

IOR Gait Full Body Model

This tutorial explains how to implement the IOR Full Body Model in Visual3D.

The IOR Full Body Model is a combination of the IOR Multi-Segment Trunk, and the IOR Lower Extremity Model.

The naming convention in this tutorial follows Serge Van Sint Jan's convention.

Downloads

Sample files may be downloaded [here](#).

The zip file contains:

1. C3D files which you can use to follow along with the tutorial
2. A model template which contains the landmark & segment definitions
3. A script which contains the planar & joint angle definitions
4. A report template which plots the relevant kinematics (joint angles & planar angles)
5. A completed CMO file

Target Placement

LCAJ/RCAJ (LA/RA): Left/Right acromion

SJN (IJ): Deepest point of the incisura jugularis

SXS (PX): Xiphoid process, i.e. most caudal point of the sternum

CV7 (C7): Spinous process of the seventh cervical vertebrae

TV2 (T2): Second thoracic vertebrae

TV7 (MAI): Midpoint between the inferior angles of the most caudal points of the two scapulae

LV1, LV3, LV5 (L1, L3, L5):

First, third and fifth lumbar vertebrae

LIAS/RIAS (LASIS/RASIS):

Left/Right anterior superior iliac spine

LIPS/RIPS (LPSIS/RPSIS):

Left/Right posterior superior iliac spine

LFTE/RFTE (LGT/RGT): Most lateral prominence of the greater trochanter

LFLE/RFLE (LLE/RLE): Most medial prominence of the medial femoral epicondyle

LFME/RFME (LME/RME): Most medial prominence of the medial femoral epicondyle

LFAX/RFAX (LHF/RHF): Proximal tip of the head of the fibula

LTTC/RTTC (TT/RTT): Most anterior border of the tibial tuberosity

LFAL/RFAL (LLM/RLM): Lateral prominence of the lateral malleolus

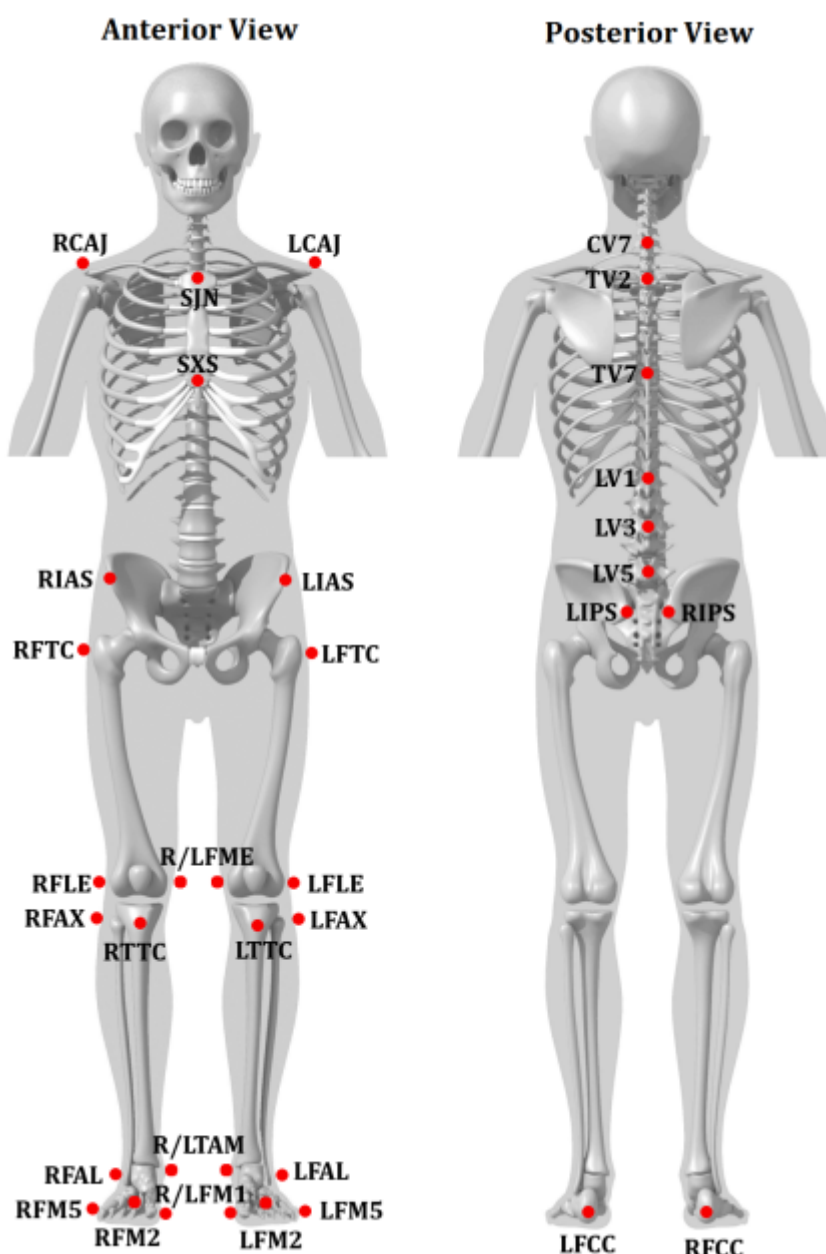
LTAM/RTAM (LMM/RMM): Most medial prominence of the medial malleolus

LFCC/RFCC (LCA/RCA): Aspect of the Achilles tendon insertion on the calcaneus

LFM1/RFM1 (LFM/RFM): Dorsal margin of the first metatarsal head

LFM2/RFM2 (LSM/RSM): Dorsal aspect of the second metatarsal head

LFM5/RFM5 (LVM/RVM): Dorsal margin of the fifth metatarsal head



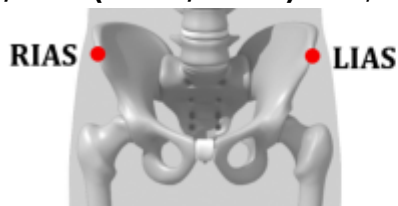
Segment Definitions

Pelvis

The pelvis segment coordinate system is consistent with the [CODA pelvis](#), from which the Left and Right Hip Joint centers are automatically created.

LIAS/RIAS (LASIS/RASIS): Left/Right anterior superior iliac spine

LIPS/RIPS (LPSIS/RPSIS): Left/Right posterior superior iliac spine



Pelvis Landmarks

1. Create SCRM:

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: SCRM
 - **Landmark Name:** SCRM
 - **Define Orientation Using:**
 - **Starting Point:** RIPS
 - **Ending Point:** LIPS
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.0 **Y:** 0.0 **Z:** 0.5
5. **Check:** Offset by Percent (1.0 = 100%)
6. **Check:** Calibration Only Landmark

Pelvis Definition

2. Create Pelvis Segment:

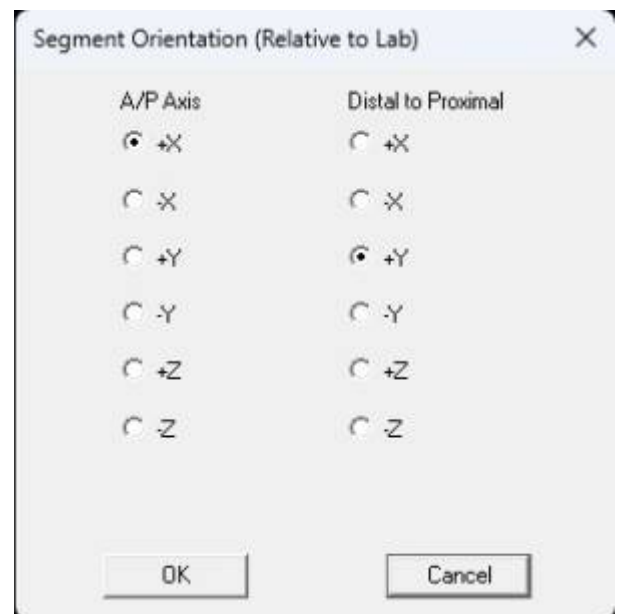
The screenshot shows the 'Pelvis' dialog box in a software application. The dialog has several tabs: 'Segments', 'Landmarks', 'Muscles', 'Subject Data / Metrics', 'Segment Properties', 'IK Constraints', and 'Pelvis'. The 'Pelvis' tab is currently selected. Inside the dialog, there are several sections:

- Define Segment Type:** A dropdown menu for 'Segment Type' is set to 'CODA'.
- Subject Name Prefix:** A text input field.
- Define Calibration Signals:** Four rows of dropdown menus for 'R.ASIS', 'L.ASIS', 'R.PSIS', and 'L.PSIS'. The selected values are 'RIAS', 'LIAS', 'RIPS', and 'LIPS' respectively.
- Define ASIS Target Radius for Hip Joint Center Offset:** A text input field for 'ASIS Target Radius' set to '0.000'.
- Select Tracking Signals:** A checkbox labeled 'Use Calibration Signals for Tracking' is checked.
- 6DOF Cutoff Frequency:** A text input field set to '0.0'.

At the bottom of the dialog, there are four buttons: 'Close Tab', 'Guess Properties', 'Apply', and 'Build Model'.

1. In the **Segments** tab, select *Pelvis* in the Segment Name box
2. In **Segment Type**, select CODA
3. Click on the **Create Segment** button
4. In the **Pelvis** dialog:
 - **Define Calibration Targets**
 - **R.ASIS:** RIAS
 - **L.ASIS:** LIAS
 - **R.PSIS:** RIPS
 - **L.PSIS:** LIPS
 - **Select Tracking Targets:**
 - LIAS, LIPS, RIAS, RIPS
5. Close **CODA Segment Markers** dialog box
6. Click on **Build Model**
7. Click on **Close Tab** before proceeding

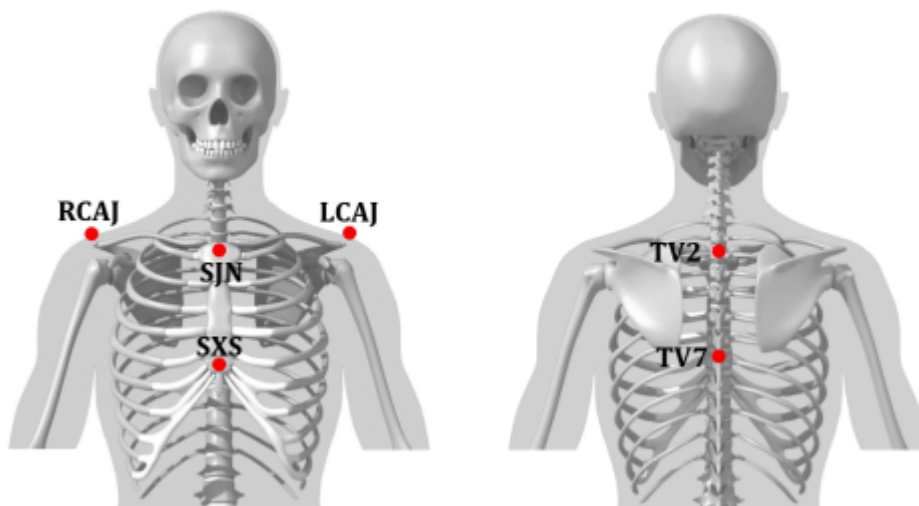
3. Modify the Segment Coordinate System



- Define the Segment Orientation as:
 - A/P Axis:** +X
 - Distal to Proximal:** +Y

Thorax Segment

This marker set is consistent with the Rizzoli Gait model and the ISB recommendations.



LCAJ/RCAJ (LAR/RA): Left/Right acromion

SJN (IJ): Deepest point of the incisura jugularis

SXS (PX): Xiphoid process, i.e. most caudal point of the sternum

C7V (C7): Spinous process of the seventh cervical vertebrae

TV2 (T2): Second thoracic vertebrae

TV7 (MAI): Midpoint between the inferior angles of the most caudal points of the two scapulae

Thorax Definition

4. Create Thorax/Ab:

The screenshot shows the 'Thorax' tab in the software interface. The 'Define Proximal Joint and Radius' section has 'Lateral' set to 'None', 'Joint Center' set to 'TV2', 'Medial' set to 'None', and 'Radius (Meters)' set to '0.5*DISTANCE(RCAJ,LCAJ)'. The 'Define Distal Joint and Radius' section has 'Lateral' set to 'None', 'Joint Center' set to 'TV7', 'Medial' set to 'None', and 'Radius (Meters)' set to '0.5*DISTANCE(RCAJ,LCAJ)'. The 'Extra Signal to Define Orientation (if needed)' section has 'Location' set to 'Anterior' and 'SXS' selected. The 'Select Tracking Signals' section has 'Use Calibration Signals for Tracking' unchecked, and the following signals are checked: SXS, TV2, TV7, and SJN. The 'Depth (Meters)' is set to 0.0 and the '6DOF Cutoff Frequency' is set to 0.0. At the bottom, there are buttons for 'Close Tab', 'Guess Properties', 'Apply', and 'Build Model'.

1. In the **Segments** tab, select *Thorax/Ab* in the Segment Name box.

2. Click **Kinematic Only**

3. Click on the **Create Segment** button

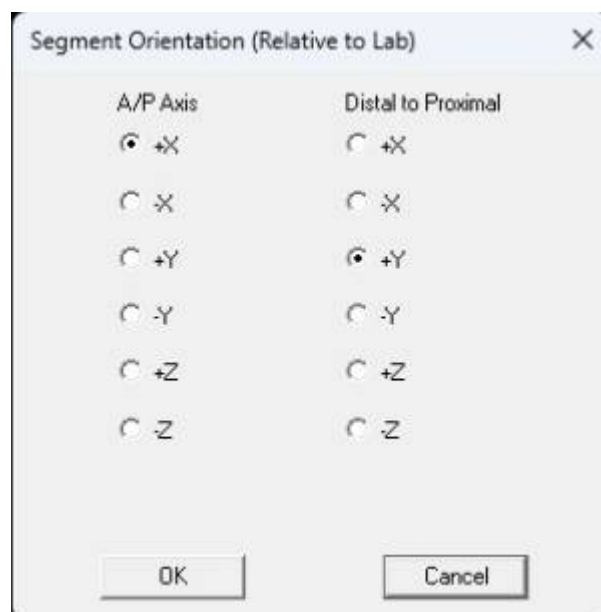
4. In the **Thorax/Ab** tab, enter these values:

- **Define Proximal Joint and Radius**
- **Lateral:** None **Joint:** TV2 **Medial:** None
- **Radius** 0.5*DISTANCE(RCAJ,LCAJ)
- **Define Distal Joint and Radius**
- **Lateral:** None **Joint:** TV7 **Medial:** None
- **Radius:** 0.5*DISTANCE(RCAJ,LCAJ)
- **Extra Target to Define Orientation**
- **Location:** Anterior SXS
- **Select Tracking Targets:**
- SJN, SXS, TV2, TV7

5. Click on **Build Model**

6. Click on **Close Tab** before proceeding.

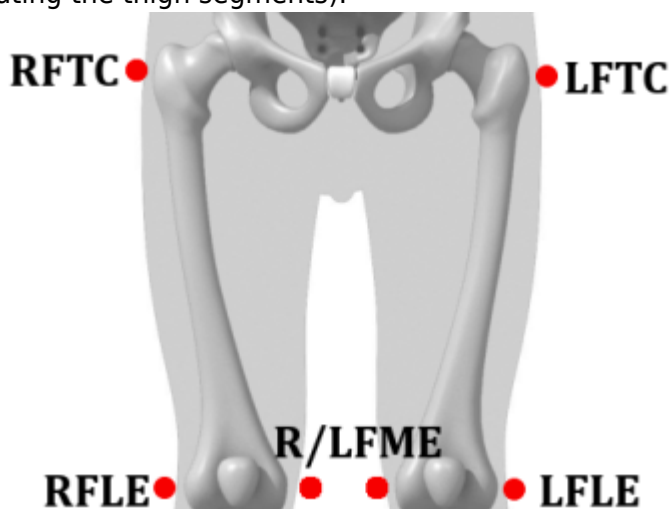
5. Modify the Segment Coordinate System ** *
Define the Segment Orientation as: * **A/P Axis:
 +X



- **Distal to Proximal: +Y**

Thigh Segment

The RIGHT_HIP/LEFT_HIP landmarks are used to define the thigh segments. These landmarks are created automatically when the Pelvis segment is defined (so the Pelvis must be defined prior to creating the thigh segments).



LFTC/RFTC (LGT/RGT): Most Lateral prominence of the greater trochanter

LFKE/RFLE (LLE/RLE): Most lateral prominence of the lateral femoral epicondyle

LFME/RFME (LME/RME): Most medial prominence of the medial femoral epicondyle

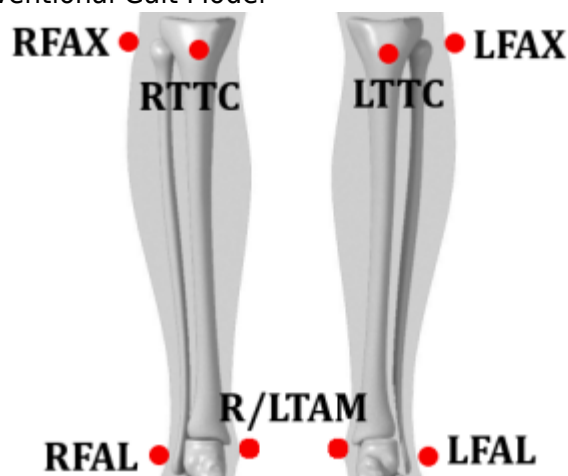
Thigh Definition

6. Create Right Thigh:

1. In the **Segments** tab, select Right Thigh in the Segment Name box
2. Click on the **Create Segment** button
3. In the **Right Thigh** tab, enter these values:
 - **Define Proximal Joint and Radius**
 - **Lateral:** None **Joint** RIGHT_HIP **Medial:** None
 - **Radius:** $0.5 * \text{DISTANCE}(\text{RIGHT_HIP}, \text{LEFT_HIP})$
 - **Define Distal Joint and Radius**
 - **Lateral:** RFLE **Joint:** None **Medial:** RFME
 - **Select Tracking Targets:**
 - RIGHT_HIP, RFLE, RFME, RFTC
4. Click on **Build Model**
5. Click on **Close Tab** before proceeding

Shank Segment

The segment coordinate system is different from the [conventional gait model](#) because the shank segment is designed according to markers located on the tibia and fibula, not the femur as with the Conventional Gait Model



LFAX/RFAX (LHF/RHF): Proximal tip of the head of the fibula

LTTC/RTTC (TT/RTT): Most anterior border of the tibial tuberosity

LFAL/RFAL (LLM/RLM): Lateral prominence of the lateral malleolus

LTAM/RTAM (LMM/RMM): Most medial prominence of the medial malleolus

Shank Landmarks

7. Create RKNE Joint Center:

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing | RKNE

Landmark Name: RKNE

Define Orientation Using:

Starting Point: RFLE (Reference)

Ending Point: RFME (On a line)

*Lateral object: (On a plane)

*Project From: (Projection onto a line or plane)

* = Optional

Existing Segment:

Landmark Offset from Start Point (Reference) or Segment Origin

Offset to Existing Calibration Target or Landmark:

Offset Using the Following ML/AP/AXIAL Offsets

ML:

AP:

AXIAL: 0.5

☒ Offset by Percent (1.0 = 100%) (Meters when not checked)

☒ Calibration Only Landmark (Not generated for assigned motion file(s))

Undo Changes Apply Build Model Close Tab

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RKNE
 - **Landmark Name:** RKNE
 - **Define Orientation Using:**
 - **Starting Point:** RFLE
 - **Ending Point:** RFME
4. Offset Using the Following **AXIAL** Offset: 0.5
5. **Check:** Offset by Percent (1.0 = 100%)
6. **Check:** Calibration Only Landmark

8. Create RANK Joint Center:

The screenshot shows the 'RANK' landmark configuration dialog in Visual3D. The 'Landmarks' tab is selected, and the 'RANK' landmark is being defined. The 'Define Orientation Using' section is expanded, showing 'Starting Point' as RFAL, 'Ending Point' as RTAM, and 'AXIAL' offset as 0.5. The 'Offset by Percent' checkbox is checked, and the 'Calibration Only Landmark' checkbox is also checked.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RANK
 - **LANDMARK Name:** RANK
 - **Define Orientation Using:**
 - **Starting Point:** RFAL
 - **Ending Point:** RTAM
4. Offset Using the Following **AXIAL** Offset: 0.5
5. **Check:** Offset by Percent (1.0 = 100%)
6. **Check:** Calibration Only Landmark

9. Create RTTC_PORJ:

The screenshot shows the 'RTTC_PROJ' dialog box within the 'Landmarks' tab. The 'Landmark Name' is 'RTTC_PROJ'. Under 'Define Orientation Using:', 'Starting Point' is 'RFAX' (Reference). 'Targets and/or Landmark:' is selected, with 'Ending Point' as 'RFAL' (On a line), '*Lateral object' as 'RTAM' (On a plane), and '*Project From' as 'RTTC' (Projection onto a line or plane). '* = Optional'. 'Existing Segment' is not selected. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', 'Offset to Existing Calibration Target or Landmark' is not selected, and 'Offset Using the Following ML/AP/AXIAL Offsets' is selected. The 'ML', 'AP', and 'AXIAL' offset fields are empty. 'Offset by Percent (1.0 = 100%) (Meters when not checked)' is unchecked. 'Calibration Only Landmark (Not generated for assigned motion file(s))' is checked. Buttons at the bottom include 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RTTC_PROJ
 - **Landmark Name:** RTTC_PROJ
 - **Define Orientation Using:**
 - **Starting Point:** RFAX
 - **Ending Point:** RTAM
 - **Lateral Object:** RTAM
 - **Project From:** RTTC
4. **Do Not Chck:** Offset by Percent (1.0 = 100%)
5. **Check:** Calibration Only Landmark

10. Create RSK_PROX:

The screenshot shows the 'RSK_PROX' dialog box in the Visual3D software. The 'Landmarks' tab is active. The 'Landmark Name' is 'RSK_PROX'. Under 'Define Orientation Using:', 'Starting Point' is 'RANK' (Reference). 'Targets and/or Landmark:' is selected, with 'Ending Point' as 'RTTC_PROJ' (On a line), '*Lateral object' as blank (On a plane), and '*Project From' as 'RKNE' (Projection onto a line or plane). '* = Optional'. 'Existing Segment' is blank. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', 'Offset to Existing Calibration Target or Landmark' is blank. 'Offset Using the Following ML/AP/AXIAL Offsets' are all blank. 'Offset by Percent (1.0 = 100%) (Meters when not checked)' is unchecked. 'Calibration Only Landmark (Not generated for assigned motion file(s))' is checked. Buttons at the bottom are 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RSK_PROX
 - **Landmark Name:** RSK_PROX
 - **Define Orientation Using:**
 - **Starting Point:** RANK
 - **Ending Point:** RTTC_PROJ
 - **Lateral Object:** Leave Blank
 - **Project From:** RKNE
4. **Do NOT Check:** Offset by Percent (1.0 = 100%)
5. **Check:** Calibration Only Landmark

Shank Definition

11. Create Right Shank:

1. In the **Segments** tab, select Right Shank in the Segment Name box
2. Click on the **Create Segment** button
3. In the **Right Shank** tab, enter these values:
 - **Define Proximal Joint and Radius**
 - **Lateral:** None **Joint:** RSK_PROX **Medial:** None
 - **Radius:** $0.5 * \text{DISTANCE}(\text{RFLE}, \text{RFME})$
 - **Define Distal Joint and Radius**
 - **Lateral:** RFAL **Joint:** None **Medial:** RTAM
 - **Select Tracking Targets:**
 - RFAL, RFAX, RTAM, RTTC

12. Modify the Segment Coordinate System:

- Define the Segment Orientation as:
- **A/P Axis:** +X
- **Distal to Proximal:** +Y

Foot Segment

The foot segment coordinate system is consistent with some version of the [Conventional Gait Model](#). The foot segment is created using the RANK/LANK landmarks which are described in the Shank Landmarks section



LFAL/RFAL (LLM/RLM): Lateral prominence of the lateral malleolus

LTAM/RTAM (LMM/RMM): Most medial prominence of the medial malleolus

LFCC/RFCC (LCA/RCA): Aspect of the achilles tendon insertion on the calcaneus

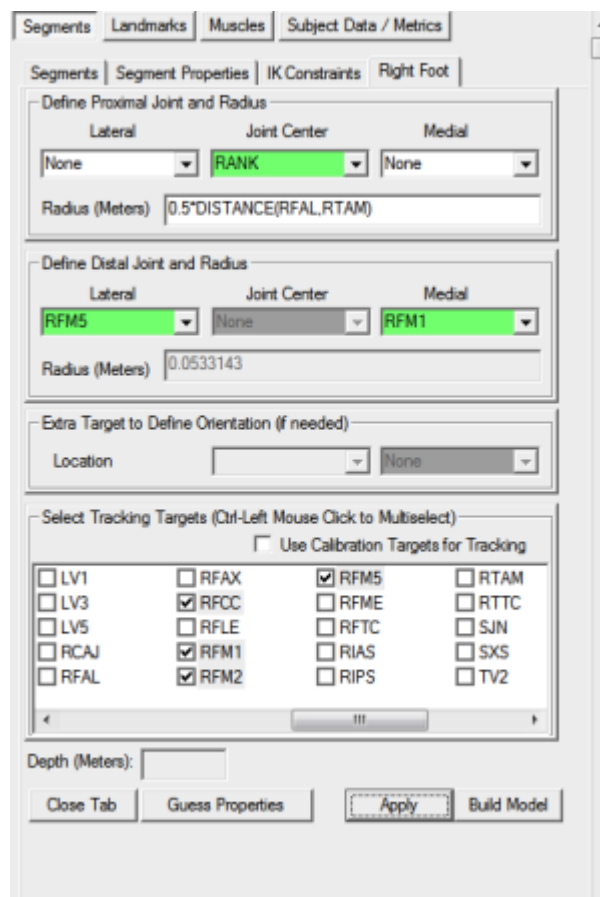
LFM1/RFM1 (LFM/RFM): Dorsal margin of the first metatarsal head

LFM2/RFM2 (LSM/RSM): Dorsal aspect of the second metatarsal head

LEFM5/RFM5 (LVM/RVM): Dorsal margin of the fifth metatarsal head

Kinetic Foot

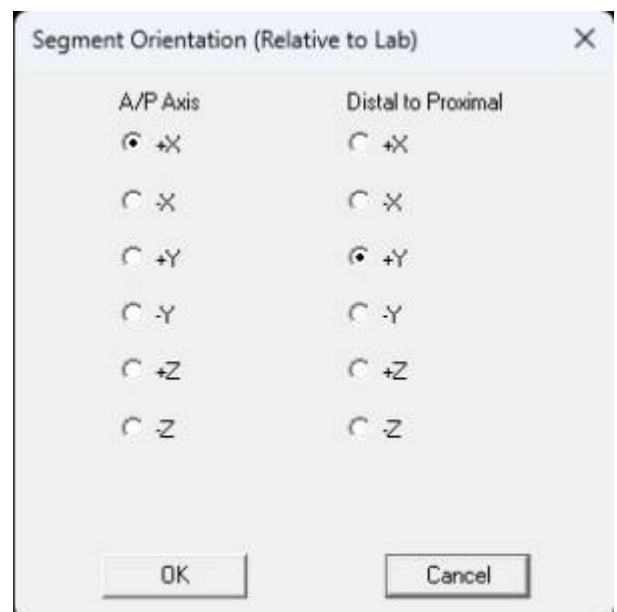
13. Create Right Foot:



1. In the **Segments** tab, select the Right Foot in the Segment Name box

2. Click on the **Create Segment** button
3. In the **Right Foot** tab, enter these values:
 - **Define Proximal Joint and Radius**
 - **Lateral:** None **Joint:** RANK **Medial:** None
 - **Radius:** $0.5 * \text{DISTANCE}(\text{RFAL}, \text{RTAM})$
 - **Define Distal Joint and Radius**
 - **Lateral:** RFM5 **Joint:** None **Medial:** RFM1
 - **Select Tracking Targets:**
 - RFCC, RFM1, RFM2, RFM5
4. Click on the **Build Model**
5. Click on **Close Tab** before proceeding

14. Modify the **Segment Coordinate System**:



- Define the Segment Orientation as:
 - **A/P Axis:** +X
 - **Distal to Proximal:** +Y

Kinematic Foot Landmarks

15. Create RFT_DIST:

The screenshot shows the 'Landmarks' tab in the Visual3D software. The 'Landmark Name' is set to 'RFT_DIST'. Under 'Define Orientation Using:', the 'Starting Point' is 'RFCC' (Reference), 'Ending Point' is 'RFM5' (On a line), '*Lateral object' is 'RFM1' (On a plane), and '*Project From' is 'RFM2' (Projection onto a line or plane). The '* = Optional' note is present. The 'Existing Segment' is set to a dropdown menu. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', the 'Offset to Existing Calibration Target or Landmark' is selected. The 'Offset Using the Following ML/AP/AXIAL Offsets' section has input fields for ML, AP, and AXIAL. The 'Offset by Percent (1.0 = 100%) (Meters when not checked)' checkbox is unchecked. The 'Calibration Only Landmark (Not generated for assigned motion file(s))' checkbox is checked. At the bottom are buttons for 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

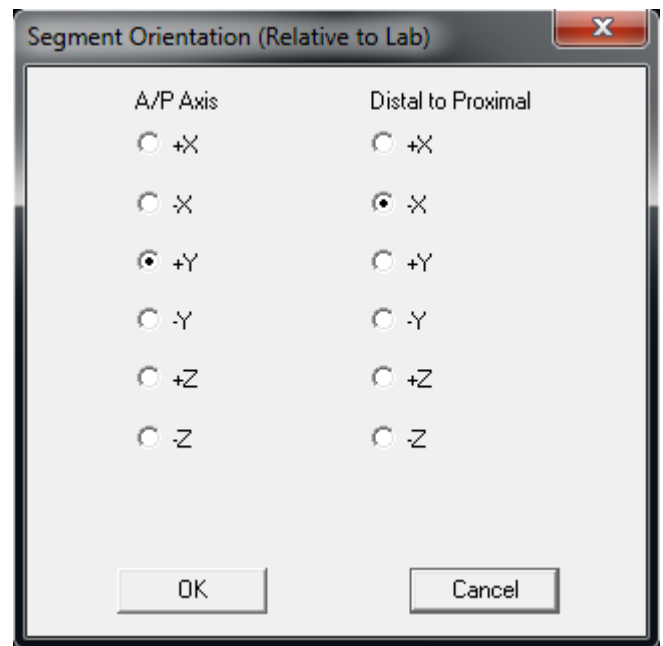
1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RFT_DIST
 - **Landmark Name:** RFT_DIST
 - **Define Orientation Using:**
 - **Starting Point:** RFCC
 - **Ending Point:** RFM5
 - **Lateral Object:** RFM1
 - **Project From:** RFM2
4. **Do NOT Check:** Offset by Percent (1.0 = 100%)
5. **Check:** Calibration Only Landmark

Kinematic Foot Definition

16. Create Right Virtual Foot:

1. In the **Segments** tab, type *Right Virtual Foot* into the Segment Name box
2. Check the **Kinematic Only** Check Box
3. Click on the **Create Segment** button
4. In the **Right Virtual Foot** tab, enter these values:
 - **Define Proximal Joint and Radius**
 - **Lateral:** None **Joint:** RFCC **Medial:** None
 - **Radius:** 0.1
 - **Define Distal Joint Radius**
 - **Lateral:** RFM5 **Joint:** RFT_DIST **Medial:** None
 - **Select Tracking Targets:**
 - RFCC, RFM1, RFM2, RFM5

17. Modify the Segment Coordinate System:



- Define the Segment Orientation as:
 - **A/P Axis:** +Y
 - **Distal to Proximal:** -X

Virtual Lab

Virtual Lab Landmarks

18. Create Lab_Origin:

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: Lab_Origin
 - **Landmark Name:** Lab_Origin
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.0 **Y:** 0.0 **Z:** 0.0
5. **Do NOT Check:** Offset by Percent (1.0 = 100%)
6. **Do NOT Check:** Calibration Only Landmark

19. Create Lab_AX:

The screenshot shows the 'Lab_AX' landmark creation dialog box. The 'Landmarks' tab is active. The 'Landmark Name' is 'Lab_AX'. Under 'Define Orientation Using:', 'Starting Point' is set to '(Reference)'. 'Targets and/or Landmark:' is set to '(On a line)'. '*Lateral object' is set to '(On a plane)'. '*Project From' is set to '(Projection onto a line or plane)'. '* = Optional'. 'Existing Segment' is set to 'LAB'. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', 'Offset to Existing Calibration Target or Landmark' is set to '(Reference)'. 'Offset Using the Following ML/AP/AXIAL Offsets' are: X: 0.0, Y: 0.0, Z: 0.1. 'Offset by Percent (1.0 = 100%) (Meters when not checked)' is unchecked. 'Calibration Only Landmark (Not generated for assigned motion file(s))' is unchecked. Buttons at the bottom are 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: Lab_Origin
 - **Landmark Name:** Lab_AX
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.0 **Y:** 0.0 **Z:** 0.1
5. **Do NOT Check:** Offset by Percent (1.0 = 100%)
6. **Do NOT Check:** Calibration Only Landmark

20. Create Lab_ML:

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: Lab_ML
 - **Landmark Name:** Lab_ML
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.1 **Y:** 0.0 **Z:** 0.0
5. **Do NOT Check:** Offset by Percent (1.0 = 100%)
6. **Do NOT Check:** Calibration Only Landmark

21. Create Lab_ML:

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing | Pel_ML

Landmark Name: Pel_ML

Define Orientation Using:

Starting Point: Lab_Origin (Reference)

Targets and/or Landmark:

Ending Point: (On a line)

*Lateral object: (On a plane)

*Project From: (Projection onto a line or plane)

* = Optional

Existing Segment: Pelvis

Landmark Offset from Start Point (Reference) or Segment Origin

Offset to Existing Calibration Target or Landmark:

Offset Using the Following ML/AP/AXIAL Offsets

ML: 0.1

AP: 0.0

AXIAL: 0.0

Offset by Percent (1.0 = 100%) (Meters when not checked)

Calibration Only Landmark (Not generated for assigned motion file(s))

Undo Changes Apply Build Model Close Tab

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: Lab_ML
 - **Landmark Name:** Lab_ML
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.1 **Y:** 0.0 **Z:** 0.0
5. **Do Not Check:** Offset by Percent (1.0 = 100%)
6. **Do NOT Check:** Calibration Only Landmark

22. Create Pel_ML:

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing | Pel_ML

Landmark Name: Pel_ML

Define Orientation Using:

Starting Point: Lab_Origin (Reference)

Targets and/or Landmark:

Ending Point: (On a line)

*Lateral object: (On a plane)

*Project From: (Projection onto a line or plane)

* = Optional

Existing Segment: Pelvis

Landmark Offset from Start Point (Reference) or Segment Origin:

Offset to Existing Calibration Target or Landmark:

Offset Using the Following ML/AP/AXIAL Offsets

ML: 0.1

AP: 0.0

AXIAL: 0.0

Offset by Percent (1.0 = 100%) (Meters when not checked)

Calibration Only Landmark (Not generated for assigned motion file(s))

Undo Changes Apply Build Model Close Tab

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: Pel_ML
 - **Landmark Name** Pel_ML
 - **Define Orientation Using:**
 - **Starting Point:** Lab_Origin
 - **Existing Segment:** Pelvis
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.1 **Y:** 0.0 **Z:** 0.0
5. **Do NOT Check:** Offset by Percent (1.0 = 100%)
6. **Do NOT Check:** Calibration Only Landmark

23. Create Pel_ML_Proj:

The screenshot shows the 'Landmarks' tab in the Visual3D software. The 'Pel_ML_Proj' landmark is being configured. The 'Landmark Name' is 'Pel_ML_Proj'. Under 'Define Orientation Using:', 'Starting Point' is 'Lab_Origin' (Reference). 'Targets and/or Landmark:' is selected, with 'Ending Point' as 'Lab_ML' (On a line), '*Lateral object' as an empty field (On a plane), and '*Project From' as 'Pel_ML' (Projection onto a line or plane). '* = Optional'. 'Existing Segment' is an empty dropdown. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', 'Offset to Existing Calibration Target or Landmark' is an empty dropdown. 'Offset Using the Following ML/AP/AXIAL Offsets' has three empty input fields for ML, AP, and AXIAL. 'Offset by Percent (1.0 = 100%) (Meters when not checked)' is unchecked. 'Calibration Only Landmark (Not generated for assigned motion file(s))' is unchecked. Buttons at the bottom are 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: Pel_ML_Proj
 - **Landmark Name:** Pel_ML_Proj
 - **Define Orientation Using:**
 - **Starting Point:** Lab_Origin
 - **Ending Point:** Lab_ML
 - **Project Point:** Pel_ML
4. **Do NOT Check:** Offset by Percent (1.0 = 100%)
5. **Do NOT Check:** Calibration Only Landmark

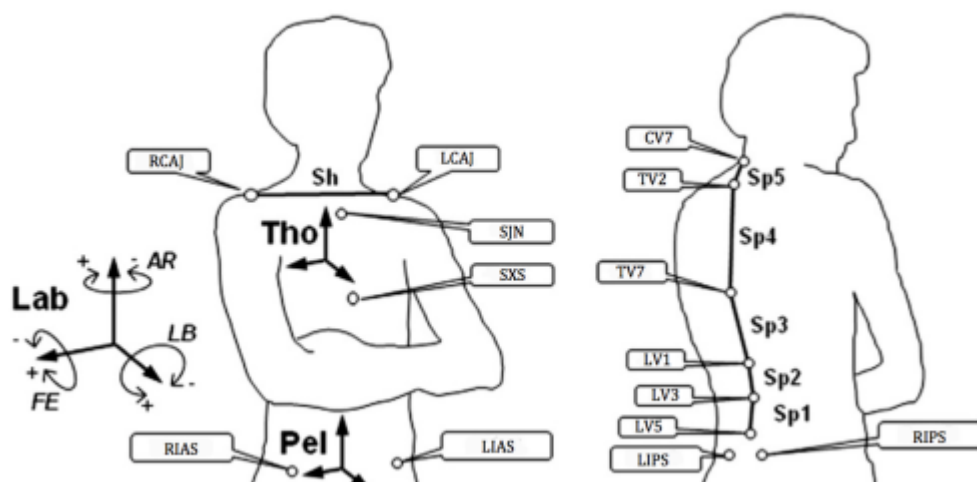
24. Create VLab_ML:

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: VLab_ML
 - **Landmark Name:** VLab_ML
 - **Define Orientation Using:**
 - **Starting Point:** Lab_Origin
 - **Ending Point:** Lab_ML
 - **Project Point:** Pel_ML_Proj
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **AXIAL:** 0.1
5. **Do NOT Check:** Offset by Percent (1.0 = 100%)
6. **Do NOT Check:** Calibration Only Landmark

Planar Angles

To calculate the orientation of the trunk segments, planar angles are calculated to determine the orientation of the various segments relative to one another. To calculate a planar angle, you need to

either reference the ORIGINAL or PROCESSED folder when defining a target. If your targets have not been filtered or interpolated, you will not have a processed folder and will need to use the ORIGINAL. However, if you plan to process your target data in any way, you should do this now, prior to creating you planar angles.



The following abbreviations are used in naming the planar angles

- **FE** Flexion/Extension
- **LB** Lateral Bending
- **AR** Axial Rotation

Spine FE & LB Landmarks

25. Create RPV_AX:

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RPV_AX

- **Landmark Name:** RPV_AX
 - **Define Orientation Using:**
 - **Starting Point:** LV5
4. Offset Using the Following **ML\AP\AXIAL** Offsets:
 - **X:** 0.0 **Y:** 0.0 **Z:** -0.05
 5. **Do NOT Check:** Offset by Percent (1.0 = 100%) (Meters when not checked)
 6. **Do NOT Check:** Calibration Only Landmark (Not generated for assigned motion file(s))

FE Planar Angles

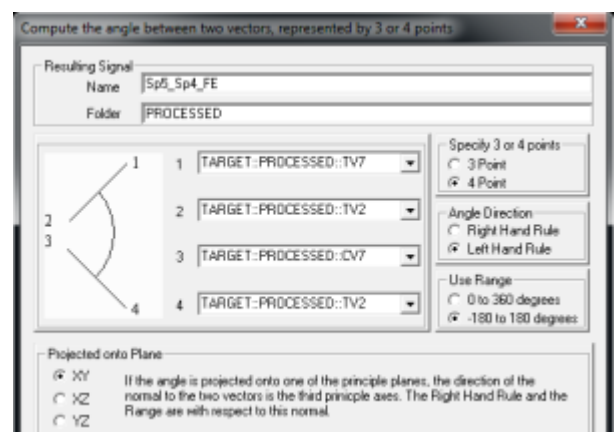
Below defines the orientation (flexion/extension) of the adjoining spine segments resolved in the pelvis coordinate system

NOTE: For the FE Planar Angles, the same definitions for the angles are used for both the left & right side. This means the different sets of signals do not need to be created for the left and right sides (as with the LB and AR planar angles).

NOTE-2: To access these dialogs, you need to edit a command pipeline, the "[Compute_Planar_Angle](#)" pipeline command.

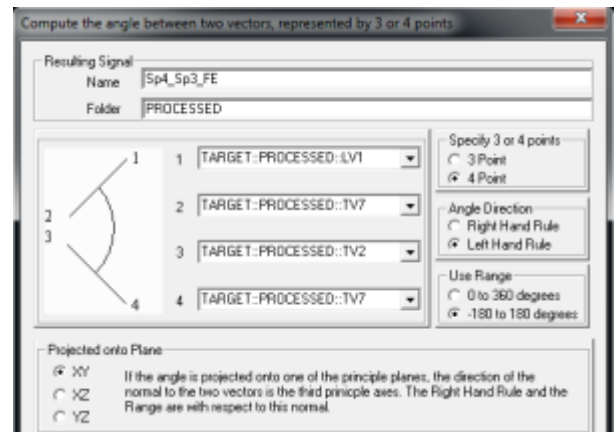
Spine FE Definitions

26. Create Sp5_sp4_FE Planar angle:



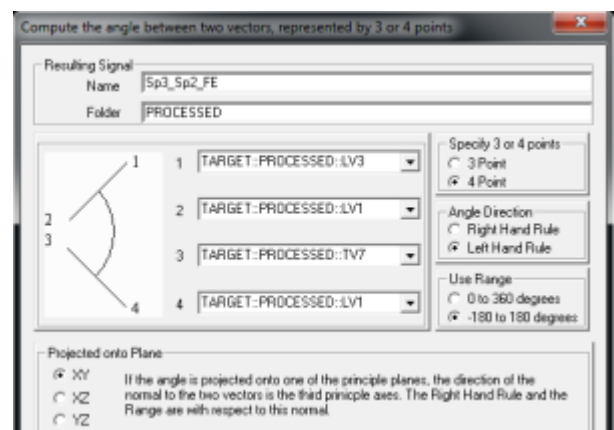
1. Define **Resulting Signal** Name: Sp5_Sp4_FE
2. Calculate a **4 point angle** between the following targets:
 1. TARGET::PROCESSED::TV7
 2. TARGET::PROCESSED::TV2
 3. TARGET::PROCESSED::CV7
 4. TARGET::PROCESSED::TV2
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plane:** XY
 - **Note:** The Reference segment will need to be changed to RPV within the text option.

27. Create Sp4_Sp3_FE planar angle:



1. Define **Resulting Signal** Name: Sp4_Sp3_FE
2. Calculate a **4 point angle** between the following
 1. TARGET::PROCESSED::LV1
 2. TARGET::PROCESSED::TV7
 3. TARGET::PROCESSED::TV2
 4. TARGET::PROCESSED::TV7
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plane:** XY
 - **Note:** The reference segment will need to be changed to RPV within the text option

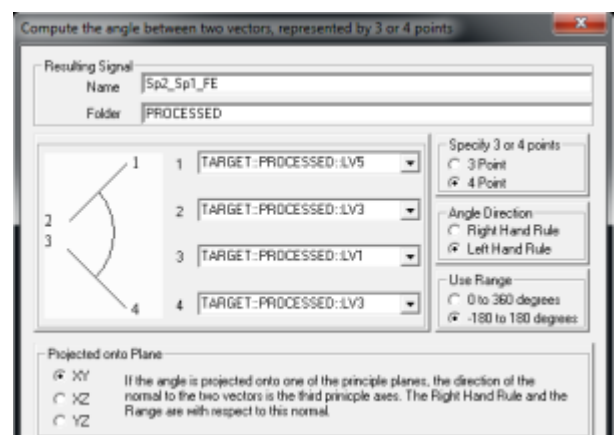
28. Create Sp3_Sp2_FE planar angle:



1. Define **Resulting Signal** Name: Sp3_Sp2_FE
2. Calculate a **4 point angle** between the following targets:
 1. TARGET::PROCESSED::LV3

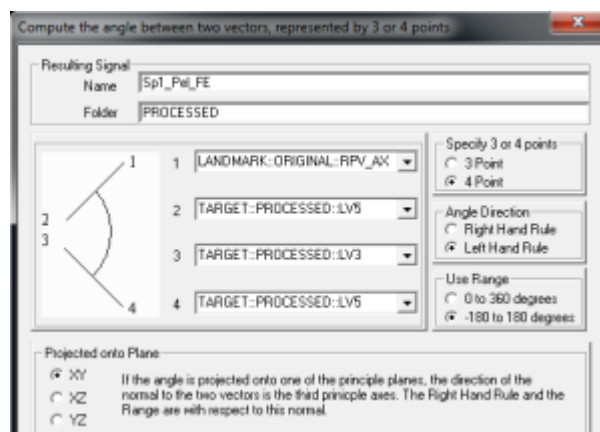
2. TARGET::PROCESSED::LV1
3. TARGET::PROCESSED::TV7
4. TARGET::PROCESSED::LV1
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plane:** XY
 - **Note:** The reference segment will need to be changed to RPV within the text option

29. Create Sp2_Sp1_FE planar angle:



1. Define **Resulting Signal** Name: Sp2_Sp1_FE
2. Calculate a **4 point angle** between the following targets:
 1. TARGET::PROCESSED::LV5
 2. TARGET::PROCESSED::LV3
 3. TARGET::PROCESSED::LV1
 4. TARGET::PROCESSED::LV3
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plane:** XY
 - **Note:** The reference segment will need to be changed to RPV within the text option.

30. Create Sp1_Pel_FE planar angle:



1. Define **Resulting Signal** Name: Sp2_Sp1_FE
2. Calculate a **4 point angle** between the following targets:
 1. LANDMARK::ORIGINAL::RPV_AX
 2. TARGET::PROCESSED::LV5
 3. TARGET::PROCESSED::LV3
 4. TARGET::PROCESSED::LV5
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plane:** XY
 - **Note:** The reference segment will need to be changed to RPV within the text option.

Shoulder LB

Below defines the orientation of the line between the shoulder targets (LCAJ/RCAJ) relative to the trunk segment

Shoulder LB & AR Landmarks

31. Create RTA_OR:

The screenshot shows the 'RTA_OR' dialog box within the 'Landmarks' tab. The 'Landmark Name' is set to 'RTA_OR'. Under 'Define Orientation Using:', 'Starting Point' is set to '(Reference)'. The 'Existing Segment' is set to 'Thorax/Ab'. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', 'Offset Using the Following ML/AP/AXIAL Offsets' is selected, with ML, AP, and AXIAL all set to 0.0. The checkbox 'Offset by Percent (1.0 = 100%) (Meters when not checked)' is checked. The checkbox 'Calibration Only Landmark (Not generated for assigned motion file(s))' is unchecked. At the bottom are buttons for 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RTA_OR
 - **Landmark Name:** RTA_OR
 - **Existing Segment:** Thorax/Ab
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.0 **Y:** 0.0 **Z:** 0.0
5. **Check:** Offset by Percent (1.0 = 100%) (Meters when not checked)
6. **Do NOT Check:** Calibration Only Landmark (Not generated for assigned motion file(s))

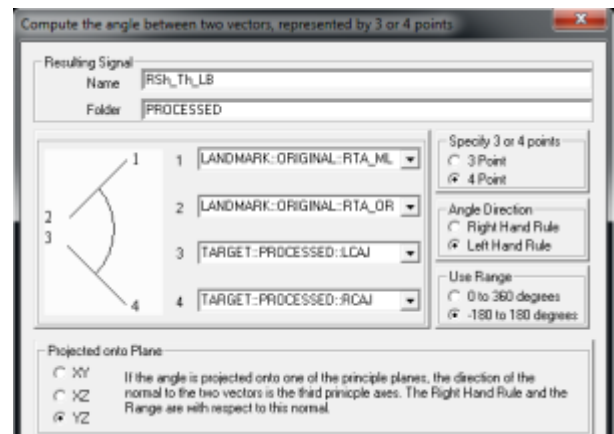
32. Create RTA_ML:

The screenshot shows the 'RTA_ML' dialog box within the 'Landmarks' tab. The 'Landmark Name' is set to 'RTA_ML'. Under 'Define Orientation Using:', 'Starting Point' is set to '(Reference)'. 'Ending Point' is set to '(On a line)'. '*Lateral object' is set to '(On a plane)'. '*Project From' is set to '(Projection onto a line or plane)'. '* = Optional'. 'Existing Segment' is set to 'Thorax/Ab'. Under 'Landmark Offset from Start Point (Reference) or Segment Origin', 'Offset to Existing Calibration Target or Landmark' is set to '(Reference)'. 'Offset Using the Following ML/AP/AXIAL Offsets' are: ML: 0.5, AP: 0.0, AXIAL: 0.0. 'Offset by Percent (1.0 = 100%) (Meters when not checked)' is checked. 'Calibration Only Landmark (Not generated for assigned motion file(s))' is unchecked. Buttons at the bottom include 'Undo Changes', 'Apply', 'Build Model', and 'Close Tab'.

1. Click **Landmarks** button
2. Click **Add New Landmark** button
3. Create Landmark: RTA_ML
 - **Landmark Name:** RTA_ML
 - **Existing Segment:** THORAX/Ab
4. Offset Using the Following **ML/AP/AXIAL** Offsets:
 - **X:** 0.5 **Y:** 0.0 **Z:** 0.0
5. **Check:** Offset by Percent (1.0 = 100%) (Meters when not checked)
6. **Do NOT Check:** Calibration Only Landmark (Not generated for assigned motion file(s))

Shoulder LB & AR Definitions

33. Create RSh_Th_LB planar angle:

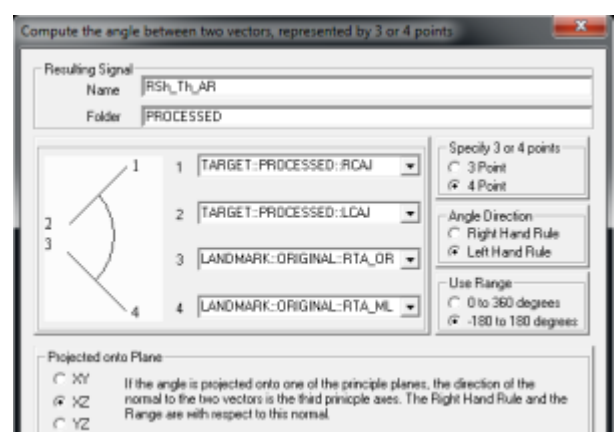


1. Define **Resulting Signal** Name: RSh_Th_LB
2. Calculate a **4 point angle** between the following targets:
 1. LANDMARK::ORIGINAL::RTA_ML
 2. LANDMARK::ORIGINAL::RTA_OR
 3. TARGET::PROCESSED::LCAJ
 4. TARGET::PROCESSED::RCAJ
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plan:** YZ
 - **NOTE:** The reference segment will need to be changed to RTA within the text options.

34. Create LSh_Th_LB planar angle:

- When defining the left signal, use same definitions **except** set:
 - **Angle Direction:** Right Hand Rule

35. Create RSh_Th_AR planar angle:



1. Define **Resulting Signal** Name: RSh_Th_AR
2. Calculate a **4 point angle** between the following targets:
 1. TARGET::PROCESSED::RCAJ
 2. TARGET::PROCESSED::LCAJ
 3. LANDMARK::ORIGINAL::RTA_OR
 4. LANDMARK::ORIGINAL::RTA_ML
 - **Angle Direction:** Left Hand Rule
 - **3D Space:** Always 0 to 180 degrees
 - **Projected onto Plane:** XZ
 - **Note:** The reference segment will need to be changed to RTA within the text option

36. Create LSh_Th_AR planar angle:

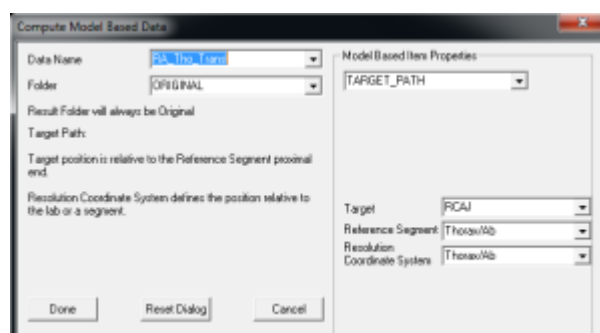
- When defining the left signal, use same definitions **except** set:
 - **Angle Direction:** Right Hand Rule

Translation

Below defines the translation of the shoulder targets (LCAJ/RCAJ) in the trunk coordinate system

Shoulder Translation Definitions

37. Define RA_Tho_Transl:



1. Open the **Compute Model Based** dialog
2. Select **TARGET_PATH** from drop down list
 - **Date Name:** RA_Tho_Transl
 - **Target:** RCAJ
 - **Reference Segment:** Thorax/Ab
 - **Resolution Coordinate System:** Thorax/Ab

38. Define LA_Tho_Transl:

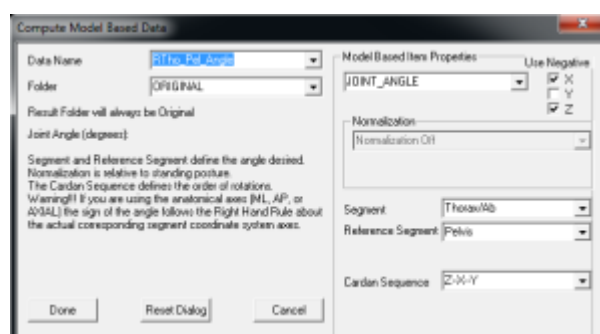
- When defining the left signal, use the same definitions **except** set:
 - **Target:** LCAJ

Joint Angles

The Tho_Pel and Tho_Lab angles are described here, while the lower extremity joint angles were created based on the segment coordinate systems described here

Joint Angle Definitions

39. Define the RTho_Pel_Angle:



1. Open the **Compute Model Based** dialog
2. Select **JOINT_ANGLE** from drop down list
 - **Data Name:** RTho_Pel_Angle
 - **Segment:** Thorax/Ab
 - **Reference Segment:** Pelvis
 - **Cardan Sequence:** Z-X-Y
3. **Use Negative:**
 - **X:** TRUE **Y:** FALSE **Z:** TRUE

40. Define LTho_Pel_Angle:

- When defining the left signal, use same definitions **except** set:
 - **Use Negative**
 - **X:** FALSE **Y:** TRUE **Z:** TRUE

41. Define the RTho_Lab_Angle:

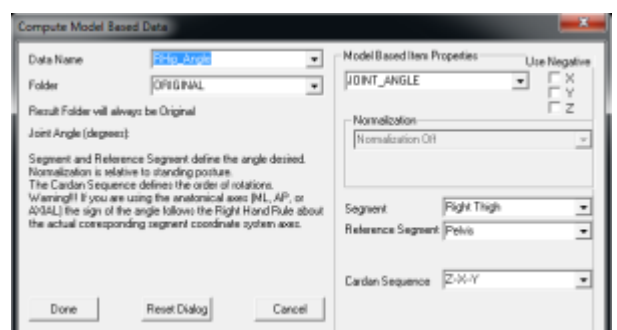


1. Open the **Compute Model Based** dialog
2. Select **JOINT_ANGLE** from the drop down list
 - **Data Name:** RTho_Lab_Angle
 - **Segment:** RThorax/Ab
 - **Reference Segment:** VLab
 - **Cardan Sequence:** Z-X-Y
3. **Use Negative:**
 - **X:** TRUE **Y:** FALSE **Z:** TRUE

42. Define LTho_Lab_Angle:

- When defining the left signal, use same definitions **except** set:
 - **Use Negative:**
 - **X:** FALSE **Y:** TRUE **Z:** TRUE

43. Define the RHip_Angle:



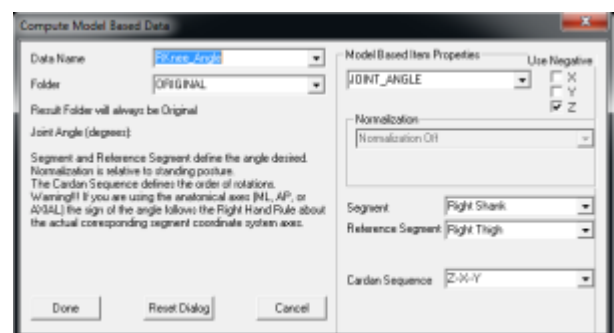
1. Open the **Compute Model Based** dialog

2. Select **JOINT_ANGLE** from drop down list
 - **Date Name:** RHip_Angle
 - **Segment:** Right Thigh
 - **Reference Segment:** Pelvis
 - **Carden Sequence:** Z-X-Y
3. **Use Negative:**
 1. **X:** FALSE **Y:** FALSE **Z:** FALSE

44. Define LHip_Angle:

- When defining the left signal, use same definitions **except** set:
 - **Segment:** Left Thigh
 - **Use Negative:**
 - **X:** TRUE **Y:** TRUE **Z:** FALSE

45. Define the RKnee_Angle:



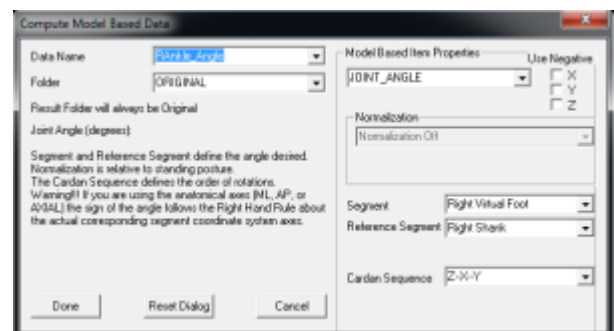
1. Open the **Compute Model Based** dialog
2. Select **JOINT_ANGLE** from drop down list
 - **Data Name:** RKnee_Angle
 - **Segment:** Right Shank
 - **Reference Segment:** Right Thigh
 - **Carden Sequence:** Z-X-Y
3. **Use Negative:**
 - **X:** FALSE **Y:** FALSE **Z:** TRUE

46. Define LKnee_Angle:

- When defining the left signal, use same definitions **except** set:

- **Segment:** Left Shank
- **Reference Segment:** Left Thigh
 - **Use Negative:**
 - **X: TRUE Y: TRUE Z: TRUE**

47. Define the RKnee_Angle:



1. Open the **Compute Model Based** dialog
2. Select **JOINT_ANGLE** from drop down list
 - **Data Name:** RAnkle_Angle
 - **Segment:** Right Virtual Foot
 - **Reference Segment:** Right Shank
 - **Cardan Sequence:** Z-X-Y
3. **Use Negative:**
 - **X: FALSE Y: FALSE Z: FALSE**

48. Define LAnkle_Angle:

- When defining the left signal, use the same definitions **except** set:
 - **Segment:** Left Virtual Foot
 - **Reference Segment:** Left Shank
 - **Use Negative:**
 - **X: TRUE Y: TRUE Z: FALSE**

IOR Multi-Segment Foot Model

detailed tutorial focusing on the [IOR Multi-Segment Foot Model](#).

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