

Example - Functional Knee

When defining the functional knee joint, the calculation defines the axis of rotation, but not the location on the axis.

Two additional landmarks (RKneMed & LKneMed) must be created off the position of the mediolateral knee targets.

[Sample files](#) for this tutorial may be downloaded.

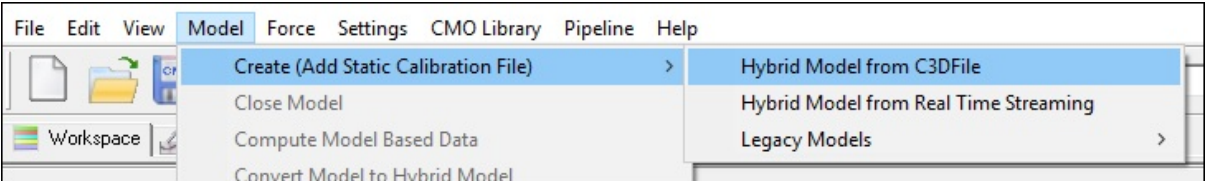
- 1) This tutorial will use the **Static.c3d** and **Functional Knee.c3d** files.
- 2) The Functional Hip.c3d file is used for the [Functional Hip Tutorial](#).
- 3) FunctionalJoints_Hip_Knee.cmo contains a static trial with both the functional hip and knee defined.

The calculation of functional joints is described [here](#).

Load Static Trial

1. From the **Model** menu, select **Create → Hybrid Model from C3D file**.

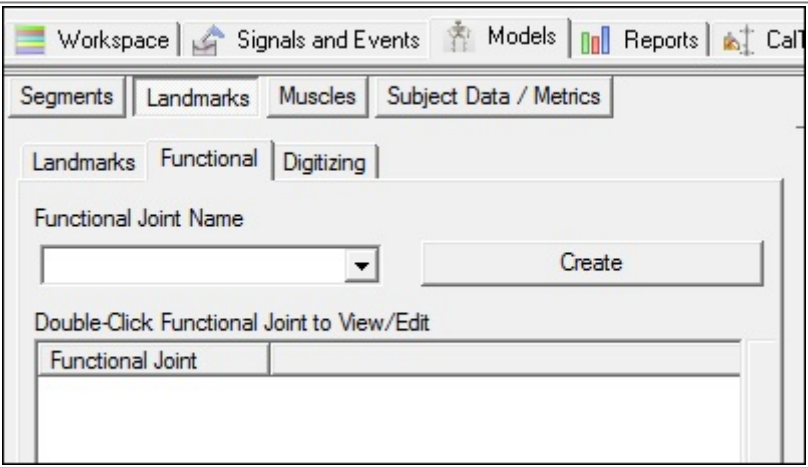
2. A dialog titled **Select the calibration file for the new model** will appear; Select *Static.c3d* Click **Open**.



Create Functional Joint

1. On the **Landmarks** tab:

1. Select the **Functional** tab



Create Right Functional Joint

- On the **Landmarks** tab:
1. Select the **Functional** tab
2. From the **Functional Joint Name** box, select **F_RKNEE**.
3. Click **Create**.

The screenshot shows the 'Functional Joint Name' dropdown menu with 'F_RKNEE' selected. The 'Create' button is visible to the right of the dropdown. The interface includes tabs for 'Workspace', 'Signals and Events', 'Models', 'Reports', and 'CalT'. Below these are tabs for 'Segments', 'Landmarks', 'Muscles', and 'Subject Data / Metrics'. The 'Landmarks' tab is active, and within it, the 'Functional' sub-tab is selected.

2. **Select tracking targets for the F_RKNEE:**
- Tracking Segment/Targets**
Select **Use Tracking Targets** (ctrl-click to multi select)
RTHI1, RTHI2, RTHI3, RTHI4
- Other Segment/Targets:**
Select **Use Other Targets** (ctrl-click to multi select)
RTIB1, RTIB2, RTIB3, RTIB4 Click on **Close Tab** before proceeding.

The screenshot shows the 'Functional Joint Algorithm' dropdown set to 'GILETTE'. The 'Compute Axis instead of Point (2nd Landmark Distance (m))' checkbox is checked, with a value of 0.100000. The 'Use Tracking Targets From Segment' radio button is selected, and the 'Use Tracking Targets' checkbox is checked. The following targets are selected: RTHI1, RTHI2, RTHI3, RTHI4, RTIB1, RTIB2, RTIB3, and RTIB4. The 'Close Tab' button is visible at the bottom left of the tracking targets section. The 'Build Model' button is visible at the bottom right. The 'Event Sequence Instance' is set to 0. The 'Algorithm Parameters' section shows 'Minimum Movement Angle' set to 2.000000 and 'Approximate Number of Combinations Used' set to 100000.

Create Left Functional Joint

1. On the **Landmarks** tab:
1. Select the **Functional** tab
2. From the **Functional Joint Name** box, select *F_LKNEE*.
3. Click **Create**.

Workspace | Signals and Events | Models | Reports | CalT

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing

Functional Joint Name

F_LKNEE Create

Double-Click Functional Joint to View/Edit

Functional Joint
F_RKNEE

2. **Select tracking targets for the F_LKNEE:**
- Tracking Segment/Targets**
Select **Use Tracking Targets** (ctrl-click to multi select)
LTHI1, LTHI2, LTHI3, LTHI4
- Other Segment/Targets:**
Select **Use Other Targets** (ctrl-click to multi select)
LTIB1, LTIB2, LTIB3, LTIB4
- Click on **Close Tab** before proceeding.

Workspace | Signals and Events | Models | Reports | CalT

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing | F_LKNEE

Functional Joint Algorithm *GILETTE*

☒ Compute Axis instead of Point (2nd Landmark Distance (m) *0.100000*)

☐ Use Tracking Targets From Segment ☒ Use Tracking Targets

☐ LMEDKNE	☐ LSHO	☒ LTHI4	☐ LTIB4
☐ LMEP	☒ LTHI1	☐ LTIB1	☐ LTOE1
☐ LPP	☒ LTHI2	☐ LTIB2	☐ LTOE2
☐ LPSI	☒ LTHI3	☐ LTIB3	☐ LTOE3

☐ Use Other Segment ☒ Use Other Targets

☐ LMEDKNE	☐ LSHO	☐ LTHI4	☒ LTIB4
☐ LMEP	☐ LTHI1	☒ LTIB1	☐ LTOE1
☐ LPP	☐ LTHI2	☒ LTIB2	☐ LTOE2
☐ LPSI	☐ LTHI3	☒ LTIB3	☐ LTOE3

Close Tab Build Model

Event Sequence Instance *0*

Defined Events

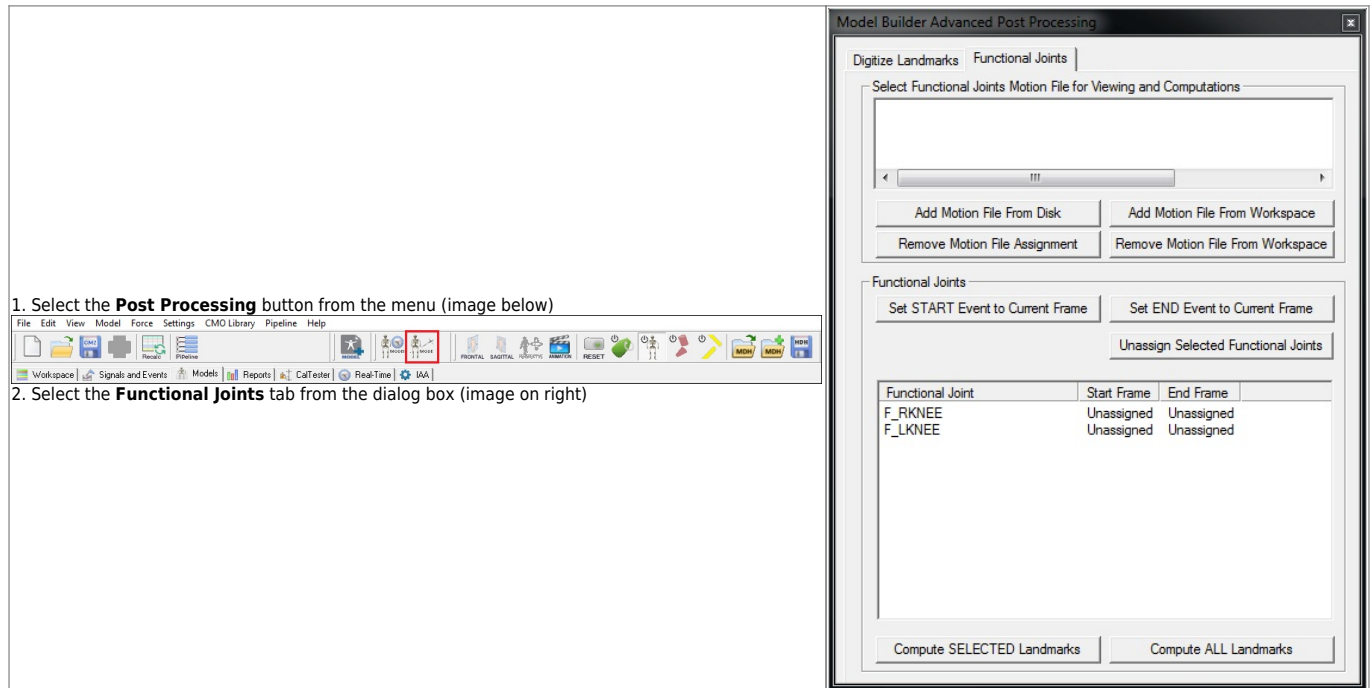
Exclude sequences

Algorithm Parameters

Minimum Movement Angle *2.000000*

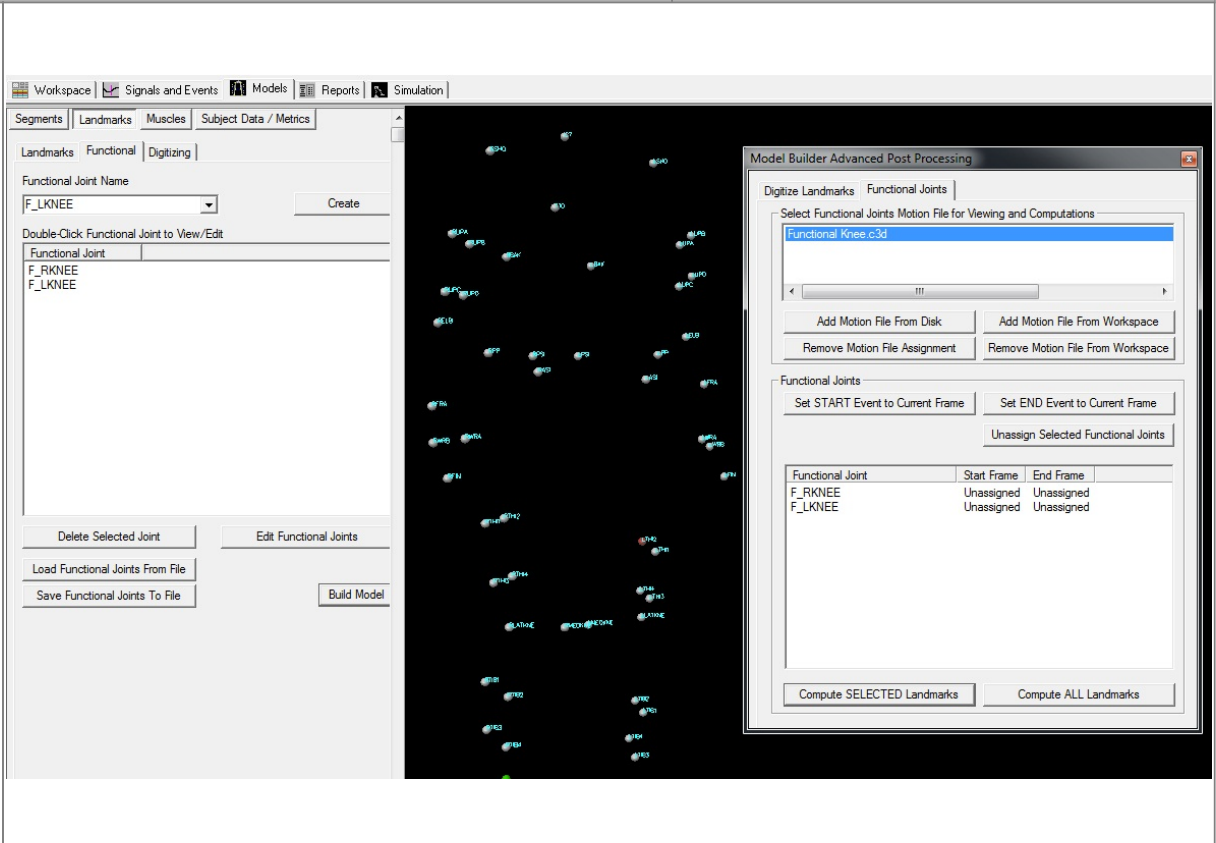
Approximate Number of Combinations Used *100000*

Model Builder Advanced Post Processing



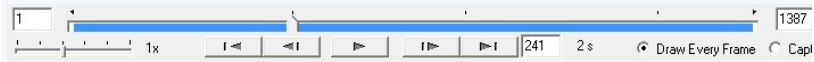
3. Open functional movement file:

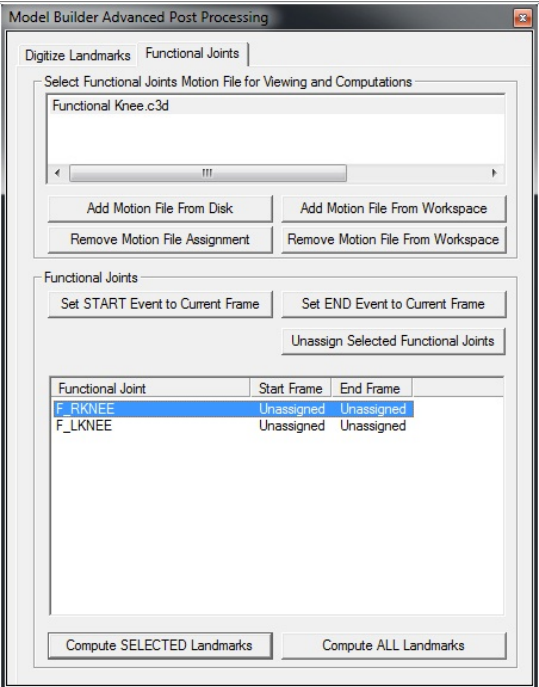
1. Select the **Add Motion File From Disk**
2. **Browse** to functional movement file, select *Functional Knee.c3d*
3. Click **Open**
4. **Select** the motion file by clicking on the trial, this will highlight the trial in **blue**.

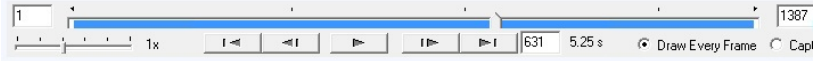


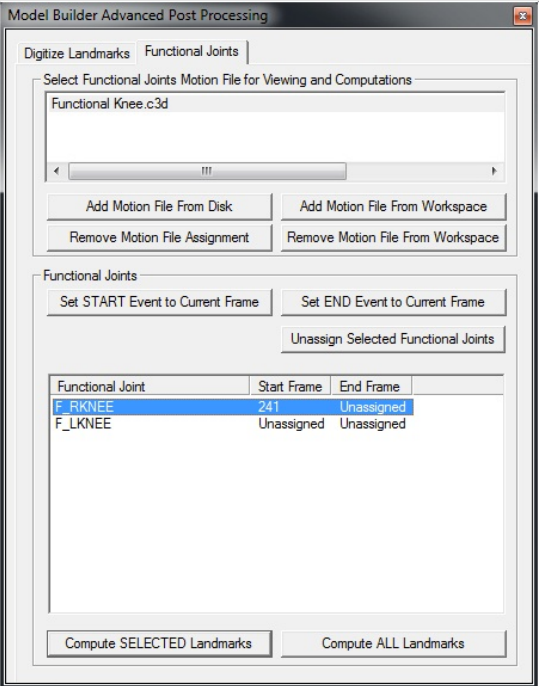
NOTE: Once the trial has been selected, the name of the trial will be highlighted and the movement file will appear in 3D viewer.

Define F_RKNEE Start and End of motion

1. Select the **START** frame of the right functional movement
1. **Select F_RKNEE**, this will highlight the joint in **blue**
2. Using the **slider** (seen below), select the START frame of the right functional movement. *Set the Start Frame to 241*
- A timeline slider with a blue bar representing the duration of the movement. The current frame is 241, and the total duration is 2 seconds. The slider is set to 'Draw Every Frame'.
3. Click **Set START Event to Current Frame**

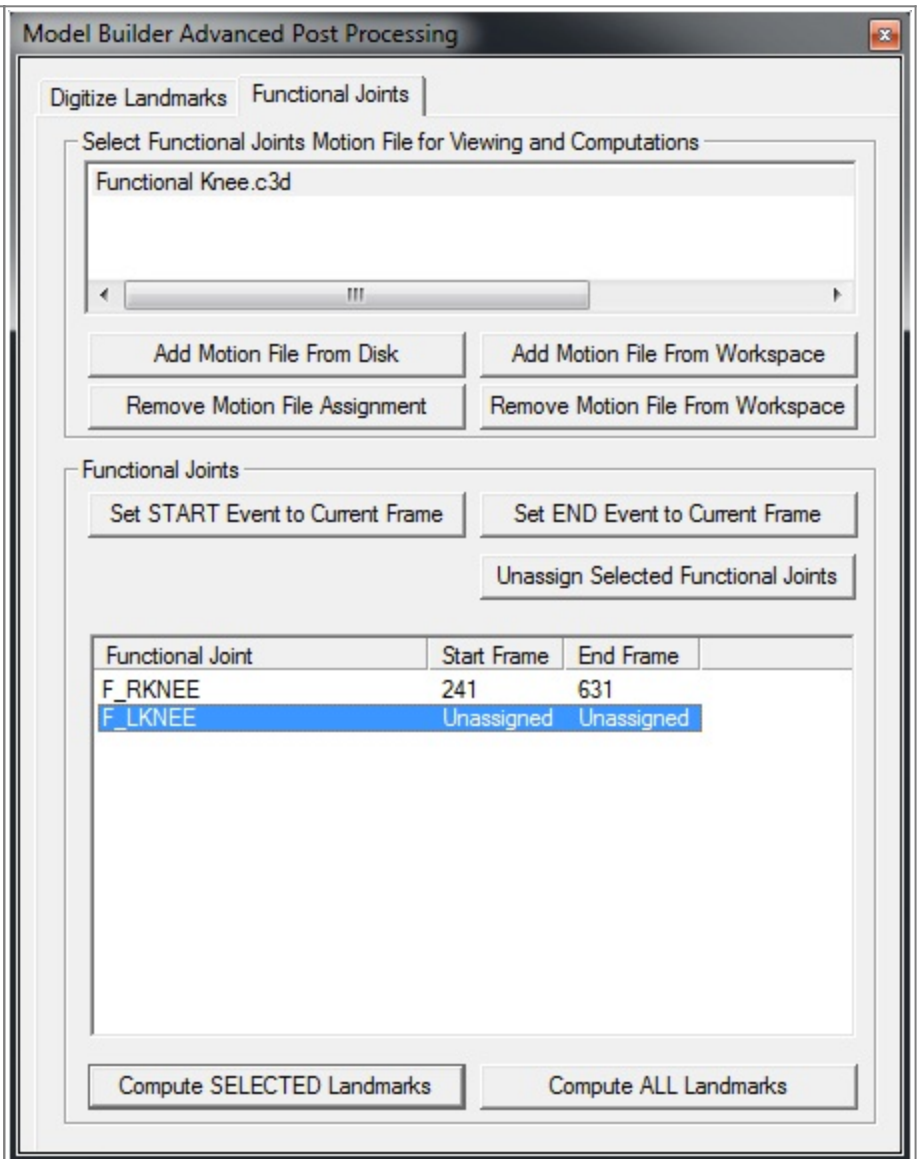


2. Select the **END** frame of the right functional movement
1. **Select F_RKNEE**, this will highlight the joint in **blue**
2. Using the **slider** (seen below), select the END frame of the right functional movement. *Set the End Frame to 631*
- A timeline slider with a blue bar representing the duration of the movement. The current frame is 631, and the total duration is 5.25 seconds. The slider is set to 'Draw Every Frame'.
3. Click **Set END Event to Current Frame**

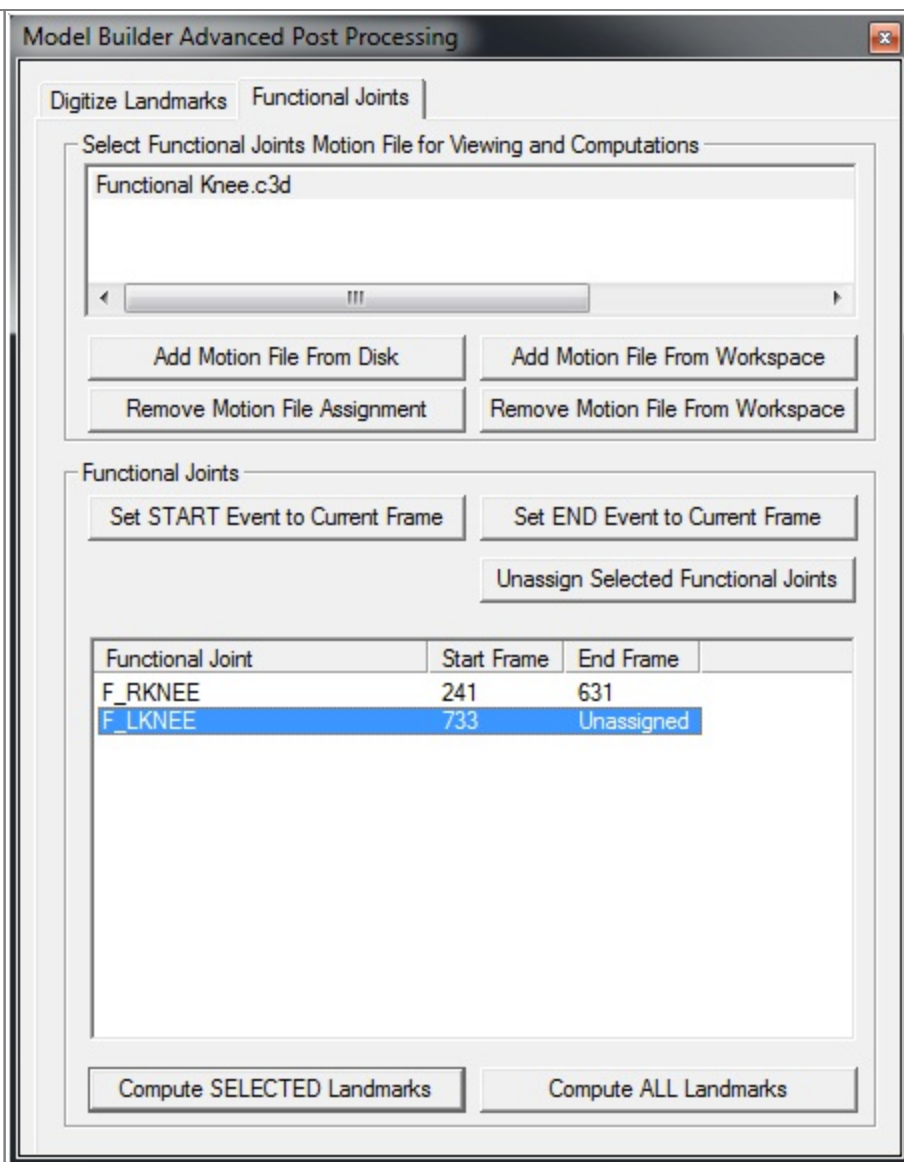


Define F_LKNEE Start and End of motion

1. Select the **START** frame of the left functional movement
1. **Select F_LKNEE**, this will highlight the joint in **blue**
2. Using the **slider**, select the START frame of the left functional movement. *Set the Start Frame to 733*
3. Click **Set START Event to Current Frame**

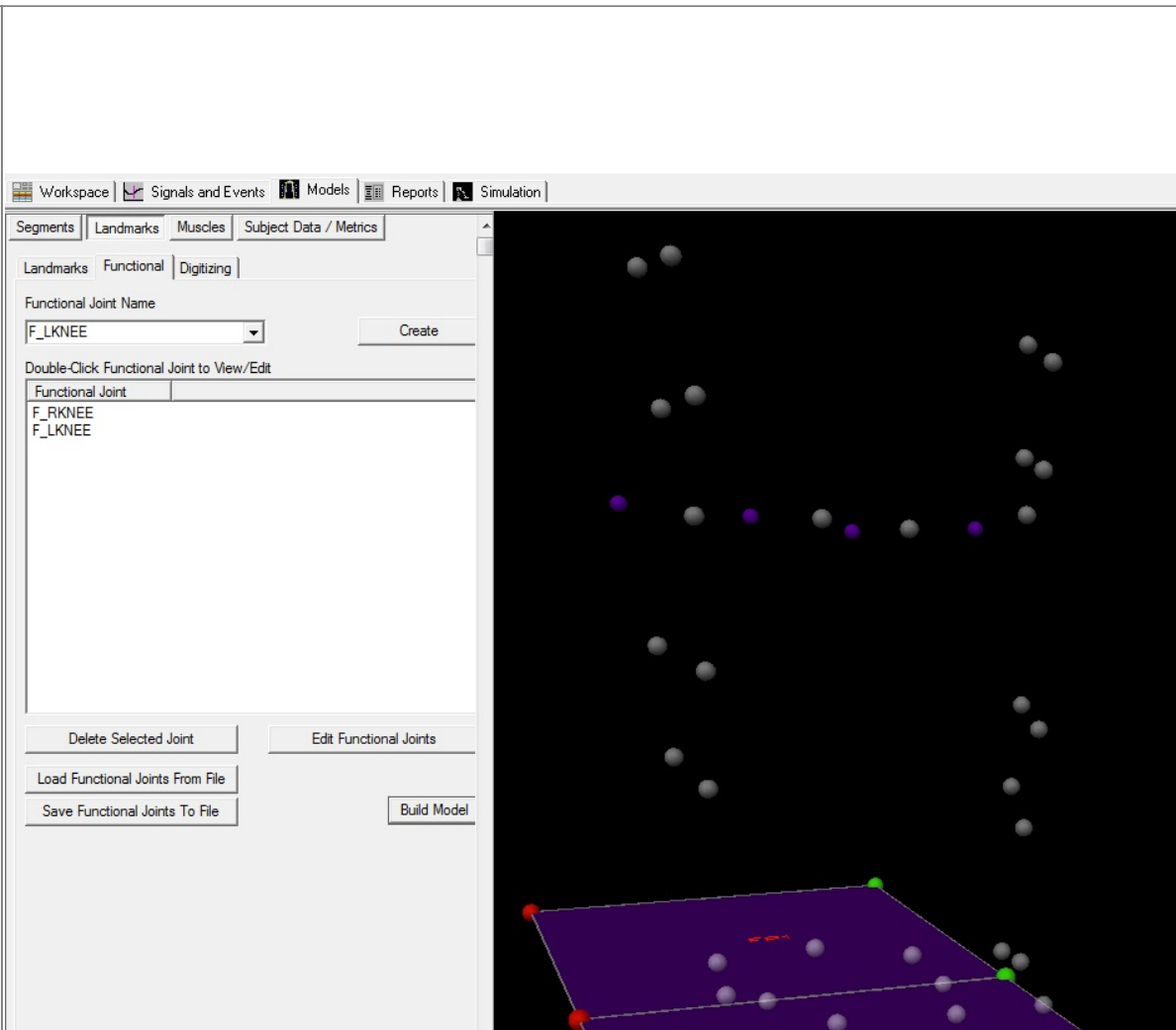


2. Select the **END** frame of the left functional movement
1. **Select F_LKNEE**, this will highlight the joint in **blue**
2. Using the **slider**, select the END frame of the left functional movement. *Set the End Frame to 1149*
3. Click **Set END Event to Current Frame**



Compute Landmarks

1. Select **Compute ALL Landmarks**
 2. **Close** the Model Builder Advanced Post Processing dialog box
 3. Four landmarks (**F_RKNEE**, **F_RKNEE_X**, **F_LKNEE** and **F_LKNEE_X**) should appear in purple in the 3D viewer
If the landmarks do NOT appear in the 3D viewer, check:
 - That the landmarks are turned on (3D View Options)
 - Check that all steps in this tutorial were completed



Compute Right Mediolateral Borders of the Knee Joint Center

The RKneLat and RKneMed landmarks created below will be used to define the mediolateral borders of the knee joint.

These landmarks will project the mediolateral targets (RLATKNE, RMEDKNE) onto the axis of rotation created by the functional joint (F_RKNEE, F_RKNEE_X).

1. Create Lateral Border of the Right Knee Joint Center (RKneLat):

Click **Landmarks** button

Click **Add New Landmark** button

Create Landmark: *RKneLat*

Landmark Name: *RKneLat*

Define Orientation Using:

Starting Point: *F_RKNEE*

Ending Point: *F_RKNEE_X*

Project From: *RLATKNE*

Do NOT Check: *Offset by Percent (1.0 = 100%)*

Calibration Only Landmark

2. Create Medial Border of the Right Knee Joint Center (RKneMed):

Click **Landmarks** button

Click **Add New Landmark** button

Create Landmark:

Landmark Name: *RKneMed*

Define Orientation Using:

Starting Point: *F_RKNEE*

Ending Point: *F_RKNEE_X*

Project From: *RMEDKNE*

Do NOT Check: *Offset by Percent (1.0 = 100%)*

Do NOT Check: *Calibration Only Landmark*

Compute Left Mediolateral Borders of the Knee Joint Center

The LKneLat and LKneMed landmarks created below will be used to define the mediolateral borders of the knee joint.

These landmarks will project the mediolateral targets (LLATKNE,LMEDKNE) onto the axis of rotation created by the functional joint (F_LKNEE,F_LKNEE_X).

1. Create Lateral Border of the Left Knee Joint Center (LKneLat):

Click **Landmarks** button

Click **Add New Landmark** button

Create Landmark: LKneLat

Landmark Name: LKneLat

Define Orientation Using:

Starting Point: F_LKNEE

Ending Point: F_LKNEE_X

Project From: LLATKNE

Do NOT Check: Offset by Percent (1.0 = 100%)

Do NOT Check: Calibration Only Landmark

Workspace | Signals and Events | Models | Reports | Si

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing

Landmark Name: LKneLat

Define Orientation Using:

Starting Point: F_LKNEE (Reference)

Targets and/or Landmarks: Ending Point: F_LKNEE_X (On a line)

*Lateral object: (On a plane)

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

* = Optional

Existing Segment: LAB

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

2. Create Medial Border of the Left Knee Joint Center (LKneMed):

Click **Landmarks** button

Click **Add New Landmark** button

Create Landmark: *LKneMed*

Landmark Name: *LKneMed*

Define Orientation Using:

Starting Point: *F_LKNEE*

Ending Point: *F_LKNEE_X*

Project From: *LMEDKNE*

Do NOT Check: *Offset by Percent (1.0 = 100%)*

Do NOT Check: *Calibration Only Landmark*

Workspace | Signals and Events | Models | Reports | Cal

Segments | Landmarks | Muscles | Subject Data / Metrics

Landmarks | Functional | Digitizing

Landmark Name: LKneMed

Define Orientation Using:

Starting Point F_LKNEE (Reference)

Targets and/or Landmarks: Ending Point F_LKNEE_X (On a line)

*Lateral object (On a plane)

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

* = Optional

Existing Segment LAB

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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