

# Add Functional Joint Landmark

This is a legacy command in Visual3D. Visual3D version 4.0 has a new interface for functional joints, and new way of specifying a functional joint landmark as part of the model template. This command should continue to work as originally implemented but it is recommended that you adopt the current approach. Functional joints are a method for modelling the joint between two segments according to their apparent relative movement. Functional joints are implemented in Visual3D as an alternative for defining joint landmarks and can be chosen to use in segment definitions if desired. The accuracy of functional joints is affected by movements performed, range and speed of motion, the participant studied and the soft tissue artifact. As a result, functional joints should be used carefully with their results being validated using another anatomical landmarks when possible, making these other methods often more trustworthy. The command can be found in the **Pipeline Workshop** under **Model Building**.

This command is based on:

**Schwartz MH, Rozumalski A** (2005) A new method for estimating joint parameters from motion data. *Journal of Biomechanics*, 38, 107-116

## Pipeline Command

The command below is as seen on the Visual3D application.

```
Add_Functional_Joint_Landmark
/LANDMARK_NAME=
! /ALGORITHM=GILETTE
! /CALIBRATION_FILE=
! /USE_TRACKING_SEGMENT=FALSE
! /TRACKING_SEGMENT_NAME=
! /TRACKING_TYPES=TARGET
! /TRACKING_FOLDER=ORIGINAL
! /TRACKING_NAMES=
! /USE_OTHER_SEGMENT=FALSE
! /OTHER_SEGMENT_NAME=
/OTHER_TYPES=TARGET
! /OTHER_FOLDERS=ORIGINAL
! /OTHER_NAMES=
! /MOTION_FILE=
! /COMPUTE_SECOND_LANDMARK_ON_AXIS=FALSE
! /SECOND_LANDMARK_DISTANCE=0.1
! /EVENT_SEQUENCE=
! /EXCLUDE_EVENTS=
! /EVENT_SEQUENCE_INSTANCE=0
! /DOWNSAMPLE_RATIO=1
! /MINIMUM_HELICAL_ROTATION_DELTA_ACCEPTED=2
! /APPROXIMATE_NUMBER_OF_COMBINATIONS_USED=2000000
;
```

## Command Parameters

|                                                  |                                                                                                                                                                                                                                          |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>/LANDMARK_NAME=</b>                           | The name of the landmark to be created.                                                                                                                                                                                                  |
| <b>/CALIBRATION_FILE=</b>                        | The name of the hybrid model. Use the full pathname.                                                                                                                                                                                     |
| <b>/TRACKING_SEGMENT_NAME=</b>                   | The joint landmark is created relative to an existing segment. For example, for the hip joint center, the pelvis is used.                                                                                                                |
| <b>/TRACKING_TYPES=</b>                          | The types of reference markers used for defining the landmark.                                                                                                                                                                           |
| <b>/TRACKING_NAMES=</b>                          | The names of reference markers used for defining the landmark                                                                                                                                                                            |
| <b>/TRACKING_FOLDER=</b>                         | The folder containing the tracking markers                                                                                                                                                                                               |
| <b>/OTHER_SEGMENT_NAME=</b>                      | The name of the other segment (e.g. the landmark does not refer to this segment                                                                                                                                                          |
| <b>/SIGNAL_TYPES=</b>                            | The types of signals used for the tracking markers.                                                                                                                                                                                      |
| <b>/SIGNAL_NAMES=</b>                            | The names of signals used for the tracking markers. Any number of tracking markers may be used.                                                                                                                                          |
| <b>/SIGNAL_FOLDER=</b>                           | The folders for signals used for the tracking markers.                                                                                                                                                                                   |
| <b>/MOTION_FILE=</b>                             | The full pathname of the motion file used. This command allows only one movement file to be used. The user should make sure that a full range of motion about all axes is contained in one file.                                         |
| <b>/EVENT_START=</b>                             | The start frame for the range of data to be used.                                                                                                                                                                                        |
| <b>/EVENT_STOP=</b>                              | The Stop frame for the range of frames of data to use.                                                                                                                                                                                   |
| <b>/COMPUTE_SECOND_LANDMARK_ON_AXIS=</b>         | TRUE or FALSE compute a second landmark that lies on an axis (used for computing a joint axis)                                                                                                                                           |
| <b>/SECOND_LANDMARK_DISTANCE=0.1</b>             | The location of the second landmark relative to the joint center                                                                                                                                                                         |
| <b>/MINIMUM_HELICAL_ROTATION_ACCEPTED=</b>       | Any combination of three frames for which the helical rotation angle is less than 5 degrees are rejected                                                                                                                                 |
| <b>/CREATE_100_REPRESENTATIVE_LANDMARKS=</b>     | a random selection of the intermediate Centers of Rotation will be saved as Landmarks.                                                                                                                                                   |
| <b>/APPROXIMATE_NUMBER_OF_COMBINATIONS_USED=</b> | If there are a large number of frames of data, the possible combinations of 3 frames becomes very big. The can specify an estimate of the number of combination used (these are selected randomly from the total number of combinations) |
| <b>/SEARCH_WINDOW=</b>                           | Only Centers of Rotation within the search radius are used for the mean value.                                                                                                                                                           |

|                                              |                                                                                                                                                   |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>/RATE_OF_VOLUME_REDUCTION=</b>            | The rate at which the domain of possible solutions is reduced.                                                                                    |
| <b>/NUMBER_OF_ITERATIONS_REDUING_RADIUS=</b> | The number of times the radius is reduced. At each iteration the cell containing the most crossings is used as the center for the next iteration. |
| <b>/MINIMUM_NUMBER_OF_VALUES_IN_RADIUS=</b>  | When the number of landmarks within the current radius falls below this number, the mean value is determined from these markers.                  |

## Dialog

The command can be edited in a text editor or in a dialog form. To edit in the dialog pop up form either click on the Edit button in the pipeline workshop or double-click on the pipeline command. The dialog is shown below.

Functional Joint Landmark Dialog

Functional Joint Name:

Functional Joint Algorithm:

Motion File Name:

Calibration File Name:

☐ Compute Axis instead of Point (2nd Landmark Distance (m))

Tracking Segment/Targets

☐ Use Tracking Segment

☒ Use Tracking Targets

Other Segment/Targets

☐ Use Targets From Other Segment

☒ Use Other Targets

Tracking Folder:

Other Folder:

Defined Events

Optional: Select an event sequence and Instance

Event Sequence Instance:

Algorithm Parameters

Minimum Movement Angle:  Approximate Number of Combinations Used:

Downsample Ratio:

This command was changed for Visual3D Version 3.83 to allow the specification of **REFERENCE MARKERS** instead of **REFERENCE SEGMENT**.

- If a Reference Segment is specified, the landmark will be created relative to that segment.
- If no Reference Segment is specified, the landmark will be created relative to the first three REFERENCE MARKERS (e.g. a Technical Coordinate System will be created from these markers). If more than 3 REFERENCE MARKERS are specified, Visual3D will use all REFERENCE MARKERS to track the Technical Coordinate System.

## NOTES

The motion trials being used to identify the functional joint landmark must be [assigned](#) to the static calibration trial.

If TRACKING\_SEGMENT\_NAME is specified, TRACKING\_TYPES, TRACKING\_NAMES, TRACKING\_FOLDER are ignored and can be left blank. The landmark will be created relative to the Tracking Segment.

If TRACKING\_SEGMENT\_NAME is blank, TRACKING\_TYPES, TRACKING\_NAMES, TRACKING\_FOLDER must be specified. The landmark will be created relative to 3 of the Tracking markers. The first two marker will be selected from the list of tracking markers so that these markers are the maximum distance apart. The third marker will be the maximum distance from a line between the other two.

If OTHER\_SEGMENT\_NAME is specified, SIGNAL\_TYPES, SIGNAL\_NAMES, SIGNAL\_FOLDER are ignored and can be left blank.

If OTHER\_SEGMENT\_NAME is blank, SIGNAL\_TYPES, SIGNAL\_NAMES, SIGNAL\_FOLDER must be specified.

## Example

The following pipeline will compute a functional joint (e.g. the location of the tip of the ROD relative to the LAB) and another landmark defined as the location of the tip relative to 3 of the tracking markers on the ROD.

The following pipeline will compute a functional joint (e.g. the location of the tip of the ROD relative to the LAB) and another landmark defined as the location of the tip relative to 3 of the tracking markers on the ROD.

File\_New

```
;
Set_Pipeline_Parameter
/PARAMETER_NAME=FOLDER
/PARAMETER_VALUE=c:\demo files\CalTesterDimensions
;
For_Each
/ITERATION_PARAMETER_NAME=INDEX
! /ITERATION_PARAMETER_COUNT_NAME=
! /ITERATION_PARAMETER_COUNT_BUFFER=
/ITEMS=1+2
```

```
;
Set_Pipeline_Parameter
/PARAMETER_NAME=MOVE
/PARAMETER_VALUE=: : FOLDER&move&: : INDEX&.c3d
;
Set_Pipeline_Parameter
/PARAMETER_NAME=STATIC
/PARAMETER_VALUE=: : FOLDER&static&: : INDEX&.c3d
;
Create_Hybrid_Model
/CALIBRATION_FILE=: : STATIC
;
Set_Subject_Weight
/CALIBRATION_FILE=: : STATIC
/WEIGHT=1.0
;
Set_Subject_Height
/CALIBRATION_FILE=: : STATIC
/HEIGHT=1
;
Open_File
/FILE_NAME=: : MOVE
;
Assign_Model_File
/CALIBRATION_FILE=: : STATIC
/MOTION_FILE_NAMES=: : MOVE
;
Add_Functional_Joint_Landmark
/LANDMARK_NAME=TIP&: : INDEX
! /ALGORITHM=GILETTE
/CALIBRATION_FILE=: : STATIC
/USE_TRACKING_SEGMENT=TRUE
/TRACKING_SEGMENT_NAME=LAB
/TRACKING_TYPES=TARGET
/TRACKING_FOLDER=ORIGINAL
/TRACKING_NAMES=UP1+UP2+UP3+UP4+UP5
! /USE_OTHER_SEGMENT=FALSE
! /OTHER_SEGMENT_NAME=
! /OTHER_TYPES=TARGET
! /OTHER_FOLDERS=ORIGINAL
! /OTHER_NAMES=
/MOTION_FILE=: : MOVE
! /COMPUTE_SECOND_LANDMARK_ON_AXIS=FALSE
! /SECOND_LANDMARK_DISTANCE=0.1
! /EVENT_SEQUENCE=
! /EXCLUDE_EVENTS=
! /EVENT_SEQUENCE_INSTANCE=0
! /DOWNSAMPLE_RATIO=1
/MINIMUM_HELICAL_ROTATION_DELTA_ACCEPTED=5
/APPROXIMATE_NUMBER_OF_COMBINATIONS_USED=1000000
```

```
;  
  
Add_Landmark  
/LANDMARK_NAME=CALTIP&: :STATIC  
/CALIBRATION_FILE=: :STATIC  
! /USER_GENERATED=TRUE  
! /USE_PERCENTAGE=FALSE  
! /CALIBRATION_ONLY=FALSE  
/USE_TARGETS=TRUE  
! /SEGMENT_NAME=  
/TARGET_TYPES=TARGET+TARGET+TARGET  
/TARGET_NAMES=UP1+UP2+UP3  
!/MCSX=  
!/MCSY=  
!/MCSZ=  
! /LANDMARK_LOCATION=  
/REFERENCE_LOCATION_NAME=TIP&: :INDEX  
/REFERENCE_LOCATION_TYPE=LANDMARK  
/USE_REFERENCE_LOCATION=TRUE ;
```

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