

Virtual Segments

We have grown accustomed to referring to **Kinematic Only** segments as **Virtual Segments**. The defining criterion for distinguishing a **Virtual Segment** from other segments in Visual3D is that these segments do not get included in the [Inverse Dynamics](#) calculations. These segments cannot be [assigned external forces](#) and will not have [joints](#) created at their proximal end points.

Using Virtual Segments for Comparison

Virtual segments are not actually segments as the term is commonly used but are actually a convenient way of identifying local coordinate systems (or [segment coordinate systems](#)). This makes them a convenient way to compare different segment definitions, by allowing multiple segment definitions without making the model's inverse dynamics ambiguous. A user/researcher may examine the differences between these segments by creating multiple virtual segments.

Defining a Virtual Laboratory

Virtual Laboratory segments are a special kind of virtual segment and often created to accomodate segment angles (such as the pelvis or the foot) relative to the direction of walking. This controls for the subject's direction of walking because the path of progression can be defined explicitly. Below are some pages that detail how to define a virtual lab that is in a different direction from the lab coordinate system as well as how one would define a virtual lab that changes direction with walking progression.

- [Creating a Virtual Lab \(Basic Walkthrough\)](#)
- [Creating a Virtual Lab \(Complete Tutorial\)](#)
- [Using the Virtual Lab](#)
- [Virtual Lab that changes direction](#)

Absolute Joint Angles

Once the virtual laboratory segment has been created, you can create an absolute angle (segment angle relative to lab). For example, [pelvis segment angles](#) can be expressed relative to virtual lab segments.

An in-depth example is to express foot progression angle with respect to the virtual lab.

- The first step is to build a **Virtual Foot** Segment for the right and left feet as described in [Normalized Joint Angle - Method 1](#).
- The second step is to compute a Joint Angle. Assuming that you are using the default Laboratory Coordinate System and the subject is walking in the anterior direction of the laboratory (e.g. Y), the Right Foot Angle can be defined as:

```
DataName: Right_Foot_Angle  
Folder: ORIGINAL
```

Model Based Item Properties: JOINT_ANGLE
Normalization: Normalization Off
Segment: Right Virtual Foot
Reference Segment: LAB
Cardan Sequence: X-Y-Z

- In this example, the foot progression angle would be the rotation about the z-axis of the laboratory.
- If your subject is walking in a different direction, you will need to create a Virtual Laboratory Coordinate system that is aligned to the direction the person is walking.

Another common use is for [Normalizing Joint Angles](#). Normalization is the process of referencing a joint (or segment) angle to the reference posture. In Visual3D the reference posture is the static trial used for the link model. We usually recommend the use of virtual segments, which can be defined so that they explicitly cause the static trial to be a reference posture.

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