

IOR Foot Model 2007

This tutorial describes the 2007 publication. For the updated 2014 IOR foot model [see here](#).

Sample Data

Sample data can be downloaded [here](#).

Once the zip file has been downloaded, you can find a static C3D and three dynamic trials in the SampleFiles folder. These files will be used to complete the tutorial.

The model, planar angles and joint angles for the right side were defined and plotted in the Leardini_2007_Angles.cmo. Once the left side angles have been defined, the report template will graph both the left and right angles.

Introduction

Visual3D is a general tool capable of implementing many different foot models.

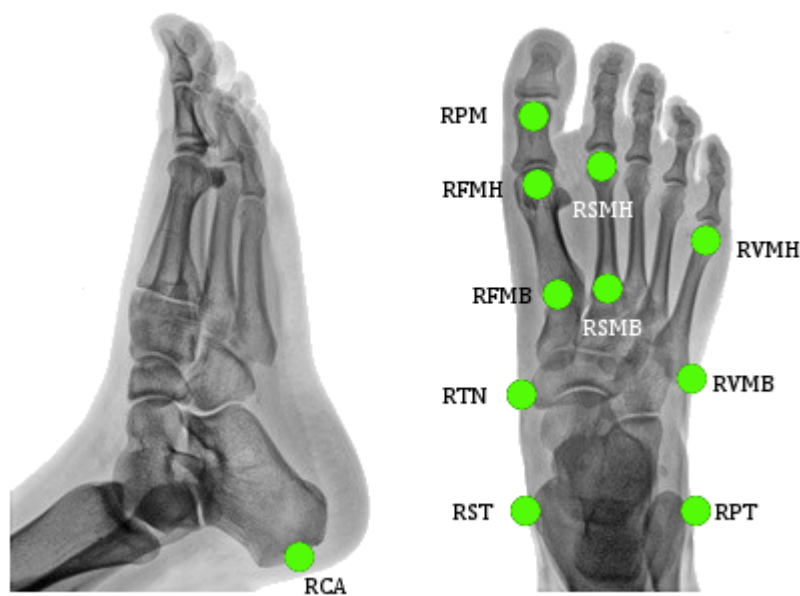
This tutorial describes the IOR Foot analysis as it was published in the ORIGINAL paper (shown below):

Leardini, A., M.G. Benedetti, L. Berti, D. Bettinelli, R. Nativo, and S. Giannini. "Rear-foot, Mid-foot and Fore-foot Motion during the Stance Phase of Gait." *Gait & Posture* 25 (2007): 453-55

Modifications were made to the original IOR Foot analysis (published in the paper below). [The modified tutorial can be found here](#).

Portinaro, N., A. Leardini, A. Panou, V. Monzani, and P. Caravaggi. "Modifying the Rizzoli foot model to improve the diagnosis of pes-planus: application to kinematics of feet in teenagers." *Journal of Foot and Ankle Research* (2014) Below is a tutorial demonstrating how to implement the ORIGINAL analysis in Visual3D. If you would rather see a fully completed model you can simply download the following file [blank] and open it in Visual3D.

Multi-Segment Foot Marker Set



CA^[1](FCC)^[2]:p. 160 = Posterior Surface of Calcaneus ST^[1](FST)^[2] = Sustentaculum Tali of Calcaneus
PT^[1](FPT)^[2] = Lateral apex of the peroneal tubercle TN^[1](FNT)^[2] = Medial apex of the tuberosity navicular
FMH^[1](FM1)^[2] = Head of 1st Metatarsus SMH^[1](FM2)^[2] = Head of 2nd Metatarsus
VMH^[1](FM5)^[2] = Head of 5th Metatarsus VMB^[1](FMT)^[2] = Tuberosity of 5th Metatarsal PM^[1](PM6)^[2] = Proximal Medial Phalanx
FMB^[1] = Base of First Metatarsal SMB^[1] = Base of Second Metatarsal

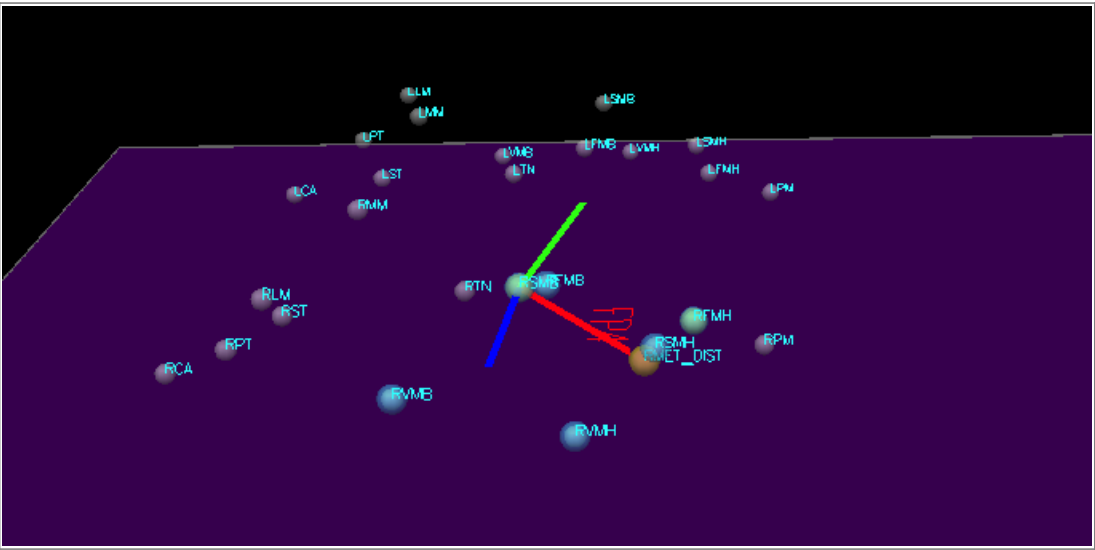
Metatarsus (Met)

Landmarks

1. Create RMET_DIST: - Click Landmarks button - Click Add New Landmark button - Create Landmark: RMET_DIST	Landmark Name: <i>RMET_DIST</i> Define Orientation Using: Starting Point: <i>RFMH</i> Ending Point: <i>RVMH</i> Lateral Object: <i>RSMB</i> Project From: <i>RSMH</i>	Do NOT Check: <i>Offset by Percent (1.0 = 100%)</i> Check: <i>Calibration Only Landmark</i>	Workspace Signals and Events Models Reports CalT Segments Landmarks Muscles Subject Data / Metrics Landmarks Functional Digitizing RMET_DIST Landmark Name: RMET_DIST Define Orientation Using: Starting Point: RFMH (Reference) ☒ Targets and/or Landmarks: Ending Point: RVMH (On a line) *Lateral object: RSMB (On a plane) *Project From: RSMH (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: ☐ 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
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Segment Definition

1. Create RMet Segment: - In the Segments tab, select <i>RMet</i> in the Segment Name box. - Select Kinematic Only - Click on the Create Segment button. - In the RMet tab, enter these values:	Define Proximal Joint and Radius Lateral: <i>None</i> Joint: <i>None</i> Medial: <i>None</i> Radius: <i>0.1</i> Define Distal Joint and Radius Lateral: <i>None</i> Joint: <i>RMET_DIST</i> Medial: <i>None</i> Radius: <i>0.1</i> Extra Target to Define Orientation Location: <i>Medial</i> <i>RFMH</i> Select Tracking Targets: <i>RFMB, RFMH, RSMB, RSMH, RVMB, RVMH</i>	- Click on Build Model. - Click on Close Tab before proceeding.	Workspace Signals and Events Models Reports CalT Segments Landmarks Muscles Subject Data / Metrics Segments Segment Properties IK Constraints RMet Define Proximal Joint and Radius Lateral Joint Center Medial None RSMB None Radius (Meters) 0.1 Define Distal Joint and Radius Lateral Joint Center Medial None RMET_DIST None Radius (Meters) 0.1 Extra Target to Define Orientation (if needed) Location Medial RFMH Select Tracking Targets (Ctrl-Left Mouse Click to Multiselect) ☐ RF2P_Offset ☐ RFMB_proj ☐ LCA ☐ LMM ☐ LAB_O ☐ RSMH_proj ☐ LFMB ☐ LPM ☐ LAB_X ☐ RSMB_proj ☐ LFMH ☐ LPT ☐ LAB_Y ☐ RVMH_proj ☐ LHF ☐ LSMB ☐ RFMH_proj ☐ RVMB_proj ☐ LLM ☐ LSMH Depth (Meters): Close Tab Guess Properties Apply Build Model
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2. Modify the Segment Coordinate System: Define the Segment Orientation as:	A/P Axis: +Y Distal to Proximal: -X	
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The image to the right (and all other images in this tutorial) show a mediolateral view of the segment coordinate system after it has been modified.

Mid-foot (Mid)

Landmarks

1. Create RID Joint Center: Click Landmarks button Click Add New Landmark button Create Landmark: RID	Landmark Name: RID Define Orientation Using: Starting Point: RTN Ending Point: RVMB	Offset Using the Following AXIAL Offset: 0.5 Check: Offset by Percent (1.0 = 100%) Check: Calibration Only Landmark	WorkspaceSignals and EventsModelsReportsCal SegmentsLandmarksMusclesSubject Data / Metrics LandmarksFunctionalDigitizingRID Landmark Name: RID Define Orientation Using: Starting PointRTN(Reference) Targets and/or Landmarks: Ending PointRVMB(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 AXIAL0.5 ☒ 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
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Segment Definition

1. Create RMid Segment:

- In the **Segments** tab, select *RMid* in the Segment Name box.
- Select **Kinematic Only**.
- Click on the **Create Segment** button.
- In the **RMid** tab, enter these values:

Define Proximal Joint and Radius

Lateral: None **Joint:** *RID* **Medial:** None

Radius: 0.1

Define Distal Joint and Radius

Lateral: None **Joint:** *RSMB* **Medial:** None

Radius: 0.1

Extra Target to Define Orientation

Location: Medial *RTN*

Select Tracking Targets: *RSMB, RTN, RVMB*

Click on **Build Model**.

Click on **Close Tab** before proceeding.

[illegible]

Calcaneus (Cal)

Landmarks

1. Create RIC Joint Center: • Click Landmarks button • Click Add New Landmark button • Create Landmark: RIC	Landmark Name: RIC Define Orientation Using: Starting Point: RST Ending Point: RPT	• Offset Using the Following AXIAL Offset: 0.5 • Check: Offset by Percent (1.0 = 100%) • Check: Calibration Only Landmark	Workspace Signals and Events Models Reports Cal Segments Landmarks Muscles Subject Data / Metrics Landmarks Functional Digitizing RIC Landmark Name: RIC Define Orientation Using: Starting Point: RST (Reference) • Targets and/or Landmarks: Ending Point: RPT (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
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Segment Definition

1. Create RCal Segment: • In the Segments tab, select <i>RCal</i> in the Segment Name box. • Click on the Create Segment button. • In the RCal tab, enter these values: Define Proximal Joint and Radius Lateral: <i>None</i> Joint: <i>RCA</i> Medial: <i>None</i> Radius: <i>0.1</i> Define Distal Joint and Radius Lateral: <i>None</i> Joint: <i>RIC</i> Medial: <i>None</i> Radius: <i>0.1</i> Extra Target to Define Orientation Location: <i>Medial</i> <i>RST</i> Select Tracking Targets: <i>RCA, RPT, RST</i> • Click on Build Model. • Click on Close Tab before proceeding.	Workspace Signals and Events Models Reports Cal Segments Landmarks Muscles Subject Data / Metrics Segments Segment Properties IK Constraints RCal Define Proximal Joint and Radius Lateral Joint Center Medial None <i>RCA</i> None Radius (Meters) 0.1 Define Distal Joint and Radius Lateral Joint Center Medial None <i>RIC</i> None Radius (Meters) 0.1 Extra Target to Define Orientation (if needed) Location <i>Medial</i> <i>RST</i> Select Tracking Targets (Ctrl-Left Mouse Click to Multiselect) ☐ RF2P_Offset ☐ RFMB_proj ☐ LCA ☐ LMM ☐ LAB_O ☐ RSMH_proj ☐ LFMB ☐ LPM ☐ LAB_X ☐ RSMB_proj ☐ LFMH ☐ LPT ☐ LAB_Y ☐ RVMH_proj ☐ LHF ☐ LSMB ☐ RFMH_proj ☐ RVMB_proj ☐ LLM ☐ LSMH Depth (Meters): Close Tab Guess Properties Apply Build Model
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2. Modify the Segment Coordinate System: • Define the Segment Orientation as: A/P Axis: +Y Distal to Proximal: -X	
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Foot (Foo)

Landmarks

1. Create RFT_DIST: • Click Landmarks button • Click Add New Landmark button • Create Landmark: RFT_DIST	Landmark Name: RFT_DIST Define Orientation Using: Starting Point: RCA Ending Point: RFMH Lateral Object: RVMH Project From: RSMH	• Do NOT Check: Offset by Percent (1.0 = 100%) • Check: Calibration Only Landmark	Workspace Signals and Events Models Reports Cal Segments Landmarks Muscles Subject Data / Metrics Landmarks Functional Digitizing RFT_DIST Landmark Name: RFT_DIST Define Orientation Using: Starting Point RCA (Reference) Targets and/or Landmarks: Ending Point RFMH (On a line) *Lateral object RVMH (On a plane) *Project From RSMH (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 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
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Segment Definition

1. Create Right Foot Segment:

- In the **Segments** tab, select *Right Foot* in the Segment Name box.
- Click on the **Create Segment** button.
- In the **Right Foot** tab, enter these values:

Define Proximal Joint and Radius

Lateral: *None* **Joint:** *RCA* **Medial:** *None*

Radius:
 $0.5 * \text{DISTANCE}(\text{RST}, \text{RPT})$

Define Distal Joint and Radius

Lateral: *None* **Joint:** *RFT_DIST* **Medial:** *None*

Radius:
 $0.5 * \text{DISTANCE}(\text{RFMH}, \text{RVMH})$

Extra Target to Define Orientation

Location:
Medial RFMH

Select Tracking Targets:
RCA, RFMH, RVMH

- Click on **Build Model**.
- Click on **Close Tab** before proceeding.

2. Modify the Segment Coordinate System:

- Define the Segment Orientation as:

Shank (Sha)

Landmarks

1. Create RIM: • Click Landmarks button • Click Add New Landmark button • Create Landmark: RIM	Landmark Name: RIM Define Orientation Using: Starting Point: RLM Ending Point: RMM	• Offset Using the Following AXIAL Offset: 0.5 • Check: Offset by Percent (1.0 = 100%) • Check: Calibration Only Landmark	Workspace Signals and Events Models Reports Cal Segments Landmarks Muscles Subject Data / Metrics Landmarks Functional Digitizing RIM Landmark Name: RIM Define Orientation Using: Starting PointRLM(Reference) • Targets and/or Landmarks: Ending PointRMM(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 AXIAL0.5 ☒ 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
2. Create RSK_PROX: • Click Landmarks button • Click Add New Landmark button • Create Landmark: RSK_PROX	Landmark Name: RSK_PROX Define Orientation Using: Starting Point: RIM Ending Point: RLM Lateral Object: RHF Project From: RTT	• Do NOT Check: Offset by Percent (1.0 = 100%) • Check: Calibration Only Landmark	Workspace Signals and Events Models Reports Cal Segments Landmarks Muscles Subject Data / Metrics Landmarks Functional Digitizing RSK_PROX Landmark Name: RSK_PROX Define Orientation Using: Starting PointRIM(Reference) • Targets and/or Landmarks: Ending PointRLM(On a line) *Lateral objectRHF(On a plane) *Project FromRTT(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 ☐ 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

Segment Definition

1. Create Right Shank Segment:

- In the **Segments** tab, select *Right Shank* in the Segment Name box.
- Click on the **Create Segment** button.
- In the **Right Shank** tab, enter these values:

Define Proximal Joint and Radius

Lateral: *None* **Joint:** *RSK_PROX* **Medial:** *None*

Radius: *DISTANCE(RSK_PROX,RHF)*

Define Distal Joint and Radius

Lateral: *None* **Joint:** *RIM* **Medial:** *None*

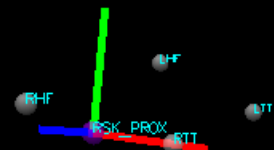
Radius: *0.5*DISTANCE(RLM,RMM)*

Extra Target to Define Orientation

Location: *Lateral* *RLM*

Select Tracking Targets: *RHF, RLM, RMM, RTT*

- Click on **Build Model**.
- Click on **Close Tab** before proceeding.

2. Modify the Segment Coordinate System: Define the Segment Orientation as:	A/P Axis: +X Distal to Proximal: +Y	
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Angles

Landmarks

The F2Pt and F2Ps planar angles are calculated as the angle between the lines created by the targets FMB-FMH and FMH-PM. To calculate this angle using the Compute Planar Angle command, an offset along the line between FMB and FMH is created to define the 3 point angle.

1. Create RF2P_Offset: • Click Landmarks button • Click Add New Landmark button • Create Landmark: RF2P_Offset	Landmark Name: RF2P_Offset Define Orientation Using: Starting Point RFMB (Reference) Ending Point RFMH (On a line) *Lateral object (On a plane) *Project From (Projection onto a line or plane) * = Optional Existing Segment	• Offset Using the Following AXIAL Offset: 1.5 • Check: Offset by Percent (1.0 = 100%) • Do NOT Check: Calibration Only Landmark	Workspace Signals and Events Models Reports CalT Segments Landmarks Muscles Subject Data / Metrics Landmarks Functional Digitizing RF2P_Offset Landmark Name: RF2P_Offset Define Orientation Using: Starting Point RFMB (Reference) Ending Point RFMH (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 1.5 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
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2. Create LF2P_Offset: • When defining the left signal, use same definitions as for the RF2P_Offset landmark	
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The F2G, S2G and V2G angles are calculated in the plane orthogonal to the ground. These landmarks will need to be projected onto the ground. To project landmarks onto the ground, the Lab_O, Lab_X and Lab_Y landmarks will need to be created to identify the plane of the ground.

3. Create Lab_O: - Click Landmarks button - Click Add New Landmark button - Create Landmark: <i>Lab_O</i>	Landmark Name: <i>Lab_O</i>	- Offset Using the Following ML/AP/AXIAL Offsets: X: 0.0 Y: 0.0 Z: 0.0 Do NOT Check: <i>Offset by Percent (1.0 = 100%) (Meters when not checked)</i> Do NOT Check: <i>Calibration Only Landmark (Not generated for assigned motion file(s))</i>	
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4. Create Lab_X: - Click Landmarks button - Click Add New Landmark button - Create Landmark: <i>Lab_X</i>	Landmark Name: <i>Lab_X</i>	- Offset Using the Following ML/AP/AXIAL Offsets: X: 0.05 Y: 0.0 Z: 0.0 Do NOT Check: <i>Offset by Percent (1.0 = 100%) (Meters when not checked)</i> Do NOT Check: <i>Calibration Only Landmark (Not generated for assigned motion file(s))</i>	
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5. Create Lab_Y: • Click Landmarks button • Click Add New Landmark button • Create Landmark: Lab_Y	Landmark Name: Lab_Y	• Offset Using the Following ML/AP/AXIAL Offsets: X: 0.0 Y: 0.05 Z: 0.0 • Do NOT Check: Offset by Percent (1.0 = 100%) (Meters when not checked) • Do NOT Check: Calibration Only Landmark (Not generated for assigned motion file(s))
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6. Create RFMH_proj: • Click Landmarks button • Click Add New Landmark button • Create Landmark: RFMH_proj

Create landmarks 7-17 by following the same format as the RFMH_proj landmark for: ****

7. RFMB	12. LFMH
8. RSMH	13. LFMB
9. RSMB	14. LSMH
10. RVMH	15. LSMB
11. RVMB	16. LVMH
	17. LVMB

**** ****

Planar Angles

F2Pt

F2Pt - the angle between the lines FMH-PM and FMB-FMH projected onto the transverse plane of the metatarsus

Represents - valgus of the first metatarsophalangeal joint

1. Create RF2Pt planar angle:

- Define **Resulting Signal**
Name: RF2Pt
- Calculate a **3 point angle** between the following targets:

1 - LANDMARK::ORIGINAL::RF2P_offset
2 - TARGET::ORIGINAL::RFMH
3 - TARGET::ORIGINAL::RPM

Angle Direction: Left Hand Rule
Use Range: -180 to 180 degrees
Projected onto Plane: XZ

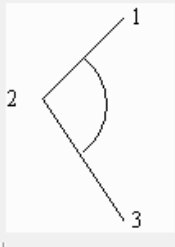
Note: The reference segment will need to be changed to RMet within the text option.

Compute the angle between two vectors, represented by 3 or 4 points

Resulting Signal

Name: RF2Pt

Folder: PROCESSED



1 LANDMARK::ORIGINAL::RF2P_offs

2 TARGET::ORIGINAL::RFMH

3 TARGET::ORIGINAL::RPM

Specify 3 or 4 points

☒ 3 Point

☐ 4 Point

Angle Direction

☐ Right Hand Rule

☒ Left Hand Rule

Use Range

☐ 0 to 360 degrees

☒ -180 to 180 degrees

Projected onto Plane

☐ XY If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal.

☒ XZ

☐ YZ

3D Space

☐ 3D Always 0 to 180 degrees (Unspecified Direction)

☐ 3D Specify a Vector Normal to the Two Vectors

Example

With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis.

3D: Angle = 95 degrees

Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees

Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees

Cancel
OK

2. Create LF2Pt planar angle:

Angle Direction: *Right Hand Rule*

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

Note: The reference segment will need to be changed to *LMet* within the text option.

S2F

S2F - the angle between the lines FMB-FMH and SMB-SMH projected onto the transverse plane of the metatarsus

1. Create RS2F planar angle:

- Define **Resulting Signal**
Name: RS2F
- Calculate a **4 point angle** between the following targets:

1 - TARGET::ORIGINAL::RSMH

2 - TARGET::ORIGINAL::RSMB

3 - TARGET::ORIGINAL::RFMB

4 - TARGET::ORIGINAL::RFMH

Angle Direction: Right Hand Rule

Use Range: -180 to 180 degrees

Projected onto Plane: XZ

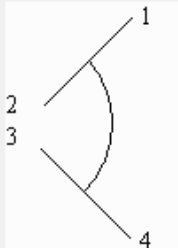
Note: The reference segment will need to be changed to RMet within the text option.

Compute the angle between two vectors, represented by 3 or 4 points

Resulting Signal

Name: RS2F

Folder: PROCESSED



1 TARGET::ORIGINAL::RSMH

2 TARGET::ORIGINAL::RSMB

3 TARGET::ORIGINAL::RFMB

4 TARGET::ORIGINAL::RFMH

Specify 3 or 4 points

☐ 3 Point

☒ 4 Point

Angle Direction

☒ Right Hand Rule

☐ Left Hand Rule

Use Range

☐ 0 to 360 degrees

☒ -180 to 180 degrees

Projected onto Plane

☐ XY If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal.

☒ XZ

☐ YZ

3D Space

☐ 3D Always 0 to 180 degrees (Unspecified Direction)

☐ 3D Specify a Vector Normal to the Two Vectors

Example

With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis.

3D: Angle = 95 degrees

Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees

Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees

Cancel
OK

2. Create LS2F planar angle:

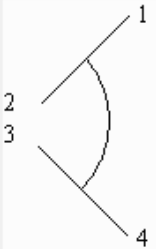
Angle Direction: *Left Hand Rule*

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

Note: The reference segment will need to be changed to *LMet* within the text option.

S2V

S2V - the angle between the lines VMB-VMH and SMB-SMH projected onto the transverse plane of the metatarsus

1. Create RS2V planar angle: • Define Resulting Signal Name: RS2V • Calculate a 4 point angle between the following targets:	1 - TARGET::ORIGINAL::RSMH 2 - TARGET::ORIGINAL::RSMB 3 - TARGET::ORIGINAL::RVMB 4 - TARGET::ORIGINAL::RVMH Angle Direction: <i>Right Hand Rule</i> Use Range: -180 to 180 degrees Projected onto Plane: XZ Note: The reference segment will need to be changed to RMet within the text option.	Compute the angle between two vectors, represented by 3 or 4 points Resulting Signal NameRS2V FolderPROCESSED  1TARGET::PROCESSED::RSMH 2TARGET::PROCESSED::RSMB 3TARGET::PROCESSED::RVMB 4TARGET::PROCESSED::RVMH Specify 3 or 4 points ☐ 3 Point ☒ 4 Point Angle Direction ☐ Right Hand Rule ☒ Left Hand Rule Use Range ☐ 0 to 360 degrees ☒ -180 to 180 degrees Projected onto Plane ☐ XY ☒ XZ ☐ YZ If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal. 3D Space ☐ 3D Always 0 to 180 degrees (Unspecified Direction) ☐ 3D Specify a Vector Normal to the Two Vectors Example With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis. 3D: Angle = 95 degrees Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees Cancel OK
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2. Create LS2V planar angle: • When defining the left signal, use same definitions except set:	Angle Direction: <i>Left Hand Rule</i> Note: The reference segment will need to be changed to LMet within the text option.
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F2G

F2G - the angle between the lines FMB-FMH and the ground, plane orthogonal to the ground (3D angle relative to the ground)

The **FMH_proj** and **FMB_proj** landmarks will be used to calculate the **F2G** planar angle which are described in the [landmarks](#) section.

1. Create RF2G planar angle:

• Define Resulting Signal Name: RF2G

• Calculate a 4 point angle between the following targets:

1 - TARGET::ORIGINAL::RFMB

2 - TARGET::ORIGINAL::RFMH

3 - TARGET::ORIGINAL::RFMH_proj

4 - TARGET::ORIGINAL::RFMB_proj

Angle Direction: Right Hand Rule

3D Space: Always 0 to 180 degrees

Compute the angle between two vectors, represented by 3 or 4 points

Resulting Signal

Name: RF2G

Folder: PROCESSED

1: TARGET::PROCESSED::RFMB

2: TARGET::PROCESSED::RFMH

3: LANDMARK::ORIGINAL::RFMH_proj

4: LANDMARK::ORIGINAL::RFMB_proj

Specify 3 or 4 points

☐ 3 Point

☒ 4 Point

Angle Direction

☒ Right Hand Rule

☐ Left Hand Rule

Use Range

☒ 0 to 360 degrees

☐ -180 to 180 degrees

Projected onto Plane

☐ XY

☐ XZ

☐ YZ

If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal.

3D Space

☒ 3D

Always 0 to 180 degrees (Unspecified Direction)

☐ 3D

Specify a Vector Normal to the Two Vectors

Example

With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis.

3D: Angle = 95 degrees

Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees

Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees

Cancel

OK

2. Create LF2G planar angle:

•

When defining the left signal, use same definitions as for the right angle

S2G

S2G - the angle between the lines SMB-SMH and the ground, plane orthogonal to the ground (3D angle relative to the ground)

The **SMH_proj** and **SMB_proj** landmarks will be used to calculate the **S2G** planar angle which are described in the [landmarks](#) section.

1. Create RS2G planar angle:

• Define Resulting Signal Name: RS2G

• Calculate a 4 point angle between the following targets:

1 - TARGET::ORIGINAL::RSMB

2 - TARGET::ORIGINAL::RSMH

3 - TARGET::ORIGINAL::RSMH_proj

4 - TARGET::ORIGINAL::RSMB_proj

Angle Direction: Right Hand Rule

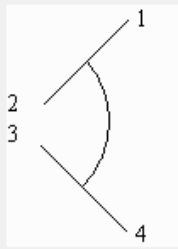
3D Space: Always 0 to 180 degrees

Compute the angle between two vectors, represented by 3 or 4 points

Resulting Signal

NameRS2G

FolderPROCESSED



1TARGET::ORIGINAL::RSMB

2TARGET::ORIGINAL::RSMH

3LANDMARK::ORIGINAL::RSMH_proj

4LANDMARK::ORIGINAL::RSMB_proj

Specify 3 or 4 points

☐ 3 Point

☒ 4 Point

Angle Direction

☒ Right Hand Rule

☐ Left Hand Rule

Use Range

☒ 0 to 360 degrees

☐ -180 to 180 degrees

Projected onto Plane

☐ XY

☐ XZ

☐ YZ

If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal.

3D Space

☒ 3D

Always 0 to 180 degrees (Unspecified Direction)

☐ 3D

Specify a Vector Normal to the Two Vectors

Example

With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis.

3D: Angle = 95 degrees

Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees

Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees

Cancel

OK

2. Create LS2G planar angle:

-
- When defining the left signal, use same definitions as for the right angle

V2G

V2G - the angle between the lines VMB-VMH and the ground, plane orthogonal to the ground (3D angle relative to the ground)

The **VMH_proj** and **VMB_proj** landmarks will be used to calculate the **V2G** planar angle which are described in the [landmarks](#) section.

1. Create RV2G planar angle:

• Define Resulting Signal Name: RV2G

• Calculate a 4 point angle between the following targets:

1 - TARGET::ORIGINAL::RVMB

2 - TARGET::ORIGINAL::RVMH

3 - TARGET::ORIGINAL::RVMH_proj

4 - TARGET::ORIGINAL::RVMB_proj

Angle Direction: Right Hand Rule

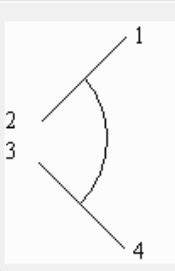
3D Space: Always 0 to 180 degrees

Compute the angle between two vectors, represented by 3 or 4 points

Resulting Signal

NameRV2G

FolderPROCESSED



1TARGET::ORIGINAL::RVMB

2TARGET::ORIGINAL::RVMH

3LANDMARK::ORIGINAL::RVMH_proj

4LANDMARK::ORIGINAL::RVMB_proj

Specify 3 or 4 points

3 Point

4 Point

Angle Direction

Right Hand Rule

Left Hand Rule

Use Range

0 to 360 degrees

-180 to 180 degrees

Projected onto Plane

XY

XZ

YZ

If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal.

3D Space

3D

Always 0 to 180 degrees (Unspecified Direction)

3D

Specify a Vector Normal to the Two Vectors

Example

With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis.

3D: Angle = 95 degrees

Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees

Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees

Cancel

OK

2. Create LV2G planar angle:

•

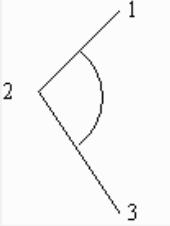
When defining the left signal, use same definitions as for the right angle

F2Ps

F2Ps - the angle between the lines FMH-PM and FMB-FMH projected onto the sagittal plane of the metatarsus
Represents - dorsiflexion of the first metatarso-phalangeal joint

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1. Create RF2Ps planar angle: - Define Resulting Signal Name: RF2Ps - Calculate a 3 point angle between the following targets:	1 - LANDMARK::ORIGINAL::RF2P_offset 2 - TARGET::ORIGINAL::RFMH 3 - TARGET::ORIGINAL::RPM Angle Direction: Right Hand Rule Use Range: -180 to 180 degrees Projected onto Plane: XY Note: The reference segment will need to be changed to RMet within the text option.	Compute the angle between two vectors, represented by 3 or 4 points Resulting Signal Name: RF2Ps Folder: PROCESSED  1 LANDMARK::ORIGINAL::RF2P_Off 2 TARGET::ORIGINAL::RFMH 3 TARGET::ORIGINAL::RPM Specify 3 or 4 points ☒ 3 Point ☐ 4 Point Angle Direction ☒ Right Hand Rule ☐ Left Hand Rule Use Range ☐ 0 to 360 degrees ☒ -180 to 180 degrees Projected onto Plane ☒ XY ☐ XZ ☐ YZ If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal. 3D Space ☐ 3D Always 0 to 180 degrees (Unspecified Direction) ☐ 3D Specify a Vector Normal to the Two Vectors Example With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis. 3D: Angle = 95 degrees Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees Cancel OK
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2. Create LF2Ps planar angle: When defining the left signal, use same definitions as for the right angle	Note: The reference segment will need to be changed to LMet within the text option.
--	---

MLA

MLA - the angle between the lines CA-ST and ST-FMH projected onto the sagittal plane of the foot
Represents - navicular drop

1. Create RMLA planar angle:

• Define Resulting Signal Name: RMLA

• Calculate a 3 point angle between the following targets:

1 - TARGET::ORIGINAL::RCA

2 - TARGET::ORIGINAL::RST

3 - TARGET::ORIGINAL::RFMH

Angle Direction: Right Hand Rule

Use Range: -180 to 180 degrees

Projected onto Plane: XY

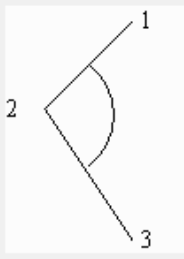
Note: The reference segment will need to be changed to RMet within the text option.

Compute the angle between two vectors, represented by 3 or 4 points

Resulting Signal

NameRMLA

FolderPROCESSED



1TARGET::ORIGINAL::RCA

2TARGET::ORIGINAL::RST

3TARGET::ORIGINAL::RFMH

Specify 3 or 4 points

☒ 3 Point

☐ 4 Point

Angle Direction

☒ Right Hand Rule

☐ Left Hand Rule

Use Range

☐ 0 to 360 degrees

☒ -180 to 180 degrees

Projected onto Plane

☒ XY

☐ XZ

☐ YZ

If the angle is projected onto one of the principle planes, the direction of the normal to the two vectors is the third principle axes. The Right Hand Rule and the Range are with respect to this normal.

3D Space

☐ 3D

Always 0 to 180 degrees (Unspecified Direction)

☐ 3D

Specify a Vector Normal to the Two Vectors

Example

With respect to the figure. Assume the two vectors lie in the XY plane; Rotation is about the Z-axis.

3D: Angle = 95 degrees

Projected onto XY: Use RHR: Use 0- to 360: Angle=265 degrees

Projected onto XY: Use RHR: Use -180 to 180: Angle=-95 degrees

Cancel

OK

2. Create LMLA planar angle:

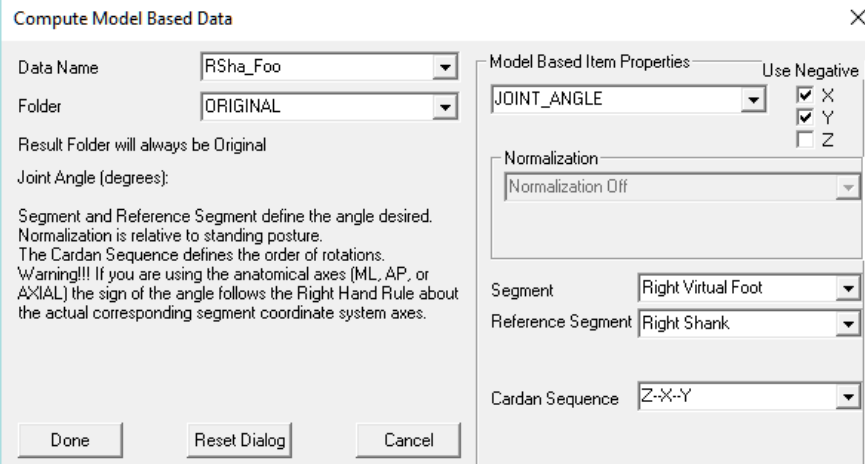
•

When defining the left signal, use same definitions as for the right angle

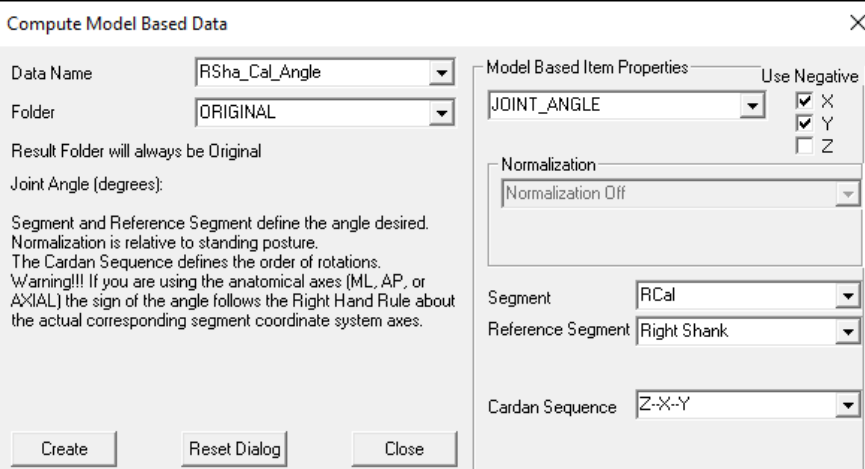
Note: The reference segment will need to be changed to LMet within the text option.

Joint Angles

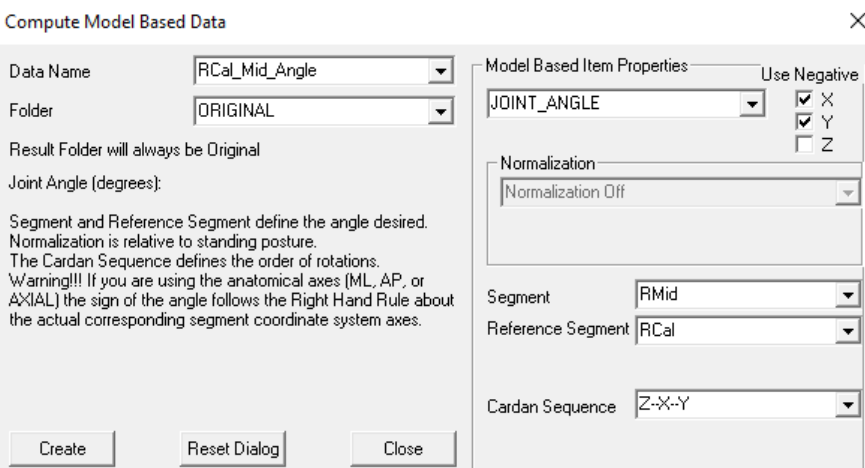
Sha_Foo_Angle

1. Define the RSha_Foo_Angle: - Open the Compute Model Based dialog - Select JOINT_ANGLE from drop down list	Data Name: <i>RSha_Foo_Angle</i> Segment: <i>Right Foot</i> Reference Segment: <i>Right Shank</i> Cardan Sequence: Z-X-Y	Use Negative: X: TRUE Y: TRUE Z: FALSE	
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Sha_Cal_Angle

1. Define the RSha_Cal_Angle: - Open the Compute Model Based dialog - Select JOINT_ANGLE from drop down list	Data Name: <i>RSha_Cal_Angle</i> Segment: <i>RCal</i> Reference Segment: <i>Right Shank</i> Cardan Sequence: Z-X-Y	Use Negative: X: TRUE Y: TRUE Z: FALSE	
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Cal_Mid_Angle

1. Define the RCal_Mid_Angle: - Open the Compute Model Based dialog - Select JOINT_ANGLE from drop down list	Data Name: <i>RCal_Mid_Angle</i> Segment: <i>RMid</i> Reference Segment: <i>RCal</i> Cardan Sequence: Z-X-Y	Use Negative: X: TRUE Y: TRUE Z: FALSE	
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Mid_Met_Angle

1. Define the RMid_Met_Angle: - Open the Compute Model Based dialog - Select JOINT_ANGLE from drop down list	Data Name: RMid_Met_Angle Segment: RMet Reference Segment: RMid Cardan Sequence: Z-X-Y	Use Negative: X: TRUE Y: TRUE Z: FALSE	Compute Model Based Data Data Name: RMid_Met_Angle Folder: ORIGINAL Result Folder will always be Original Joint Angle (degrees): Segment and Reference Segment define the angle desired. Normalization is relative to standing posture. The Cardan Sequence defines the order of rotations. Warning!!! If you are using the anatomical axes (ML, AP, or AXIAL) the sign of the angle follows the Right Hand Rule about the actual corresponding segment coordinate system axes. CreateReset DialogClose Model Based Item Properties JOINT_ANGLE Use Negative: X Y Z Normalization: Normalization Off Segment: RMet Reference Segment: RMid Cardan Sequence: Z-X-Y
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Cal_Met_Angle

1. Define the RCal_Met_Angle: - Open the Compute Model Based dialog - Select JOINT_ANGLE from drop down list	Data Name: RCal_Met_Angle Segment: RMet Reference Segment: RCal Cardan Sequence: Z-X-Y	Use Negative: X: TRUE Y: TRUE Z: FALSE	Compute Model Based Data Data Name: RCal_Met_Angle Folder: ORIGINAL Result Folder will always be Original Joint Angle (degrees): Segment and Reference Segment define the angle desired. Normalization is relative to standing posture. The Cardan Sequence defines the order of rotations. Warning!!! If you are using the anatomical axes (ML, AP, or AXIAL) the sign of the angle follows the Right Hand Rule about the actual corresponding segment coordinate system axes. CreateReset DialogClose Model Based Item Properties JOINT_ANGLE Use Negative: X Y Z Normalization: Normalization Off Segment: RMet Reference Segment: RCal Cardan Sequence: Z-X-Y
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References

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[1.00](#) [1.01](#) [1.02](#) [1.03](#) [1.04](#) [1.05](#) [1.06](#) [1.07](#) [1.08](#) [1.09](#) [1.10](#)

Leardini, A., M.G. Benedetti, L. Berti, D. Bettinelli, R. Nativo, and S. Giannini. "Rear-foot, Mid-foot and Fore-foot Motion during the Stance Phase of Gait." Gait & Posture 25 (2007): 453-55

2.

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[2.0](#) [2.1](#) [2.2](#) [2.3](#) [2.4](#) [2.5](#) [2.6](#) [2.7](#) [2.8](#)

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