

Custom Shadow Segments

Overview

Virtual segments provide a convenient way to include multiple definitions for a segment within a single model, but these multiple definitions do not easily allow for external constraints (like an [Inverse Kinematic](#) chain) to be applied consistently across all segment definitions. For example, if a Virtual Segment is defined with relation to a segment and then an Inverse Kinematics constraint is applied to the original segment, the changes in the original segment's pose estimation do not propagate to the Virtual Segment.

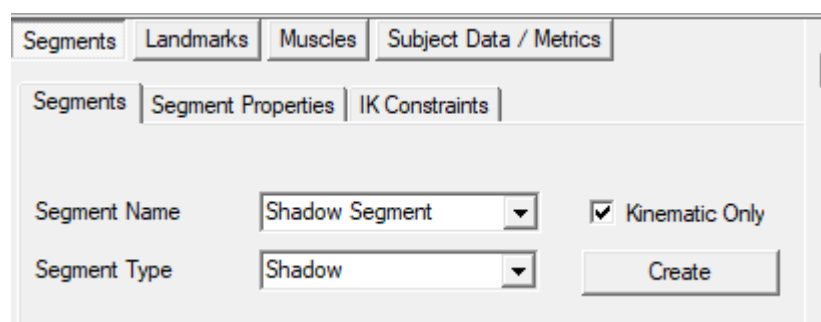
Shadow segments resolve this issue by allowing that segment's pose to be defined as a transformation of the original segment's pose estimation. Users can use the [Expression](#) function [Pose_4x4](#) when defining their own shadow segments.

This tutorial will demonstrate how to create custom shadow segments and how they can be used.

Segment Definition

The shadow segment must be defined based on a pre-existing segment therefore, before continuing ensure you have a model with a already defined segment that you wish to shadow. More information on segments and how they can be defined can be found [here](#).

Once a segment has been created, the shadow segment can be created the same way as any other segment in the **Segments** tab of the model builder. Type in your desired shadow segment name (i.e. Shank_Shadow) and change the segment type to shadow. Select Kinematic only and press create. When using a shadow segment, it should not be used in the kinetic chain as they are primarily reference segments rather than physical body segments. As they don't have any mass or inertial properties they should not be included in the kinetic chain.



The screenshot shows the 'Segment Properties' dialog box with the following details:

- Tab: Segments
- Segment Name: Shadow Segment
- Segment Type: Shadow
- Kinematic Only: ☒
- Create button

Once created, you will be automatically taken to the new shadow segment tab. First select the segment you wish to shadow (The pelvis will be used for this example). Now, you must define the 4x4 rotation which is the heart of defining the shadow segment. More information on this command can be found [Here](#). The following shadow pelvis would adjust the X coordinate rotation by 10 degrees. The first three zeros are for translational changes and the next three are rotational. The next conditions are just further defining the new segment with 0.1 chosen for the radius as it is a common default value.

Segments

Segment Properties

IK Constraints

Shadow Pelvis

X

Segment to Shadow

Pelvis

Copy Segment Properties to Shadow Segment

POSE4X4(0,0,0,10,0,0,123)

Rotation 4x4

Rotation 4x4 wrt SCS

Pelvis

Segment Length

RPV_SEG_LENGTH

Proximal Radius

0.1

Distal Radius

0.1

Depth

RPV_DEPTH

POSE4X4(R_HEEL,0,0,0,123)

Example Expressions

Close Tab

Apply

Build Model

You should now be able to see your shadow segment in your model. In this example the new segment is rotated 10 degrees about the segment X-axis from the original.

Analysis

Shadow segments are often used in comparison to the anatomical results. Due to shadow segments not being part of the kinetic chain only kinematic analysis can be done on these segments.

Here are some samples of analysis that can be done on a shadow segment:

[Joint Angles](#)

[Joint Velocity](#)

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