

Segment Geometry

Visual3D models segments as cones, cylinders, spheres, and ellipsoids.

VISUAL3D calculates the mass, moments of inertia (IXX, IYY, IZZ) and center of gravity location for each segment.

Hanavan E. (1964) A Mathematical Model for the Human Body. Technical Report, Wright-Patterson Air Force Base.

For segments created using a [valid default name](#), the segmental weight is determined from the total body weight and [Dempster's regression equations](#). The user can use the MASS qualifier to override the default value or to specify the weight of a segment with a non-default name. The segmental weight should be entered in kilograms. The principle moments of inertia are determined from the segmental weight and geometry. The user can use the IXX, IYY and IZZ qualifiers to override the default values or specify the inertia of a segment with a non-default name. The moments of inertia should be entered $\text{kg}\cdot\text{m}^2$.

Although these segment types differ geometrically, they all require a defined distal and proximal radius.

Cones - Frusta of right cones

For segments modeled as frusta of right cones, VISUAL3D requires both the proximal and distal segment radii. If both a medial and a lateral target are used at the end of a segment during the subject calibration, then the radius at that end is determined to be one-half of the distance between these targets. If only a single target is used at a segment end, then a qualifier, either DIST_RAD or PROX_RAD, must be used.

Cylinders - Right elliptical cylinders

For segments modeled as right elliptical cylinders, VISUAL3D requires a proximal segment radius, a distal segment radius (major axis), and a segment depth (minor axis radius). The inertial properties of the segment are calculated using the distal radius, the depth and the computed segment length. However, the proximal radius is still required to determine the location of the proximal segment end. If both a medial and lateral targets are used at one end of a segment during subject calibration, then the radius at that end is determined to be one-half of the distance between these targets. If only a single target is used at the end of a segment then a qualifier, either DIST_RAD or PROX_RAD, must be used. The depth of cylindrical segments must always be specified. The cylindrical depth is equal to one-half the distance from anterior to posterior. The qualifier DEPTH is used to specify this distance.

Spheres

For segments modeled as spheres, VISUAL3D requires a proximal segment radius and a distal segment radius. The inertial properties of the segment are calculated using only the distal radius.

However, the proximal radius is still required to determine the location of the proximal segment end. If both a medial and a lateral target are used at one end of a segment during subject calibration, then the radius at that end is determined to be one-half of the distance between these targets. If only a single target is used at the end of a segment then a qualifier, either DIST_RAD or PROX_RAD, must be used.

One notable difference arises in creating spherical segments. VISUAL3D expects the distal targets to be located at 50% of the distance between segment ends. This allows the distal radius to produce a realistic measure of the dimension of the sphere.

Ellipsoids

For segments modeled as ellipsoids, VISUAL3D requires a proximal segment radius and a distal segment radius. The inertial properties of the segment are calculated using the distal radius and the computed segment length. However, the proximal radius is still required to determine the location of the proximal segment end. If both a medial and lateral targets are used at one end of a segment during subject calibration, then the radius at that end is determined to be one-half of the distance between these targets. If only a single target is used at the end of a segment then a qualifier, either DIST_RAD or PROX_RAD, must be used.

One notable difference arises in creating elliptical segments. VISUAL3D expects the distal targets to be located at 50% of the distance between segment ends. This allows the distal radius to produce a realistic measure of the elliptical dimensions.

Radius at the distal segment end (DIST_RAD)

A distal segment radius is required for all segments. It will be used to determine both the locations of the distal segment end and the segmental anthropometric properties. If both medial and lateral targets are used at the distal end of the segment during subject calibration, then the radius at that end is determined to be one-half of the distance between these targets. If only a single target is then the DIST_RAD qualifier must be used.

Radius at the proximal segment end (PROX_RAD)

A proximal segment radius is required for all segments. It will be used to determine the location of the proximal segment end. If both medial and lateral targets are used at the proximal end of the segment during subject calibration, then the radius at that end is determined to be one-half of the distance between these targets. If only a single target is then the PROX_RAD qualifier must be used. In addition, the proximal segment radius will be used to estimate the anthropometric properties for some geometries.

Depth of Cylindrical Segments (DEPTH)

In order to compute the moments of inertia for segments that have a cylindrical geometry, VISUAL3D requires that the depth of all cylinders be specified. The cylindrical depth is equal to one-half the

distance from anterior to posterior. The qualifier DEPTH is used to specify this distance.

Custom Segment

Custom segment may be created by selecting “CUSTOM_SEG” and modifying the segment properties. An example of this can be found [here](#).

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