
| Maximum element growth rate | 1.5 |
| Predefined size | Coarser |

### Free Triangular 1 (ftri1)

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Remaining |



Free Triangular 1

Settings

| **Description** | **Value** |
| --- | --- |
| Number of iterations | 4 |
| Maximum element depth to process | 4 |

Information

| **Description** | **Value** |
| --- | --- |
| Last build time | < 1 second |
| Built with | COMSOL 6.2.0.290 (win64), Dec 16, 2024, 1:31:38 PM |

# Study 1: Eigenfrequency

Computation information

|  |  |
| --- | --- |
| Computation time | 9 s |

## Parametric Sweep

| **Parameter name** | **Parameter value list** |
| --- | --- |
| i\_c | 0 1 |

Study settings

| **Description** | **Value** |
| --- | --- |
| Sweep type | Specified combinations |
| Parameter name | i\_c |
| Unit |  |

Parameters

| **Parameter name** | **Parameter value list** | **Parameter unit** |
| --- | --- | --- |
| i\_c (Damping controller) | 0 1 |  |

## Eigenfrequency

Study settings

| **Description** | **Value** |
| --- | --- |
| Include geometric nonlinearity | Off |

Study settings

| **Description** | **Value** |
| --- | --- |
| Desired number of eigenfrequencies | 12 |
| Desired number of eigenfrequencies | On |
| Search for eigenfrequencies around shift | 0[Hz] |

Physics and variables selection

| **Physics interface** | **Solve for** | **Equation form** |
| --- | --- | --- |
| Multibody Dynamics (mbd) | On | Automatic (Eigenfrequency) |

Store in output

| **Interface** | **Output** | **Selection** |
| --- | --- | --- |
| Multibody Dynamics (mbd) | Physics controlled |  |

Mesh selection

| **Component** | **Mesh** |
| --- | --- |
| Component 1 | Mesh 1 |

## Solver Configurations

### Solution 1

#### Compile Equations: Eigenfrequency (st1)

Study and step

| **Description** | **Value** |
| --- | --- |
| Use study | [Study 1: Eigenfrequency](#cs3330125) |
| Use study step | Eigenfrequency |

Log

<---- Compile Equations: Eigenfrequency in Study 1: Eigenfrequency/Solution 1

      (sol1) -------------------------------------------------------------------

Started at Dec 17, 2024, 11:09:41 PM.

Geometry shape function: Linear Lagrange

Parameter i\_c = 1.0 .

Time: 2 s.

Physical memory: 1.25 GB

Virtual memory: 1.65 GB

Ended at Dec 17, 2024, 11:09:43 PM.

----- Compile Equations: Eigenfrequency in Study 1: Eigenfrequency/Solution 1

      (sol1) ------------------------------------------------------------------>

#### Dependent Variables 1 (v1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | [Step 1: Eigenfrequency](#cs5674485) |

Log

<---- Dependent Variables 1 in Study 1: Eigenfrequency/Solution 1 (sol1) -------

Started at Dec 17, 2024, 11:09:43 PM.

Solution time: 0 s.

Physical memory: 1.25 GB

Virtual memory: 1.65 GB

Ended at Dec 17, 2024, 11:09:43 PM.

----- Dependent Variables 1 in Study 1: Eigenfrequency/Solution 1 (sol1) ------>

##### Displacement field (comp1.u) (comp1\_u)

General

| **Description** | **Value** |
| --- | --- |
| Field components | {comp1.u, comp1.v} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.012067 |

##### comp1.mbd\_rd\_disp (comp1\_mbd\_rd\_disp)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.rd1.U, comp1.mbd.rd1.V, comp1.mbd.rd2.U, comp1.mbd.rd2.V, comp1.mbd.rd3.U, comp1.mbd.rd3.V, comp1.mbd.rd4.U, comp1.mbd.rd4.V, comp1.mbd.rd5.U, comp1.mbd.rd5.V, comp1.mbd.rd6.U, comp1.mbd.rd6.V} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.012067 |

##### comp1.mbd\_rd\_rot (comp1\_mbd\_rd\_rot)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.rd1.Phi, comp1.mbd.rd2.Phi, comp1.mbd.rd3.Phi, comp1.mbd.rd4.Phi, comp1.mbd.rd5.Phi, comp1.mbd.rd6.Phi} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.1 |

##### comp1.mbd\_jnt\_disp (comp1\_mbd\_jnt\_disp)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj1.U1, comp1.mbd.fxj1.U2, comp1.mbd.fxj2.U1, comp1.mbd.fxj2.U2, comp1.mbd.fxj3.U1, comp1.mbd.fxj3.U2, comp1.mbd.fxj4.U1, comp1.mbd.fxj4.U2, comp1.mbd.fxj5.U1, comp1.mbd.fxj5.U2, comp1.mbd.fxj6.U1, comp1.mbd.fxj6.U2, comp1.mbd.fxj7.U1, comp1.mbd.fxj7.U2, comp1.mbd.fxj8.U1, comp1.mbd.fxj8.U2} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.012067 |

##### comp1.mbd\_jnt\_rot (comp1\_mbd\_jnt\_rot)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj1.Th, comp1.mbd.fxj2.Th, comp1.mbd.fxj3.Th, comp1.mbd.fxj4.Th, comp1.mbd.fxj5.Th, comp1.mbd.fxj6.Th, comp1.mbd.fxj7.Th, comp1.mbd.fxj8.Th} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.1 |

##### Reaction force (comp1.mbd.fxj7.RF) (comp1\_mbd\_fxj7\_RF)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj7.RFx, comp1.mbd.fxj7.RFy} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.456E6 |

##### Reaction moment (comp1.mbd.fxj7.Rphi) (comp1\_mbd\_fxj7\_Rphi)

General

| **Description** | **Value** |
| --- | --- |
| State components | comp1.mbd.fxj7.Rphi |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.757E5 |

##### Reaction force (comp1.mbd.fxj8.RF) (comp1\_mbd\_fxj8\_RF)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj8.RFx, comp1.mbd.fxj8.RFy} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.456E6 |

##### Reaction moment (comp1.mbd.fxj8.Rphi) (comp1\_mbd\_fxj8\_Rphi)

General

| **Description** | **Value** |
| --- | --- |
| State components | comp1.mbd.fxj8.Rphi |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.757E5 |

#### Eigenvalue Solver 1 (e1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | [Step 1: Eigenfrequency](#cs5674485) |
| Eigenvalue transformation | Eigenfrequency |
| Desired number of eigenvalues | 12 |
| Unit | Hz |
| Search for eigenvalues around shift | 0[Hz] |

Output

| **Description** | **Value** |
| --- | --- |
| Scaling of eigenvectors | Maximum |
| Maximum absolute value | 1.21E-6 |

Log

<---- Eigenvalue Solver 1 in Study 1: Eigenfrequency/Solution 1 (sol1) ---------

Started at Dec 17, 2024, 11:09:43 PM.

Eigenvalue solver

Number of degrees of freedom solved for: 48.

Symmetric matrices found.

Scales for dependent variables:

Reaction force (comp1.mbd.fxj7.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj7.Rphi): 1.8e+05

Reaction force (comp1.mbd.fxj8.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj8.Rphi): 1.8e+05

comp1.mbd\_jnt\_disp: 0.012

comp1.mbd\_jnt\_rot: 0.1

comp1.mbd\_rd\_disp: 0.012

comp1.mbd\_rd\_rot: 0.1

Orthonormal null-space function used.

Nonsymmetric eigenvalue solver

Iter      ErrEst  Nconv

   1           0     24

49 linear system solutions.

49 matrix multiplications.

48 re-orthogonalizations.

Solution time: 1 s.

Physical memory: 1.37 GB

Virtual memory: 1.67 GB

Ended at Dec 17, 2024, 11:09:44 PM.

----- Eigenvalue Solver 1 in Study 1: Eigenfrequency/Solution 1 (sol1) -------->

##### Advanced (aDef)

Assembly settings

| **Description** | **Value** |
| --- | --- |
| Reuse sparsity pattern | On |

### Parametric Solutions 1

#### i\_c=0 (su1)

General

| **Description** | **Value** |
| --- | --- |
| Solution | i\_c=0 (sol3) |

Log

<---- Compile Equations: Eigenfrequency in Study 1: Eigenfrequency/Solution 1

      (sol1) -------------------------------------------------------------------

Started at Dec 17, 2024, 11:09:36 PM.

Geometry shape function: Linear Lagrange

Running on Intel64 Family 6 Model 142 Stepping 12, GenuineIntel.

Using 1 socket with 4 cores in total on DESKTOP-7P3UO8U.

Available memory: 7.95 GB.

Parameter i\_c = 0.0 .

Time: 2 s.

Physical memory: 1.17 GB

Virtual memory: 1.38 GB

Ended at Dec 17, 2024, 11:09:39 PM.

----- Compile Equations: Eigenfrequency in Study 1: Eigenfrequency/Solution 1

      (sol1) ------------------------------------------------------------------>

<---- Dependent Variables 1 in Study 1: Eigenfrequency/Solution 1 (sol1) -------

Started at Dec 17, 2024, 11:09:39 PM.

Solution time: 0 s.

Physical memory: 1.17 GB

Virtual memory: 1.38 GB

Ended at Dec 17, 2024, 11:09:39 PM.

----- Dependent Variables 1 in Study 1: Eigenfrequency/Solution 1 (sol1) ------>

<---- Eigenvalue Solver 1 in Study 1: Eigenfrequency/Solution 1 (sol1) ---------

Started at Dec 17, 2024, 11:09:39 PM.

Eigenvalue solver

Number of degrees of freedom solved for: 48.

Symmetric matrices found.

Scales for dependent variables:

Reaction force (comp1.mbd.fxj7.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj7.Rphi): 1.8e+05

Reaction force (comp1.mbd.fxj8.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj8.Rphi): 1.8e+05

comp1.mbd\_jnt\_disp: 0.012

comp1.mbd\_jnt\_rot: 0.1

comp1.mbd\_rd\_disp: 0.012

comp1.mbd\_rd\_rot: 0.1

Orthonormal null-space function used.

Real symmetric eigenvalue solver

Iter      ErrEst  Nconv

   1           0     12

15 linear system solutions.

45 matrix multiplications.

14 re-orthogonalizations.

Solution time: 2 s.

Physical memory: 1.2 GB

Virtual memory: 1.4 GB

Ended at Dec 17, 2024, 11:09:41 PM.

----- Eigenvalue Solver 1 in Study 1: Eigenfrequency/Solution 1 (sol1) -------->

#### i\_c=1 (su2)

General

| **Description** | **Value** |
| --- | --- |
| Solution | i\_c=1 (sol4) |

Log

<---- Compile Equations: Eigenfrequency in Study 1: Eigenfrequency/Solution 1

      (sol1) -------------------------------------------------------------------

Started at Dec 17, 2024, 11:09:41 PM.

Geometry shape function: Linear Lagrange

Parameter i\_c = 1.0 .

Time: 2 s.

Physical memory: 1.25 GB

Virtual memory: 1.65 GB

Ended at Dec 17, 2024, 11:09:43 PM.

----- Compile Equations: Eigenfrequency in Study 1: Eigenfrequency/Solution 1

      (sol1) ------------------------------------------------------------------>

<---- Dependent Variables 1 in Study 1: Eigenfrequency/Solution 1 (sol1) -------

Started at Dec 17, 2024, 11:09:43 PM.

Solution time: 0 s.

Physical memory: 1.25 GB

Virtual memory: 1.65 GB

Ended at Dec 17, 2024, 11:09:43 PM.

----- Dependent Variables 1 in Study 1: Eigenfrequency/Solution 1 (sol1) ------>

<---- Eigenvalue Solver 1 in Study 1: Eigenfrequency/Solution 1 (sol1) ---------

Started at Dec 17, 2024, 11:09:43 PM.

Eigenvalue solver

Number of degrees of freedom solved for: 48.

Symmetric matrices found.

Scales for dependent variables:

Reaction force (comp1.mbd.fxj7.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj7.Rphi): 1.8e+05

Reaction force (comp1.mbd.fxj8.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj8.Rphi): 1.8e+05

comp1.mbd\_jnt\_disp: 0.012

comp1.mbd\_jnt\_rot: 0.1

comp1.mbd\_rd\_disp: 0.012

comp1.mbd\_rd\_rot: 0.1

Orthonormal null-space function used.

Nonsymmetric eigenvalue solver

Iter      ErrEst  Nconv

   1           0     24

49 linear system solutions.

49 matrix multiplications.

48 re-orthogonalizations.

Solution time: 1 s.

Physical memory: 1.37 GB

Virtual memory: 1.67 GB

Ended at Dec 17, 2024, 11:09:44 PM.

----- Eigenvalue Solver 1 in Study 1: Eigenfrequency/Solution 1 (sol1) -------->

# Study 2

Computation information

|  |  |
| --- | --- |
| Computation time | 13 s |

## Frequency Response

| **Frequencies (Hz)** |
| --- |
| range(2,0.2,20) |

Study settings

| **Description** | **Value** |
| --- | --- |
| Include geometric nonlinearity | Off |

Settings

| **Description** | **Value** |
| --- | --- |
| Frequencies | {2, 2.2, 2.4, 2.6, 2.8, 3, 3.2, 3.4, 3.6, 3.8, 4, 4.2, 4.4, 4.6, 4.8, 5, 5.2, 5.4, 5.6, 5.8, 6, 6.2, 6.4, 6.6, 6.8, 7, 7.2, 7.4, 7.6, 7.8, 8, 8.2, 8.4, 8.6, 8.8, 9, 9.2, 9.4, 9.6, 9.8, 10, 10.2, 10.4, 10.6, 10.8, 11, 11.2, 11.4, 11.6, 11.8, 12, 12.2, 12.4, 12.6, 12.8, 13, 13.2, 13.4, 13.6, 13.8, 14, 14.2, 14.4, 14.6, 14.8, 15, 15.2, 15.4, 15.6, 15.8, 16, 16.2, 16.4, 16.6, 16.8, 17, 17.2, 17.4, 17.6, 17.8, 18, 18.2, 18.4, 18.6, 18.8, 19, 19.2, 19.4, 19.6, 19.8, 20} |

Physics and variables selection

| **Physics interface** | **Solve for** | **Equation form** |
| --- | --- | --- |
| Multibody Dynamics (mbd) | On | Automatic (Frequency domain) |

Store in output

| **Interface** | **Output** | **Selection** |
| --- | --- | --- |
| Multibody Dynamics (mbd) | Physics controlled |  |

Mesh selection

| **Component** | **Mesh** |
| --- | --- |
| Component 1 | Mesh 1 |

## Solver Configurations

### Solution 5

#### Compile Equations: Frequency Response (st1)

Study and step

| **Description** | **Value** |
| --- | --- |
| Use study | [Study 2](#cs8947292) |
| Use study step | Frequency Response |

Log

<---- Compile Equations: Frequency Response in Study 2/Solution 5 (sol5) -------

Started at Dec 17, 2024, 11:42:01 PM.

Geometry shape function: Linear Lagrange

Running on Intel64 Family 6 Model 142 Stepping 12, GenuineIntel.

Using 1 socket with 4 cores in total on DESKTOP-7P3UO8U.

Available memory: 7.95 GB.

Time: 2 s.

Physical memory: 1.51 GB

Virtual memory: 1.7 GB

Ended at Dec 17, 2024, 11:42:03 PM.

----- Compile Equations: Frequency Response in Study 2/Solution 5 (sol5) ------>

#### Dependent Variables 1 (v1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | [Step 1: Frequency Response](#cs1177077) |

Initial value calculation constants

| **Constant name** | **Initial value source** |
| --- | --- |
| freq | range(2,0.2,20)[Hz] |

Log

<---- Dependent Variables 1 in Study 2/Solution 5 (sol5) -----------------------

Started at Dec 17, 2024, 11:42:03 PM.

Solution time: 0 s.

Physical memory: 1.51 GB

Virtual memory: 1.7 GB

Ended at Dec 17, 2024, 11:42:03 PM.

----- Dependent Variables 1 in Study 2/Solution 5 (sol5) ---------------------->

##### Displacement field (comp1.u) (comp1\_u)

General

| **Description** | **Value** |
| --- | --- |
| Field components | {comp1.u, comp1.v} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.012067 |

##### comp1.mbd\_rd\_disp (comp1\_mbd\_rd\_disp)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.rd1.U, comp1.mbd.rd1.V, comp1.mbd.rd2.U, comp1.mbd.rd2.V, comp1.mbd.rd3.U, comp1.mbd.rd3.V, comp1.mbd.rd4.U, comp1.mbd.rd4.V, comp1.mbd.rd5.U, comp1.mbd.rd5.V, comp1.mbd.rd6.U, comp1.mbd.rd6.V} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.012067 |

##### comp1.mbd\_rd\_rot (comp1\_mbd\_rd\_rot)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.rd1.Phi, comp1.mbd.rd2.Phi, comp1.mbd.rd3.Phi, comp1.mbd.rd4.Phi, comp1.mbd.rd5.Phi, comp1.mbd.rd6.Phi} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.1 |

##### comp1.mbd\_jnt\_disp (comp1\_mbd\_jnt\_disp)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj1.U1, comp1.mbd.fxj1.U2, comp1.mbd.fxj2.U1, comp1.mbd.fxj2.U2, comp1.mbd.fxj3.U1, comp1.mbd.fxj3.U2, comp1.mbd.fxj4.U1, comp1.mbd.fxj4.U2, comp1.mbd.fxj5.U1, comp1.mbd.fxj5.U2, comp1.mbd.fxj6.U1, comp1.mbd.fxj6.U2, comp1.mbd.fxj7.U1, comp1.mbd.fxj7.U2, comp1.mbd.fxj8.U1, comp1.mbd.fxj8.U2} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.012067 |

##### comp1.mbd\_jnt\_rot (comp1\_mbd\_jnt\_rot)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj1.Th, comp1.mbd.fxj2.Th, comp1.mbd.fxj3.Th, comp1.mbd.fxj4.Th, comp1.mbd.fxj5.Th, comp1.mbd.fxj6.Th, comp1.mbd.fxj7.Th, comp1.mbd.fxj8.Th} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 0.1 |

##### Reaction force (comp1.mbd.fxj7.RF) (comp1\_mbd\_fxj7\_RF)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj7.RFx, comp1.mbd.fxj7.RFy} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.456E6 |

##### Reaction moment (comp1.mbd.fxj7.Rphi) (comp1\_mbd\_fxj7\_Rphi)

General

| **Description** | **Value** |
| --- | --- |
| State components | comp1.mbd.fxj7.Rphi |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.757E5 |

##### Reaction force (comp1.mbd.fxj8.RF) (comp1\_mbd\_fxj8\_RF)

General

| **Description** | **Value** |
| --- | --- |
| State components | {comp1.mbd.fxj8.RFx, comp1.mbd.fxj8.RFy} |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.456E6 |

##### Reaction moment (comp1.mbd.fxj8.Rphi) (comp1\_mbd\_fxj8\_Rphi)

General

| **Description** | **Value** |
| --- | --- |
| State components | comp1.mbd.fxj8.Rphi |

Scaling

| **Description** | **Value** |
| --- | --- |
| Method | Manual |
| Scale | 1.757E5 |

#### Stationary Solver 1 (s1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | [Step 1: Frequency Response](#cs1177077) |

Results while solving

| **Description** | **Value** |
| --- | --- |
| Probes | None |

Log

<---- Stationary Solver 1 in Study 2/Solution 5 (sol5) -------------------------

Started at Dec 17, 2024, 11:42:03 PM.

Parametric solver

Nonlinear solver

Number of degrees of freedom solved for: 48.

Parameter freq = 2.

Symmetric matrices found.

Scales for dependent variables:

Reaction force (comp1.mbd.fxj7.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj7.Rphi): 1.8e+05

Reaction force (comp1.mbd.fxj8.RF): 1.5e+06

Reaction moment (comp1.mbd.fxj8.Rphi): 1.8e+05

comp1.mbd\_jnt\_disp: 0.012

comp1.mbd\_jnt\_rot: 0.1

comp1.mbd\_rd\_disp: 0.012

comp1.mbd\_rd\_rot: 0.1

Orthonormal null-space function used.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1         0.3      0.0015   1.0000000         0.3    2    1    1  2.7e-15  6.8e-16

   2     4.6e-05     1.6e-12   1.0000000     4.6e-05    3    2    2  2.9e-15  6.3e-16

Parameter freq = 2.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1         0.3      0.0013   1.0000000         0.3    5    3    3  4.4e-15  3.6e-16

   2     3.8e-05     1.2e-12   1.0000000     3.8e-05    6    4    4    3e-15  8.1e-16

Parameter freq = 2.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0011   1.0000000        0.29    8    5    5  3.5e-15  5.7e-16

   2     3.1e-05     1.5e-12   1.0000000     3.1e-05    9    6    6  4.3e-15  6.5e-16

Parameter freq = 2.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29     0.00097   1.0000000        0.29   11    7    7  4.5e-15  3.7e-16

Parameter freq = 2.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29     0.00096   1.0000000        0.29   13    8    8  5.1e-15  3.8e-16

Parameter freq = 3.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29       0.001   1.0000000        0.29   15    9    9  5.5e-15  3.5e-16

   2     2.7e-05     3.3e-12   1.0000000     2.7e-05   16   10   10  4.7e-15  3.5e-16

Parameter freq = 3.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0011   1.0000000        0.29   18   11   11  4.9e-15  5.4e-16

   2     2.9e-05       2e-12   1.0000000     2.9e-05   19   12   12    3e-15  4.5e-16

Parameter freq = 3.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0011   1.0000000        0.29   21   13   13  6.4e-15  3.9e-16

   2     3.1e-05     3.6e-12   1.0000000     3.1e-05   22   14   14  2.2e-15  3.4e-16

Parameter freq = 3.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   24   15   15  3.1e-15  4.9e-16

   2     3.1e-05     3.5e-12   1.0000000     3.1e-05   25   16   16  2.3e-15  3.2e-16

Parameter freq = 3.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   27   17   17  2.8e-15  6.7e-16

   2     3.1e-05     4.5e-12   1.0000000     3.1e-05   28   18   18  2.7e-15  4.6e-16

Parameter freq = 4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   30   19   19  7.1e-15  5.2e-16

   2       3e-05     7.3e-12   1.0000000       3e-05   31   20   20  5.5e-15  3.3e-16

Parameter freq = 4.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   33   21   21  5.1e-15    5e-16

   2       3e-05     1.9e-12   1.0000000       3e-05   34   22   22  4.4e-15  3.7e-16

Parameter freq = 4.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1         0.3      0.0012   1.0000000         0.3   36   23   23  5.4e-15  4.3e-16

   2       3e-05     2.8e-12   1.0000000       3e-05   37   24   24  2.2e-15    4e-16

Parameter freq = 4.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1         0.3      0.0012   1.0000000         0.3   39   25   25  7.2e-15  3.1e-16

   2       3e-05         8.6   1.0000000       3e-05   40   26   26  9.1e-15  3.8e-16

Parameter freq = 4.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   42   27   27  6.8e-15  4.3e-16

   2       3e-05     8.3e-12   1.0000000       3e-05   43   28   28    3e-15  2.8e-16

Parameter freq = 5.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   45   29   29  5.5e-15    1e-15

   2     2.9e-05     5.4e-12   1.0000000     2.9e-05   46   30   30  2.1e-15  3.6e-16

Parameter freq = 5.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.29      0.0012   1.0000000        0.29   48   31   31  4.5e-15  6.1e-16

   2     2.8e-05     1.4e-11   1.0000000     2.8e-05   49   32   32  4.7e-15  3.1e-16

Parameter freq = 5.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.28       0.001   1.0000000        0.28   51   33   33  7.4e-15  5.6e-16

   2     2.5e-05     1.4e-11   1.0000000     2.5e-05   52   34   34  4.7e-15  3.4e-16

Parameter freq = 5.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.27     0.00083   1.0000000        0.27   54   35   35  3.5e-15  4.3e-16

Parameter freq = 5.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.26     0.00063   1.0000000        0.26   56   36   36  8.6e-15  6.4e-16

Parameter freq = 6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.24     0.00045   1.0000000        0.24   58   37   37  3.8e-15  5.7e-16

Parameter freq = 6.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.22     0.00033   1.0000000        0.22   60   38   38  5.6e-15  4.9e-16

Parameter freq = 6.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.21     0.00024   1.0000000        0.21   62   39   39    7e-15  4.7e-16

Parameter freq = 6.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.21     0.00019   1.0000000        0.21   64   40   40  3.9e-15  5.7e-16

Parameter freq = 6.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1         0.2     0.00015   1.0000000         0.2   66   41   41  3.9e-15  5.6e-16

Parameter freq = 7.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.19     0.00012   1.0000000        0.19   68   42   42  6.5e-15    7e-16

Parameter freq = 7.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.17      0.0001   1.0000000        0.17   70   43   43  2.2e-15  8.2e-16

Parameter freq = 7.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.16       9e-05   1.0000000        0.16   72   44   44  2.6e-15  1.1e-15

Parameter freq = 7.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.15       8e-05   1.0000000        0.15   74   45   45  1.4e-15  3.9e-16

Parameter freq = 7.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.14     7.3e-05   1.0000000        0.14   76   46   46  1.6e-15  8.2e-16

Parameter freq = 8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.13     6.8e-05   1.0000000        0.13   78   47   47    3e-15  7.7e-16

Parameter freq = 8.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.12     6.3e-05   1.0000000        0.12   80   48   48  1.7e-15  5.4e-16

Parameter freq = 8.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.11     5.9e-05   1.0000000        0.11   82   49   49  2.4e-15  7.5e-16

Parameter freq = 8.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.11     5.6e-05   1.0000000        0.11   84   50   50  1.8e-15  6.9e-16

Parameter freq = 8.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1         0.1     5.3e-05   1.0000000         0.1   86   51   51  1.9e-15  3.1e-16

Parameter freq = 9.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.095       5e-05   1.0000000       0.095   88   52   52  2.5e-15  3.6e-16

Parameter freq = 9.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.09     4.7e-05   1.0000000        0.09   90   53   53  2.2e-15  4.8e-16

Parameter freq = 9.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.086     4.5e-05   1.0000000       0.086   92   54   54  2.5e-15  7.3e-16

Parameter freq = 9.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.081     4.2e-05   1.0000000       0.081   94   55   55  1.5e-15  4.6e-16

Parameter freq = 9.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.077       4e-05   1.0000000       0.077   96   56   56  1.3e-15  3.4e-16

Parameter freq = 10.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.074     3.8e-05   1.0000000       0.074   98   57   57  2.9e-15  5.5e-16

Parameter freq = 10.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.07     3.5e-05   1.0000000        0.07  100   58   58  1.6e-15  6.3e-16

Parameter freq = 10.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.067     3.3e-05   1.0000000       0.067  102   59   59  3.3e-15  2.3e-16

Parameter freq = 10.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.064     3.1e-05   1.0000000       0.064  104   60   60  2.5e-15  5.1e-16

Parameter freq = 10.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.061     2.9e-05   1.0000000       0.061  106   61   61  1.7e-15  4.6e-16

Parameter freq = 11.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.058     2.7e-05   1.0000000       0.058  108   62   62  1.2e-15  2.6e-16

Parameter freq = 11.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.055     2.5e-05   1.0000000       0.055  110   63   63    1e-15  5.9e-16

Parameter freq = 11.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.052     2.3e-05   1.0000000       0.052  112   64   64  1.9e-15  5.5e-16

Parameter freq = 11.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.05     2.2e-05   1.0000000        0.05  114   65   65  1.6e-15  6.1e-16

Parameter freq = 11.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.048       2e-05   1.0000000       0.048  116   66   66  1.1e-15  3.2e-16

Parameter freq = 12.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.046     1.9e-05   1.0000000       0.046  118   67   67  9.5e-16  3.3e-16

Parameter freq = 12.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.044     1.7e-05   1.0000000       0.044  120   68   68  1.2e-15  2.8e-16

Parameter freq = 12.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.042     1.6e-05   1.0000000       0.042  122   69   69  1.8e-15    5e-16

Parameter freq = 12.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.04     1.5e-05   1.0000000        0.04  124   70   70  1.3e-15  2.5e-16

Parameter freq = 12.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.038     1.4e-05   1.0000000       0.038  126   71   71  1.6e-15  2.2e-16

Parameter freq = 13.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.037     1.3e-05   1.0000000       0.037  128   72   72  1.2e-15  4.9e-16

Parameter freq = 13.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.035     1.2e-05   1.0000000       0.035  130   73   73  1.1e-15  4.8e-16

Parameter freq = 13.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.034     1.1e-05   1.0000000       0.034  132   74   74    8e-16  2.7e-16

Parameter freq = 13.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.032     9.9e-06   1.0000000       0.032  134   75   75  1.5e-15  3.3e-16

Parameter freq = 13.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.031     9.1e-06   1.0000000       0.031  136   76   76  8.7e-16  3.7e-16

Parameter freq = 14.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.03     8.5e-06   1.0000000        0.03  138   77   77  1.3e-15  4.9e-16

Parameter freq = 14.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.029     7.8e-06   1.0000000       0.029  140   78   78  1.2e-15  3.4e-16

Parameter freq = 14.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.028     7.3e-06   1.0000000       0.028  142   79   79  8.1e-16  2.3e-16

Parameter freq = 14.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.027     6.7e-06   1.0000000       0.027  144   80   80  1.7e-15  4.9e-16

Parameter freq = 14.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.026     6.2e-06   1.0000000       0.026  146   81   81  9.5e-16    3e-16

Parameter freq = 15.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.025     5.8e-06   1.0000000       0.025  148   82   82  8.2e-16  3.7e-16

Parameter freq = 15.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.024     5.4e-06   1.0000000       0.024  150   83   83  1.4e-15  4.5e-16

Parameter freq = 15.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.023       5e-06   1.0000000       0.023  152   84   84  1.4e-15  6.1e-16

Parameter freq = 15.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.022     4.6e-06   1.0000000       0.022  154   85   85  1.2e-15  7.5e-16

Parameter freq = 15.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.022     4.6e-06   1.0000000       0.022  156   86   86  1.1e-15  3.5e-16

Parameter freq = 16.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.021     4.2e-06   1.0000000       0.021  158   87   87  5.7e-16  2.5e-16

Parameter freq = 16.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.02     4.2e-06   1.0000000        0.02  160   88   88  5.4e-16  3.1e-16

Parameter freq = 16.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1        0.02     3.5e-06   1.0000000        0.02  162   89   89  7.6e-16  2.9e-16

Parameter freq = 16.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.019     3.4e-06   1.0000000       0.019  164   90   90    6e-16  2.8e-16

Parameter freq = 16.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.019     3.1e-06   1.0000000       0.019  166   91   91  6.4e-16  1.9e-16

Parameter freq = 17.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.018     3.1e-06   1.0000000       0.018  168   92   92  8.2e-16    4e-16

Parameter freq = 17.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.018     2.9e-06   1.0000000       0.018  170   93   93  7.4e-16  2.3e-16

Parameter freq = 17.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.017     2.8e-06   1.0000000       0.017  172   94   94  6.8e-16  3.8e-16

Parameter freq = 17.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.017     2.8e-06   1.0000000       0.017  174   95   95  1.2e-15  5.1e-16

Parameter freq = 17.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.016     2.4e-06   1.0000000       0.016  176   96   96  1.4e-15  4.8e-16

Parameter freq = 18.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.016     2.7e-06   1.0000000       0.016  178   97   97  1.4e-15  2.8e-16

Parameter freq = 18.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.015     2.8e-06   1.0000000       0.015  180   98   98  1.4e-15    4e-16

Parameter freq = 18.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.015     3.7e-06   1.0000000       0.015  182   99   99    1e-15  3.6e-16

Parameter freq = 18.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.015     2.5e-06   1.0000000       0.015  184  100  100  1.5e-15  3.5e-16

Parameter freq = 18.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.014     1.9e-06   1.0000000       0.014  186  101  101  5.9e-16  5.2e-16

Parameter freq = 19.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.014     1.9e-06   1.0000000       0.014  188  102  102  1.1e-15    4e-16

Parameter freq = 19.2.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.014       2e-06   1.0000000       0.014  190  103  103  1.4e-15    3e-16

Parameter freq = 19.4.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.014     2.6e-06   1.0000000       0.014  192  104  104  1.2e-15  4.2e-16

Parameter freq = 19.6.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.013     2.5e-06   1.0000000       0.013  194  105  105  1.7e-15  3.6e-16

Parameter freq = 19.8.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.013     2.1e-06   1.0000000       0.013  196  106  106    9e-16  2.8e-16

Parameter freq = 20.

Iter      SolEst      ResEst     Damping    Stepsize #Res #Jac #Sol   LinErr   LinRes

   1       0.013     3.1e-06   1.0000000       0.013  198  107  107  1.5e-15  4.9e-16

Solution time: 11 s.

Physical memory: 1.51 GB

Virtual memory: 1.7 GB

Ended at Dec 17, 2024, 11:42:14 PM.

----- Stationary Solver 1 in Study 2/Solution 5 (sol5) ------------------------>

##### Advanced (aDef)

Assembly settings

| **Description** | **Value** |
| --- | --- |
| Reuse sparsity pattern | On |

##### Parametric 1 (p1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | [Step 1: Frequency Response](#cs1177077) |
| Run continuation for | No parameter |

Parameters

| **Parameter name** | **Parameter value list** | **Parameter unit** |
| --- | --- | --- |
| freq | range(2,0.2,20) | Hz |

##### Fully Coupled 1 (fc1)

General

| **Description** | **Value** |
| --- | --- |
| Linear solver | [Direct](#cs3844024) |

Method and termination

| **Description** | **Value** |
| --- | --- |
| Nonlinear method | Constant (Newton) |
| Maximum number of iterations | 50 |

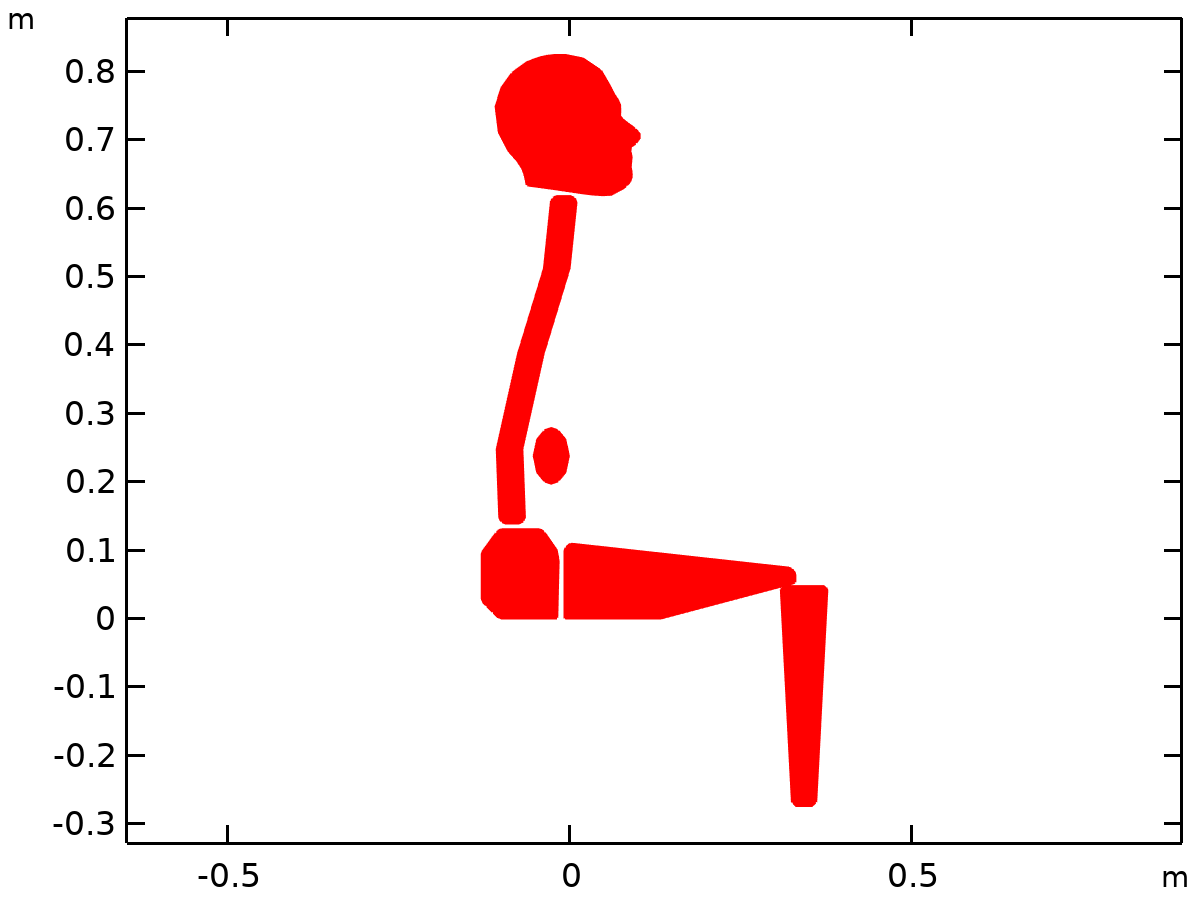
# Results

## Datasets

### Study 1: Eigenfrequency/Solution 1

Solution

| **Description** | **Value** |
| --- | --- |
| Solution | [Solution 1 (sol1)](#cs9747316) |
| Component | Component 1 (comp1) |

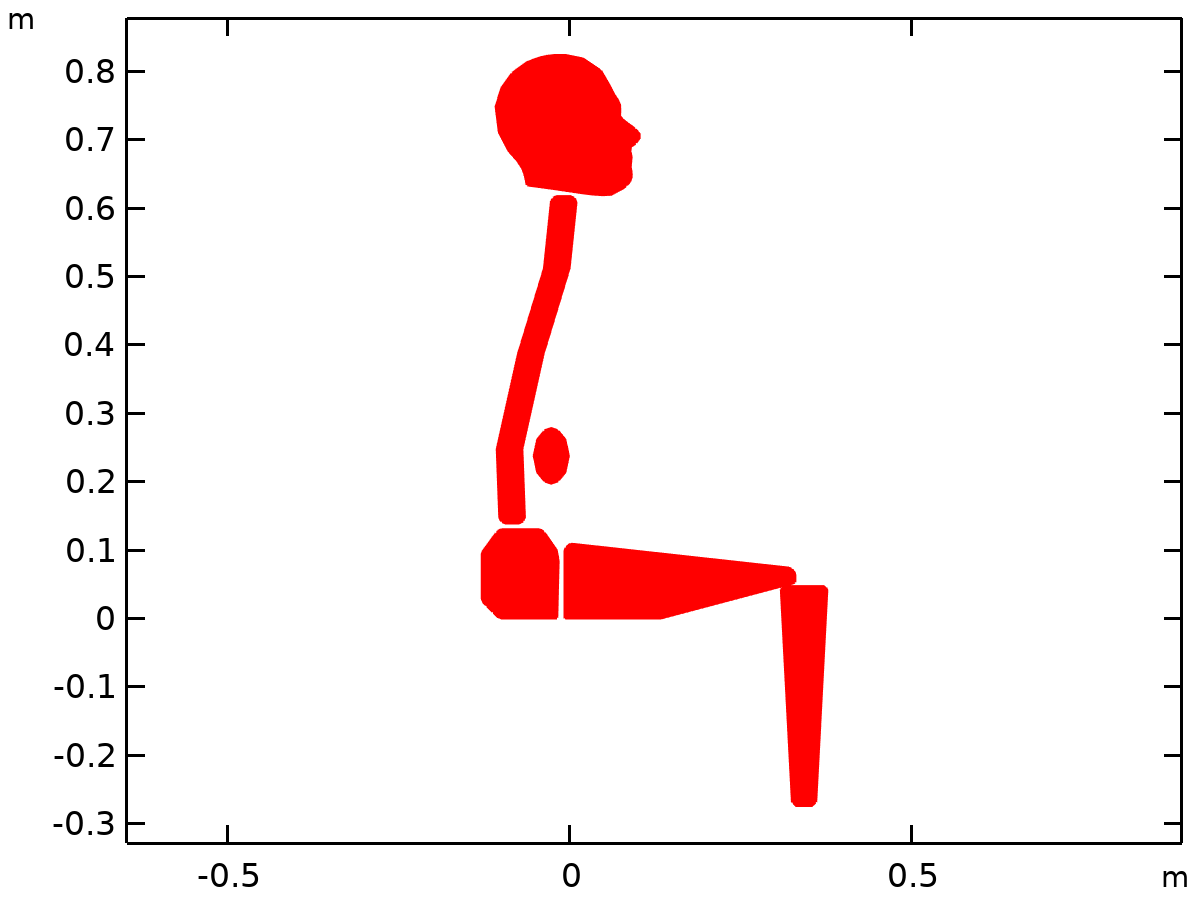


Dataset: Study 1: Eigenfrequency/Solution 1

### Study 1: Eigenfrequency/Parametric Solutions 1

Solution

| **Description** | **Value** |
| --- | --- |
| Solution | [Parametric Solutions 1 (sol2)](#cs1189280) |
| Component | Component 1 (comp1) |

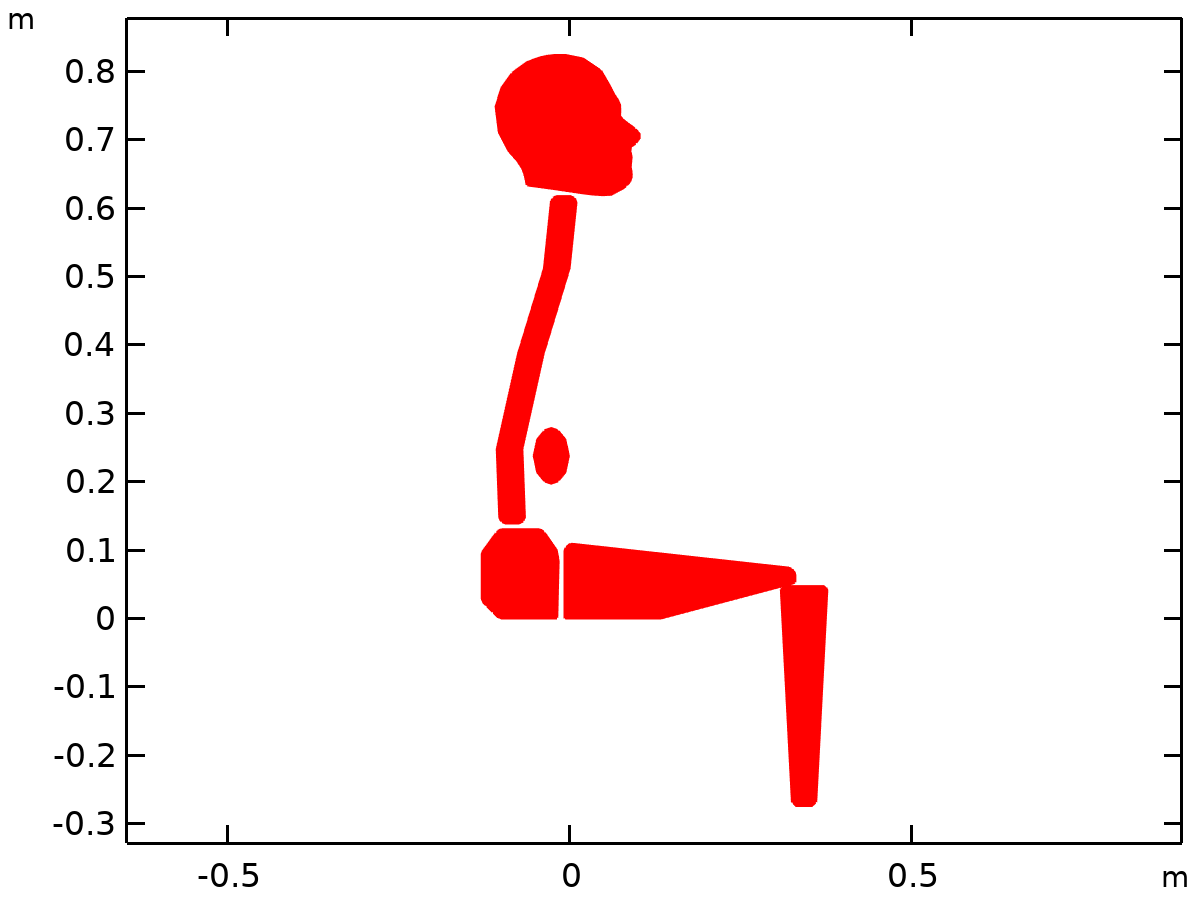


Dataset: Study 1: Eigenfrequency/Parametric Solutions 1

### Study 2/Solution 5

Solution

| **Description** | **Value** |
| --- | --- |
| Solution | [Solution 5 (sol5)](#cs6940599) |
| Component | Component 1 (comp1) |



Dataset: Study 2/Solution 5

## Plot Groups

### Mode Shape (mbd)

[COMSOLlink[]]

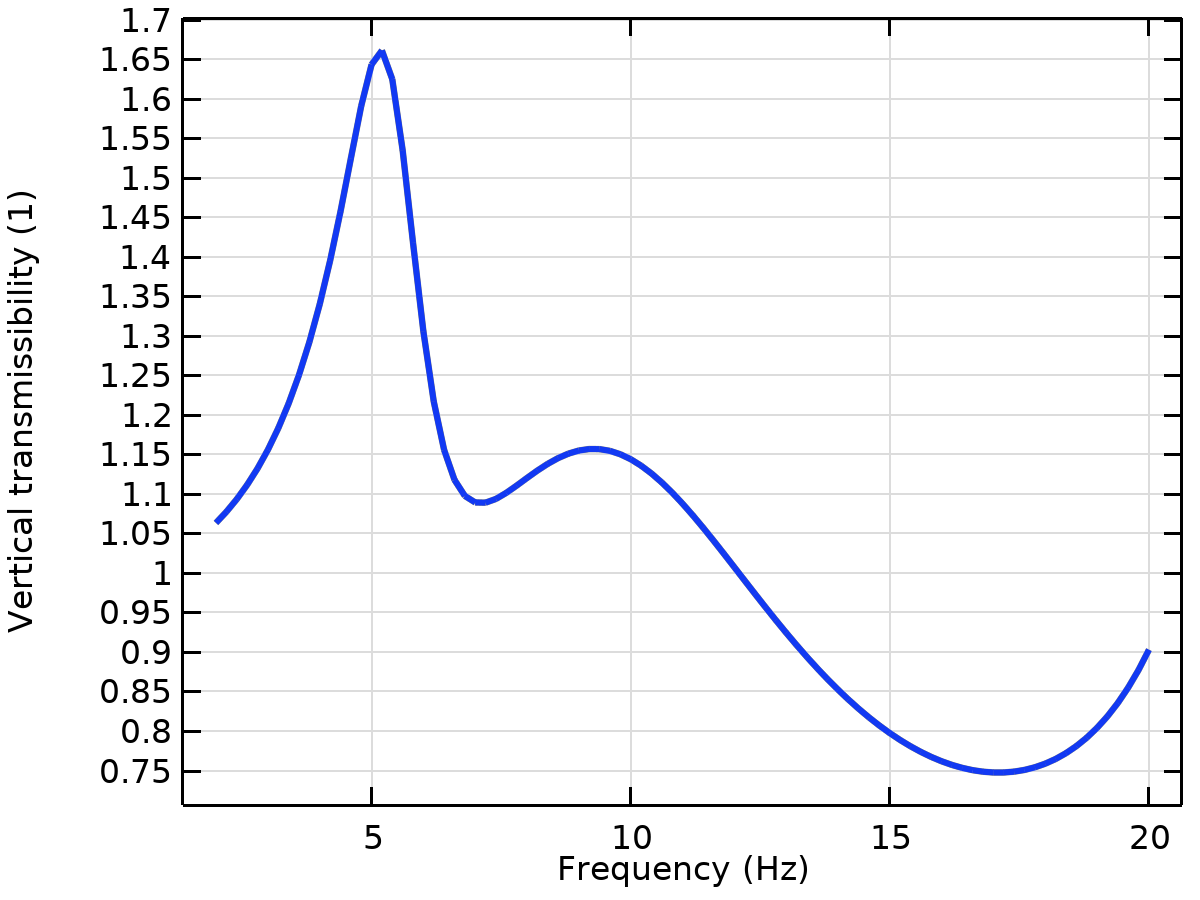
Surface: Displacement magnitude (m)

### Displacement (mbd)

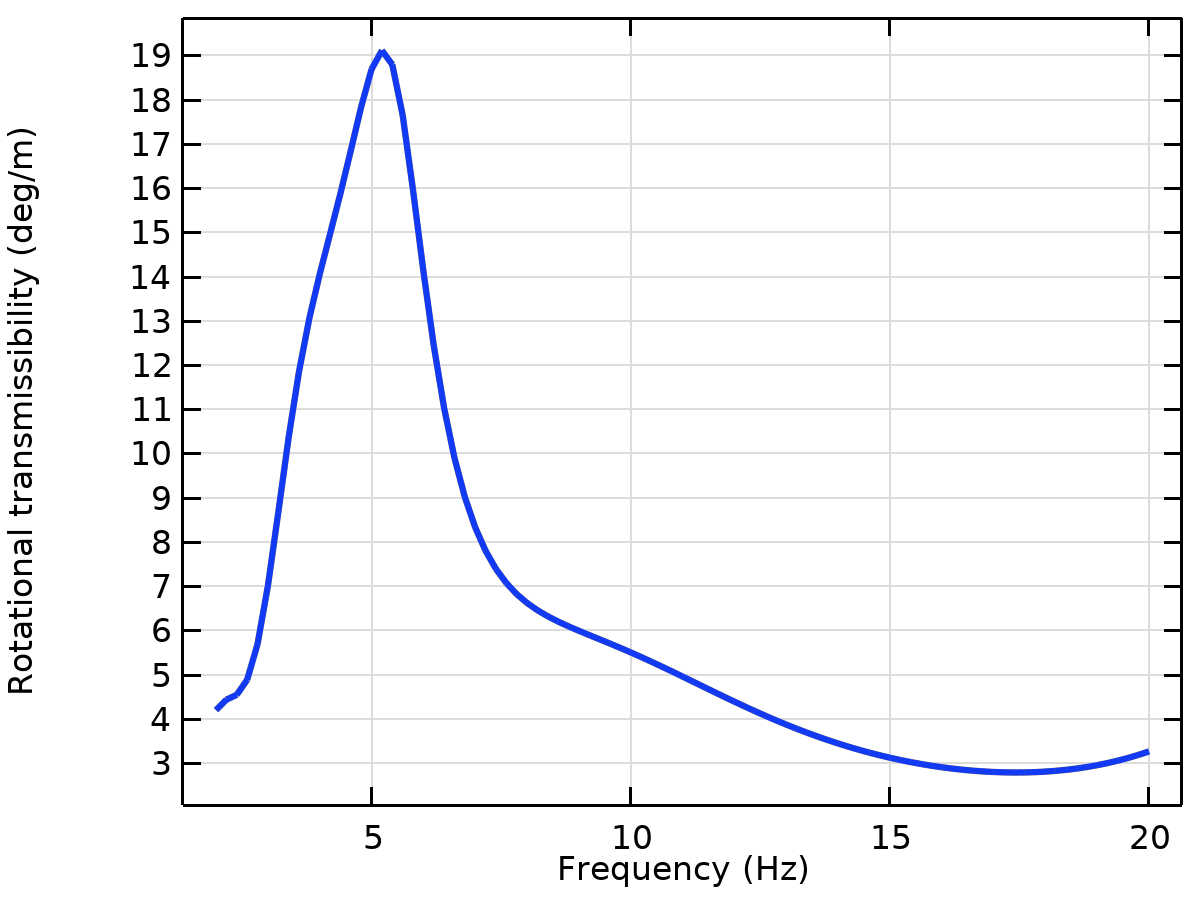
[COMSOLlink[]]

Surface: Displacement magnitude (m)

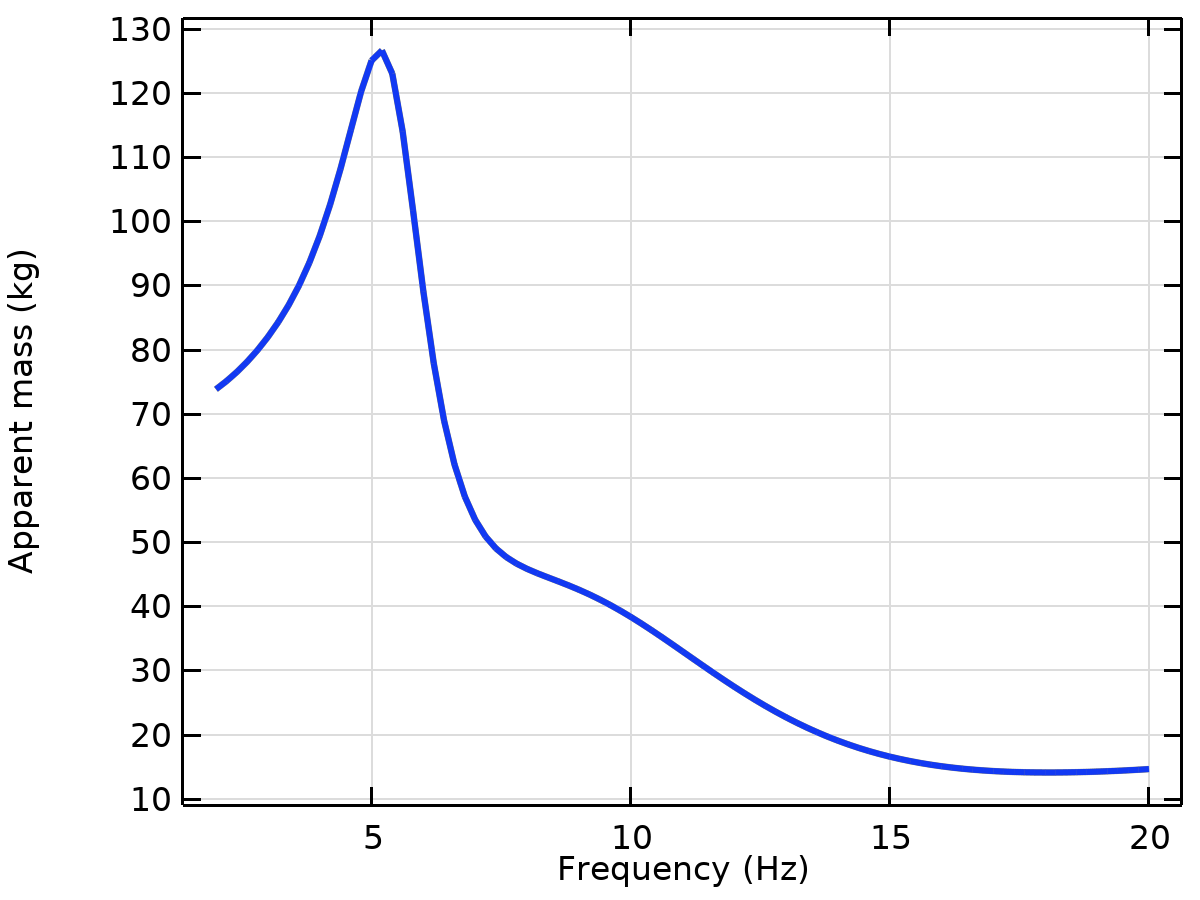
### Vertical Transmissibility



### Rotational Transmissibility



### Apparent Mass



## Evaluation Groups

### Eigenfrequencies (Study 1: Eigenfrequency)

Data

| **Description** | **Value** |
| --- | --- |
| Dataset | [Study 1: Eigenfrequency/Parametric Solutions 1 (sol2)](#cs8937436) |

Features

| **Feature** | **Column** |
| --- | --- |
| [Global Evaluation 1](#cs3237406) | i\_c |

Results

| **i\_c** | **Eigenfrequency (Hz)** | **Angular frequency (rad/s)** | **Damping ratio (1)** | **Quality factor (1)** |
| --- | --- | --- | --- | --- |
| 0 | 0.36698 | 2.3058 | 0 | Inf |
| 0 | 0.52677 | 3.3098 | 0 | Inf |
| 0 | 1.0389 | 6.5278 | 0 | Inf |
| 0 | 2.6445 | 16.616 | 0 | Inf |
| 0 | 3.5039 | 22.016 | 0 | Inf |
| 0 | 4.2283 | 26.567 | 0 | Inf |
| 0 | 4.9304 | 30.978 | 0 | Inf |
| 0 | 5.5888 | 35.116 | 0 | Inf |
| 0 | 6.5442 | 41.119 | 0 | Inf |
| 0 | 7.2321 | 45.44 | 0 | Inf |
| 0 | 8.2325 | 51.726 | 0 | Inf |
| 0 | 18.501 | 116.25 | 0 | Inf |
| 1 | 0.026653i | 0.16746i | 1 | 0.5 |
| 1 | 0.026685i | 0.16767i | 1 | 0.5 |
| 1 | 0.072343i | 0.45455i | 1 | 0.5 |
| 1 | 0.43009i | 2.7023i | 1 | 0.5 |
| 1 | 0.43134i | 2.7102i | 1 | 0.5 |
| 1 | 0.67865i | 4.2641i | 1 | 0.5 |
| 1 | 2.069i | 13i | 1 | 0.5 |
| 1 | 15.401i | 96.765i | 1 | 0.5 |
| 1 | 35.571i | 223.5i | 1 | 0.5 |
| 1 | 53.767i | 337.83i | 1 | 0.5 |
| 1 | 0.61301 + 0.24466i | 3.8516 + 1.5372i | 0.37068 | 1.3489 |
| 1 | 1.7671 + 0.494i | 11.103 + 3.1039i | 0.26923 | 1.8572 |
| 1 | 3.2854 + 0.92005i | 20.643 + 5.7809i | 0.26967 | 1.8541 |
| 1 | 5.4106 + 0.86504i | 33.996 + 5.4352i | 0.15787 | 3.1671 |
| 1 | 9.3347 + 4.4043i | 58.652 + 27.673i | 0.42671 | 1.1718 |
| 1 | 22.587 + 2.0235i | 141.92 + 12.714i | 0.089229 | 5.6036 |
| 1 | 22.823 + 1.2256i | 143.4 + 7.7006i | 0.053623 | 9.3243 |

#### Global Evaluation 1

Expressions

| **Expression** | **Unit** | **Description** |
| --- | --- | --- |
| 2\*pi\*freq | rad/s | Angular frequency |
| imag(freq)/abs(freq) | 1 | Damping ratio |
| abs(freq)/imag(freq)/2 | 1 | Quality factor |

Expressions

| **Name** | **Value** | **Unit** | **Description** |
| --- | --- | --- | --- |
| mbd.refpntx | 0 |  | Reference point for moment computation, x-component |
| mbd.refpnty | 0 |  | Reference point for moment computation, y-component |
| mbd.refpntz | 0 |  | Reference point for moment computation, z-component |

### Participation Factors (Study 1: Eigenfrequency)

Data

| **Description** | **Value** |
| --- | --- |
| Dataset | [Study 1: Eigenfrequency/Parametric Solutions 1 (sol2)](#cs8937436) |

Features

| **Feature** | **Column** |
| --- | --- |
| [Global Evaluation 1](#cs9391374) | i\_c |

Results

| **i\_c** | **Eigenfrequency (Hz)** | **Participation factor, normalized, X-translation (1)** | **Participation factor, normalized, Y-translation (1)** | **Participation factor, normalized, Z-translation (1)** | **Participation factor, normalized, X-rotation (1)** | **Participation factor, normalized, Y-rotation (1)** | **Participation factor, normalized, Z-rotation (1)** | **Effective modal mass, X-translation (kg)** | **Effective modal mass, Y-translation (kg)** | **Effective modal mass, Z-translation (kg)** | **Effective modal mass, X-rotation (kg\*m^2)** | **Effective modal mass, Y-rotation (kg\*m^2)** | **Effective modal mass, Z-rotation (kg\*m^2)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0.36698 | -6.3254 | -0.0023066 | 0 | 0 | 0 | 1.211 | 40.01 | 5.3204E-6 | 0 | 0 | 0 | 1.4666 |
| 0 | 0.52677 | -0.055212 | -5.2247 | 0 | 0 | 0 | 0.24639 | 0.0030484 | 27.297 | 0 | 0 | 0 | 0.06071 |
| 0 | 1.0389 | 1.1991 | -0.20485 | 0 | 0 | 0 | 1.6108 | 1.4378 | 0.041965 | 0 | 0 | 0 | 2.5946 |
| 0 | 2.6445 | 0.21981 | -0.19712 | 0 | 0 | 0 | 0.26676 | 0.048315 | 0.038856 | 0 | 0 | 0 | 0.071159 |
| 0 | 3.5039 | -4.4353 | -0.50347 | 0 | 0 | 0 | -0.63916 | 19.672 | 0.25348 | 0 | 0 | 0 | 0.40852 |
| 0 | 4.2283 | 1.442 | -1.8154 | 0 | 0 | 0 | 0.82605 | 2.0795 | 3.2957 | 0 | 0 | 0 | 0.68236 |
| 0 | 4.9304 | -0.26581 | -1.7925 | 0 | 0 | 0 | 0.20048 | 0.070657 | 3.2131 | 0 | 0 | 0 | 0.040193 |
| 0 | 5.5888 | -0.02849 | -3.8008 | 0 | 0 | 0 | 0.040319 | 8.1167E-4 | 14.446 | 0 | 0 | 0 | 0.0016257 |
| 0 | 6.5442 | 2.8418 | -0.26499 | 0 | 0 | 0 | 0.55643 | 8.0759 | 0.070219 | 0 | 0 | 0 | 0.30961 |
| 0 | 7.2321 | 0.050943 | -0.1083 | 0 | 0 | 0 | -0.0050005 | 0.0025951 | 0.011729 | 0 | 0 | 0 | 2.5005E-5 |
| 0 | 8.2325 | -0.13713 | -3.9569 | 0 | 0 | 0 | -0.9571 | 0.018804 | 15.657 | 0 | 0 | 0 | 0.91604 |
| 0 | 18.501 | -7.4016E-4 | -2.6635 | 0 | 0 | 0 | 0.10403 | 5.4783E-7 | 7.0944 | 0 | 0 | 0 | 0.010823 |
| 1 | 0.026653i | -5.2919E-4 | 5.2096 | 0 | 0 | 0 | -0.24588 | 2.8005E-7 | 27.14 | 0 | 0 | 0 | 0.060458 |
| 1 | 0.026685i | 6.3286 | 4.5274E-4 | 0 | 0 | 0 | -0.8827 | 40.052 | 2.0497E-7 | 0 | 0 | 0 | 0.77916 |
| 1 | 0.072343i | 4.5246 | -0.66528 | 0 | 0 | 0 | -1.6916 | 20.472 | 0.4426 | 0 | 0 | 0 | 2.8613 |
| 1 | 0.43009i | 1.9466 | -0.7979 | 0 | 0 | 0 | 0.76372 | 3.7891 | 0.63664 | 0 | 0 | 0 | 0.58327 |
| 1 | 0.43134i | 5.2487 | -1.5696 | 0 | 0 | 0 | 1.5734 | 27.549 | 2.4637 | 0 | 0 | 0 | 2.4756 |
| 1 | 0.67865i | 5.7273 | 3.0636 | 0 | 0 | 0 | -0.15293 | 32.802 | 9.3859 | 0 | 0 | 0 | 0.023388 |
| 1 | 2.069i | -0.74265 | 0.77949 | 0 | 0 | 0 | -0.49734 | 0.55152 | 0.6076 | 0 | 0 | 0 | 0.24734 |
| 1 | 15.401i | 1.6297 | -0.016991 | 0 | 0 | 0 | -0.44431 | 2.6559 | 2.8868E-4 | 0 | 0 | 0 | 0.19741 |
| 1 | 35.571i | -0.0065193 | 0.44438 | 0 | 0 | 0 | -0.029157 | 4.2501E-5 | 0.19747 | 0 | 0 | 0 | 8.5014E-4 |
| 1 | 53.767i | 0.088769 | 0.005472 | 0 | 0 | 0 | 0.013588 | 0.00788 | 2.9943E-5 | 0 | 0 | 0 | 1.8463E-4 |
| 1 | 0.61301 + 0.24466i | -5.4607 - 0.12498i | -0.22019 + 0.019905i | 0 | 0 | 0 | 1.7551 - 0.014072i | 29.804 + 1.3649i | 0.048087 - 0.0087658i | 0 | 0 | 0 | 3.0803 - 0.049397i |
| 1 | 1.7671 + 0.494i | -3.1732 + 0.85014i | 0.1239 + 0.015656i | 0 | 0 | 0 | -0.93279 - 0.23801i | 9.3463 - 5.3953i | 0.015107 + 0.0038797i | 0 | 0 | 0 | 0.81345 + 0.44403i |
| 1 | 3.2854 + 0.92005i | -3.1676 + 1.1555i | 0.22745 + 0.0012549i | 0 | 0 | 0 | -0.89173 - 0.13679i | 8.6984 - 7.3205i | 0.051734 + 5.7085E-4i | 0 | 0 | 0 | 0.77647 + 0.24395i |
| 1 | 5.4106 + 0.86504i | -0.03397 + 0.0018148i | -5.21 + 0.19716i | 0 | 0 | 0 | 0.18095 - 0.02975i | 0.0011507 - 1.233E-4i | 27.105 - 2.0545i | 0 | 0 | 0 | 0.031858 - 0.010767i |
| 1 | 9.3347 + 4.4043i | -0.0075544 + 0.041202i | -5.7513 + 0.53304i | 0 | 0 | 0 | 0.20901 - 0.042842i | -0.0016405 - 6.2251E-4i | 32.794 - 6.1314i | 0 | 0 | 0 | 0.041851 - 0.017909i |
| 1 | 22.587 + 2.0235i | 0.030327 - 0.01081i | -0.057061 + 0.03796i | 0 | 0 | 0 | 8.1268E-4 - 0.0054015i | 8.0286E-4 - 6.5565E-4i | 0.001815 - 0.0043321i | 0 | 0 | 0 | -2.8516E-5 - 8.7794E-6i |
| 1 | 22.823 + 1.2256i | 2.8633E-4 + 0.006835i | -0.53171 + 0.10593i | 0 | 0 | 0 | 0.018052 - 0.0053761i | -4.6635E-5 + 3.9141E-6i | 0.2715 - 0.11265i | 0 | 0 | 0 | 2.9696E-4 - 1.941E-4i |

#### Global Evaluation 1

Expressions

| **Expression** | **Unit** | **Description** |
| --- | --- | --- |
| mpf1.pfLnormX | 1 | Participation factor, normalized, X-translation |
| mpf1.pfLnormY | 1 | Participation factor, normalized, Y-translation |
| mpf1.pfLnormZ | 1 | Participation factor, normalized, Z-translation |
| mpf1.pfRnormX | 1 | Participation factor, normalized, X-rotation |
| mpf1.pfRnormY | 1 | Participation factor, normalized, Y-rotation |
| mpf1.pfRnormZ | 1 | Participation factor, normalized, Z-rotation |
| mpf1.mEffLX | kg | Effective modal mass, X-translation |
| mpf1.mEffLY | kg | Effective modal mass, Y-translation |
| mpf1.mEffLZ | kg | Effective modal mass, Z-translation |
| mpf1.mEffRX | kg\*m^2 | Effective modal mass, X-rotation |
| mpf1.mEffRY | kg\*m^2 | Effective modal mass, Y-rotation |
| mpf1.mEffRZ | kg\*m^2 | Effective modal mass, Z-rotation |

Expressions

| **Name** | **Value** | **Unit** | **Description** |
| --- | --- | --- | --- |
| mbd.refpntx | 0 |  | Reference point for moment computation, x-component |
| mbd.refpnty | 0 |  | Reference point for moment computation, y-component |
| mbd.refpntz | 0 |  | Reference point for moment computation, z-component |