Human Builder



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Workbench Description

Human Builder Menu Bar Manikin Tools Toolbar Manikin Posture Toolbar Manikin Workbench Access Toolbar Manikin Simulation Toolbar Manikin Workspace Analysis Toolbar

Glossary

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Preface

Human Builder is based on a best-in-class human modeling system which, for many years, has permitted detailed investigation into human-centered design issues in the context of a workplace before it physically exists. Human Builder provides very accurate simulation of humans and their interactions with products to ensure they will operate naturally in a workplace tailored to their tasks. The Human Builder product specifically focuses on creating and manipulating digital humans for "first level" human-product interaction analysis.

Human Builder consists of a number of advanced tools for creating, manipulating and analyzing how manikins (based on the 5th, 50th and 95th percentile value) can interact with a product. The manikins can then be used to assess the suitability of a product for form, fit and function. The manikins can be intuitively created and manipulated in conjunction with the digital mockup to check features such as reach and vision. A simple-to-use interface ensures that first-level human factors studies can be undertaken by non-human factors specialists.

Tools contained within the Human Builder product include manikin generation, gender specification, percentile specification, direct kinematics and inverse kinematics manipulation techniques, animation generation, monocular, binocular and ambinocular vision simulation, as well as vision output cones.

How to Use this Guide
Where to Find More Information

How to Use this Guide

This book describes how to use the Human Builder product. Before you read it, you should be familiar with basic concepts such as document windows, standard tool bars, and view tool bars.

If you are new user, start with the tutorial in the Getting Started section.

The remaining sections of the book provide procedures for using the features of the Human Builder product. The procedures are divided into basic and advanced sections.

A Workbench Description section describes each functional icon or command in the workbenches.

The Glossary provides definitions of terms specific to Human Builder and related products.





Where to Find More Information

After reading Human Builder, we recommend that you also read:

- Human Posture Analysis
- Human Measurements Editor
- Human Activity Analysis
- Conventions





What's New?

New Functionalities

Manikin simulation commands

Manikin workspace analysis

Enhanced Functionalities

Vision

Capability to change the color properties of peripheral and central cones.

Compass snap operations

Manikin skin points are now accessible for use with a number of existing functionalities, i.e., redefining an offset for inverse kinematics.

Constraints auto-update

Update can now be set to automatic mode or manual mode in Tools/Options..

Oriented plane constraint

Capability to build a plane constraint with a specific orientation.

Inverse kinematics mode

Capability to orient the compass in the segment frame.

Balance management in inverse kinematics (IK) behaviors

Manikins can be manipulated with IK while keeping their balance. Feet Motion and Pelvic Motion are balance options found in the IK Behaviors tab of the manikin properties panel.

Getting Started

This tutorial provides an overview of Human Builder functionality. It provides a step-by-step scenario showing you how to use key functions. The tasks described in this section are:

Standard Manikin Creation Creating a Forearm/Hand Model

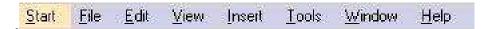
Standard Manikin Creation



This task describes how to create a standard manikin. Once created, the manikin will appear in the specification tree right under the chosen father product. The manikin will then be a component of the chosen product.



1. Go to the Start menu (see below)



2. From the Start menu, select Ergonomics Design & Analysis -> Human Builder.



3. From the Insert menu, select New Manikin.



OR

Select the Manikin Creation button in the Manikin Tools toolbar.

4. The New manikin dialog box appears with two tabs: Manikin and Optional.

Manikin tab



Father product: Since manikins are created inside CATProduct documents, you must select the Father product by clicking the desired document in the specification tree. The Father document's name will automatically be placed in the read-only field.



The Father product is the product that the manikin will be attached to in the specification tree. It can be the root product or any other product under the root.



Please note that the Father product cannot be another manikin.

Manikin name: In this field, you can enter a name for the manikin i.e., Driver, Passenger, Machine X Operator, etc. This name is typically used to identify the manikin within the document. Several manikins may have the same name.

Please note that if you leave this field blank, the default name will be *Manikin1 (2, 3, etc.)*, and the manikin will be saved under *Manikin1.CATProduct.*



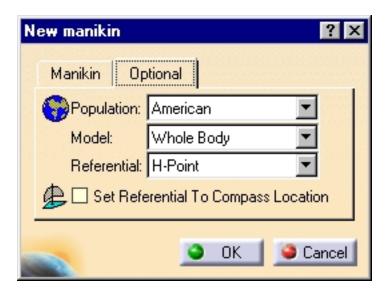
Gender: In this field, you must choose whether the manikin will be a man or a woman.

Percentile: You can choose the percentile (between 0.01 and 99.9) that the new manikin will be built from.



The percentile is applied to the stature (height) as well as the weight of the new manikin. It indicates the group the manikin will belong to within the ordered statistical population. In other words, the stature and the weight of the new manikin will both be set at the chosen percentile. All other anthropometric variables will be estimated by the system based on the default anthropometric database.

Optional tab



Population: In this field, select the nationality of the manikin from the default set of populations: American, Canadian, French, Japanese, or Korean.

Model: In this field, choose the model-type desired: whole body, right forearm, or left forearm.

Referential: In this field, choose the initial referential point of the new manikin. The choices are: Eye point, H-Point (default), Left foot, Right foot, Lowest foot, and Crotch. For more information, see the Referential example below.

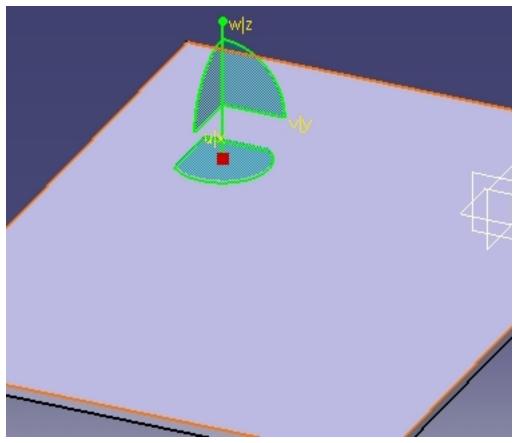
Set Referential to Compass Location: If this parameter is activated, you will be able to assign the initial position of the manikin with the compass, i.e., a plant floor. If the parameter is not activated, the manikin will be displayed at its default position (world origin). For more information, see the Referential example below.

5. Select the OK button. The new manikin will appear.

It may be necessary to click on the Fit All In icon to make the whole manikin fit the viewpoint.

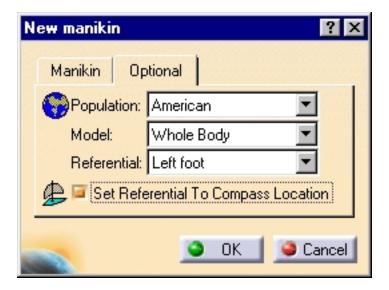
Referential example

1. In the samples directory, open the file *Floor.CATProduct*. Snap the compass to the desired location on the floor.

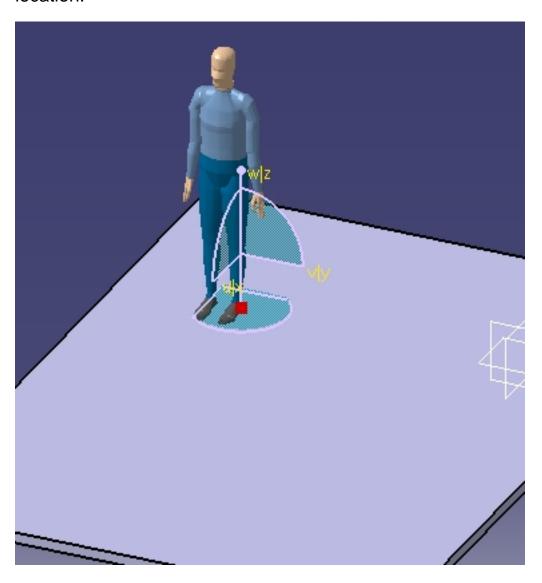


2. Select the Create a manikin icon. Select the Father product in the

Manikin tab as described above. In the Optional tab, set the left foot as the referential and activate Set Referential to Compass Location as shown below. Click OK.



The manikin is created with its referential (left foot) set to the compass location.









Creating a Forearm/Hand Model



This task describes how to create a forearm model with fully-articulated hand.



1. From the Insert menu, select New Manikin.



OR

Select the Manikin Creation button



in the Manikin Tools toolbar.

2. The New manikin dialog box appears.



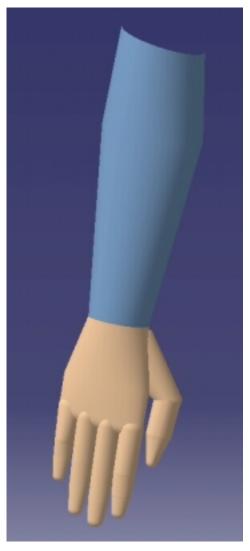
3. Select the Father product and the Manikin name. Accept the defaults in the Gender, Population, and Percentile fields.

For Model: Select Right Forearm or Left Forearm.



Select the OK button.

The selected forearm/hand model appears.





Once the forearm/hand model is created, position it with the compass in the same manner that you position a manikin. It is also possible to:

- use the Posture Editor on the forearm
- use the forward kinematics command



on the hand, fingers,

and thumb

paste local postures from a library



Some functions may not be used with the forearm/hand model. These are: the vision function , the inverse kinematics functions , the

reach mode , the constraint function and all commands in the

Human Activities workbench.









Basic Tasks

These are the basic tasks that a user performs using Human Builder:

Using Forward Kinematics Changing Manikin Display Attributes Assigning Descriptions (Memos) Using the Copy/Paste Function Using the Inverse Kinematics Mode **Applying Standard Poses** Positioning the Manikin Using the Posture Editor **Library Management** Using the Reset, Mirror Copy, and Swap Functions Accessing the Graphical Properties of Segments Accessing the Graphical Properties of Lines of Sight **Accessing Other Vision Options** Using Posture Undo/Redo Retrieving Center of Gravity Coordinates Redefining the Manikin Referential **Using Global Collision Detection** Using the Place Mode

Using Forward Kinematics



This task describes how to control the manikin's movements using forward kinematics with the available manipulators as well as the Undo/Redo command.



1. In the toolbar, select the Forward Kinematics icon





Note that this icon **must** be unselected by clicking on it again in order to access another function.

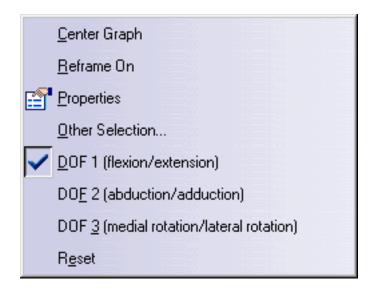
2. Select the manikin's part that you wish to move by clicking it with the left mouse button. Two arrows appear: one indicates the direction of the motion and the other indicates the rotation axis for the active degree of freedom.



3. With the left mouse button, drag the selected segment so that the mouse cursor follows the arrow. The chosen segment will move.

By default, the movement exerted will be done according to DOF1 (Degree of Freedom 1), which is either flexion or extension depending on the direction of rotation.

4. If you wish to change the active degree of freedom, click the right mouse button in order to activate the contextual menu. Choose, the desired DOF.



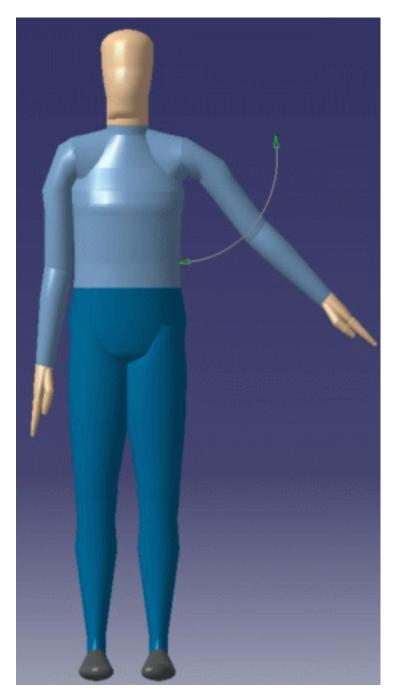


It is often easier to move a segment when the direction of the viewpoint is parallel to the rotation axis.

As in the image below, the best viewpoint to move the flexion/extension DOF is from a side view.



As in the image below, the best viewpoint to move the adduction/abduction DOF is from a front view.

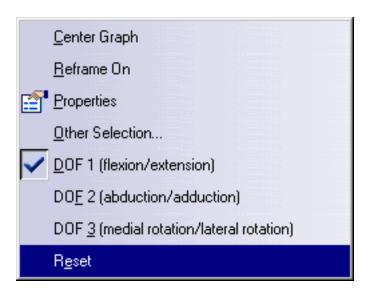




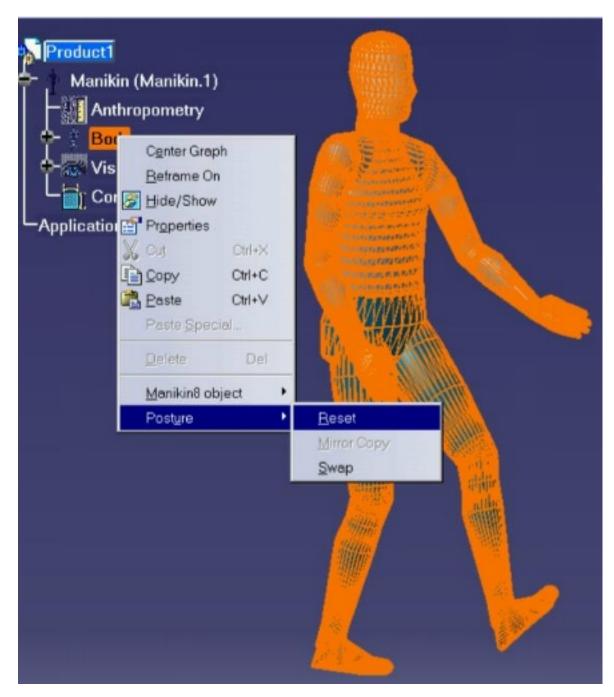
The Quick View toolbar can be very helpful when using the forward kinematics command; manikins can be seen from many viewpoints.



5. To reset the selected segment, click the right mouse button to activate the contextual menu. Then, choose Reset.



To reset the whole posture, select the Body node in the specification tree. With a right mouse click, activate the contextual menu on that same segment and choose Reset.



The manikin will take the default (standing) posture.



Using Undo/Redo

The Undo command reverses (cancels) the last segment manipulation. Click the Undo icon in the main menu toolbar to execute the Undo command.

An Undo operation can also be undone. For example, you can restore the last posture applied to a segment with successive calls to the Redo command.

The images below illustrate the undo operation on a posture applied using the forward kinematics command.

Initial posture

Forward kinematics applied



First Undo applied



Second Undo applied





The Redo command repeats the last cancelled action. Click the Redo icon in the main menu toolbar to execute the Redo command.

A Redo operation can also be undone. For example, you can restore the last posture applied to a segment with successive calls to the Undo command.

Position after Undo applied

Position after first Redo applied

Position after second Redo applied













Using the Quick View Toolbar



The Quick View toolbar can be very helpful when using the forward kinematics command. Manikins can seen from the following viewpoints:











- Top View
- Bottom View
- Isometric View



Front View



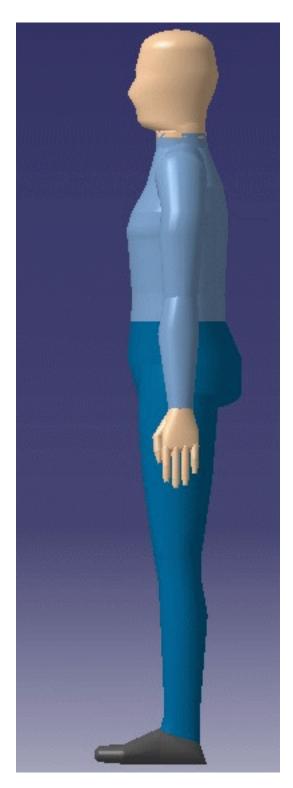
Back View



Left View



Right View



Top View



Bottom View







Changing Manikin Display Attributes



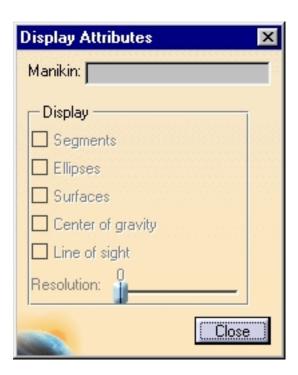
This task describes how to set and edit manikin display attributes.



In the toolbar, select the Display Attributes icon . The Display Attributes

dialog box appears displaying the following choices:

- Manikin:
- Segments
- Ellipses
- Surfaces
- Center of gravity
- Line of sight
- Resolution



Manikin:

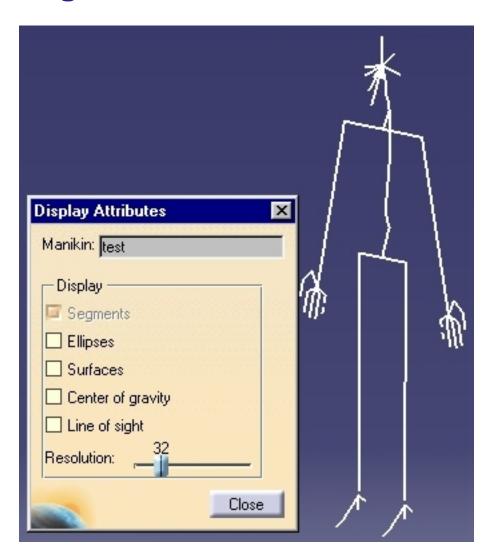
The Manikin field remains empty until you select the desired manikin. To make the selection, click with the left mouse button directly on the manikin or select the manikin from within the product tree. The selected manikin's name will appear in the Manikin field to confirm your selection.

You can select manikins continuously while this command is running. Each selection will cancel the previous one and the Manikin field will be updated with the name of the newly selected manikin.

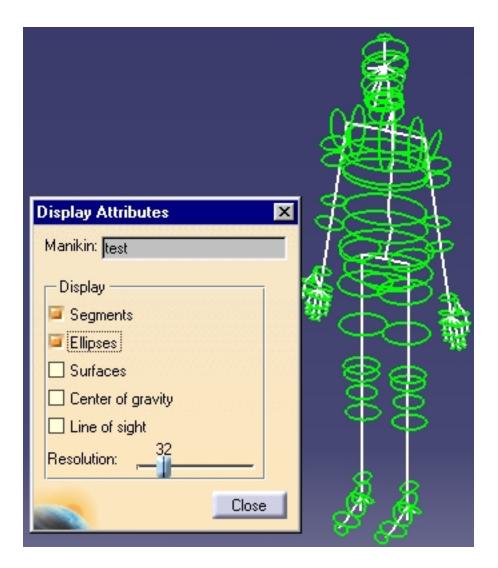
Three types of manikin displays are available: segments, ellipses, and surfaces.

- To change the manikin display, select the display type with the appropriate toggle button.
- Various display types can be selected at the same time.

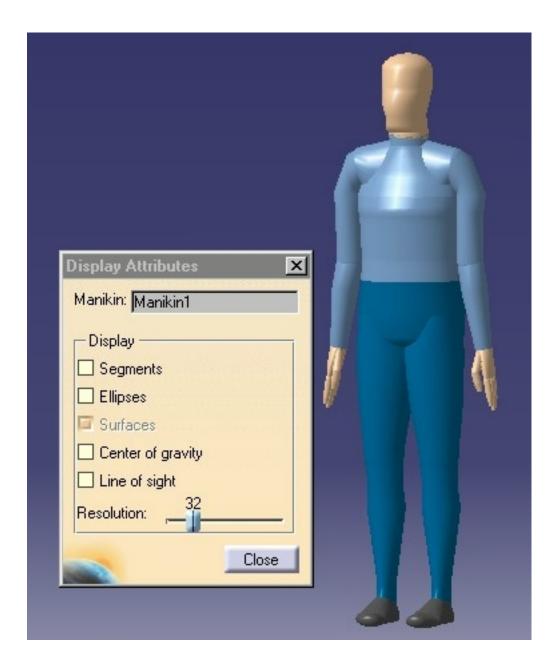
Segments



Ellipses

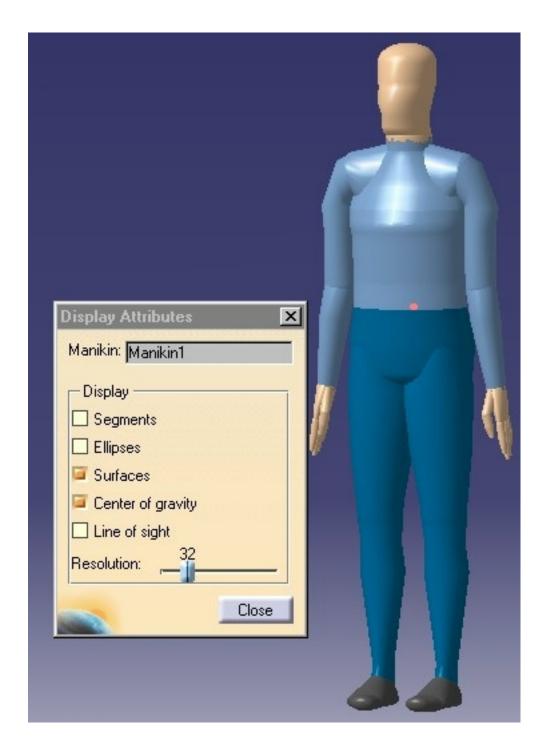


Surfaces



Center of gravity

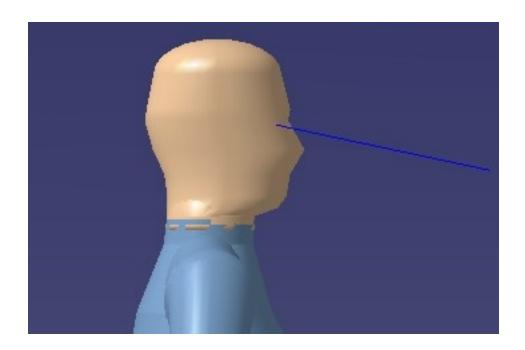
The center of gravity **cannot** be manipulated. However, the center of gravity's position automatically updates when any segment is manipulated.



Line of sight

The line of sight is designed to facilitate the manipulation of the manikin's vision. The blue line can be selected as any other segment of the manikin. For instance, it can be manipulated with the forward kinematics

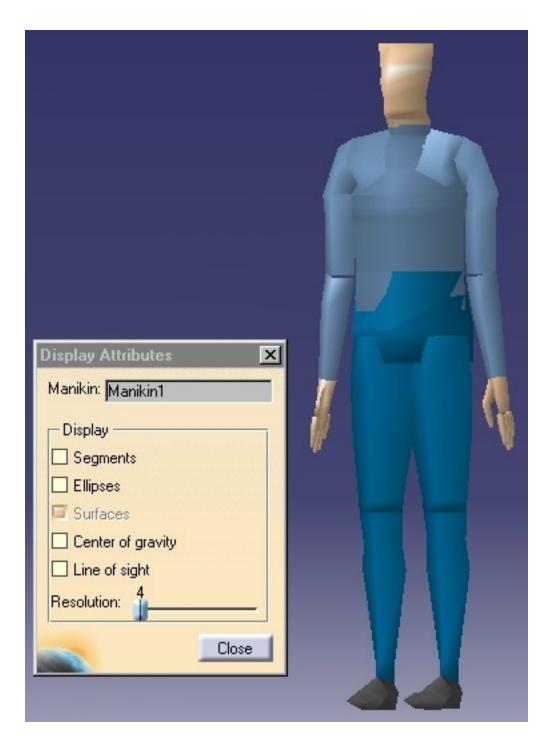
command.



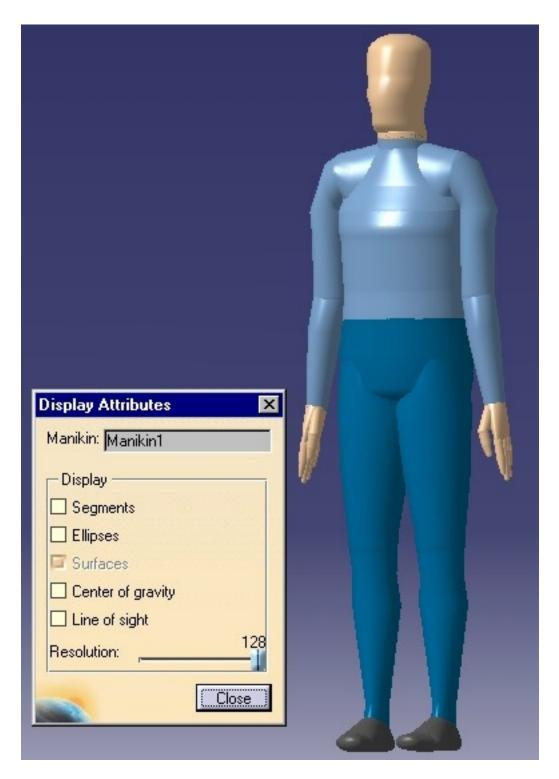
Resolution

Resolution represents the number of points taken on each ellipse to draw the surfaces at manikin creation. The default value of this parameter is 32 but it can vary from 4 to 128.

Low resolution:



High resolution:











Assigning Descriptions (Memos)



This task describes how to create a memo that will be assigned to the manikin.



The Human Measurements Editor enables you to add descriptions of the manikin's anthropometry or of an anthropometric variable. This is a convenient way for you to keep a history on the variables and to determine where, when, and why they have been modified.

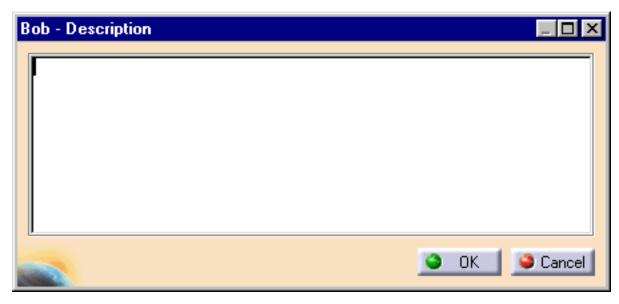


1. In the toolbar, select the Memo icon.



2. Select the manikin you want to assign a description to. The description window will appear. Write the description in the window and click OK. To retrieve the note, click the memo button again.

If the description window remains displayed, select a different manikin. The contents of the window will be updated to display the description (if any) assigned to that manikin.



Descriptions can also be created for the vision, the anthropometry, or the
posture of the manikin using the Memo command. Select the appropriate
node in the specification tree (Manikin, Anthropometry, Vision, or Body)
and the corresponding description will appear in the text field.









Using the Copy/Paste Function



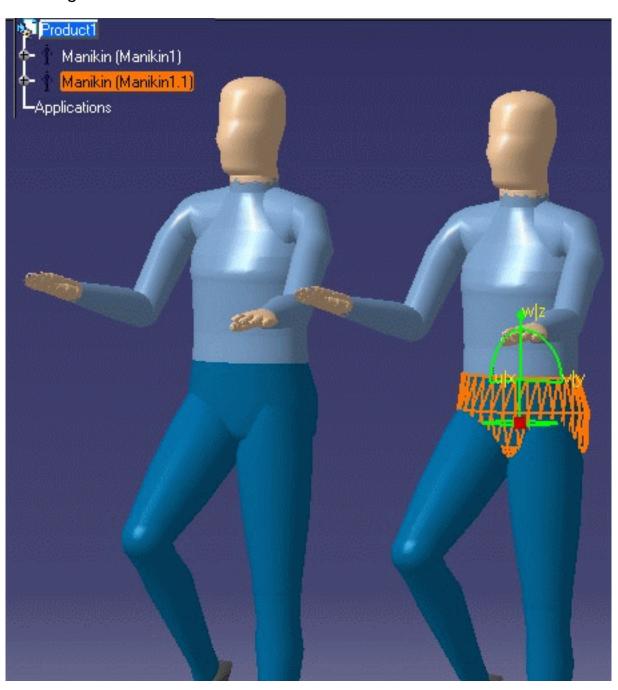
This task describes the Copy/Paste function used with manikin parts.



In the specification tree, select a manikin. Click the right mouse button to activate the contextual menu. Select Copy.

Select a product or another manikin. From the contextual menu, select Paste.

The parameters of the first manikin are copied onto the second manikin, or a new manikin is created and placed under the selected product, as shown in the image below.













Using the Inverse Kinematics Segment Frame Mode and Worker Frame Mode



This task describes how to move the manikin's segments using the:



Inverse Kinematics (IK) Segment Frame Mode

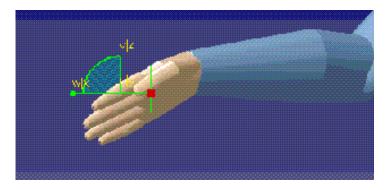


Inverse Kinematics (IK) Worker Frame Mode



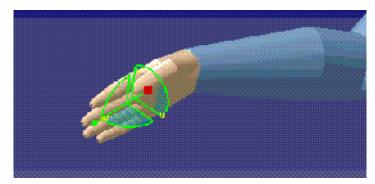
IK Worker Frame mode

This mode behaves in the same manner <u>except</u> the compass is oriented in the worker (global) frame.



IK Segment Frame mode

In this mode, any segment selection made in the 3D environment will automatically snap the compass to the associated segment IK control point. The compass is oriented in the segment frame.





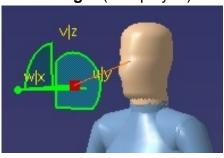
IK Worker Frame mode

1. Click on the IK Worker Frame mode icon.

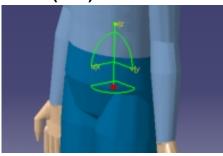


2. Click on a manikin segment. The compass will snap to the selected segment's control point. These seven control points are:

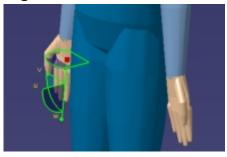
Line of Sight (if displayed)



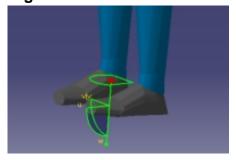
Pelvis (root)



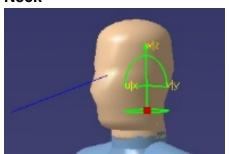
Right Hand



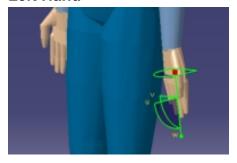
Right Foot



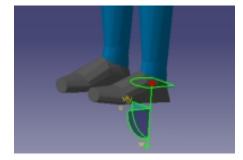
Neck



Left Hand



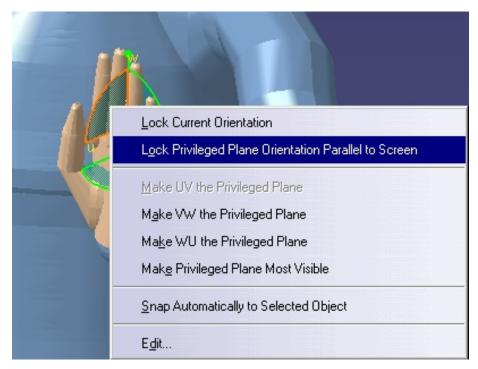
Left Foot



3. On the compass, select the axis corresponding to the direction of the desired movement and start dragging. The controlled point will follow the compass movements.



4. The compass can be locked to stay in the plane you are working on. Use the compass contextual menu (click the compass with the right mouse button) and select Lock Privileged Plane Orientation Parallel to Screen.

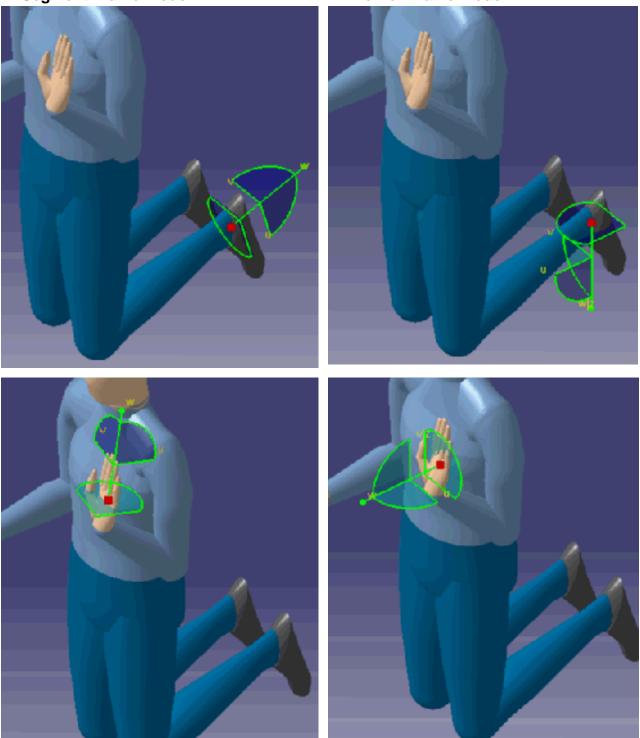




IK Segment Frame mode

This commands orients the compass in the segment frame. Compare how the compass orientation differs from that in the IK Worker Frame mode, for example:

IK Segment Frame mode IK Worker Frame mode



5. When finished, drag the compass back to the empty space or select View -> Reset Compass from the main menu.









Applying Standard Poses



This task describes how to easily apply standard poses to a manikin without using the compass.



- This feature is particularly intended for positioning the spine as a whole in order to apply squatting, stooping, twisting, leaning, and adjusted elbow postures.
- Use the Restore Posture button in each tab of the Standard Pose dialog box to return the manikin to the posture it had before entering the
- Edit manikin posture by typing in the desired value or by using the spinner arrows. Press the Enter key. In both cases, the posture is updated automatically. You can also change the step value of the spinners by right-clicking the spinner arrows; the contextual menu appears as follows:



Use the Constraints check boxes to "freeze" the positions of the hands and the direction of vision while the rest of the manikin is moving. This option cannot be used in the Hand Grasp and the Adjust Elbow tabs.

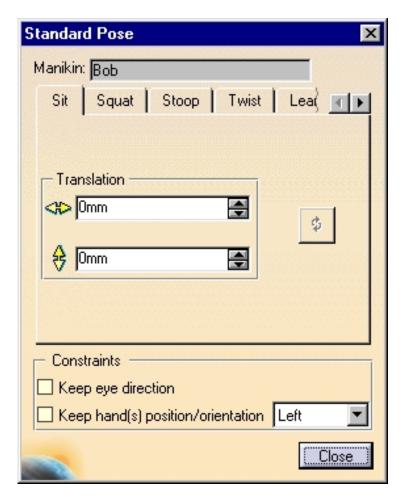


Select the Standard Pose icon



and then select the manikin in the scene or

from the specification tree. The Standard Pose dialog box appears.

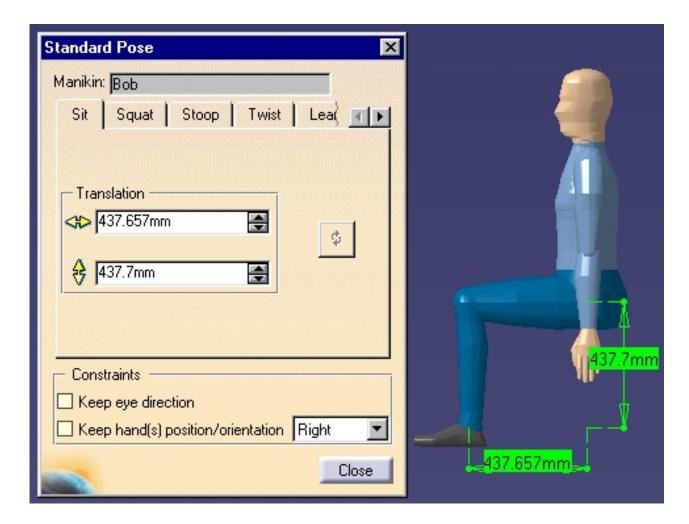


The standard poses are:

- Sit
- Squat
- Stoop
- Twist
- Lean
- HandGrasp
- Adjust Elbow

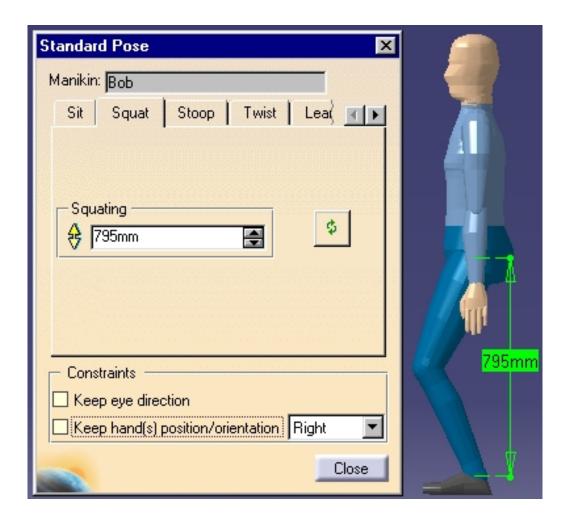
Sit

This tab includes two editors to quickly set the height and depth of the sitting posture.



Squat

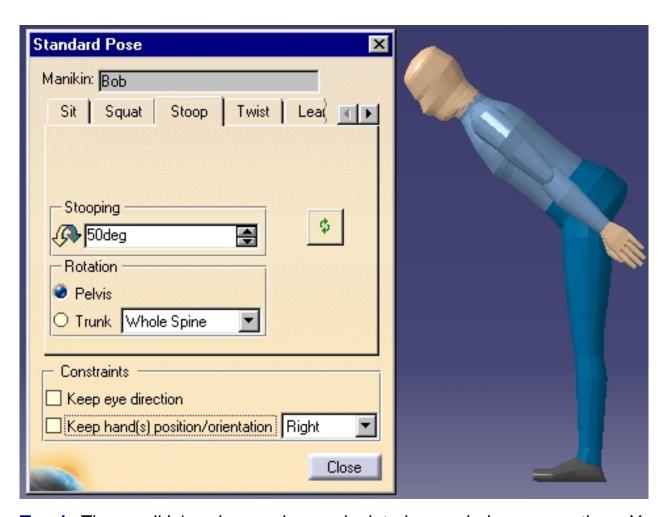
This tab includes an editor to quickly set the height of the squatting posture.



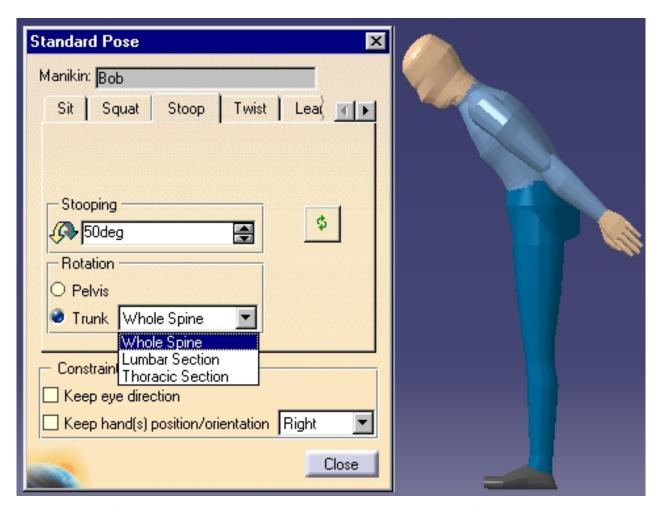
Stoop

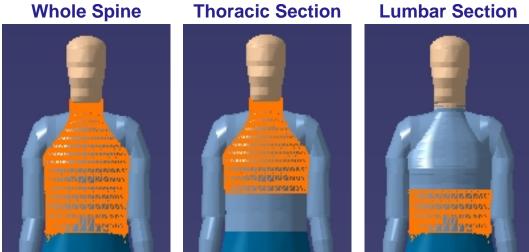
This tab includes an editor, a pelvis option, and a trunk option.

Pelvis: The manikin's trunk can be bent with pelvic rotation; the pelvis will rotate around the hips. Both pelvis and trunk rotation can be performed independently of each other but cannot be used together.



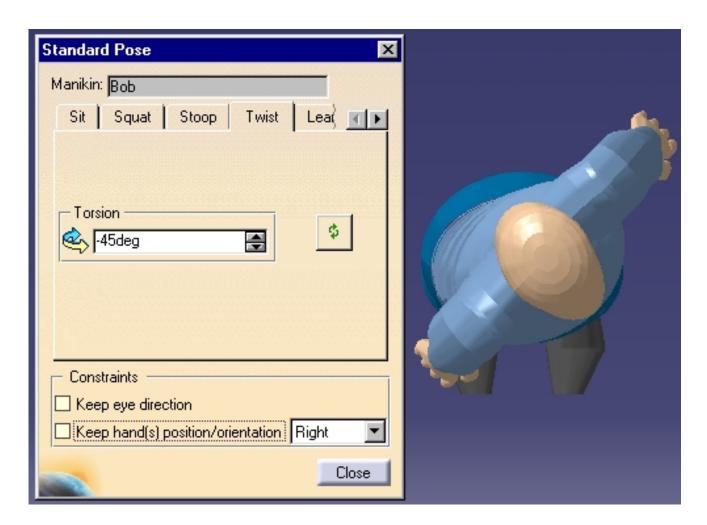
Trunk: The manikin's spine can be manipulated as a whole or as sections. You can choose which section of the spine (whole spine, lumbar section, or thoracic section) to flex/extend (sagittal plane) in forward kinematics (DOF 1).





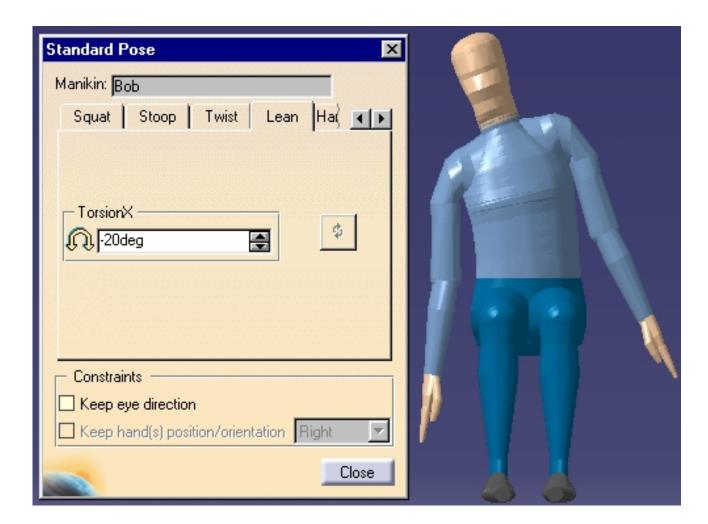
Twist

This tab includes an editor to quickly move the whole spine in forward kinematics (DOF 3, i.e., left/right rotation).



Lean

This tab includes an editor to quickly flex the whole spine laterally in forward kinematics (DOF 2, i.e., lateral flexion).

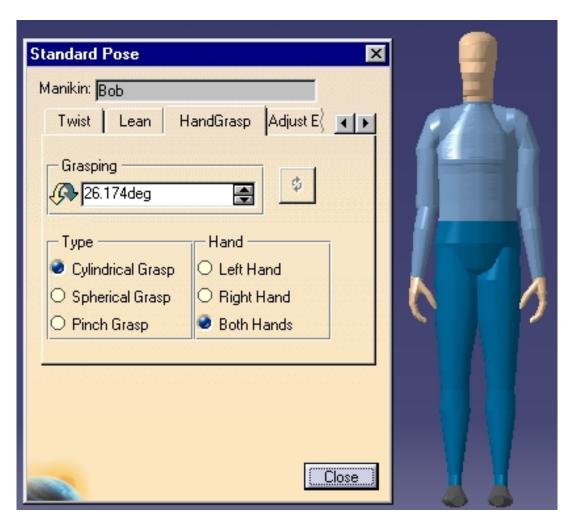


Hand Grasp

Three types of hand grasps are included in this option: cylindrical grasp, spherical grasp, and pinch grasp. The grasps can be done with the left or right hands independently, or with both hands together. Use the editor to loosen or tighten the grasp.



- This option can be used with the forearm model. Constraints are not available in this tab.



Cylindrical Grasp Spherical Grasp



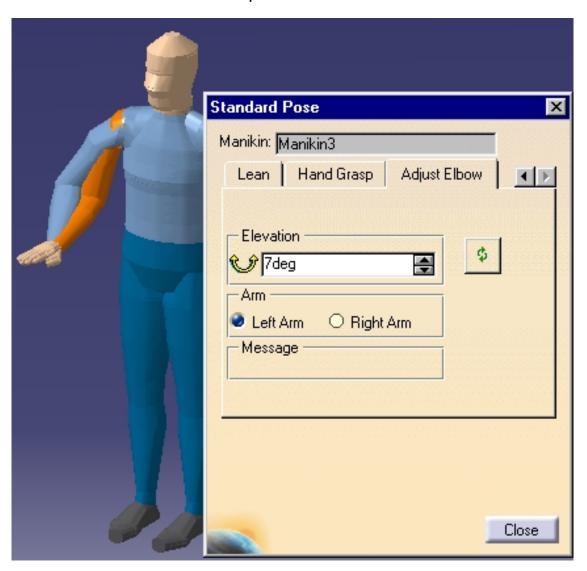


Pinch Grasp



Adjust Elbow

This tab includes an editor to quickly adjust the elevation, up or down, of the right or left elbow. This is used to adjust the elbow while keeping the selected hand and shoulder at a fixed position.











Positioning the Manikin with the Compass



This task describes how to move the manikin around the scene.

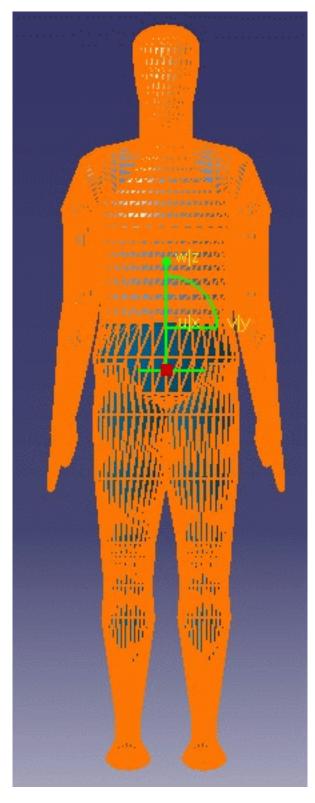


- 1. In the specification tree, activate the manikin's father product by double-clicking it.
- 2. Select the compass and drag in on the manikin you wish to move. Note that the snap is successful only if the compass turns **green**.



3. Select a plane on the compass and drag it or rotate it. The whole manikin will follow the move.













Using the Posture Editor



This task describes the functions of the Posture Editor and how to use them to move manikin segments.



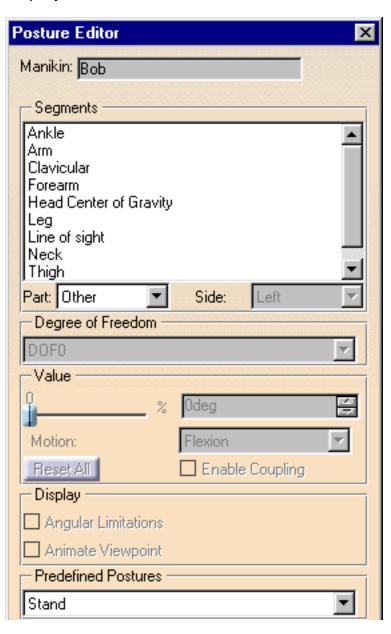
The Posture Editor is a tool used to move manikin segments in forward kinematics. The segments or degrees of freedom (DOF) are moved one step at a time. This tool allows you to give a precise value to each degree of freedom of every joint.

The manikin's structure consists of 68 articulated joints with 6 coupled joints (range of motion can depend on the position of a neighbor joint).



1. Select the Posture Editor icon. The Posture Editor dialog box is

displayed on the screen when the manikin is selected.





The Posture Editor dialog box is divided into five sections:

Segments
DOF
Value
Display
Predefined Postures

The Degrees of Freedom can be modified either through the Value section or through their graphical representations.



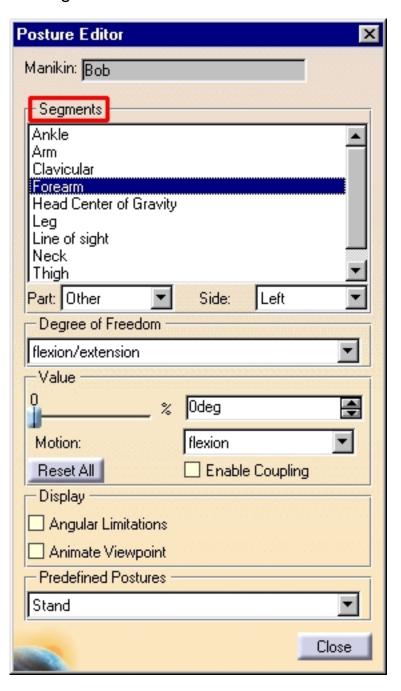
Segments



This page describes the Segment section functionality of the Posture Editor dialog box.



Displayed below the manikin name is a list of human body segments corresponding to the selection made in the Part menu. Click on the name of the segment in the list to select it.



Part:

The Part options menu allows you to choose the category of body segments to edit on the manikin The three categories listed are:

1. Hand:

Edit the segments of the hand including the center of prehension.

2. Spine:

Edit the segments making up the spinal column of the manikin.

3. Other:

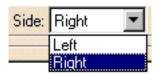
Edit all articulated segments excluding hand and spine segments. Other is the default option when the dialog box opens.



Side:

When you edit certain segments such as the arm, you can choose which side you want to work with: Left or Right.

Left is the default option when the dialog box opens.









Degree of Freedom

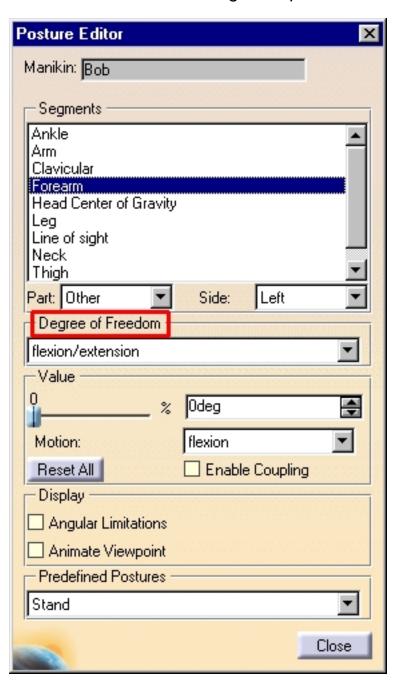


This page describes the Degree of Freedom (DOF) functionality of the Posture Editor dialog box.



- From the Degree of Freedom list, you can choose from three types of DOFs:
 - flexion/extension
 - abduction/adduction
 - medial rotation/lateral rotation

The default when the dialog box opens is flexion/extension.





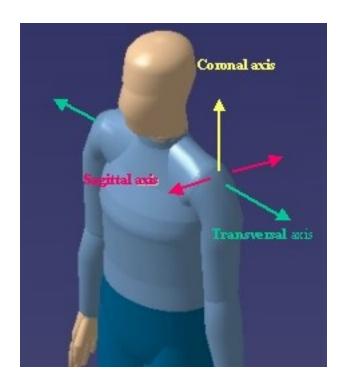
A segment can have up to three DOFs. Examples of possible segment DOFs are:

- The forearm has two DOFs:
 - flexion/extension
 - pronation/supination
- The arm has three DOFs
 - flexion/extension
 - abduction/adduction
 - medial rotation/lateral rotation



Each of the DOF types, flexion/extension, abduction/adduction, and medial rotation/lateral rotation, also have specific movement types. These are:

DOF	Movement Type	Axis
flexion extension	dorsiflexion hyperextension	transversal
abduction adduction	eversion, ulnar deviation, elevation inversion, radial deviation, depression	sagittal
medial rotation lateral rotation	supination pronation	coronal











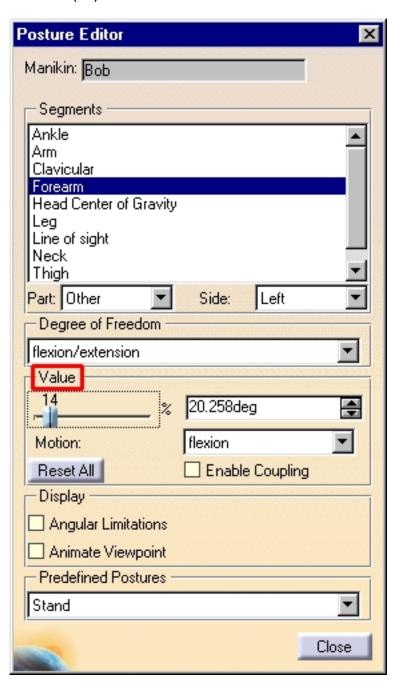
Value



This page describes the Value functionality of the Posture Editor dialog box.



Use the Value functionality to assign a precise posture to a segment. The value of the DOF is presented in angle and in percentage of the total range of motion (%).

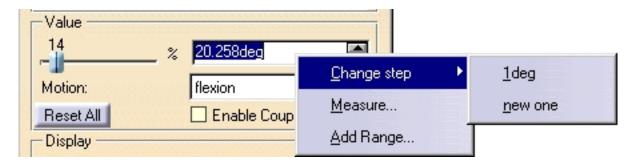


Value percentage slider

The percentage (%) slider corresponds to the value in percentage of the total range of motion for the selected DOF. This value can be edited directly by sliding the cursor with the left mouse button.

Value spinner

This field allows you to enter a specific value in degrees using the keyboard. You can increment or decrement to segment rotation one unit at a time using the small arrows at the right end of this field. You can also change the step by using the spinner's contextual menu.



Motion

The motion field corresponds to the direction of movement, 0 degrees being the neutral point.



Coupling:

The range of motion (flexibility, functional limitation) for six pairs of segments on the manikin can be coupled, i.e., conditional to the position of another joint. These segments are: the claviculars, the arms, the forearms, the thighs, the legs, and the ankles.

Coupling modifies the range of motion of these segments only. It has no effect on any relationship that may exist between other body segments.

By default, coupling is inactive.









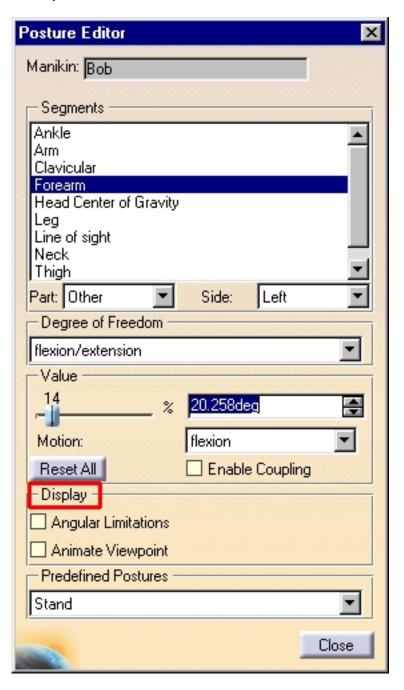
Display



This task describes the Display functionality of the Posture Editor dialog box.



The Display function has two options: Angular Limitations and Animate Viewpoint.



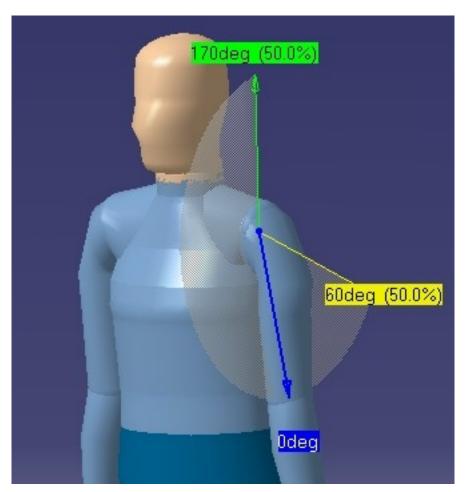
Angular Limitations (chart)

This check button displays or hides the graphical representation of the angular

limitations for each degree of freedom.

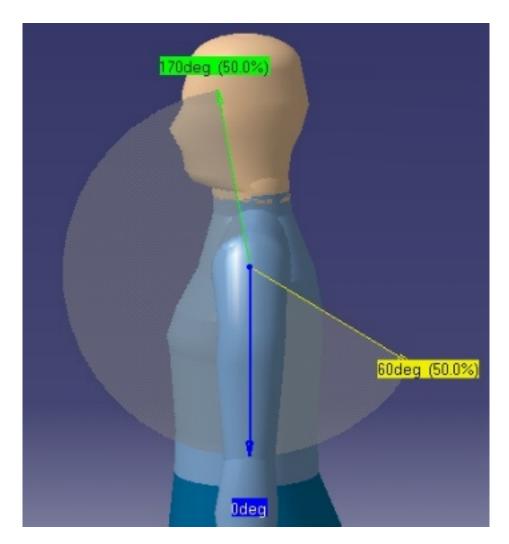
Two arrows limit this range of motion, which is set by default at the 50th percentile of the population.

- The green arrow shows the upper limit
- The yellow arrow shows the lower limit
- The blue arrow represents the segment's current position



Animate Viewpoint

This option zooms on the selected segment and changes the viewpoint in order to provide the best possible view for that degree of freedom. This improves the range of motion chart display and as well as the capability to better manipulate the blue arrow.







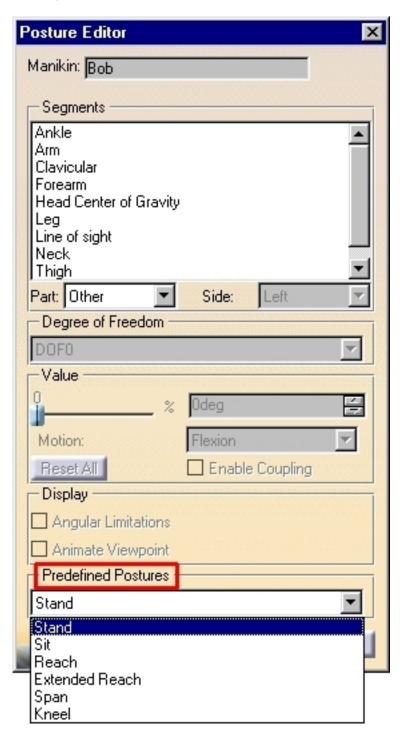




Predefined Postures

(#)

This task describes the Predefined Postures functionality of the Posture Editor dialog box.





Use the Predefined Postures functionality to assign a predefined posture to the manikin. From the Predefined Postures list, choose from the six available postures.

Stand

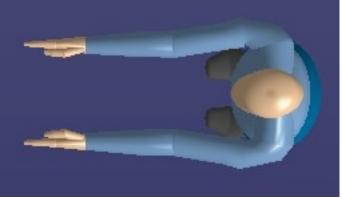


Sit



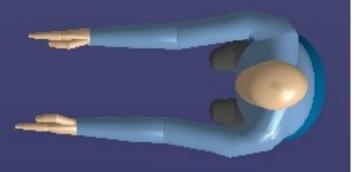
Reach





Extended Reach





Span



Kneel









Library Management



This procedure describes the commands that allow you to create, read, and update a manikin-related library.



A library is a collection of manikin-related data (i.e., postures, angular limitations, anthropometries, preferred angles, etc.). This file type bears the extension *.swl*.

The two library management commands are:

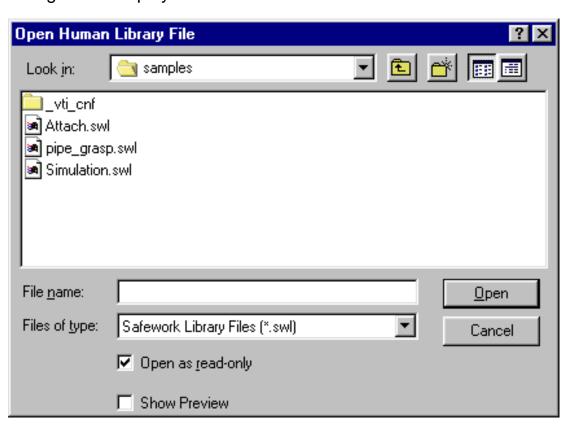
- Load Library
- Save in Library



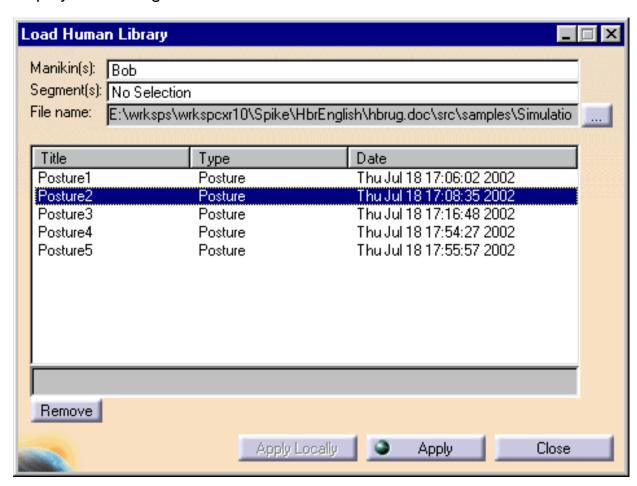
Load Human Library

This command opens the Open Safework Library File dialog box that is used to load an existing library file.

 Select the Open Human Library icon dialog box is displayed.



2. Select a file name and click Open. The Load Human Library dialog box is displayed showing the contents of the selected file.



The manikin and segment selection fields display the following:

Manikin(s):

- "No Selection" when no manikin is selected, i.e., No Selection
- The name of the selected manikin when only one manikin is selected, i.e., Bob
- "X selected" (X = more than one) when several manikins are selected, i.e., 3 selected

Segment(s):

- "No Selection" when no segment is selected, i.e., No Selection
- "Y selected" (Y = one or more) when one or more segments are selected, i.e., 1 selected



Click in the selection fields (manikin or segment) to make them active. In the dialog box image above, the manikin selection field is active. As long as this dialog box is open, you can switch back and forth between these to fields. The objects highlighted in the 3D viewer are updated according to the active mode. You can add or remove an element to the active selection by clicking the corresponding 3D representation.

3. Remove Remove

To remove an item from the list, select the item and click Remove.

4. Apply Apply

Apply considers only the manikin selection. Select an item and click Apply (or double-click the item). The item selected is applied to the manikin(s) selected in the manikin selection field of the dialog box. The progress indicator in the dialog box shows the load action.

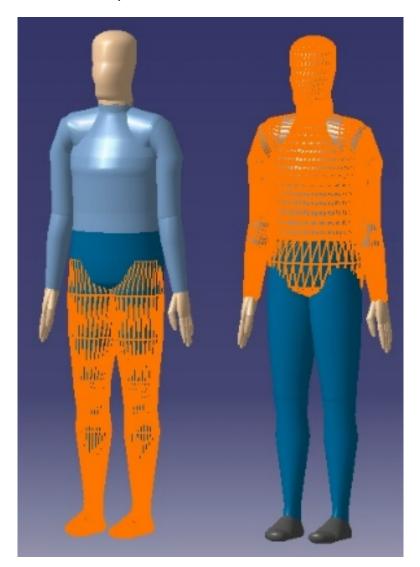
5. Apply Locally Apply Locally

Apply Locally considers only the segment selection. It gives the capability to copy only selected parts of a global posture stored in a library to the selected manikin. The posture will be applied to all selected segments even if these segments belong to more than one manikin.

Posture stored in a library



a. Select the segments of the manikin (or manikins) on which to apply the global posture i.e., the legs of Manikin1 plus the trunk of Manikin2. The segment selection can be made either in the specification tree or directly on the 3D representation.



b. When the Load Human Library is displayed, select the posture that will be locally applied and press the Apply Locally button. Only the posture corresponding to the selected segments is pasted.



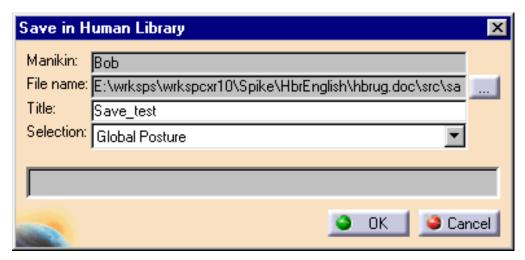
6. Click Close to exit from the dialog box.



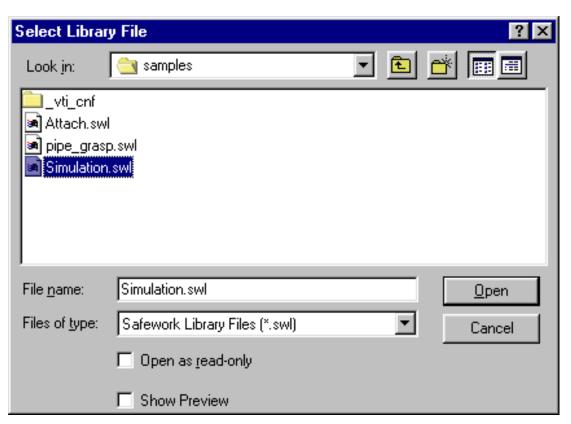
Save In Library

This command allows you to save the postures, anthropometries and the vision parameters of the manikin in a library file.

 Click the Save in Human Library icon box is displayed.



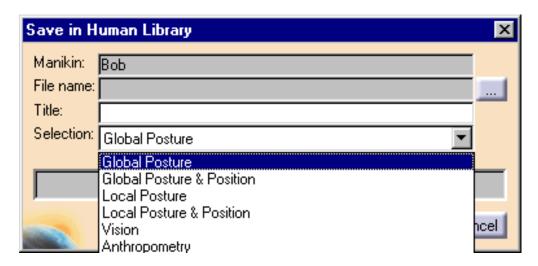
2. Select a manikin and click the browse icon to select a file. The Select Library File dialog box is displayed.



3. Enter or select a file name and click Open. If the file does not exist, a confirmation window is displayed to create it.



4. The Save in Human Library dialog box is displayed. Select the type of part to be saved with the Selection combo.



"Global Posture & Position" and "Local Posture & Position" give the capability to save the global posture together with the manikin's position, or the local posture of selected segment(s) together with the manikin's position into a Human Library. When re-applying a posture saved in such a way, the target manikin **will be moved** to its original position and orientation (the one it had when the posture was saved) and then the global posture will be applied to it.

5. Enter a title in the Title field.

Click OK.

The file is saved automatically and the progress indicator shows the save action. Otherwise, an error window is displayed if the description is missing.



6. Click Cancel to exit the dialog box or to cancel the save action.









Using the Reset, Mirror Copy, and Swap Functions



This task describes posture functionality. These functions are:

Global Posture Reset
Global Posture Swap
Local Posture Reset
Local Posture Mirror Copy
Local Posture Swap





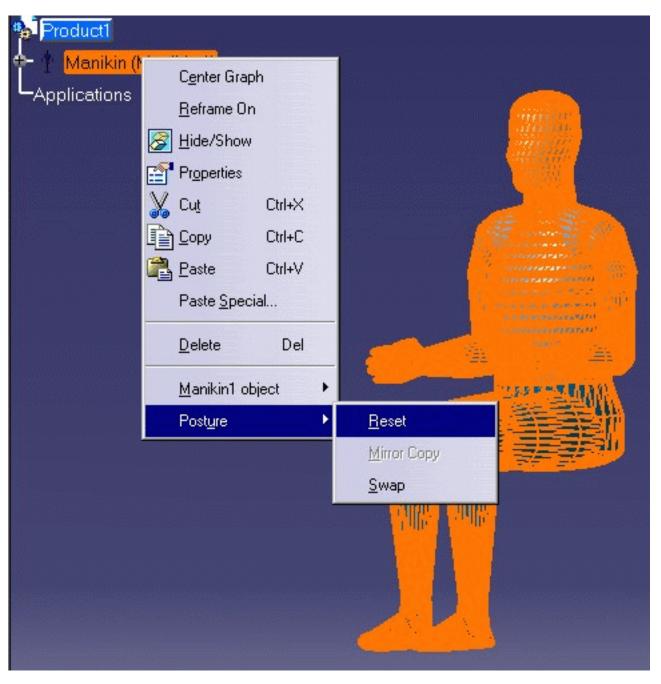


Global Posture Reset



To reset the entire posture, select the Manikin node in the specification tree (see below). Right-click the mouse to activate the contextual menu and choose Posture -> Reset.

The manikin will take the default (standing) posture.





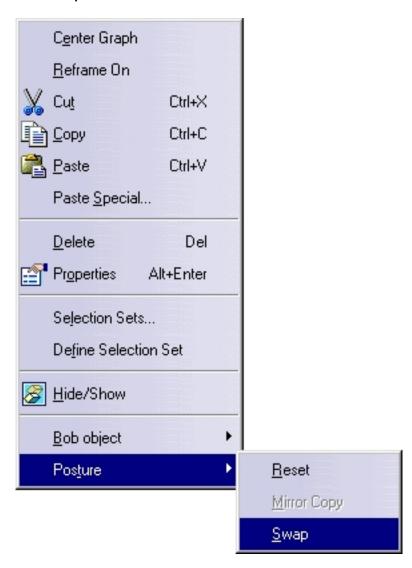




Global Posture Swap



To swap the entire posture, select the Manikin node in the specification tree. Right-click the mouse to activate the contextual menu and choose Posture -> Swap.



The software swaps the posture by copying the posture of individual segments to the opposite side and vice versa. For instance, if the manikin is crossing its left leg before the swap, it will be crossing its right knee after the swap.











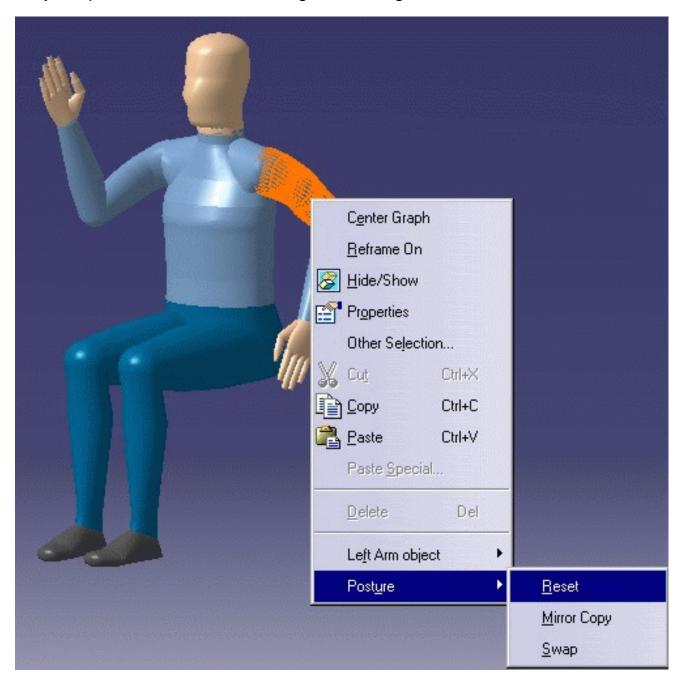


Local Posture Reset



It is also possible to reset the posture of an individual segment. Select the segment to reset, activate the contextual menu with the right mouse button, and choose Posture -> Reset.

Only the posture of the selected segment or segments will be reset.









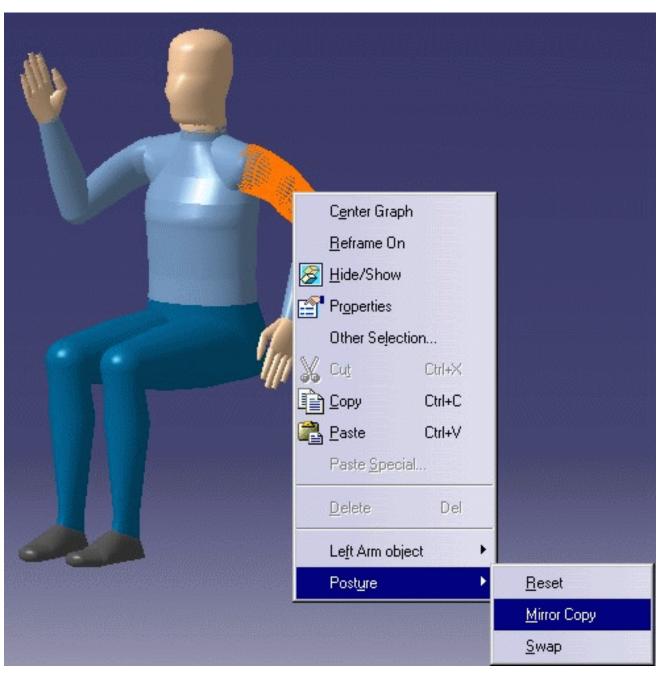


Local Posture Mirror Copy



To apply the mirror copy functionality to a limited set of segments, click on the desired segments to select them, then right click the mouse to activate the contextual menu. Choose Posture -> Mirror Copy.

The mirror copy functionality copies the selected posture onto the equivalent segment on the opposite side of the manikin. For instance, it copies the posture from the left arm to the right arm. This helps in creating symmetrical postures.





Please note that the mirror copy functionality can only be applied to segments that have an equivalent segment on the other side of the manikin. Therefore, no mirror copy is possible on the neck segment since there is no right or left neck.







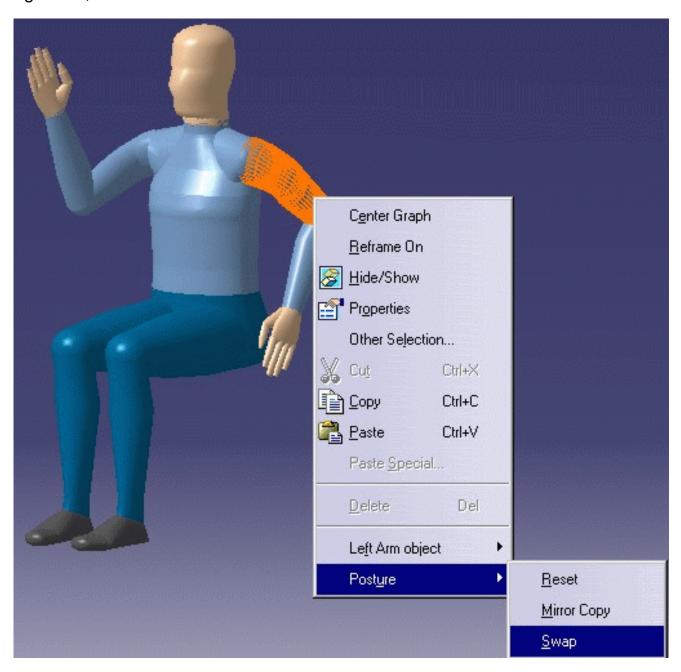


Local Posture Swap



To swap a local posture, select the desired segments, right-click the mouse to activate the contextual menu, and choose Posture -> Swap.

The manikin swaps the posture of the selected segments with the equivalent segments on the other side. For instance, the left arm takes the posture of the right arm, and vice versa.









Accessing the Graphical Properties of Segments



The following tasks describe how to access the graphical properties of segments as well as the following:

Changing the Color of a Segment
Changing the Properties of Ellipses
Changing the Properties of Segments
Changing the Transparency of the Surfaces
Accessing the Graphical Properties Toolbar
Whole Manikin Graphical Properties









Changing the Color of a Segment

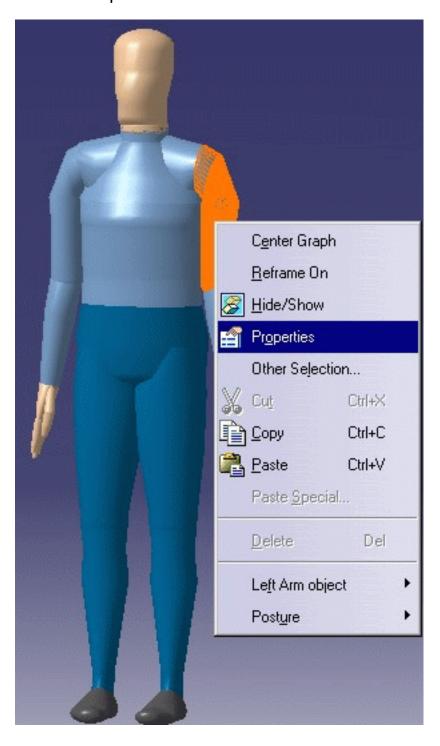


You can change the color of a segment by using the contextual menu or the edit menu.

Using the contextual menu



 To change the color of a segment using the contextual menu, right-click the mouse on the desired segment to activate the contextual menu, and choose Properties.



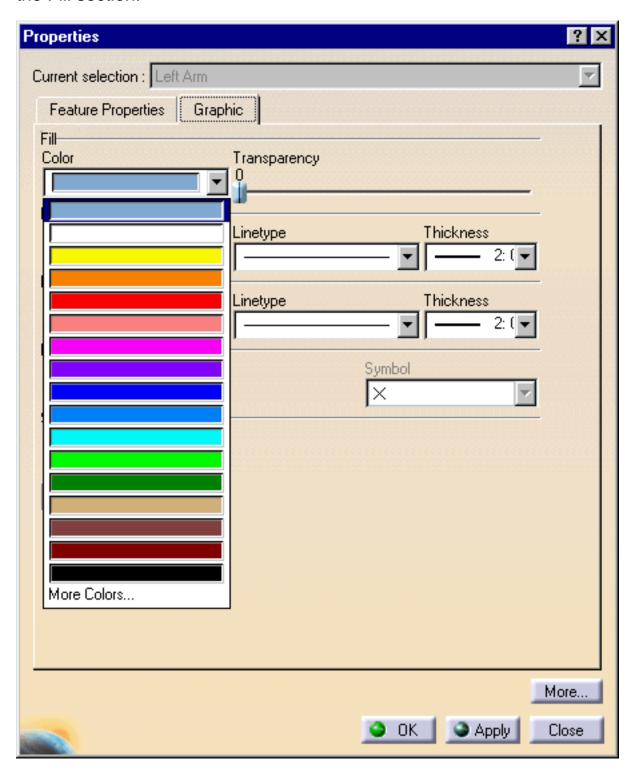
Using the Edit menu



1. To change the color of a segment using the Edit menu, from the main menu select Edit -> Properties.



2. The Properties dialog box is displayed. Click on the Graphic tab and go to the Fill section.



3. Select a color and click Apply. The surface color of the selected segment will change accordingly (see below).





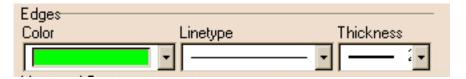




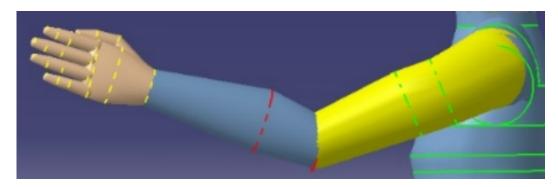
Changing the Properties of Ellipses



Use the Edges section of the Properties dialog box to choose or change the color, line type and thickness of the selected ellipses.



In the example below, the ellipses of the forearm have been changed to dashed red lines; the ellipses of the hand to dashed yellow lines.







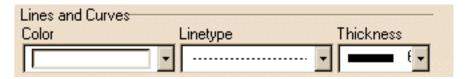




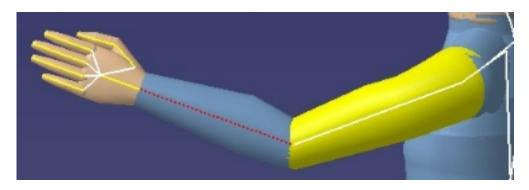
Changing the Properties of Segments



To change the properties of the segments themselves, choose a color from the Lines and Curves section of the Properties dialog box.



You can also change the color, line type, and thickness of the selected segments. In the example below, the forearm segment color has been changed to red.











Changing the Transparency of the Surfaces



To change the transparency of the surfaces, manipulate the Transparency slider in the Fill section of the Properties dialog box.



Moving the slider to a value greater than 0 (zero) activates the transparency for the selected surfaces. The greater the value, the more transparent the surface becomes. Transparency values range from 0 to 255.









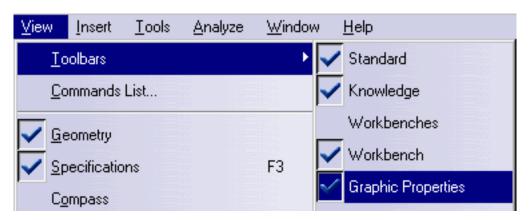
Accessing the Graphical Properties Toolbar



The graphical properties of segments can also be changed using the Graphic Properties toolbar.



Activate the Graphic Properties toolbar by selecting View -> Toolbars -> Graphic Properties in the main menu toolbar.



The Graphic Properties toolbar (see below) can now be accessed. When a segment is interactively selected, some portions of the Graphic Properties toolbar are enabled. It is then possible to change the colors of the surfaces and segments selected using this toolbar.



- 1. **Color**: Displays and changes the color of the selected element.
- 2. **Transparency value**: Displays and changes the current transparency value. A value of 100% indicates 0 (zero) transparency.
- 3. **Line thickness**: Displays and changes the current line thickness. When applied to a segment, only the line thickness of the segment may be changed, not the ellipses.
- 4. **Line type**: Displays and changes the current line type of the segment.
- 5. Disabled: not used with manikin segments.
- 6. Disabled: not used with manikin segments.









Whole Manikin Graphical Properties



It is also possible to access and change the graphical properties of the manikin as a whole. To do this, select the Manikin node in the specification tree and, from the main menu toolbar, choose Edit -> Properties.

This will apply the chosen graphical properties to the entire manikin and will override any properties set for individual segments.







Accessing the Graphical Properties of Lines of Sight



The following tasks describe how to access the graphical properties of lines of sight as well as:

- Change the color of the line of sight
- Change the peripheral contour of vision windows.

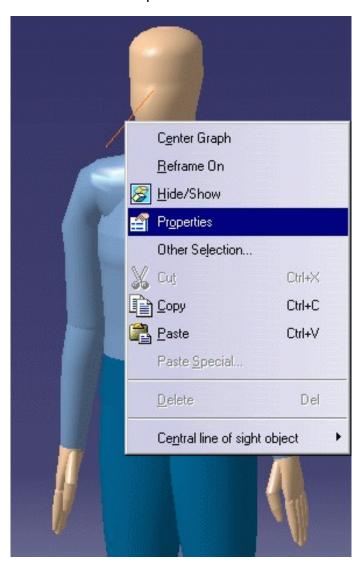


Changing the color of the line of sight



There are two ways to access the Properties menu: through the contextual menu that is accessed by right-clicking the mouse, or by selecting Edit -> Properties in the main menu toolbar.

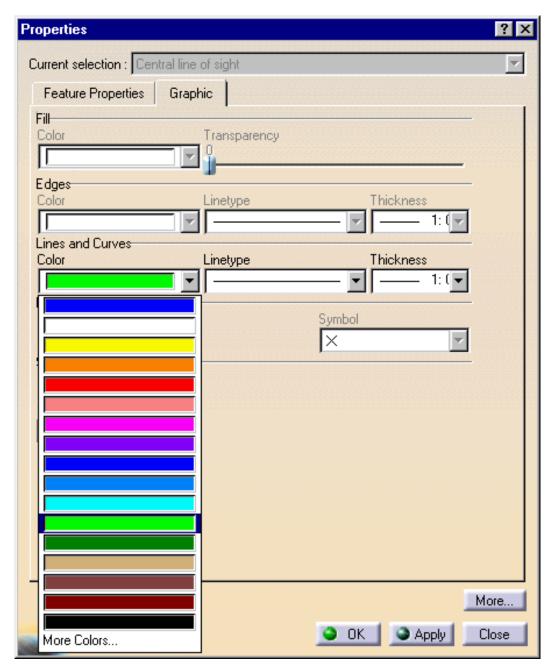
 To change the color of a line of sight, click the right mouse button on the desired line of sight (located under the Vision node of the manikin). This will activate the contextual menu. Choose Properties.



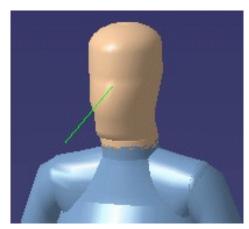
Go to the main menu toolbar and choose Edit -> Properties.



2. The Properties dialog box is displayed on the screen. Select the Graphic tab and go to the Lines and Curves section.



3. Select a color and click Apply. The color of the selected line of sight changes accordingly.



Changing the peripheral contour of vision windows



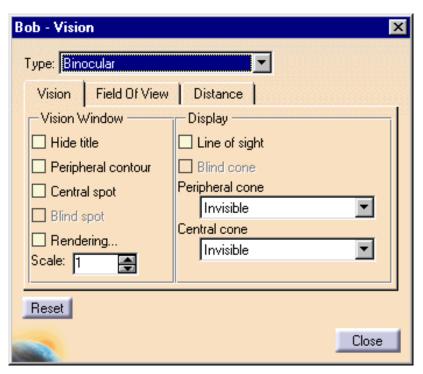
Changing the color of the line of sight (see above) also changes the color of the peripheral contour associated with that line of sight.

1 Open the manikin's vision. To do this, select the Vision icon

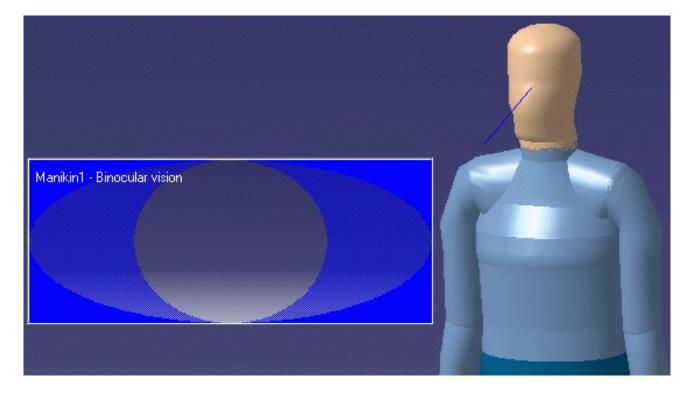


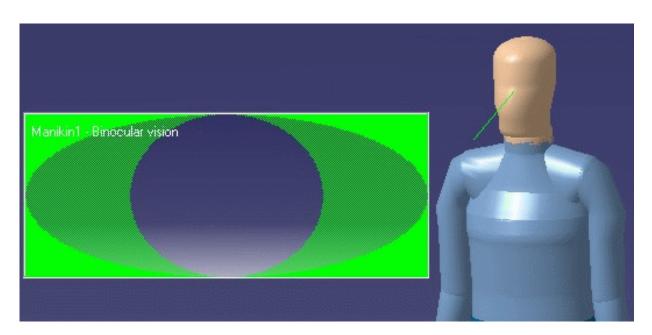
from the Manikin

Tools toolbar and then select a manikin. The Vision dialog box for the selected manikin appears. Note that no dialog box will appear until the manikin is selected.



- 2. In the Vision dialog box, select the boxes for Vision window, Peripheral contour, and Line of sight, as shown above.
- **3.** Change the color of the associated line of sight and note what happens to the peripheral contour.













Accessing Other Vision Options



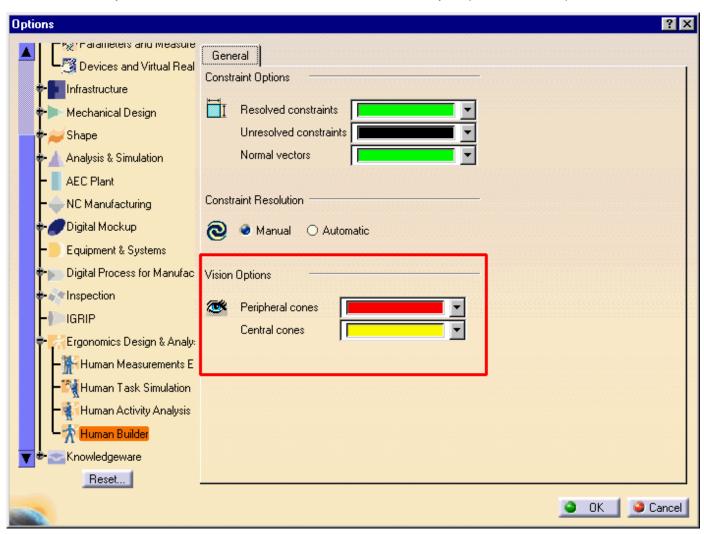
This procedure describes how to set and modify the color of manikin peripheral cones and central cones.



In the main menu, select Tools -> Options.

Scroll down, if necessary and select Ergonomics Design & Analysis -> Human Builder.

The image below shows the default colors for peripheral cones (red) and central cones (yellow). You may modify these colors at any time i.e., for better visual contrast with the colors in your particular workspace.











Using Posture Undo/Redo



The posture Undo/Redo feature allows you to reverse (cancel) the last posture applied to the manikin.



Undo

Click the Undo icon in the main menu toolbar to execute the Undo command.

An Undo operation can also be undone. For example, you can restore the last posture with successive calls to the Redo command.

The images below show the state of the manikin after applying the Undo command to a particular posture.

Initial position Posture applied

Undo applied







In the example above, the posture can be applied either by using the forward kinematics command or by pasting an existing posture from a library (see Load Library).



This command repeats the last cancelled action. Click the Redo icon 🔂 in the main menu toolbar to execute the Redo command.

A redo operation can also be undone. For example, you can cancel the last Redo command by invoking the Undo command.

Posture after Undo applied Posture after Redo applied Posture after Undo applied







In the Human Builder product, the posture Undo/Redo function applies to the following operations:

- Forward kinematics
- Posture reset (local or global)
- Posture mirror/copy
- Posture swap
- Applying a posture from a library IK mode
- Reach mode
- Place mode
- Standard pose









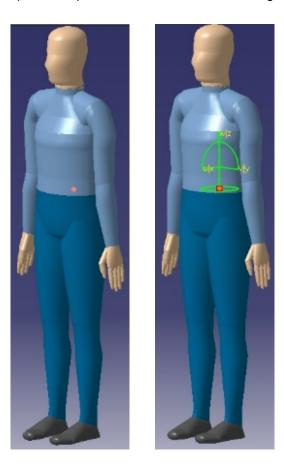
Retrieving Center of Gravity Coordinates



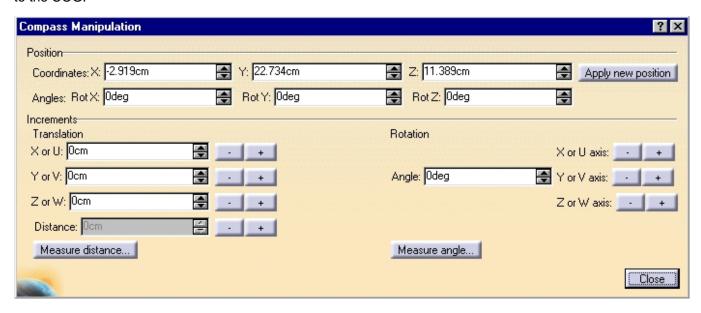
This procedure describes how to retrieve a manikin's center of gravity coordinates.



1. Snap the compass on the manikin's center of gravity (COG).



2. Once the compass is snapped, double-click on the compass to activate the Compass Manipulation dialog box. The dialog box displays the coordinates (x, y, z) of the center of gravity and allows manikin positioning according to the COG.











Redefining the Manikin Referential

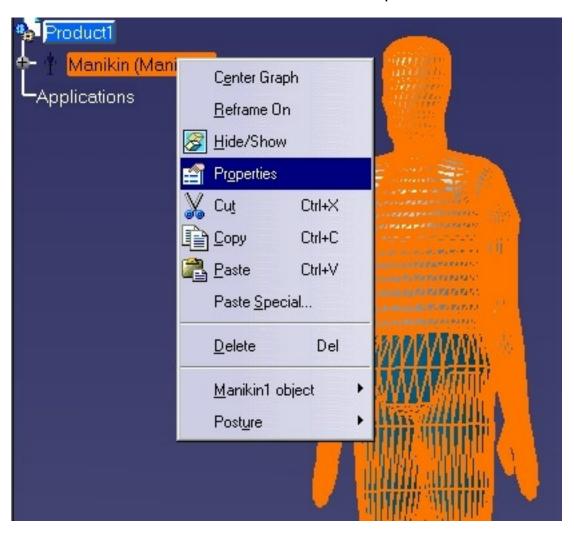


This procedure describes how to change the referential of a manikin.

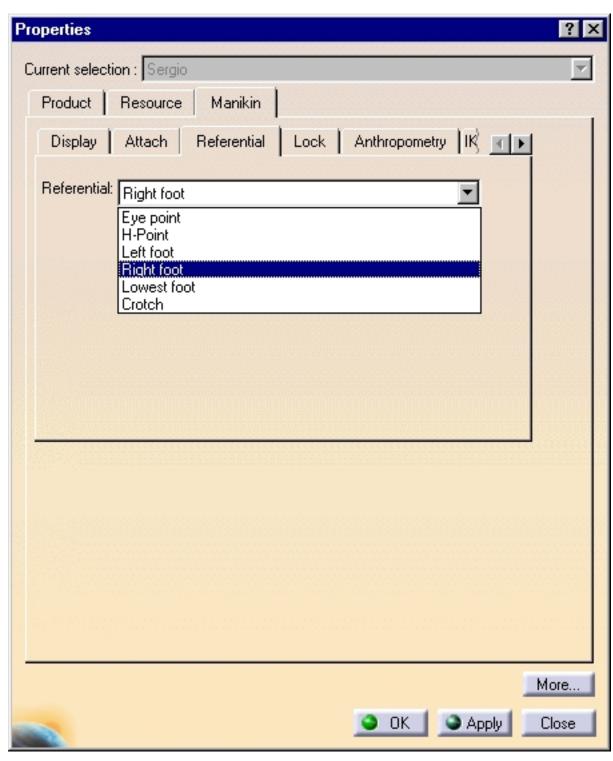
The referential is the point on the manikin that will remain fixed when a global posture or an anthropometry is applied. For instance, if the manikin is standing on a flat surface (the floor) and a sitting posture is applied, the feet will remain on the ground.



 In the specification tree, select a manikin. Click the right mouse button to activate the contextual menu and choose Properties.



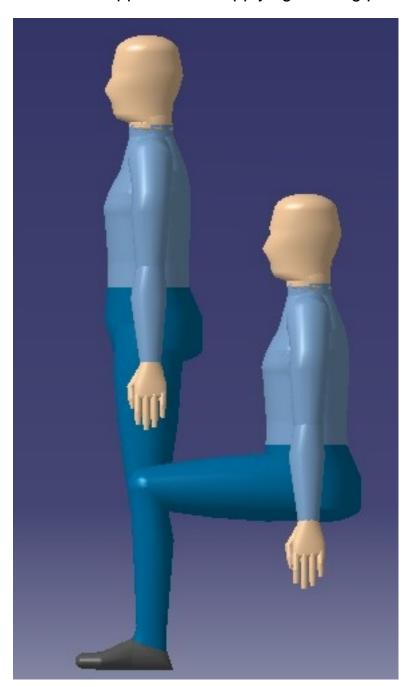
2. The Properties dialog box is displayed. Click the Manikin tab and select the Referential sub-tab.



3. Using the Referential combo, select the part of the body that will become the new referential and click Apply. The changes are saved.

4. Click Close or OK to exit from the dialog box.

Example: In the example below, the left foot is the selected referential. See what happens when applying a sitting posture.











Using Global Collision Detection



This procedure describes how to use global collision detection. This command can be activated in the following manipulation modes:

- Forward Kinematics
- the Posture Editor
- Inverse Kinematics mode
- Reach Mode
- Place mode
- Standard Pose





Collision Detection Off

In this state, collision detection is disabled.



Collision Detection On

In this state, collision detection is enabled and the elements involved in the collision will be highlighted in the 3D viewer.

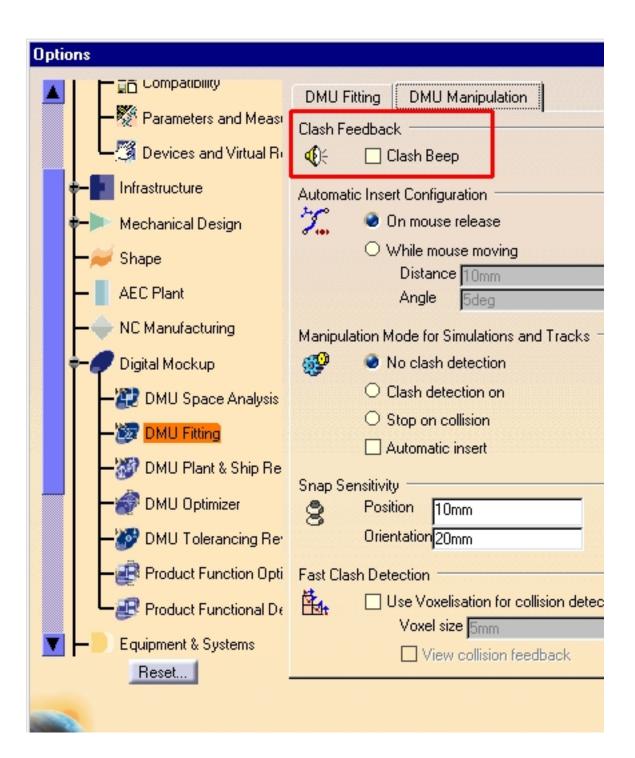


Collision Detection Stop

In this state, collision detection is enabled, the elements involved in the collision will be highlighted in the 3D viewer, an audible beep may be heard (if set in Tools -> Options), and manikin motion will stop.

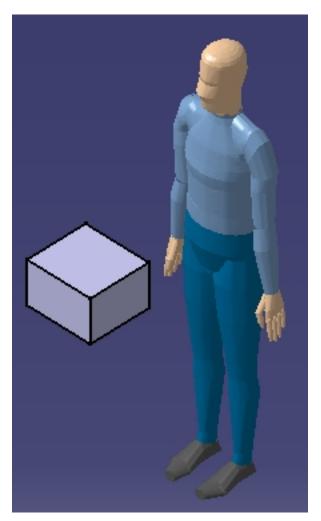
Setting audible feedback

From the main menu, select Tools -> Options -> DMU Fitting. Under the DMU Manipulation tab, activate or de-activate Clash Feedback as shown below.





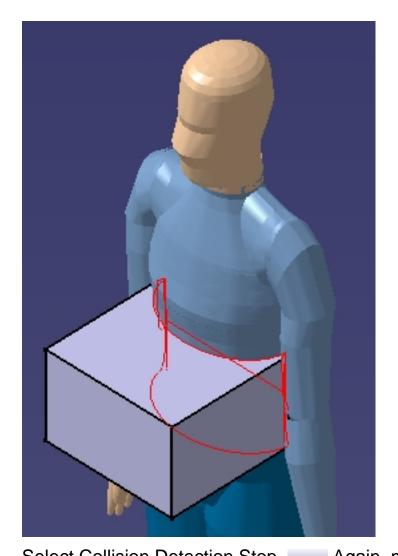
1. In the Samples directory, open the file Manikin_and_Box.CATProduct.



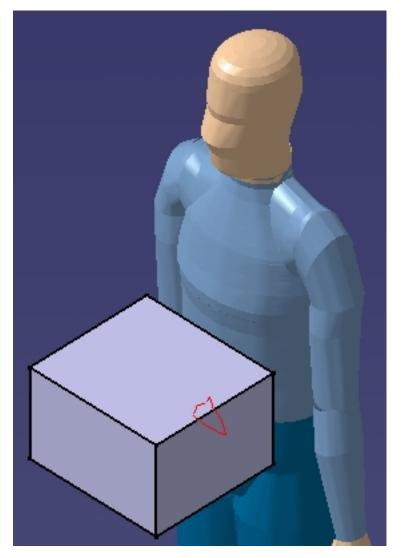
2. In the Manikin Simulation toolbar, select Collision Detection On.



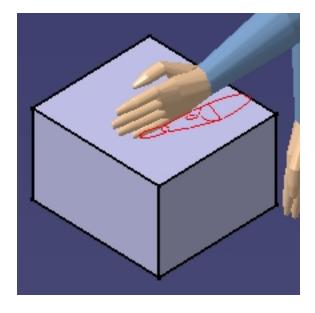
Using the compass, move the manikin so that it collides with the box.



3. Select Collision Detection Stop. Again, move the manikin so that it collides with the box. Note that the manikin stops movement at the point of collision and the visual feedback is updated correspondingly.



4. Using the Posture Editor, flex the manikin's arm so that it collides with the box.











Using the Place Mode



This procedure describes how to use the Place Mode command. This command uses a manikin's referential to snap it to user-defined compass locations.

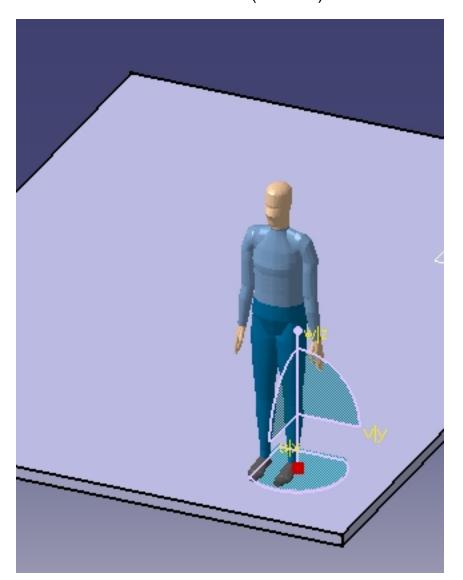


1. From the samples directory, open the *Manikin_on_Floor.CATProduct* file. The manikin's referential was set at creation to Left Foot.

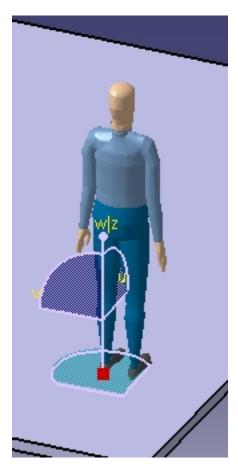


- 2. Select the Place Mode icon in the Manikin Posture toolbar.
- 3. Place the compass at the desired location on the floor.

4. Select the manikin in either the specification tree or 3D viewer. The manikin is instantly snapped to the new location and placed in accordance to its referential (left foot).



5. The manikin respects the position of the compass. Drag the compass; the manikin will follow. Rotate the compass; the manikin rotates.



6. Re-define the manikin's referential and repeat steps 2 - 5 above.



- Any further move of the compass will have an effect on the last selected manikin.
- To de-activate Place Mode, click on the Place Mode icon a second time.







Advanced Tasks

These are the advanced tasks that a user performs using Human Builder:

Using the Vision Function
Interactive Positioning with the Reach Mode
Redefining the Segment Offset for Inverse Kinematics
Attaching an Object to a Manikin Segment
Managing Multiple Constraints
Using the Inverse Kinematics Mode
Using the Reach Envelope
Manikin Catalog Management
Using Manikin Simulation Commands
Manikin Workspace Analysis

Using the Vision Function



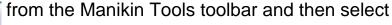
This task describes the Vision function and how to set and edit manikin vision attributes. Using this function, you will see a scene through the manikin's eyes, displayed in a separate window.



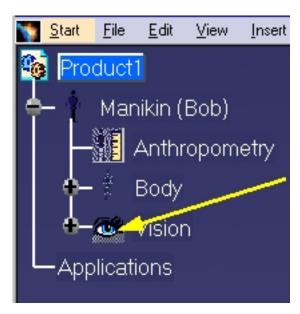
Just like humans, a manikin can see its environment. Manikin vision can be with both eyes or limited to only one eye. Even the blind spot is simulated.



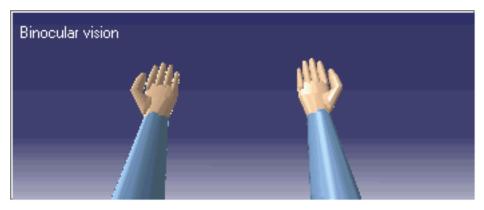
1. Select the Vision icon ____ f



a manikin OR double-click on the desired manikin's Vision node to achieve the same results.



The default vision window appears.





No vision window will appear until the manikin is selected.

2. Right-click anywhere on the vision window. The vision menu appears.



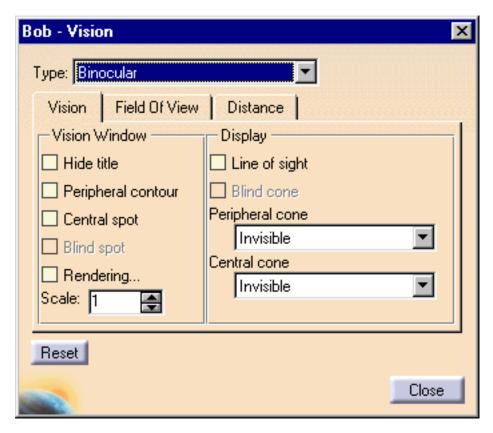
Choose **Edit** from the following options:

Export As... to export the view as an image file

Edit to edit the manikin's vision with the Vision dialog box

Close to close the vision window

3. The Vision dialog box for the selected manikin appears.



4. The Vision dialog box is divided into four distinct areas containing all available vision attributes:

Type Field
Vision Tab
Field of View Tab
Distance Tab

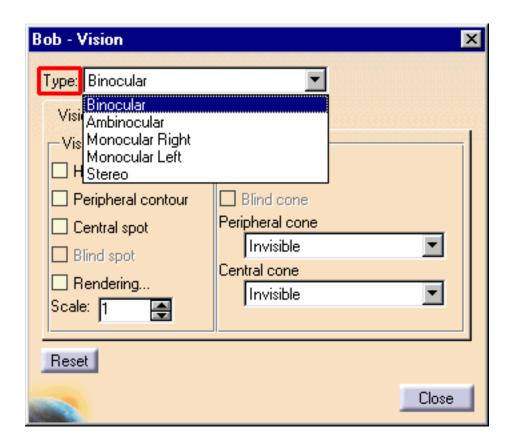




Type Field



This page describes the Type functionality of the Vision dialog box. Just like humans, a manikin can see its environment. Manikin vision can be with both eyes or limited to only one eye. Even the blind spot is simulated.



The Type options menu allows you to choose between five different representations of vision. The vision window displays each vision type selected.

The five types of vision are:

- Binocular
- Ambinocular
- Right monocular
- Left monocular
- Stereo

Binocular

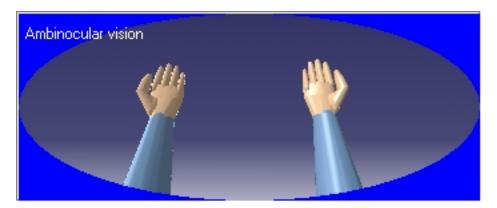
The manikin's vision, like human vision, is made up of several different zones. One of these zones represents the vision of the two eyes.

Each eye has a field of view shaped like an ellipse. Binocular vision can be interpreted as the zone defined by the intersection of the two shapes that define the right and left monocular visions. It represents the area you can see with both right and left eyes (clear zone).



Ambinocular

Ambinocular vision is defined as the zone represented by the union of two shapes which define the right and left monocular visions. It represents the entire field of vision that we can see with our eyes.



Monocular Right

Right monocular vision represents the field of vision of the right eye only.



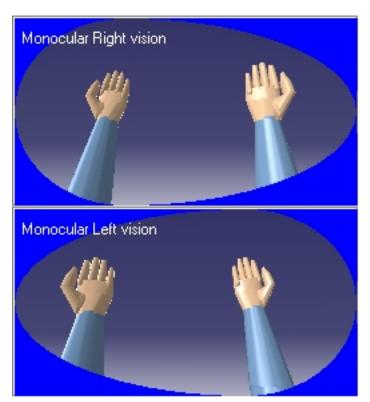
Monocular Left

Left monocular vision represents the field of vision of the left eye only.



Stereo

The vision of both left and right eyes in two distinct windows displayed side by side. Selecting the stereo type of vision activates both left and right lines of sight.





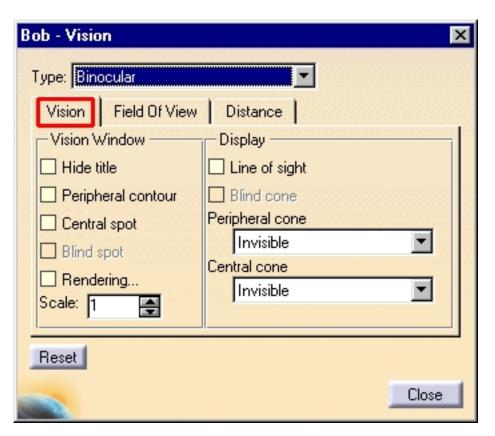




Vision Tab

(

The Vision tab of the Vision dialog box is divided into two sections. Use the options under Vision Window and Display to set and edit your manikin's vision attributes.



Read more about Vision Window and Display functionality:

Vision Window Display



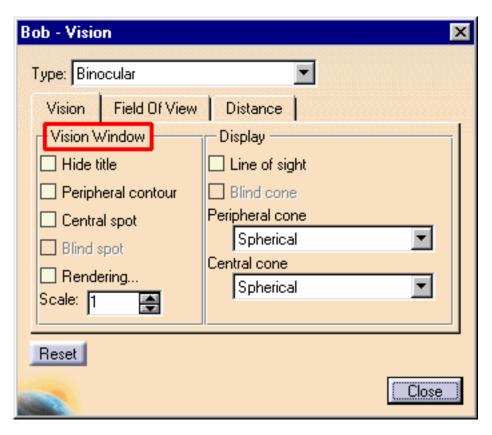




Vision Window



Vision Window functionality is accessed via the Vision tab in the Vision dialog box.



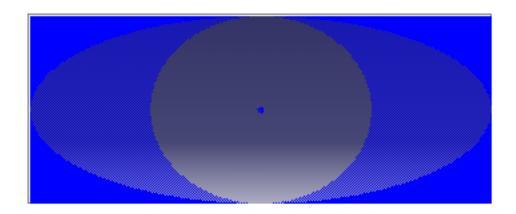
Use the following options to customize the vision window of your manikin:

- Hide title
- Peripheral contour
- Central spot
- Blind spot
- Rendering...
- Scale

Hide title

This option hides or displays the title inscription on the opened vision window.

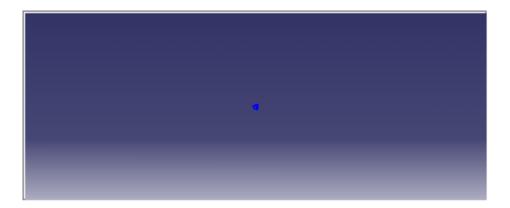
Vision Window without title:



Peripheral contour

This option prompts or cancels the window's colored zone display bordering the field of vision. By default, the peripheral contour is not displayed.

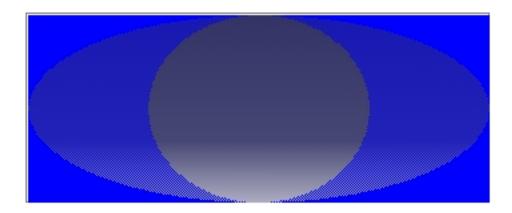
Vision window without peripheral contour:



Central spot

The central spot of vision corresponds to the focus location. It is the end of the line sight. The Central spot button prompts or cancels the display of the central point of vision; that central spot is represented by a circle.

Vision window without central spot display:

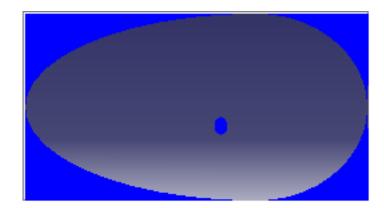


Blind spot

The area of the human eye that is not covered with sensitive cells is the point where the optic nerve is attached to the eye.

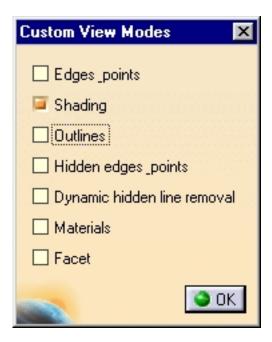
This field is represented by a blue point in the vision window. The blind spot is only represented in monocular vision. The Blind spot button prompts or cancels the display of the blind spot.

By default, the blind spot is not displayed.



Rendering...

Clicking on the Rendering... button will display the Custom View Modes options menu. Use this menu to change the view mode in all vision windows.



Scale

Use the Scale field to decrease or increase the size of the Vision window to a maximum of three (3) times its original size.



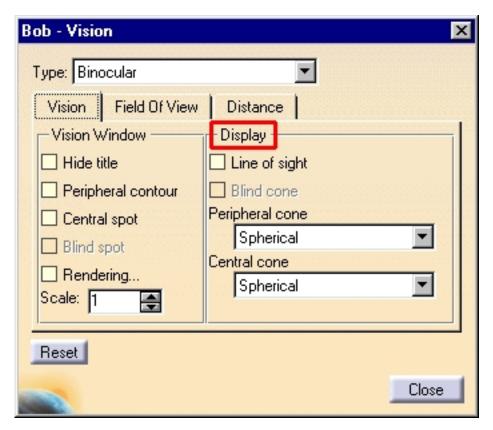




Display



Display functionality is accessed via the Vision tab in the Vision dialog box.



Use the following options to customize the vision display of your manikin:

- Line of sight
- Blind cone
- Peripheral cone
- Central cone

Line of sight

The Line of sight button prompts or cancels the display of the active line of sight. The line of sight acts like a segment with a control point at one end. This control point can be used to manipulate the vision by means of inverse kinematics.

The line of sight is designed to facilitate the manipulation of the manikin's field of vision. Focus takes place on the control point.

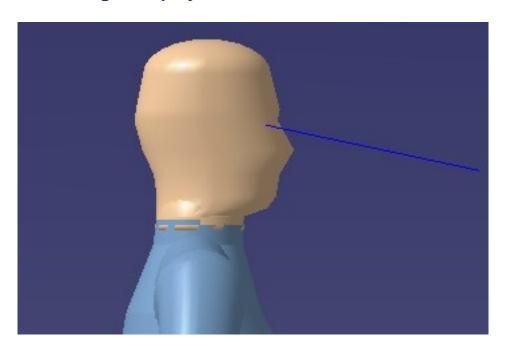
Three lines of sight are available on the manikin:

The right and left lines of sight represent the right and left monocular vision.

The central line of sight represents the binocular and ambinocular vision.

The appropriate line of sight is activated when a vision type (see Type) is selected. Selecting the stereo type of vision activates both left and right lines of sight.

Line of sight display:



Blind cone

The blind cone is the 3D graphical representation of the mathematical model bordering the eye's blind spot. The blind cone is only available in monocular vision. The Blind Cone menu prompts or cancels the display of the blind cone.

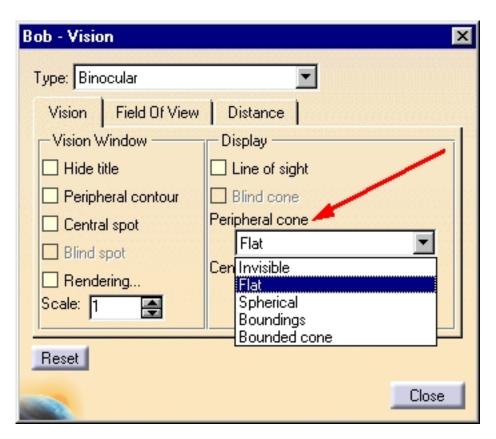
By default, the blind cone is not displayed.

Note: The blind cone is not implemented in the current release.

Peripheral cone

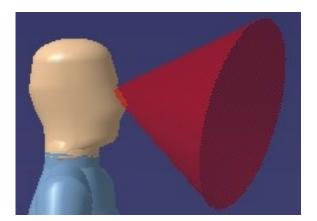
The peripheral cone is the 3D graphical representation of the mathematical model bordering the human field of vision. The Peripheral cone menu prompts or cancels the display of the contours of the field of vision in the scene.

By default, this cone is not displayed. When it is displayed, the vision cone is directly tied to the active line of sight. The tip of the cone corresponds to the origin of the line of sight, i.e., the eyes.

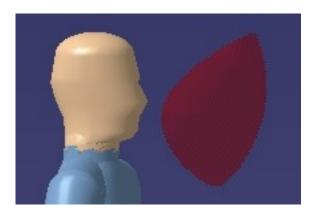


The following images illustrate the different types of peripheral cones available.

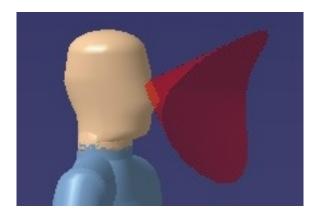
Flat display:



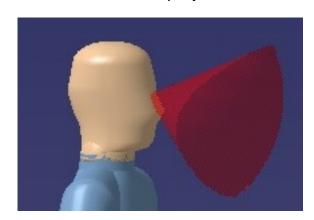
Boundings display:



Spherical display:



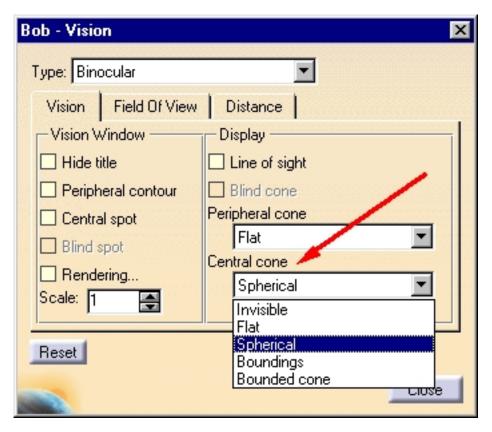
Bounded cone display:



Central cone

The central cone is the 3D graphical representation of the mathematical model bordering the central vision called the fovea. The Central cone menu prompts or cancels the display of the central cone of the manikin.

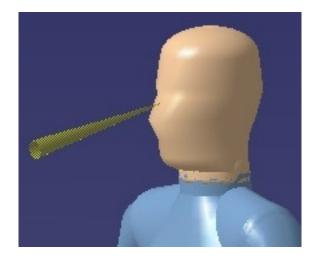
By default, the central cone is not displayed.



The following images illustrate the different types of central cones available.

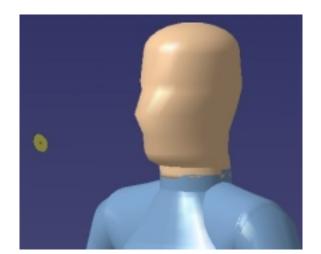
Flat display:

Spherical display:

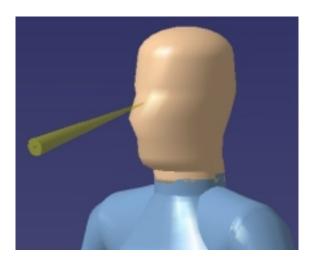




Boundings display:



Bounded cone display:





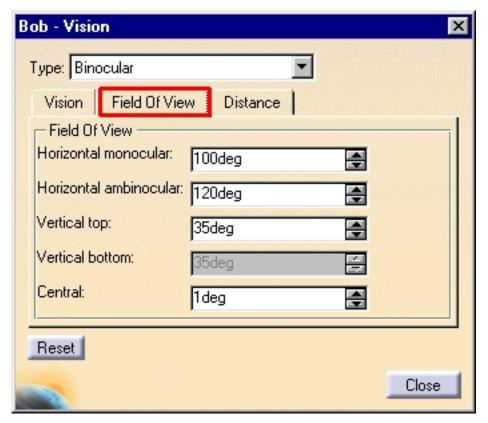




Field of View Tab



This page describes the functionality within the Field of View tab of the Vision dialog box.



Use the Field of View functionality to assign values to the following parameters:

- Horizontal monocular
- Horizontal ambinocular
- Vertical top
- Vertical bottom
- Central

The parameters are expressed in the units set in the environment.

Horizontal monocular:

This parameter defines the horizontal field of view (XY plane) in monocular mode. The default value of this angle is 100 degrees.

Horizontal ambinocular:

This parameter defines the horizontal field of view (XY plane) in ambinocular

mode. The default value of this angle is 120 degrees.

Vertical top:

This parameter defines the vertical field of view above the central spot (XZ plane) in all vision modes. The default value of this angle is 35 degrees.

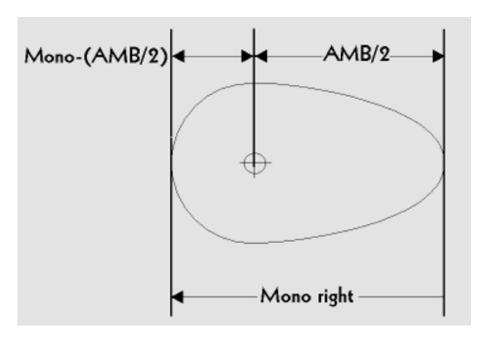
Vertical bottom:

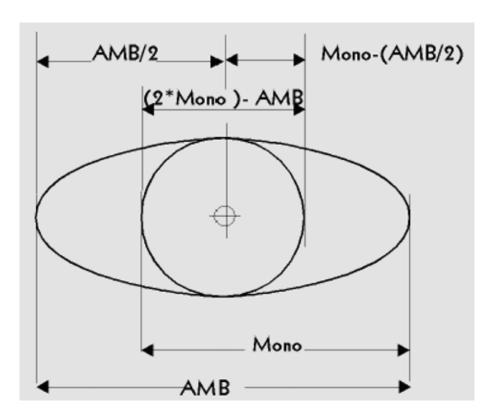
This parameter defines the vertical field of view below the central spot (XZ plane) in all vision modes. The default value of this angle is 35 degrees.

Central:

This parameter defines the field of view of the central vision (fovea). Because this central vision is circular, it is characterized by only one value. The default value is 6 degrees, the maximum value is 20 degrees, and the minimum value is 0.5 degrees.

The diagrams below illustrate the dimensions used by the parameters of this section.









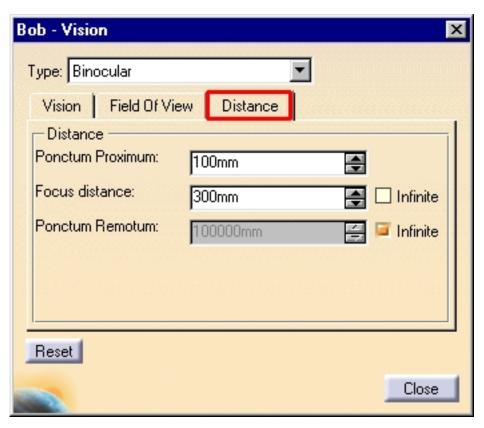




Distance Tab



This page describes the Distance functionality of the Vision dialog box.

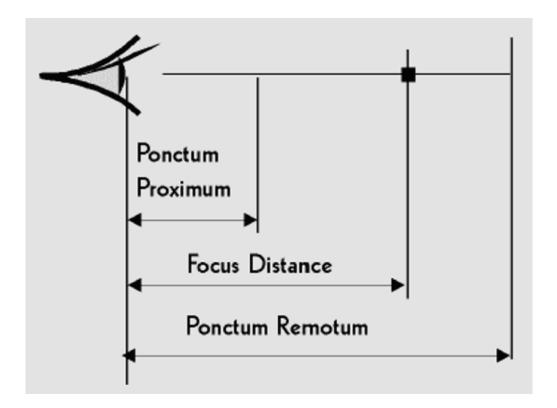


The Distance section assigns the following parameters:

- Ponctum proximum
- Focus distance
- Ponctum remotum

These parameters correspond to the depth of the minimal and maximal fields as well as the distance from the focal point.

The diagram below illustrates the dimensions used by the Distance parameters.



Ponctum proximum

This parameter defines the minimum accommodation distance or depth of vision. This value corresponds to the nearest point that can be seen clearly. The default value is 10 centimeters.

Focus distance

The focus or focal distance corresponds to the length of the active line of sight. The default value is 30 centimeters.

Ponctum remotum

This parameter defines the maximum accommodation distance of the vision. It corresponds to the crystalline relax position for objects located from a distance of five meters to infinite. The default value for this parameter is set to infinite (the Infinite button is enabled).







Interactive Positioning with the Reach Mode



This command provides you with a powerful positioning tool. It takes advantage of the manikin's inverse kinematics capability to reach the exact position and two or three orientations in the 3D space.

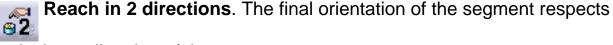
You can select the segment of the manikin to perform the reach (also known as the end effector), then activate the Reach Mode by selecting either of the two Reach icons. The point to reach will be specified by the position

of the V5 compass. You then must snap the compass to any existing geometry. As soon as the compass is released, the selected segment automatically reaches the compass's position.



More about activating Reach functionality

The difference between the two is that the resolution is not made the same way; otherwise, the functionality is the same.



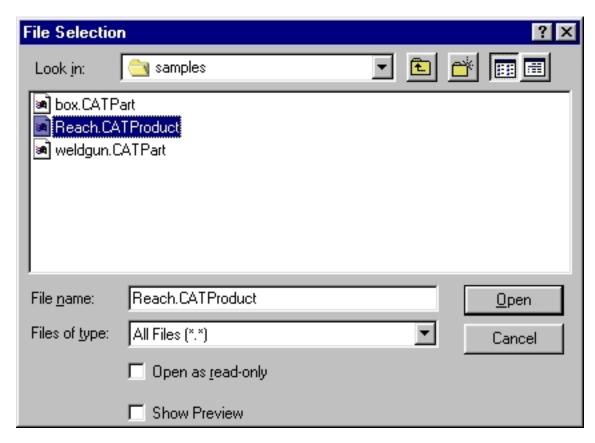
only the w direction of the compass.

Reach in 3 directions. The final orientation of the segment respects all

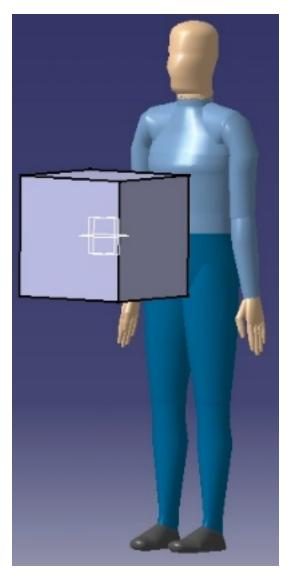
three directions of the compass.



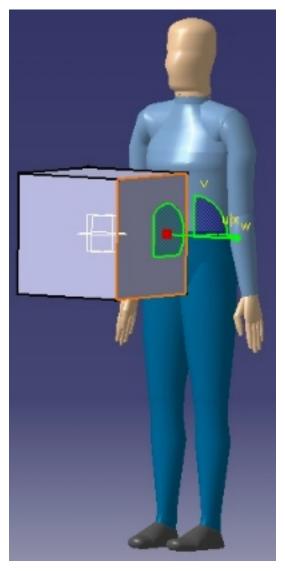
1. From the main menu, select File -> Open. Select the Reach.CATProduct file from the samples directory.



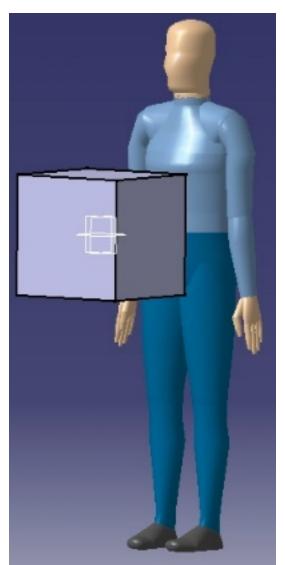
Open the file.

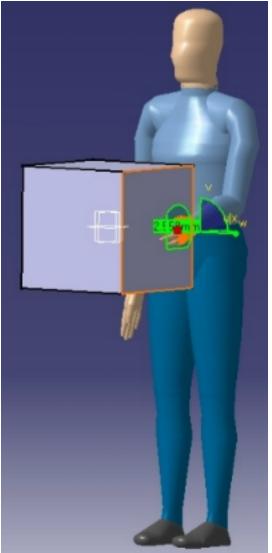


- 2. Select a Reach Mode icon.
- 3. Place the compass at the Reach location.



4. Select the segment that must reach the location specified by the compass. The selected segment should automatically reach that point, as illustrated below.





With Reach Mode still active, manipulate the compass to fine-tune the posture.

- 5. Drag the compass away from its original location, the selected segment will follow the motion of the compass. If the compass is picked and placed at another location, the segment will try to reach the new target.
- 6. Select another segment. This segment becomes the active segment for the Reach and will follow the compass wherever it goes as long as the command remains active.
- 7. If the Reach Mode is active, click Undo to make the manikin resume the posture it had before Reach was applied.
- **8.** To deactivate Reach Mode, select the Reach Mode icon a second time.



The number displayed at the compass location indicates the distance between the target and the segment. It therefore measures the Reach precision: a distance of 0 indicates a perfect Reach.



The Reach distance is also displayed on the status bar and is updated continuously:

Reach error margin: 0.483cm









Redefining the Segment Offset for Inverse Kinematics



The Offset command is used to redefine the behavior of the Reach Mode. The Reach Mode's default behavior is to make the end point of the selected segment reach the compass location. The Offset command allows you to transfer that "end point" to another point in the 3D space, which will then be used to perform inverse kinematics. An example of this would be when the manikin must perform some inverse kinematics while handling an object.



In redefining the offset, the compass may be snapped to manikin skin points. Thus, the subsequent reach operation is resolved from the skin rather than the central point of the segment.

The goal of this task is to transfer the end effector of the manikin's right hand to the tip of the tool the manikin is holding. This is done so that when the Reach Mode is applied to the right hand, the inverse kinematics will be transferred to the tip of the tool. The tool will then do the reach on behalf of the hand.

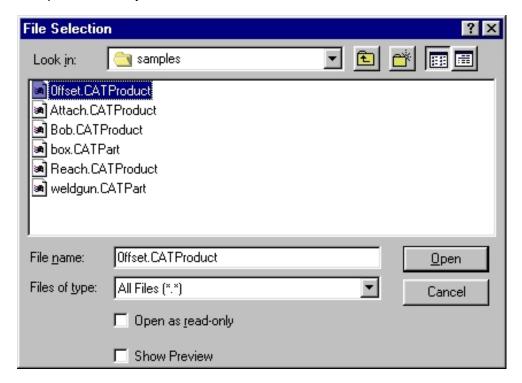
Note that in the sample file used in this task, the correct posture must first be loaded and the tool attached to the manikin's hand.



- The Offset feature can be redefined for any segment of any manikin
- The Offset feature is not available on the forearm model



1. From the main menu, select File -> Open. Select the Offset.CATProduct file from the samples directory.



Open the file.

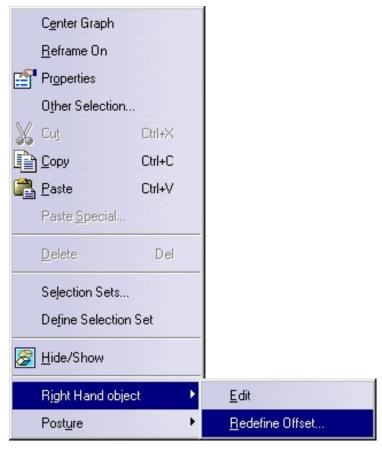


2. Position the manikin with respect to the geometry that must be attached.

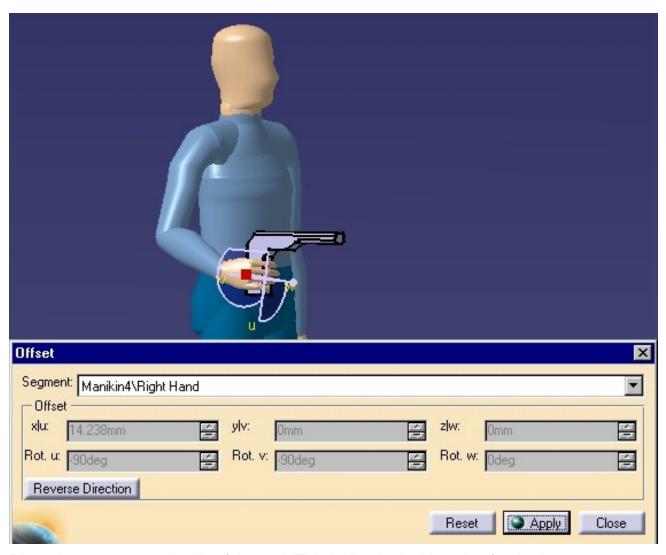
For this example, load the Attach library with the Load Library command and choose the Attach_sample posture. This places the manikin posture so that it appears to be handling the tool with its right hand.

- 3. Select the Attach/Detach icon and attach the weld gun to the manikin's right hand.
- **4.** Right-click the manikin's right hand. The contextual menu appears.

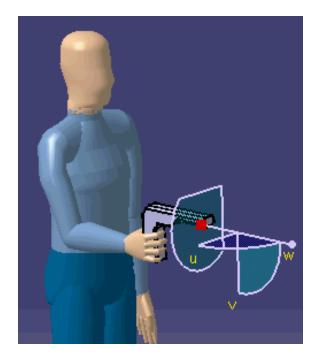




5. Select Redefine Offset... from the Right Hand object sub-menu. The Offset dialog box is displayed and the V5 compass automatically moves to the hand location.



6. Place the compass at the tip of the tool. This is the desired location for the inverse kinematics.





To redefine the offset on the manikin's skin surface:

- 1. Select the desired segment.
- 2. Right-click on that segment and select Redefine Offset from the contextual menu as you did in step 4, above.
- 3. Select the segment again.

 The compass is placed on the skin surface of that segment.
- **7.** Click the Apply button. The offset is automatically calculated and the results shown in the dialog box.
- 8. Click Close to validate the new offset. The offset is now transferred from the hand to the tip of the tool.
- When editing the offset of any segment, the compass is automatically placed at the current offset location. The default offset location is the end point of the segment being edited.
- To reset the offset back to its default value, open the Offset dialog box on the segment and click the Reset button. Click Close to close the dialog box.
- The Reverse Direction button reverses the current orientation of the compass. This feature is typically used when the geometry is manipulated in design mode where the compass goes inside the geometry when snapped to an object.









Attaching an Object to a Manikin Segment



The Attach function creates a one-way relationship between a manikin segment and one or more objects in its environment. The attached object becomes a slave to the segment. Once attached, this object will move with the same matrix as its master segment.

This task is divided into three parts:

- Attaching an object to a manikin segment
- Checking existing attaches on a specific manikin
- Detaching an object from a manikin segment



It is important to note that the Attach is a **one-way relationship**; the object follows the segment, not the opposite. If the object is moved (i.e., using the compass) after the attach is made, the segment **will not** follow the object's motion.



When doing any Attach, the compass may be snapped to manikin skin points, not just the central point of a segment.



Refer to the status bar for information and instructional prompts.



Attaching an object to a manikin segment

1. From the main menu, select File -> Open. Select the Attach.CATProduct file from the samples directory.



Open the file.



2. Position the manikin with respect to the geometry that must be attached. For this example, load the Attach library with the Load Library command and choose the Attach_sample posture. This places the manikin

posture so that it appears to be handling the tool with its right hand.

3. Select the Attach/Detach icon.



- **4.** Select the object to attach (in this case, the tool).
- 5. Select the manikin segment to which the geometry will be attached (in this case, the manikin's right hand).

A message window appears confirming the attach.

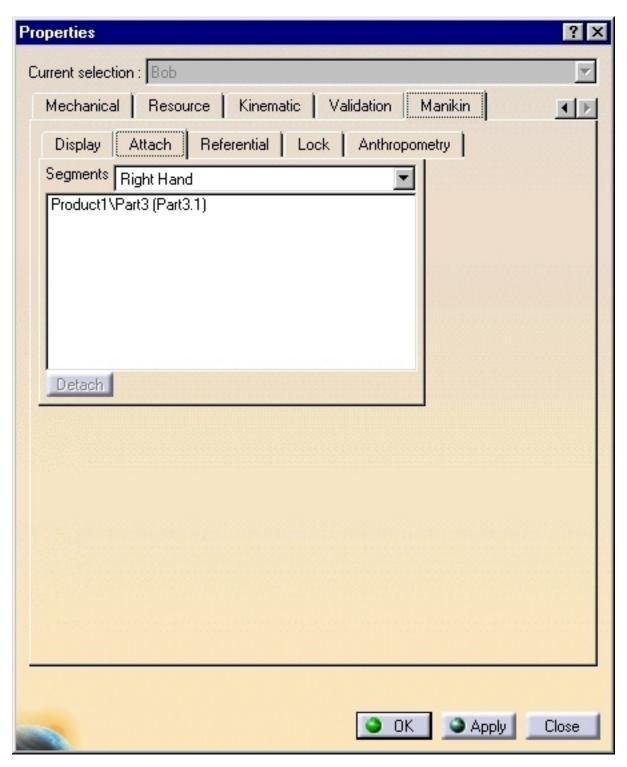


6. Once the object is attached, it will follow the motion of its master segment. Move the hand (master segment) using forward kinematics and inverse kinematics. The tool will follow the hand's motion. This is also the case when a posture is applied to the manikin or if the manikin as a whole is moved within the 3D environment.



Checking existing attaches on a specific manikin

- Access the Properties panel. To do this, right-click on the manikin OR select the manikin, then select Edit -> Properties from the main menu.
- 2. The Properties panel appears. Click the More More button and go to the Manikin tab which is the last tab of the panel.



Depending on the installation, the Manikin tab may contain four or five sub-tabs: Display, Attach, Referential, Lock (optional), and Anthropometry.

3. Select the Attach sub-tab to view attach management information. A selection list displays the names of the attached geometry in a segment-by-segment manner.



An object may be attached to one segment at a time.



Several objects may be attached to a single segment.



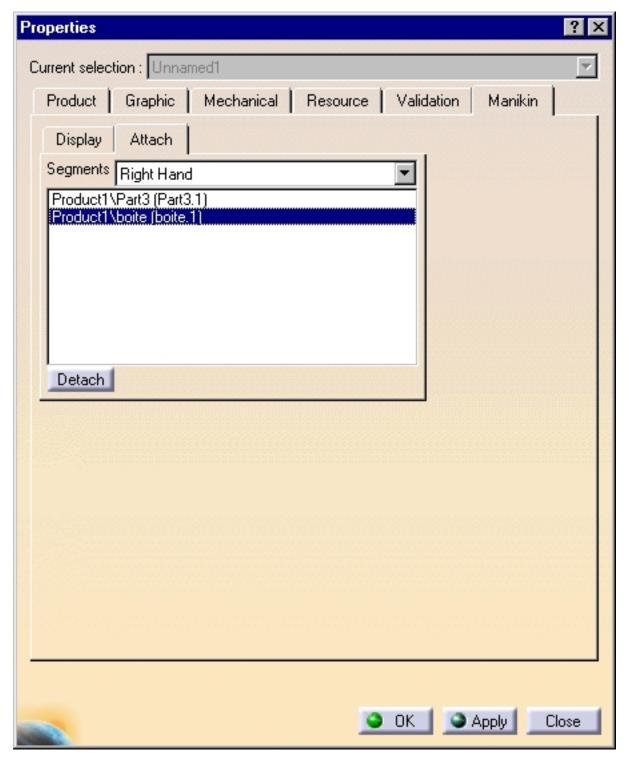
Detaching an object from a manikin segment

There are two ways to detach an object from a segment:

- through the Properties panel
- with the Attach/Detach command

Detaching through the Properties Panel

- Access the manikin Properties Panel. To do this, right-click on the manikin OR select the manikin, then select Edit -> Properties from the main menu.
- 2. The Properties panel appears. Click the More More... button and go to the Manikin tab which is the last tab of the panel.



- **3.** Select the object to detach and press the Detach button. The object is removed from the list.
- **4.** Click the Apply button. The selected object is detached from the manikin segment.



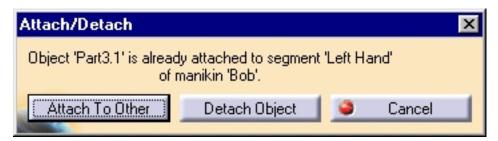
The Apply button **must** be pressed for the selected object to be detached.

Detaching with the Attach/Detach command

1. Select the Attach icon.



- 2. Select the object to detach.
- **3.** A message window appears offering three options: Attach to Other, Detach Object, and Cancel.



4. Select the Detach Object button. A message window appears confirming the detach.











Managing Multiple Constraints



The Constraint command gives you the capability to constrain the manikin in its environment. With constraints, the manikin can perform inverse kinematics (IK) to calculate the necessary posture needed to reach multiple specific targets.



A constraint will always belong to one manikin. At any given time, the list of constraints on a manikin will appear underneath that manikin in the specification tree. Inactive constraints will also be listed.



At any time, you may update the active constraints at each modification in the workspace (automatic update), or only update the active constraints when needed (manual update).

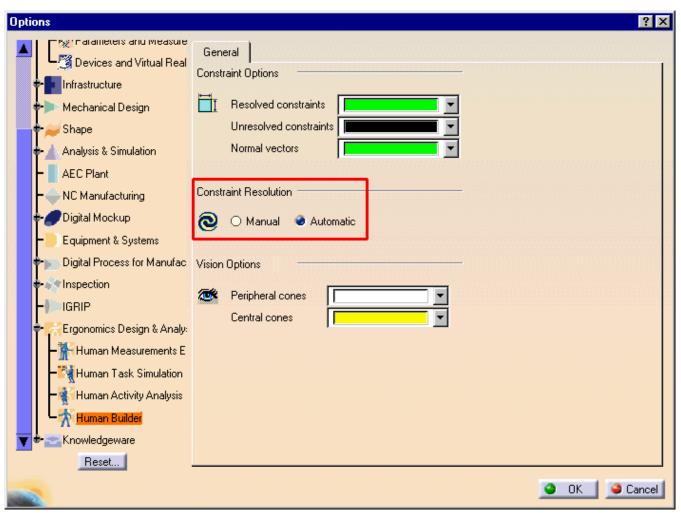
By default, constraint update mode is set in the **Manual** mode and you must select the Update icon



Manikin Tools toolbar each time you want to update the active constraints and resolve the inverse kinematics.

In **Automatic** mode, the inverse kinematics will react as soon as the configuration of the environment changes; when the objects move, the inverse kinematics updates in real time.

As shown in the image below, you can change the update mode at any time by selecting Tools -> Options -> Ergonomics Design & Analysis -> Human Builder. The Manual and Automatic update options are available in the General tab under the Constraint Resolution heading.





. From the samples directory, open the Manikin and Box.CATProduct file.

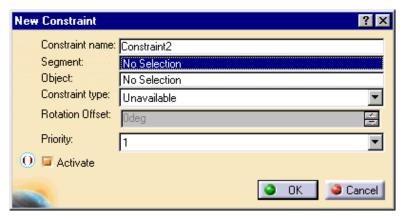
For this procedure the constraint update mode is set at the default Manual mode.

2. Select the Insert Constraint icon.



3. The New Constraint dialog box appears.





Constraint name: By default, this name is "Constraint*N*" where *N* is an incremental number.

Segment: This field must be highlighted to activate the segment selection mode. You can select a segment (end effector) associated with the constraint from either the 3D viewer or the specification tree.

Object: This field must be highlighted to activate the object selection mode. In the environment, select an object, (i.e. a point line, or plane) to which the constraint is related.

Constraint type: The choices in this combo field are automatically updated according to the type of object you select. If you select a:

- opint, the only choice is "Contact", i.e., coincide the segment endpoint with the selected point.
- line, the choices are:
 - "Coincidence", i.e., coincide the line representing the segment with the selected line.
 - "Contact" i.e., coincide the segment endpoint with the line.
- plane, the choices are:
 - "Coincidence (2 directions)"
 - "Contact (3 directions)"



Rotation Offset: This option is only available when a plane is selected and the constraint type selected is "Contact (3 directions)".

The rotation offset that you specify in this field will force that specific rotation to the end effector, i.e., the constrained segment. This will make the end effector rotate around the normal vector of the plane. The rotation value that you set in the New Constraint dialog box can be modified in the Constraint properties.

To access the Constraint properties dialog box, double-click on the constraint in the specification tree or in the 3D view.

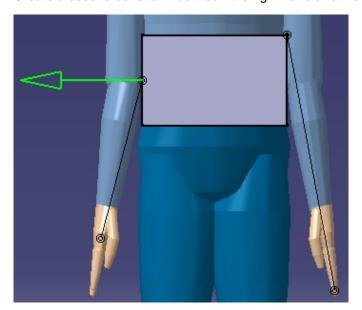


Priority: Select a priority level for the constraint between 1 and 4. Priority 1 is the highest. By default, the priority is set to 1.

Activate: Activate or deactivate the new constraint.

3. Create a constraint between the left finger and the left side of the box.

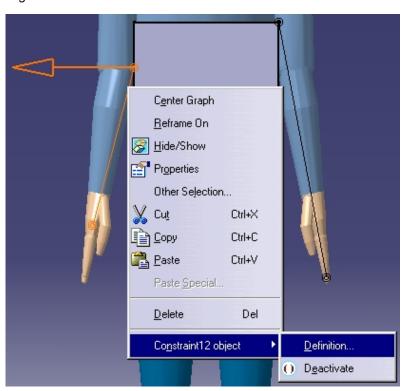
4. Create a second constraint between the right hand and the right side of the box.





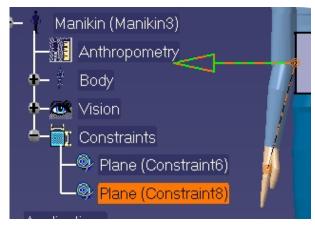
Each constraint is represented by:

- two small concentric circles located at the segment endpoint;
- two small concentric circles located on the object (point, line or plane);
- a line between the segment endpoint and the object;
- in the case of a plane constraint, an arrow representing the normal vector to that plane.
- 5. Right-click on a constraint in the 3D viewer and select Definition. . . for the constraint object as shown below:

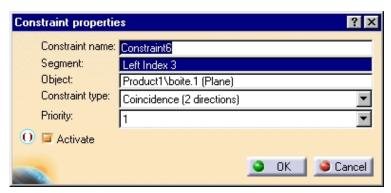


OR

Double-click on the constraint object in the specification tree.



6. The Constraint Properties dialog box appears. Edit constraint attributes as desired. You may activate/deactivate the constraint here or in the contextual menu shown in step 5.

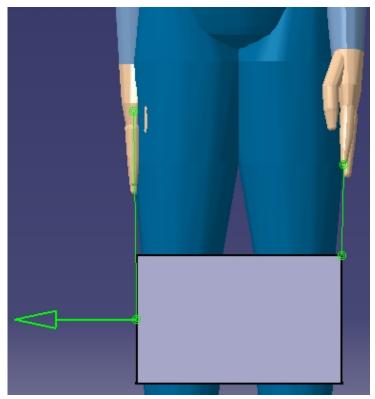


7. Move the box. The constraints are unresolved and must be updated.



By default:

- a resolved constraint is green;
- an unresolved constraint is black;
- the normal vectors are green;
- upon creation, a constraint has the unresolved status.
- 8. Select the Update icon to resolve the active IK constraints. The constraints and normal vectors are now green indicating that they are resolved.

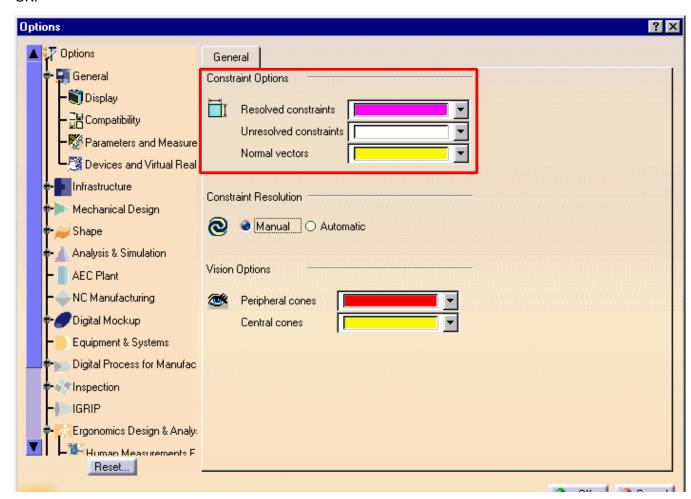


9. Move the box again so that the constraints go to an unresolved state.

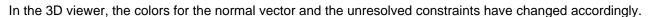


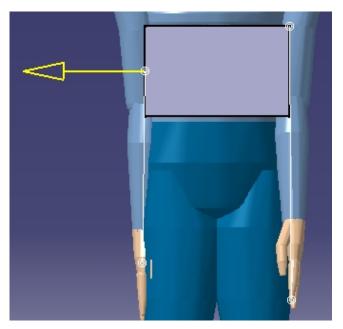
Constraints can be shown in two different colors: the resolved color and the unresolved color. You can change these colors and also the color of the normal vectors.

10. To change the colors, select Tools -> Options -> Ergonomics Design & Analysis -> Human Builder. Under the General tab, choose new colors for resolved and unresolved constraints as well as for normal vectors. Click on OK.

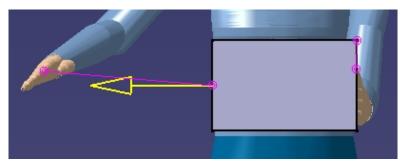




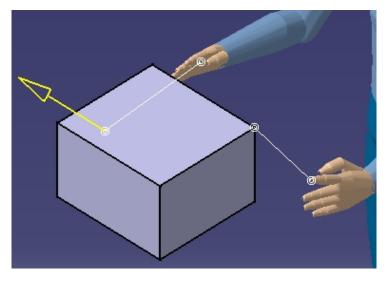




11. Update the constraints again. The resolved constraints are the new color.



12. Verify that the new unresolved constraint color is applied. Move the manikin so that the constraints become unresolved and the color changes.











Using the Inverse Kinematics Mode



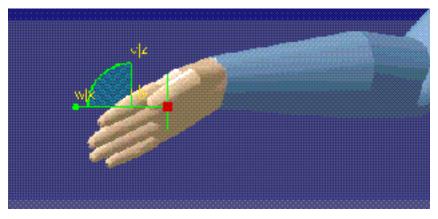
The Inverse Kinematics (IK) mode gives you the capability to manipulate the manikin's IK with designed behaviors. This function is principally for moving the upper body in relationship to the manipulation of the arms and legs. This manipulation will eventually induce spine and/or hip motion in order to translate and orient the manikin toward the target. In other words, these behaviors will modify the IK chain, making it **local** (limbs only) or **global** (limbs and spine and pelvis).



Two commands are available in IK mode and either may be used depending on the need or the operation to be performed (making a new posture or fine-tuning and existing posture). Both commands provide easy access to manikin IK capabilities. The only difference between the two is in the compass orientation (as illustrated below). These commands are mutually exclusive; activating one automatically deactivates the other. For more information, see Using the Inverse Kinematics Segment Frame Mode and Worker Frame Mode.

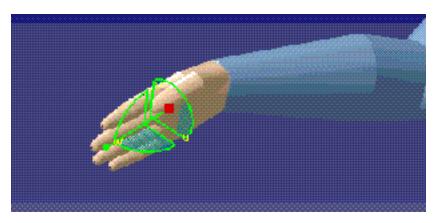


IK Worker Frame mode



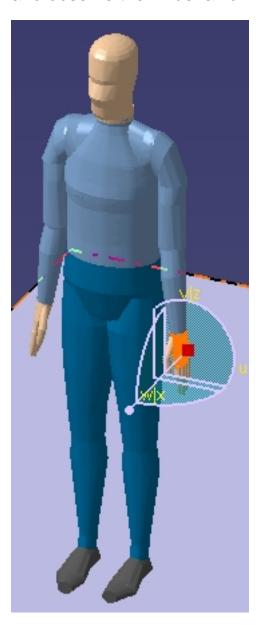


IK Segment Frame mode





- **1.** From the samples directory, open the *Manikin_on_Floor.CATProduct* file.
- 2. Select the IK Worker Frame Mode icon in the Manikin Posture toolbar and select the manikin's left hand. Move the manikin's left hand and observe the IK behavior.





The manikin's IK behavior is currently the default Limb IK chain. If no other behavior option is selected, the IK manipulators, i.e., IK Mode, Reach Mode, will drive the arms and legs in order to simulate natural motion.

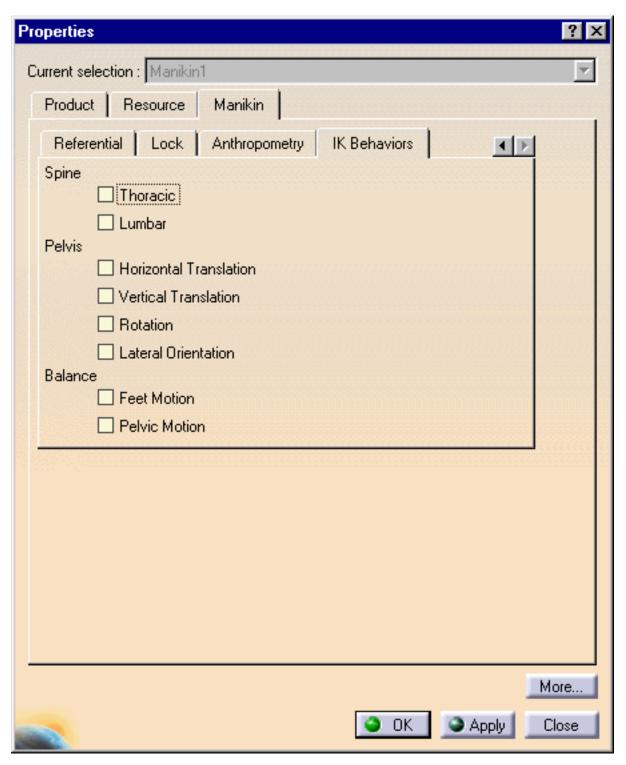
Note that all the options are not mutually exclusive; more than one item can be activated at the same time. For example, activating both the Thoracic and Lumbar options will initiate motion of the entire spine if the target cannot be reached by extending the arms.

If multiple Pelvis options are selected, the manikin's pelvis will move (translate, rotate, or laterally orient, depending on the option selected) with or without preliminary spine motion, depending on the selection status of the Spine option.

3. Right-click on the manikin in the specification tree and select Properties in the contextual menu. The Properties dialog box appears. Select the Manikin tab then scroll to the right and select the IK Behaviors tab.

In this tab, you can select various options under these headings:

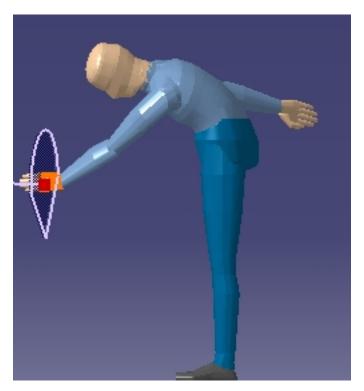
- Spine
- Pelvis
- Balance



Using the Spine options

4. Select both the Thoracic and Lumbar spine options and click on OK. You should still be in IK Mode.

5. Again move the left hand. The behaviors of the moving sections of the spine are evident.



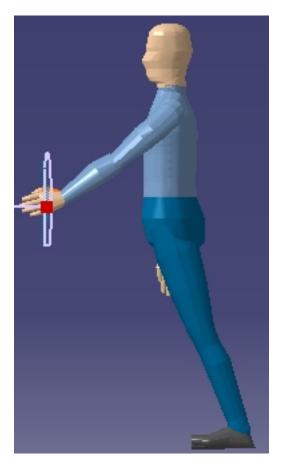
6. Return the manikin to a standard standing pose.

Using the Pelvis options

7. Re-open the Properties dialog box and de-activate the Spine options.

Horizontal Translation

- 8. Activate Horizontal Translation and select the manikin's left hand.
- 9. Move the manikin's left hand upward and to the front; observe the IK behavior. When Horizontal Translation is active, the manikin's hip will move forward as the compass is dragged.



Vertical Translation

- **11.** In the Properties dialog box, de-activate Horizontal Translation and activate Vertical Translation.
- 12. Select the manikin's left hand.
- **13.** Drag the compass downward and observe the IK behavior. When Vertical Translation is active, the manikin's hip will move down (the manikin will squat) as the compass is dragged.



Rotation

- **15.** In the Properties dialog box, de-activate Vertical Translation and activate Rotation.
- 16. Select the manikin's left hand.
- **17.** Drag the compass forward and observe the IK behavior. When Rotation is active, the pelvis will rotate forward causing a stoop pose.



Lateral Orientation

- **18.** In the Properties dialog box, de-activate Rotation and activate Lateral Orientation.
- 19. Select the manikin's left hand.
- **20.** Drag the compass to the side and observe the IK behavior. When Lateral Orientation is active, the manikin's hip will twist.





Using the Balance options

This option enables you to manipulate the manikin with inverse kinematics while keeping the manikin in balance.

When these options are selected (only one may be chosen at a time), the balance is checked, in real-time, every time the posture of the manikin changes.

Feet Motion

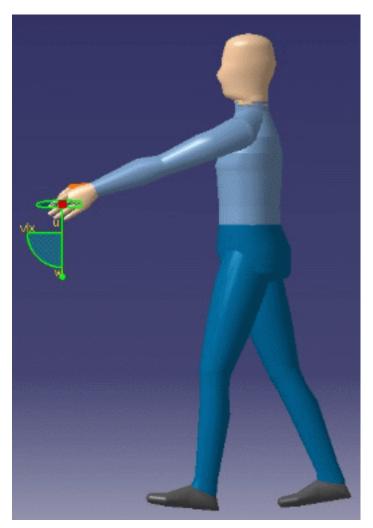
22. In the Properties dialog box, activate all the options under both the Spine and Pelvis headings.

Under the Balance heading, activate Feet Motion.

23. Select the manikin's left hand.

24. Drag the compass forward and down.

With the Feet Motion option activated, when the manikin loses balance, the foot not supporting the body weight (the foot with the highest distance from the center of gravity's current position) moves in the direction of the motion in order to keep the balance (keep the center of gravity inside the base of support).



25. Return the manikin to a standing pose.

Pelvis Motion

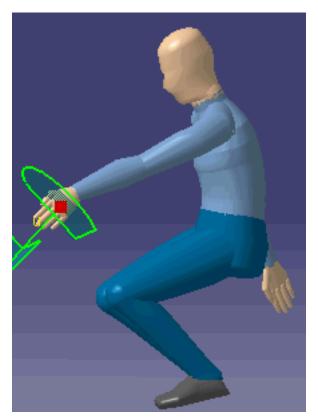
26. In the Properties dialog box, retain all the settings under the Spine and Pelvis headings.

Under the Balance heading, activate Pelvis Motion. Feet Motion will automatically deactivate at this time.

27. Select the manikin's left hand.

28. Drag the compass forward and down.

With the Pelvis Motion option activated, when the manikin loses balance, the pelvis tips in order to keep the balance (keep the center of gravity inside the base of support).



29. Repeat this procedure using the IK Segment Frame mode to get a feel for how this command differs from the IK Worker Frame mode.









Using the Reach Envelope



This procedure describes how to use the powerful reach envelope creation tool. This tool takes advantage of the manikin's inverse kinematics (IK) capability to evaluate manikin arm reachability in the 3D space. It is particularly useful in facilitating product design and review.



A reach envelope is a surface that represents all the possible positions the manikin can reach using only the arm and forearm. The motion starts at the shoulder.

- You can create two reach envelopes: one each for the right and left hand.
- The reach envelope is included in the clash detection algorithm.



- **1.** From the samples directory, open the *Manikin_on_Floor.CATProduct* file.
- 2. Select the Reach Envelope icon and select the manikin's left hand or any segment belonging to the hand. The reach envelope, a surface representing the maximum reach limit, is created around the shoulder joint.

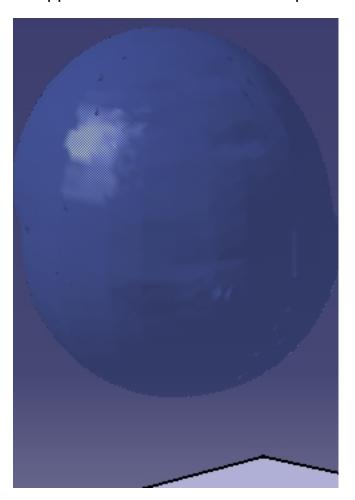




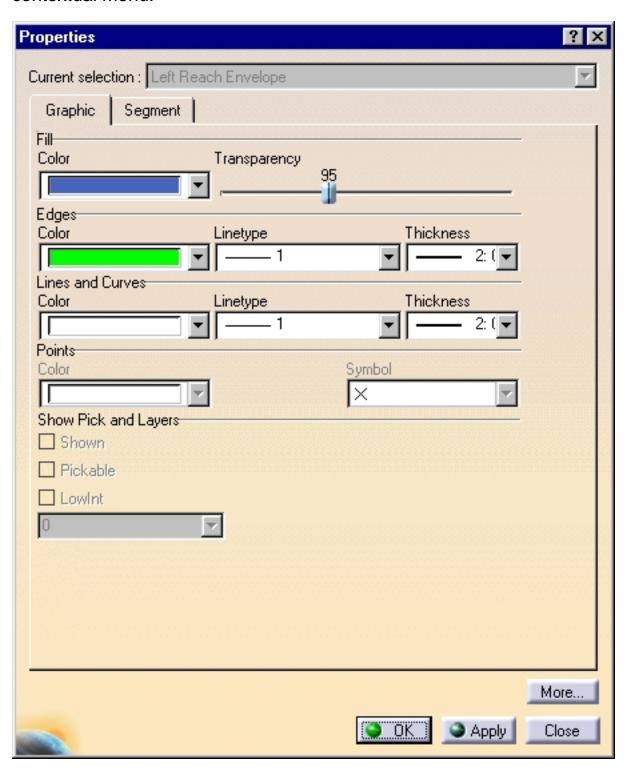
The reach envelope computation will take the IK offset of the selected segment into account. (For more information about offset functionality, see Redefining the Segment Offset for Inverse Kinematics.) This will enable you to create the reachability of the tip of a tool, for example, if the offset of the hand had previously been relocated to that point on the tool.

The reach will also be influenced by the arm's angular limitations and preferred angles. For example, it is possible to create a reach envelope representing the comfort zone for a given task.

3. With the right mouse button, select the manikin in the specifications tree. From the contextual menu, select the Hide/Show command. The manikin disappears while the reach envelope remains displayed.



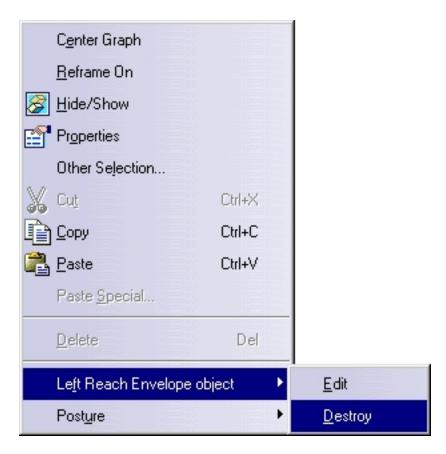
4. Change the graphical properties in the reach envelope's Properties dialog box. Right-click on the reach envelope, and select Properties in the contextual menu.



5. Using the Posture Editor, the IK Mode, or the Standard Pose command, manipulate the manikin's spine. The reach envelope will follow.



Destroy the reach envelope. To do this, right-click on the reach envelope and select from the contextual menu as shown below.











Manikin Catalog Management



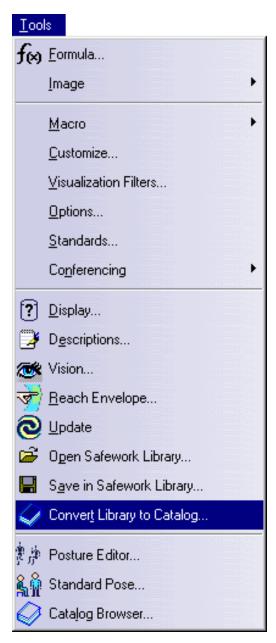
This procedure describes the use and management of manikin catalogs including the following tasks:

- Converting *.swl files into catalog files
- Reusing postures from a catalog file
- Storing postures in a catalog file



Converting *.swl files into catalog files

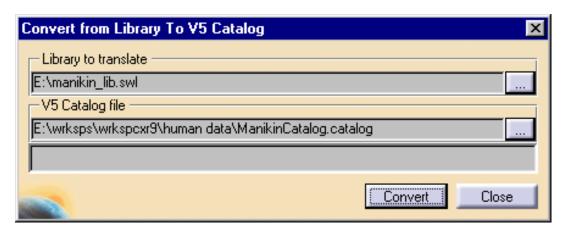
1. From the Tools menu, select the Convert Library to Catalog command.



The Convert from Library to V5 Catalog dialog box appears.

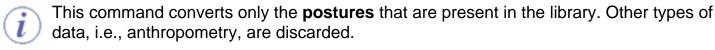
2. Select the library to be converted and the name of the target catalog, i.e., where the postures will be stored. When both files are correctly entered, the Convert button becomes available.

Click the Convert button; the progression of the conversion process is shown at the bottom of the dialog box.



When the conversion is finished, a dialog box will appear displaying the number of postures converted.

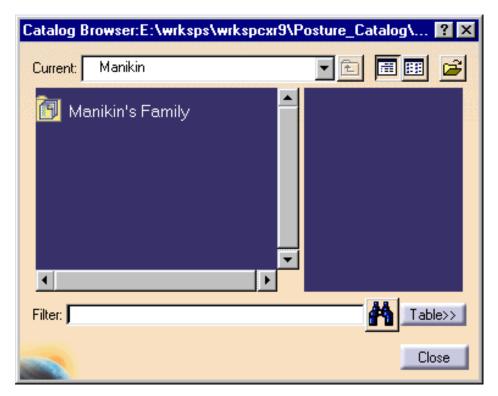






Reusing postures from a catalog file

1. To open an existing posture catalog, select the Open Catalog icon. The catalog browser is displayed.



The catalog browser always opens with the most recently used document. To open another catalog in the browser, load the catalog using the Open icon the top right of the catalog browser window.

2. Open the appropriate family containing the postures by double-clicking that family. The postures contained in the catalog are displayed.



3. Select a posture in the left frame of the browser to activate the preview of that posture in the right frame.

4. To paste a posture from the catalog browser, select (no need to double-click) the posture to apply (making it highlight in the left frame) then select the manikin in the 3D view on which that posture must be applied. The manikin will take the new posture.



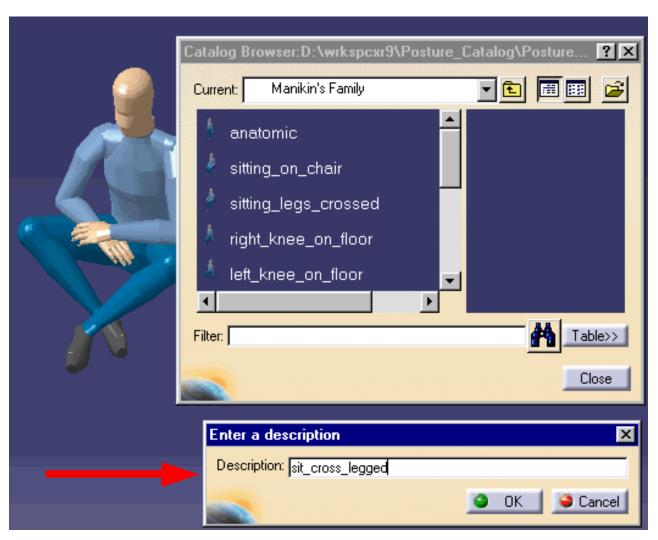
- **5.** To paste another posture to the same manikin or to another manikin, select the new posture, as before, from the catalog browser, then select the manikin in the 3D view.
- 6. Click on Close to exit the catalog browser.



Storing postures in a catalog file

1. To save a posture directly into a catalog, select the Save in Catalog icon. The catalog browser is displayed.

- 2. Open the catalog in which the posture will be stored; activate the appropriate family by double-clicking on it.
- **3.** Select the manikin whose posture must be stored in the catalog. A panel will appear asking for a description of the posture.



4. Enter a posture description for the posture that is about to be saved. Click on OK. The catalog browser is updated, displaying the new posture that has been saved.



5. To save the posture of another manikin, select that manikin in the 3D view and repeat the steps above.









Using Manikin Simulation Commands



The Manikin Simulation toolbar contains a number of commands that are useful in Human Builder and Human Activity Analysis.



For information about each of these commands, please see:



Using the Shuttle Command



Using the Simulation Command



Using the Compile Simulation Command



Using the Replay Command



Using the Track Command



Using the Play a Simulation Command



Using Global Collision Detection









©Using the Shuttle Command



This procedure describes how to create, move, and reset a shuttle.



A shuttle is a set of products defined explicitly by selecting products individually. Shuttles are persistent and can be stored in your document. Shuttles are identified by name in the specification tree and by a symbol in the geometry area.

When a manikin is selected be a shuttle or a component of a shuttle, the whole manikin is selected. Individual segments may not be selected.



Create a shuttle

1. From the Samples directory, open the Shuttle_sample.CATProduct file.



2. Select the Shuttle icon in the Manikin Simulation toolbar and then

(while holding down the Shift key) select the Pipe and the Manikin in the specification tree.

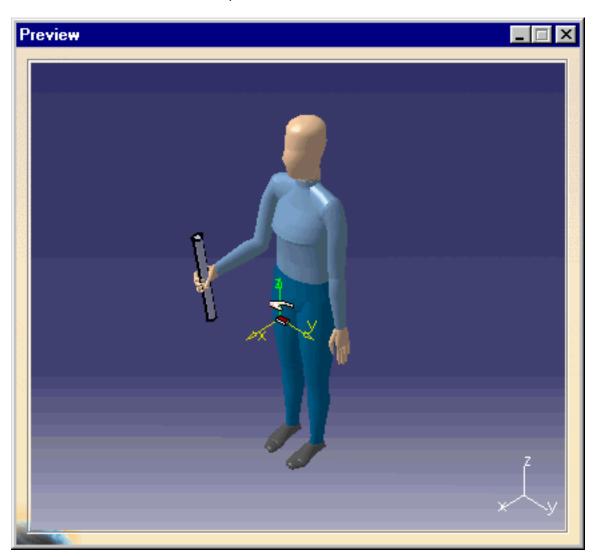
OR

While holding down the Shift key, select the Pipe and the Manikin in the specification tree and then select the Shuttle icon in the Manikin

Simulation toolbar.

At this time, the following items appear:

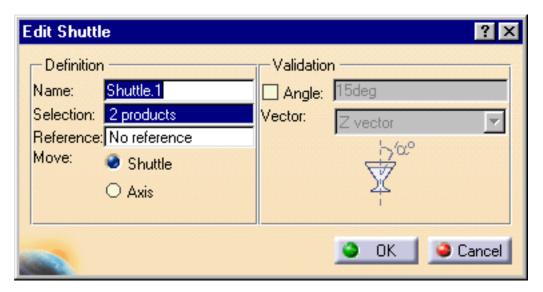
 Preview window (the shuttle symbol corresponds to the to-be-created shuttle axis)



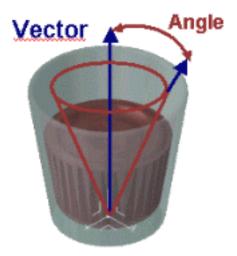
Manipulation toolbar



Edit Shuttle dialog box



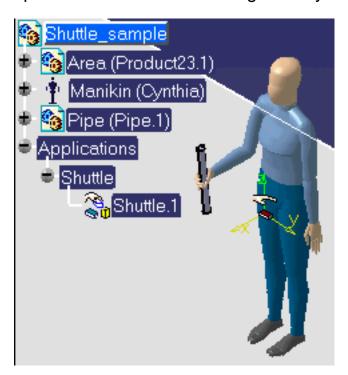
In this dialog box, you can specify a maximum rotation angle around the absolute axis for the shuttle. This is very useful in avoiding liquids from spilling out from specific assemblies such as a gas tank. The shuttle motion is defined and validated with respect to the angle value defined.



- 2. In the dialog box, check the Angle option (optional). The Angle and Vector fields are no longer grayed-out and you may enter the desired values.
- 3. Enter a name for your shuttle (optional).

4. Click OK to finish creating the shuttle.

The shuttle, consisting of the pipe and the manikin, is identified in the specification tree and in the geometry area.





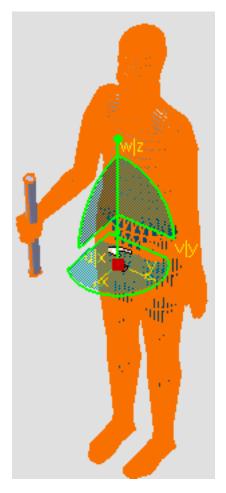
Move the shuttle

- **1.** Double-click Shuttle.1 in the specification tree.
 - The Edit Shuttle dialog box, the Preview window and the Manipulation toolbar appear.

Note that, by default, the graphic manipulator is attached to the shuttle and that the Attach icon in the Manipulation toolbar is activated.



The 3D compass snaps to the shuttle axis.



The Move shuttle option is activated by default which means that both the shuttle axis and the geometry move together.

3. Use the 3D compass to move the shuttle to the desired location.



Reset the shuttle

Select the Reset icon in the Manipulation toolbar. The shuttle will move back to its original position.





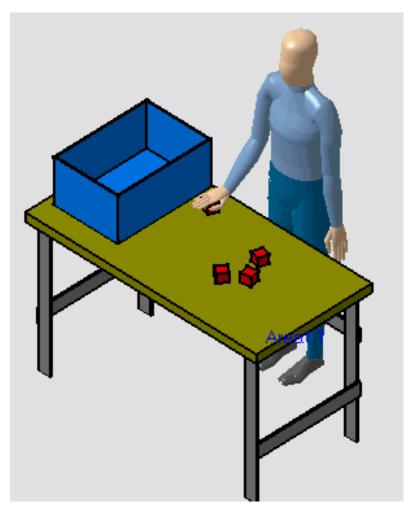


Wusing the Simulation Command



This procedure explains how to record a simulation.

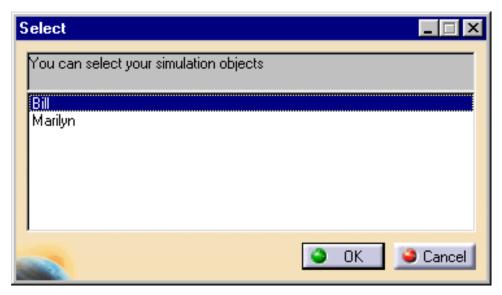
1. Open the Simulation_sample.CATProduct file in the samples directory.



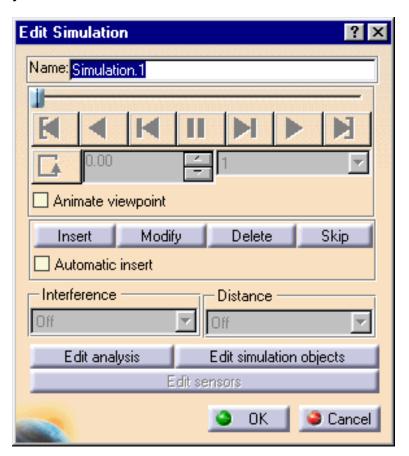
2. Select the Simulation icon in the Manikin Simulation toolbar.

3. The Select panel appears listing all items in the specification tree that can be used in a simulation.

Select the manikin, Bill.



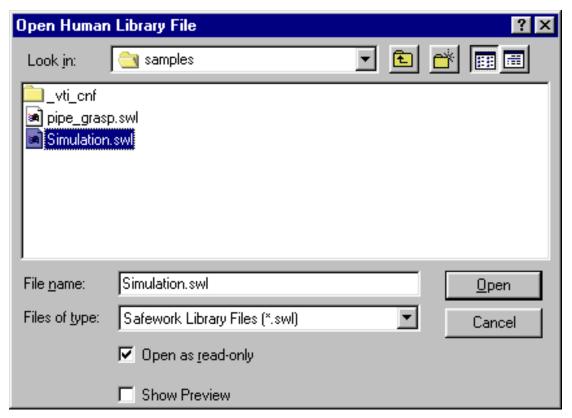
4. The Edit Simulation dialog box appears. Accept the default name or rename your simulation as desired.



5. For this simulation, you will use postures that have been saved in the Human Library.

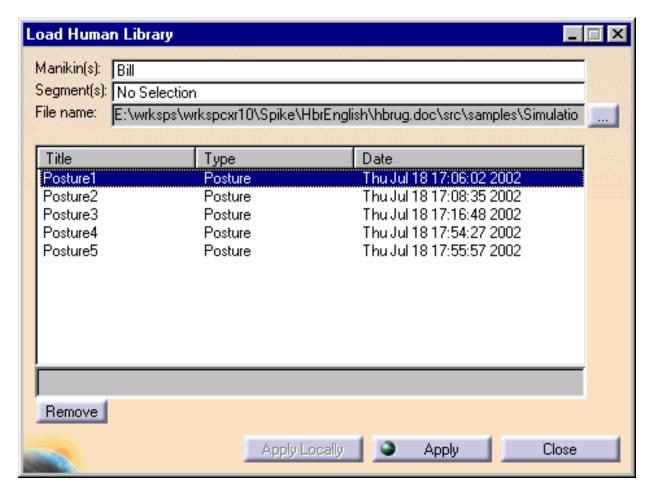
Select the Load Human library icon from the Manikin Tools toolbar.

6. Select the Simulation library file as shown below.



7. The Load Human Library dialog box appears.

In the specification tree, select Bill and then double-click on Posture1.



Posture1 is the default posture of the Simulation sample.CATProduct file.

Close the Load Human Library dialog box. The Edit Simulation dialog box reappears.

8. In the Edit Simulation dialog box, click the Insert button.

Posture1 has been inserted.

- 9. Again, open the Simulation library file and load Posture2.
- 10. Insert Posture2 into the simulation.
- **11.** Repeat steps 5 8 until all five of the postures have been inserted into the simulation.

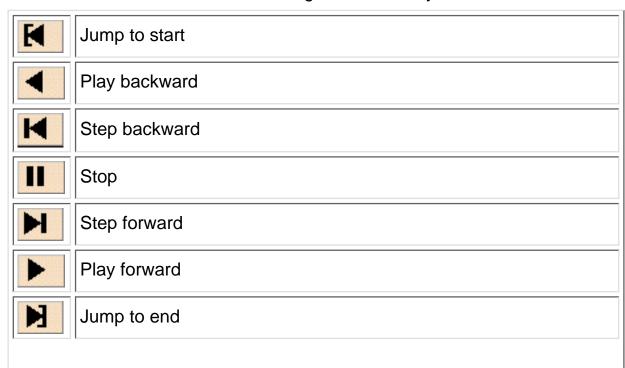
The Edit Simulation dialog box indicates that 5 insertions have been made.



The Simulation appears in the specification tree under Applications.



12. Use the VCR-like buttons in the dialog box to check your simulation.





Change loop mode. (Single looping can be toggled to continuous looping.









Using the Compile Simulation Command



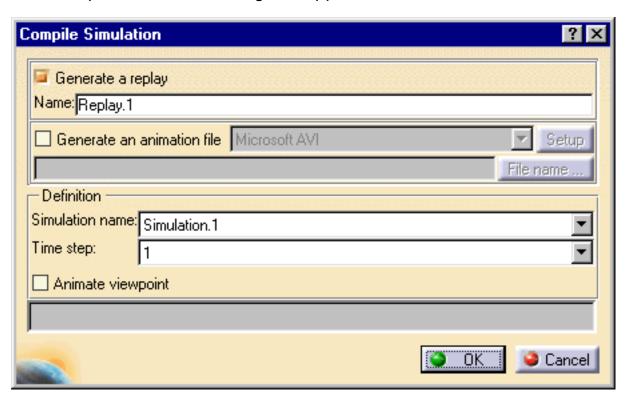
This procedure describes how to compile a simulation as either a replay or an animation file. A replay is a snapshot of the process at a particular time. Any changes made to the process after it has been compiled into a replay will not appear in that replay. An animation file can be either in AVI or MPG format or in a series of JPG still images.



How to compile a simulation

After you have run the simulation and verified that it is one you want to compile, select the Compile Simulation icon .

The Compile Simulation dialog box appears.



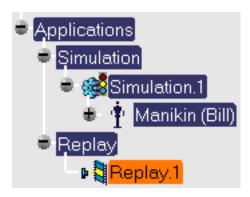
In this dialog box, choose a compiling option:

- Generate a replay
- Generate an animation file

Generate a replay

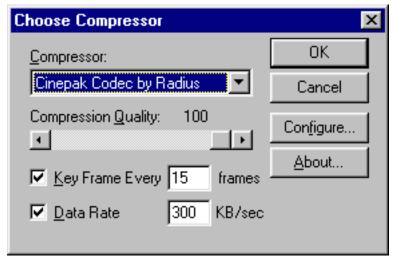
This is the default option. Accept the default name or enter one of your own; modify the time step size if you like, and then click the OK button.

The new replay appears in the specification tree under Applications.

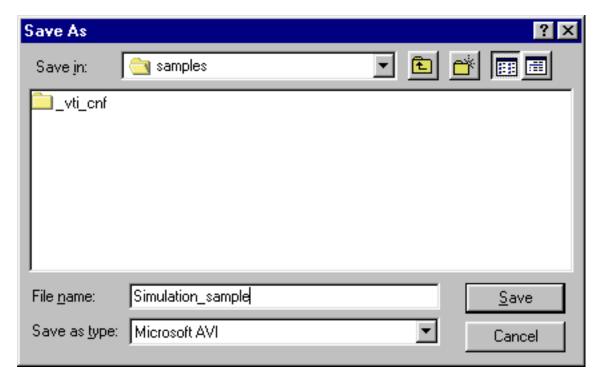


Generate an animation file

- 1. Choose either Microsoft AVI or Still Image as the option file type.
- 2. Select the Setup button to access the Choose Compressor dialog box where you may choose a compressor type, select compression quality, and configure your output as defined by the compressor you select.



3. Select the File name ... button to access the Save As dialog box. Specify the desired location and name the file. The dialog box automatically specifies the file type.



Note: The Still Image option produces a JPG of each recorded segment of the simulation.



WUsing the Replay Command

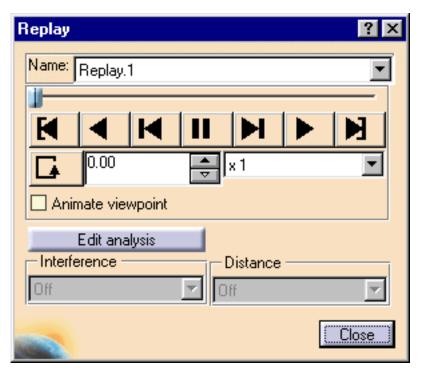


This procedure describes how to use the Replay command. This command can only be used if you have compiled a simulation as a Replay. A replay is a snapshot of the process at a particular time. Any changes made to the process after it has been compiled into a replay will not appear in that replay.

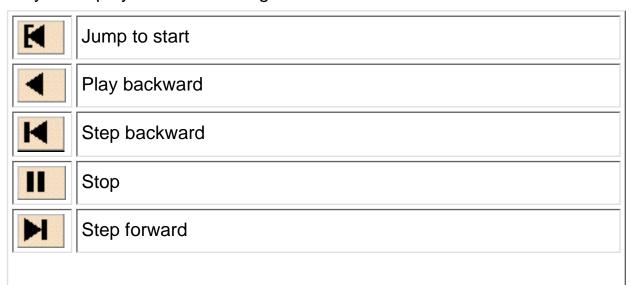


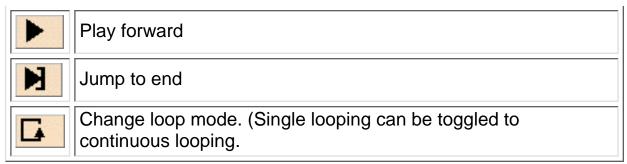
1. Select the Replay icon in the Manikin Simulation toolbar.

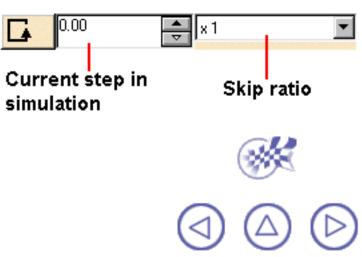
The Replay dialog box appears. Select the desired replay in the Name combo box.



2. Play the replay simulation using the slider or the VCR-like buttons.







WUsing the Track Command



This procedure demonstrates how to use the Track command.



A track is the route of a moving object. Objects can be:

- products
- shuttles
- section planes
- lights
- cameras
- the seven Inverse Kinematic (IK) control points of a manikin

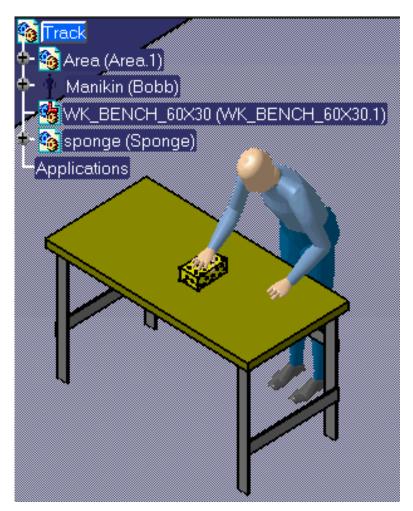
Note: A manikin's seven IK control points are the:

- line of sight (if displayed)
- neck
- pelvis (root)
- right and left hands
- right and left feet

For more information, see Using the Inverse Kinematics Mode.

Attach the object to the segment

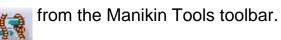
1. In the Samples directory, open the Track_sample.CATProduct_file.



2. In the track you will create, the manikin will wipe the workbench with the sponge. The sponge must first be attached to the manikin's hand. (An object attached to a segment is a one-way relationship. The object will follow the movement of the segment; the segment will not follow the movement of the object).

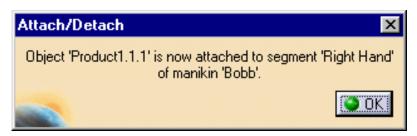
To make the attachment:

Select the Attach/Detach icon



- Select the sponge.
- Select the manikin's right hand.

A message appears confirming that the sponge is now attached to manikin Bobb's right hand.



Record the track

3. Select the Track command from the Manikin Simulation toolbar.

At this time, the following items appear. Click on the links for more detailed information.

Recorder toolbar



Player toolbar



Track dialog box



4. From the specification tree or in the 3D viewer, select the manikin's right hand segment.

"Right Hand" appears in the Object field of the dialog box and the Manipulation toolbar appears.



5. In the Interpolater combo field, select the Spline interpolater.



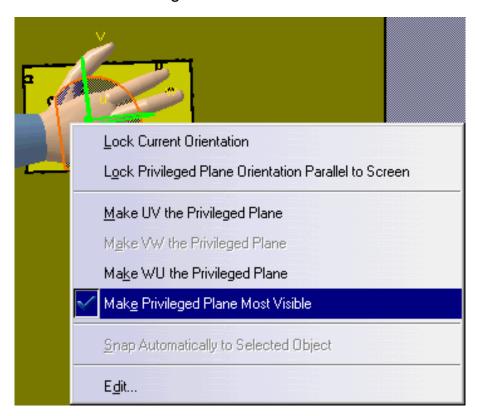
The 3D compass attaches to the hand in the default position for that segment.

6. In the Quick View toolbar, select the Top View icon.

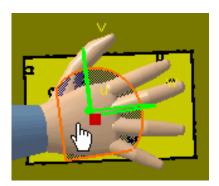


7. Right-click on the compass to bring up the contextual menu.

Select "Make Privileged Plane Most Visible".



8. Place the cursor on the compass so that the privileged plane turns orange.

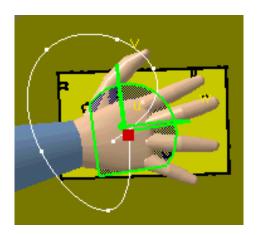


9. Hold the left mouse button down and drag the compass.

The hand and sponge will follow.

- **10.** Click the record icon in the Record toolbar.
- 11. Repeat steps 9 and 10 several more times.

The track of the recorded shots is shown; with points indicating the individual recording shots.



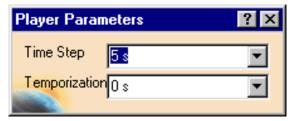
The track is also shown in the specification tree.



12. Click OK to exit the Track command or run the track simulation as described below.

Run the track simulation

- **13.** To re-open Track.1, double-click on it in the specification tree.
- **14.** Select the Parameters icon in the Player toolbar. Set the Time Step to "5 s".



15. In the Player toolbar, select the Play Forward icon to see the simulation.









The Recorder Toolbar



Use the buttons in the Recorder toolbar to record, modify, or delete a shot of the track you are creating.





Record a new shot.

Each time you move the object is positioned with the 3D compass, press this button to record the new shot.



Modify the current shot

Records the modification(s) on one shot at a time.



Delete the current shot.

Deletes one shot after another. You need to be positioned on the shot to for it to be deleted.





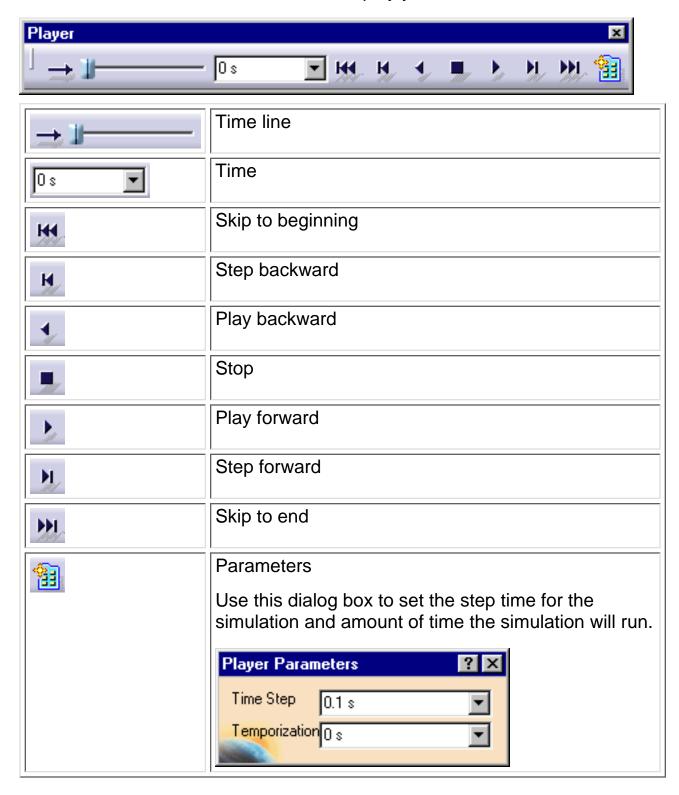


The Player Toolbar



The Player toolbar is available every time you create a track or a sequence, or when you play a track or a simulation. You can undock the Player toolbar at any time

Use the VCR-like buttons or the slider to play your simulation.









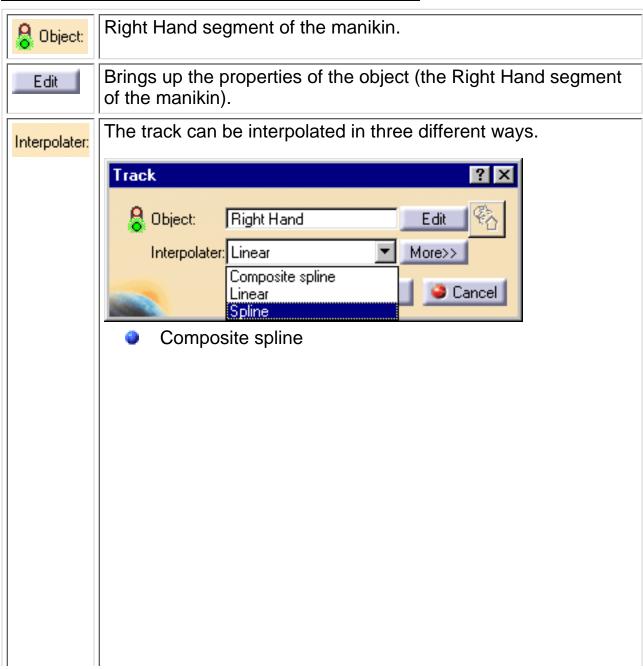


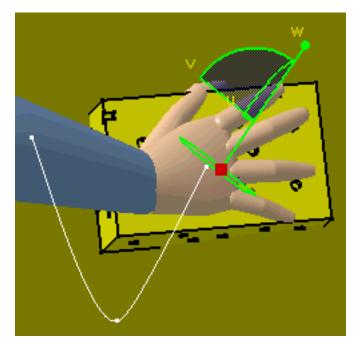
The Track Dialog Box

(i)

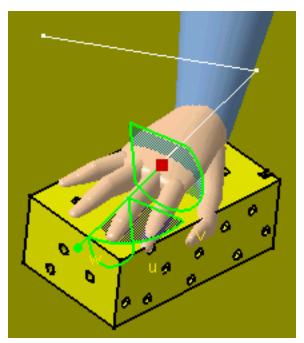
For demonstration purposes, the following explanation of the Track dialog box correlates to the Track_sample.CATProduct file.



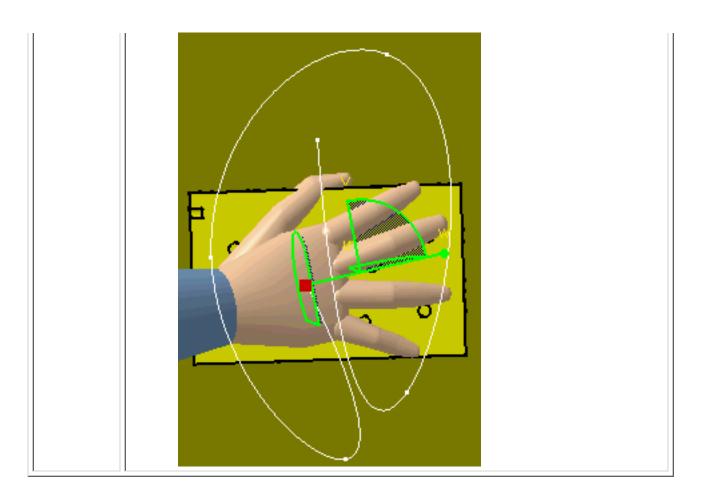




Linear



Spline









Using the Play Simulation Command



This procedure describes how to use the Play Simulation command.



A simulation has been created and can be seen in the specification tree. **Or**

Open the Simulation_complete.CATProduct file in the samples directory.



1. Select the Play Simulation icon from the Manikin Simulation toolbar. The Player toolbar appears.



- **2.** From the specification tree, select the simulation that you would like to play.
- 3. Play the simulation using the VCR-like buttons in the Player Toolbar.
 For more information about the functionality of these buttons, please see The Player Toolbar.



Manikin Workspace Analysis



You can effectively analyze the manikin's workspace using the commands in the Manikin Workspace Analysis toolbar. For more information, read the following topics about these commands.

Distance and Band Analysis

Arc through 3 Points

Measure Between











©Distance and Band Analysis



This procedure demonstrates how to use the Distance and Band Analysis command.

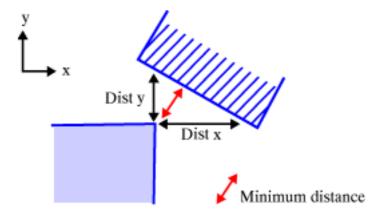


Measuring distances



When measuring distances between products, you can measure the minimum distance or the distance along the x, y, or z axis.

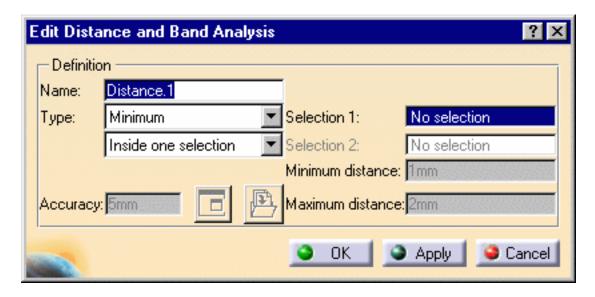
The drawing below shows the differences among distances along two of the axes or the minimum distance.



Select the Distance and Band Analysis icon.

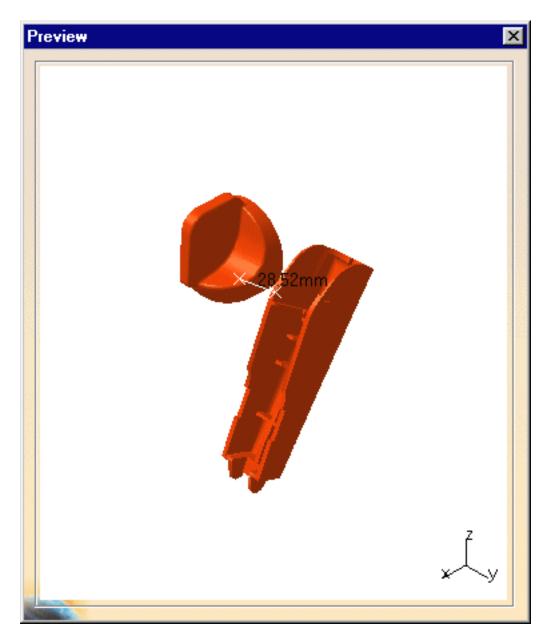


The Edit Distance and Band Analysis dialog box appears. The default distance analysis is measuring the minimum distance inside one selection

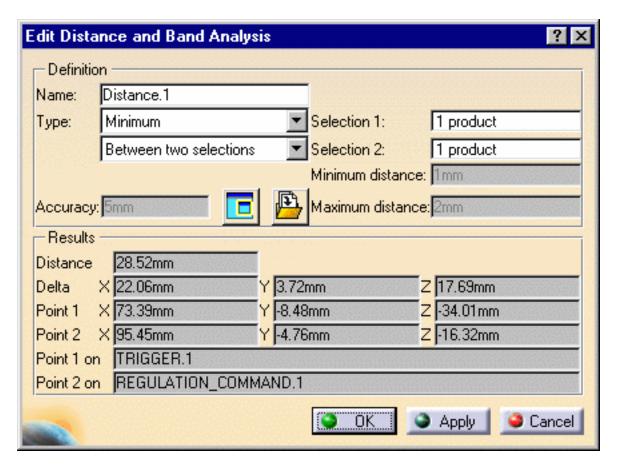


- **2.** Select a Type in the upper combo box. The choices are:
 - Minimum
 - Along X
 - Along Y
 - Along Z
 - Band analysis
- **3.** Use the lower combo box to select where you want the measurement to occur. The options are:
 - Inside one selection (default type):
 Within any one selection, tests each product of the selection against all other products in the same selection.
 - Between two selections: Tests each product in the first selection against all products in the second selection.
 - Selection against all: Tests each product in the defined selection against all other products in the document.
- **4.** If you chose *Inside one selection*, select one product; otherwise select two products.
- **5.** Click the Apply button to calculate the distance.

A preview window appears visualizing the selected products and the minimum distance (represented by a double-headed arrow and a value).



The dialog box box expands to show the results.



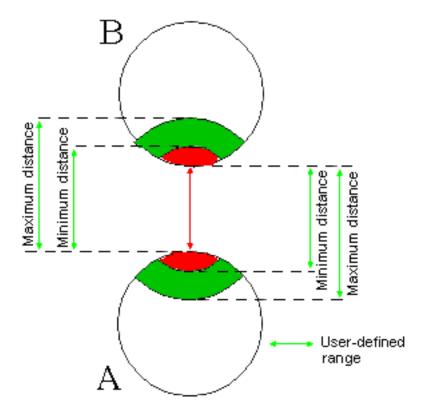
Minimum distance and other information identifying all distance components is given in the expanded dialog box. X,Y,Z coordinates of start and end points on products selected for the distance calculation as well as products themselves are identified.



Using band analysis

Band analysis is used to compute and visualize areas on products corresponding to a minimum distance within a user-defined range.

The drawing below illustrates what band width means in this context.





You must find the minimum distance, as shown above, before computing a band analysis.

- **6.** In the Edit Distance and Band Analysis dialog box, set the Type to Band Analysis.
- **7.** Set the Minimum and Maximum distance to define the band width (e.g., to 32 and 36mm respectively).

Default values are 1 and 2mm respectively.

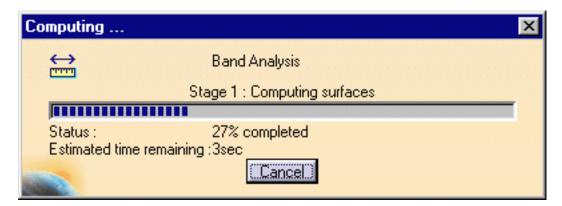
8. If you wish, alter the Accuracy setting.

The value entered defines the maximum value for the length of the longest side of a triangular representation of the results. This representation is used to obtain the red and green surfaces.

The default value is 5mm. A lower value will give you a more accurate result.

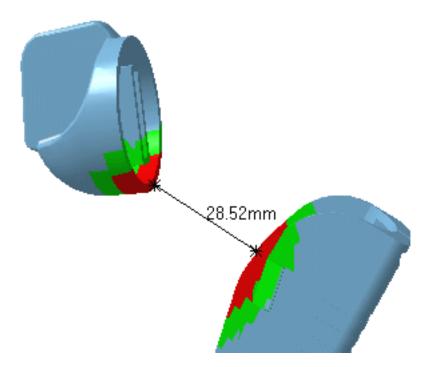
9. Click on Apply.

A progress bar is displayed letting you monitor and, if necessary, interrupt the calculation (by pressing Cancel).

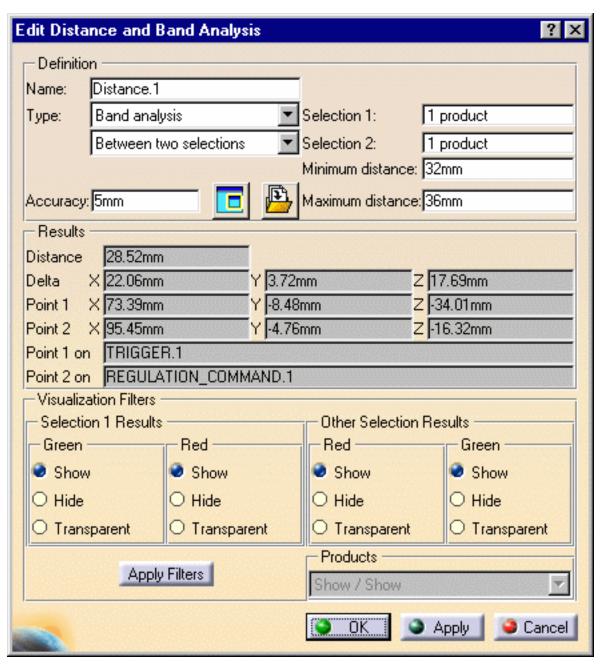


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Red surfaces identify the areas where the minimum distance between the products is less than the specified minimum distance.



The Edit Distance and Band Analysis dialog box expands to include filters letting you better visualize the green and red surfaces.

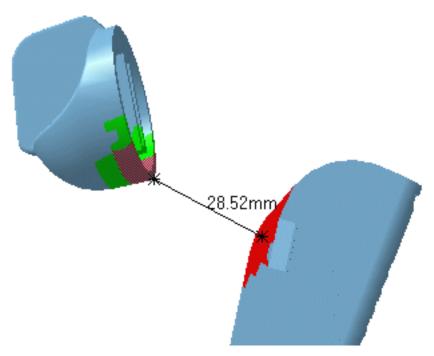


10. Set the appropriate options to show, hide or make transparent the green and red surfaces corresponding to band analysis results for components in selection 1.

11. Repeat for other components, i.e. those measured against selection 1.

In the "Inside one selection" computation type, visualization filters are valid where two products only are selected.

In our example, we set Selection 1 (the Trigger) results in green to Hide and Other Selection (the Regulation_Command) results in red to Transparent.



12. Click OK in the Edit Distance and Band Analysis dialog box when done.







Arc through 3 Points Analysis



This command is used to measure the length, radius and angle of an arc drawn through three points.

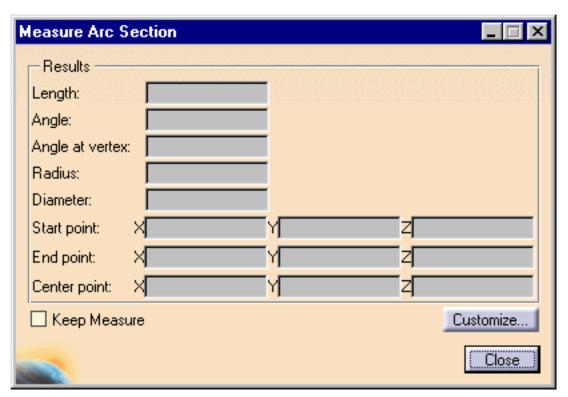
1. Select the Arc through 3 Points icon



in the Manikin Workspace

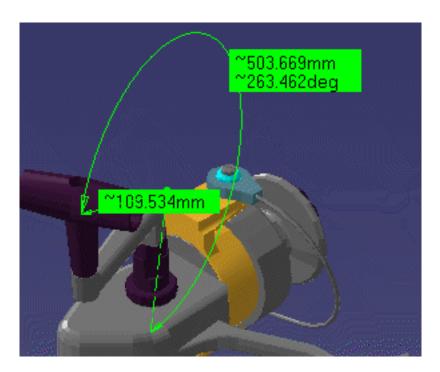
Analysis toolbar.

The Measure Arc Section dialog box appears.

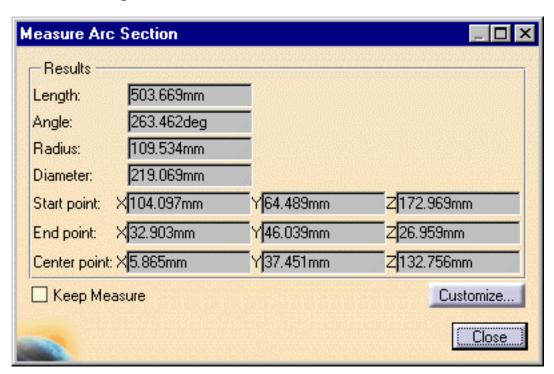


2. On the geometry in the 3D view, use your mouse to position the start point, click, and then repeat for the center and end points.

When you finish clicking the last point, the arc appears on the geometry:



and the dialog box fills with data:





If you opt to keep the measurement, the data appears in the specification tree under the applications section.



For more information about this command, see the *DMU Space Analysis User's Guide*.









Measure Between Analysis



This procedure explains how to use the Measure Between command to measure distances and angles between geometrical entities (surfaces, edges, vertices and entire products) or between points.

This procedure has two parts:

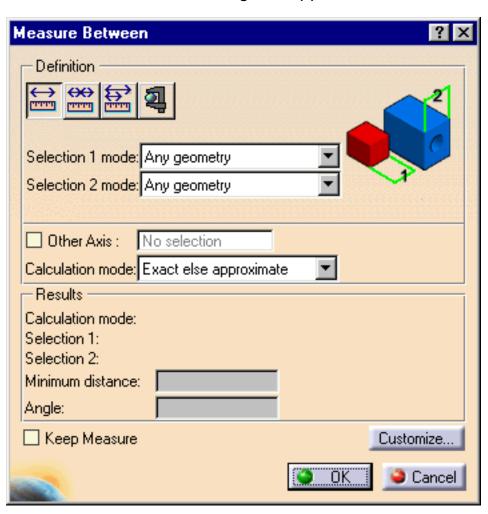
- Using Measure Between
- Customizing Your Measure



Using Measure Between

 Click on the Measure Between icon Analysis toolbar.

The Measure Between dialog box appears.



Set the desired measure type by pressing one of the buttons in the 2. Definition section of the dialog box.

When you press	You see	It represents
←→	2	Between (default type): Measures distance and angle between selected items
	1 2	Chain: Lets you chain measures with the last selected item becoming the first selection in the next measure.
₩	12	Fan: Fixes the first selection as the reference so that you always measure from this item

3. Use the pull down menus to set the desired measure mode for both selection 1 and selection 2.

The possible modes are:

Any geometry (default mode):

Measures distances and angles between defined geometrical entities (points, edges, surfaces, etc.).

Note: The Arc center mode is activated in this selection mode. This mode recognizes the axis of cylinders and lets you measure the distance between two cylinder axes, for example.

Any geometry, infinite:

Measures distances and angles between the infinite geometry (plane or line) on which the selected geometrical entities lie. The Arc center mode is activated and this mode also recognizes cylinder axes. For all other selections, the measure mode is the same as any geometry.

Picking point:

Measures distances between points selected on defined geometrical entities. Always gives an approximate measure. **Point only:**

Measures distances between points. Dynamic highlighting is limited to points.

Edge only:

Measures distances and angles between edges. Dynamic highlighting is limited to edges and is thus simplified compared to the Any geometry mode. All types of edges are supported.

Surface only:

Measures distances and angles between surfaces. Dynamic highlighting is limited to surfaces and is thus simplified compared to the Any geometry mode.

Picking áxis:

Measures distances and angles between an entity and an infinite line perpendicular to the screen.

Simply click to create an infinite line perpendicular to the screen.

Intersection:

Measures distances between intersection points between two edges or an edge and a surface. In this case, two selections are necessary to define selection 1 and selection 2 items.

Edge limits:

Measures distances between endpoints or midpoints of edges. Endpoints only are proposed on curved surfaces.

Arc center:

Measures distances between the centers of arcs.

Coordinate:

Measures distances between coordinates entered for selection 1 and/or selection 2 items.

4. Set the calculation mode.

The choices are:

Exact else approximate (default mode):

Measures access exact data and wherever possible true values are given. If exact values cannot be measured, approximate values are given (identified by a ~ sign).

Exact:

Measures access exact data and true values are given. Note that you can only select exact items in the geometry area or specification tree.

In certain cases, in particular if products are selected, a warning dialog box informs you that the exact measure could not be made.

Approximate:

Measures are made on tessellated objects and approximate values are given (identified by a ~ sign).

5. Do you have a local V5 axis system?

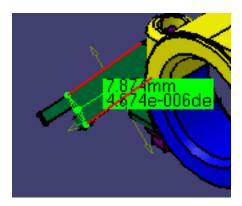
- If YES, check the Keep Measure box.
- If NO, leave it blank.

- **6.** Do you want the measurement results to remain on the geometry you have seen them in the dialog box?
 - If YES, check the Keep Measure box.
 - If NO, leave it blank.
- 7. On the geometry, click to select a surface, edge or vertex, or an entire product (Selection 1).
- **8.** Click to select another surface, edge or vertex, or an entire product (Selection 2).

In the Results area of the box, the type of geometry selected (e.g., line) appears as well as its location on the part.

Calculation mode: Exact
Selection 1: Line on Pad.2...Oil_Dipper.1
Selection 2: Line on Pad.2...Oil_Dipper.1
Minimum distance: 7.874mm
Angle: 4.674e-006deg

The measurement also appears on the geometry. The selected geometry appears highlighted.



- **9.** (Optional) You can repeat steps 2-8 for other geometries.
- 10. Click OK to end the session.

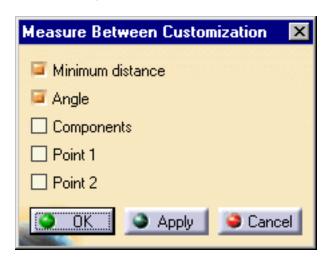
The measurements will disappear from the geometry, unless you selected the Keep Measure box.

Customizing the Measurements

This sub procedure can be performed at any time during steps 2-8, above. Performing this step enables you to see additional data about the measurements you are taking.

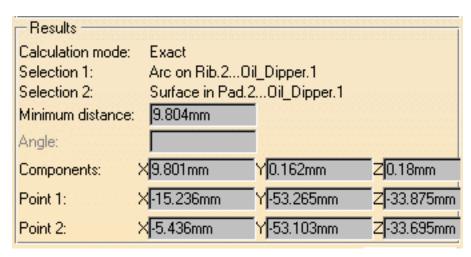
1. Select the Customize button on the dialog box.

The dialog box shown below appears (the default values are checked)



2. Check any additional values you wish to see and click the OK button.

Additional results appear in the Measure Between dialog box. An example appears below:





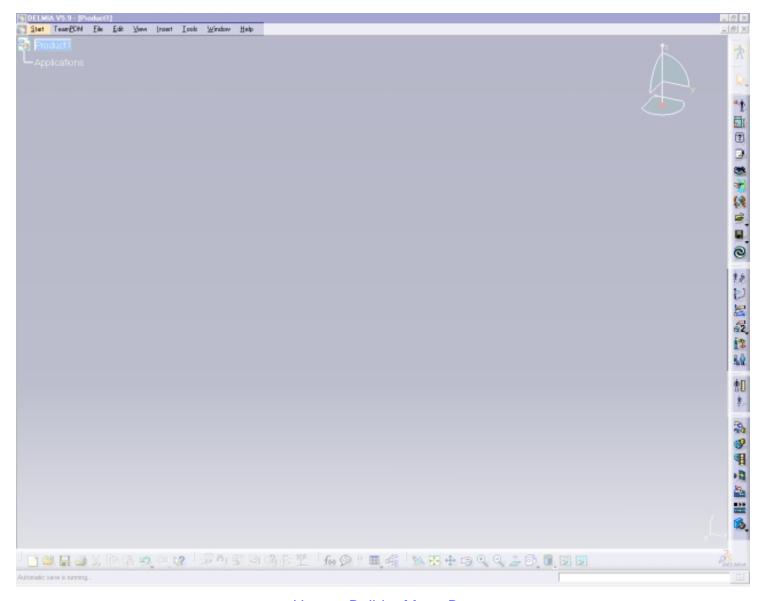




Workbench Description

The Human Builder Version 5 application window looks like the image below.

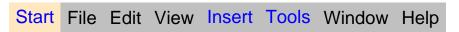
Click the hotspots to see the related documentation.



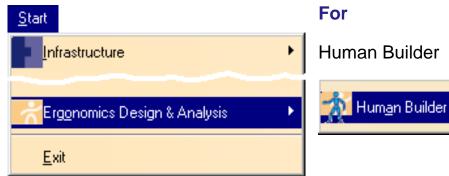
Human Builder Menu Bar Manikin Tools Toolbar Manikin Posture Toolbar Manikin Workbench Access Toolbar Manikin Simulation Toolbar Manikin Workspace Analysis Toolbar

Human Builder Menu Bar

The various menus and menu commands that are specific to Human Builder are described below.



Start



See

Human Builder Standard
Manikin
Creation

Insert



For See

New Constraint

Managing

Multiple

Constraints

Attach/Detach Attaching an

Object to a Manikin Segment

New Manikin Standard

Manikin Creation

Tools

For	See
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Descriptions Assigning Descriptions (Memos) Vision Using the Vision **Function** Reach Envelope Using the Reach Envelope Update Managing Multiple Constraints Open Safework Library Library Management Save in Safework Library Library Management Convert Library to Catalog Manikin Catalog Management Posture Editor Using the **Posture Editor** Standard Pose **Applying** Standard Poses





Manikin Tools Toolbar

This toolbar contains the following tools:









See Standard Manikin Creation



See Managing Multiple Constraints



See Changing Manikin Display Attributes



See Assigning Descriptions (Memos)



See Using the Vision Function



See Using the Reach Envelope



See Attaching an Object to a Manikin Segment



See Library Management



See Manikin Catalog Management



See Library Management



See Manikin Catalog Management



See Managing Multiple Constraints







Manikin Posture Toolbar

This toolbar contains the following tools:









See Using the Posture Editor



See Using Forward Kinematics





See Using the Inverse Kinematics Segment Frame Mode and Worker Frame Mode





See Using the Inverse Kinematics Segment Frame Mode and Worker Frame Mode

See Redefining the Segment Offset for Inverse Kinematics

See Using the Inverse Kinematics Behavior Function



See Interactive Positioning with the Reach Command



See Interactive Positioning with the Reach Command



See Using the Place Mode



See Applying Standard Poses







Manikin Workbench Access Toolbar

This toolbar contains the following tools:





Human Measurements Editor: Basic Tasks



Human Posture Analysis: Basic Tasks







Manikin Simulation Toolbar

This toolbar contains the following tools:







See Using the Shuttle Command



See Using the Simulation Command



See Using the Compile Simulation Command



See Using the Replay Command



See Using the Track Command



See Using the Play Simulation Command



See Using Global Collision Detection



See Using Global Collision Detection



See Using Global Collision Detection







Manikin Workspace Analysis Toolbar

This toolbar contains the following tools:





See Distance and Band Analysis



See Arc Through 3 Points Analysis



See Measure Between Analysis





Glossary

under construction

A

abduction The movement of a limb away from the median, or

midline, of the body.

adduction The movement of a limb toward the median, or midline,

of the body.

ambinocular vision The zone defined by the union of two shapes that

define the right and left monocular visions. The entire

field of vision that can be seen with both eyes.

angular limitations The manikin's joint limitations.

anthropometry The study of proportional relationships between the

shape, weight and size of body segments.

B

binocular vision The zone defined by the intersection of the two shapes

that define the right and left monocular visions. The zone that can be seen by both the right and left eyes.

blind cone The 3D graphical representation of the mathematical

model bordering the eye's blind spot. Available for

monocular vision only.

blind spot The area of the eye where the optic nerve is attached.

C

center of gravity That point at the exact center of an object's mass.

central cone The 3D graphical representation used to create a model

that represent the mathematical model of the central

point.

central spot of vision Corresponds to the focus location. The end of the line

of sight.

constraint The relationship of a manikin to its surrounding

environment.

coronal axis The vertical axis perpendicular to the transverse plane

that is dividing the body into superior and inferior

portions.

COG See center of gravity.

D

degree(s) of freedom Each linear or rotary movement along or about a given

axis. Manikin segments can have up to three DOFs.

depression Shoulder adduction movement.

DOF Degree(s) of freedom

dorsiflexion Ankle upward flexion movement

E

elevation Shoulder abduction movement

eversion Ankle abduction movement

extension The act of straightening a limb at a joint.

F

father product The product the manikin will be attached to in the

specification tree. It can be the root product or any other

product under the root.

flexion The act of bending a limb at a joint, thus forming an

angle.

fovea

The fovea of the eye is a small pit in the center of the retina that contains cones but no rods. When looking directly at a point, its image falls on the fovea. The fovea covers an angle of about 2 degrees. Visual acuity is normally greatest for images on the fovea.

Н

hyperextension

Extending the extremity beyond anatomical position.

inversion

Ankle adduction movement

lateral rotation

The rotation of a body part away from the median, or midline, of the body.

left monocular vision

The field of vision of the left eye only

line of sight

Designed to facilitate the manipulation of the manikin's field of vision. It can be selected as any other segment of the manikin.

M

manikin

A virtual human.

medial rotation

The rotation of a body part toward the median, or midline, of the body.

monocular vision

The field of vision from one eye only.

P

peripheral cone

The 3D graphical representation of the mathematical model bordering the human field of vision. The tip of the cone corresponds to the origin of the line of sight, i.e. the eyes.

plantar flexion Ankle flexion movement in the direction of the sole of

the foot.

ponctum proximum The minimum accommodation distance or depth of

vision; the nearest point that can be seen clearly.

ponctum remotum The maximum accommodation distance of the vision;

the crystalline relax position for objects located from five

meters to infinity.

postural score A function used to evaluate the manikin's posture.

posture The position of the whole manikin (global posture) or of

parts of the manikin such as hand posture (local

posture).

product tree Process/ Product/ Resource (PPR) tree. The PPR tree

is a 2D view of the process. It lists all the products and resources required to make a specific product. It also lists, in hierarchical form, the actions required to

perform the process that produces the product.

pronation The movement of the forearm so that the hand rests

palm down on a surface.

R

radial deviation Wrist adduction movement (toward the radial bone, on

the thumb side of the arm).

range of motion The range of translation and rotation of a joint for each

of its degrees of freedom.

reach envelope A surface that represents all the possible surfaces the

manikin can reach using only the arm and forearm. The

motion starts at the shoulder.

right monocular vision The field of vision of the right eye only.

rotation A circular or turning movement of a body part, such as

the back or head, around its axis.

sagittal axis Horizontal axis in the anterior-posterior orientation. This

axis is perpendicular to the coronal plane that is dividing

the body into anterior and posterior portions.

segment A section of the manikin such as forearm, neck, thigh,

ankle, etc.

shuttle

specification tree Area of the document window reserved for viewing the

design specifications of a part, presented in the form of

a tree structure.

stereo vision The vision of both left and right eyes in two distinct

windows displayed side by side. This type of display is use for special needs such as vision in a stereo head

mounted display.

supination The movement of the forearm so that the hand rests

palm up on a surface.

Т

transversal axis Horizontal axis in the left-right orientation. This axis is

perpendicular to the sagittal plane that is dividing the

body into left and right portions.

U

ulnar deviation Wrist abduction movement (toward the ulna bone, on

the little finger side of the arm).

V

visual field The entire area that can be seen when the eye is

forward, including peripheral vision.

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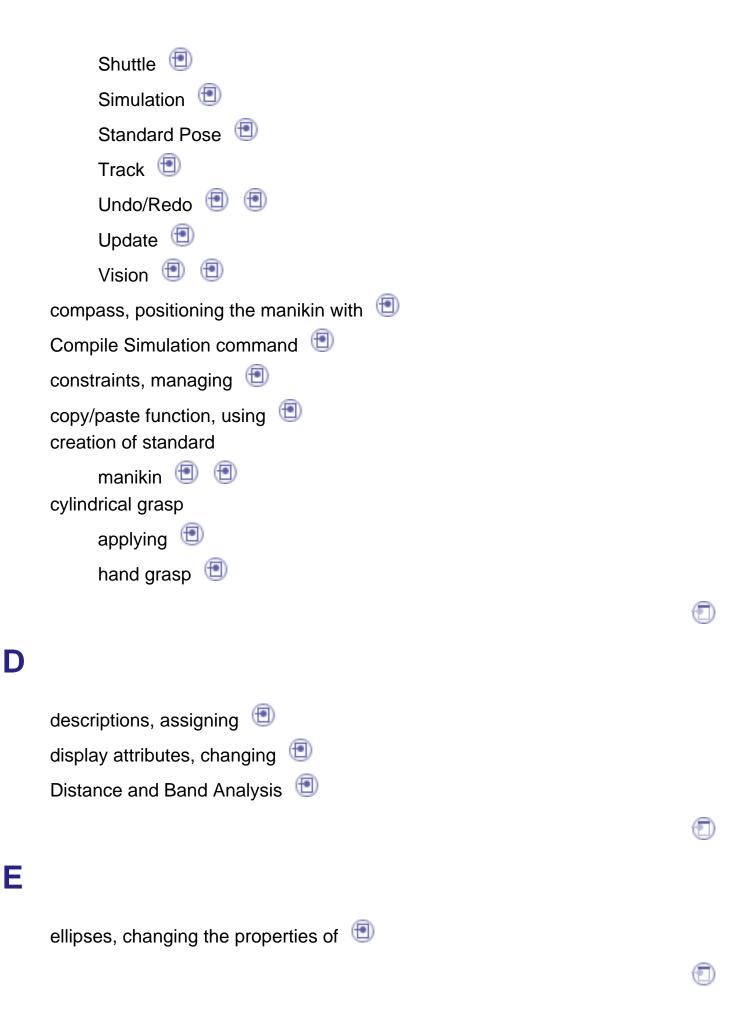
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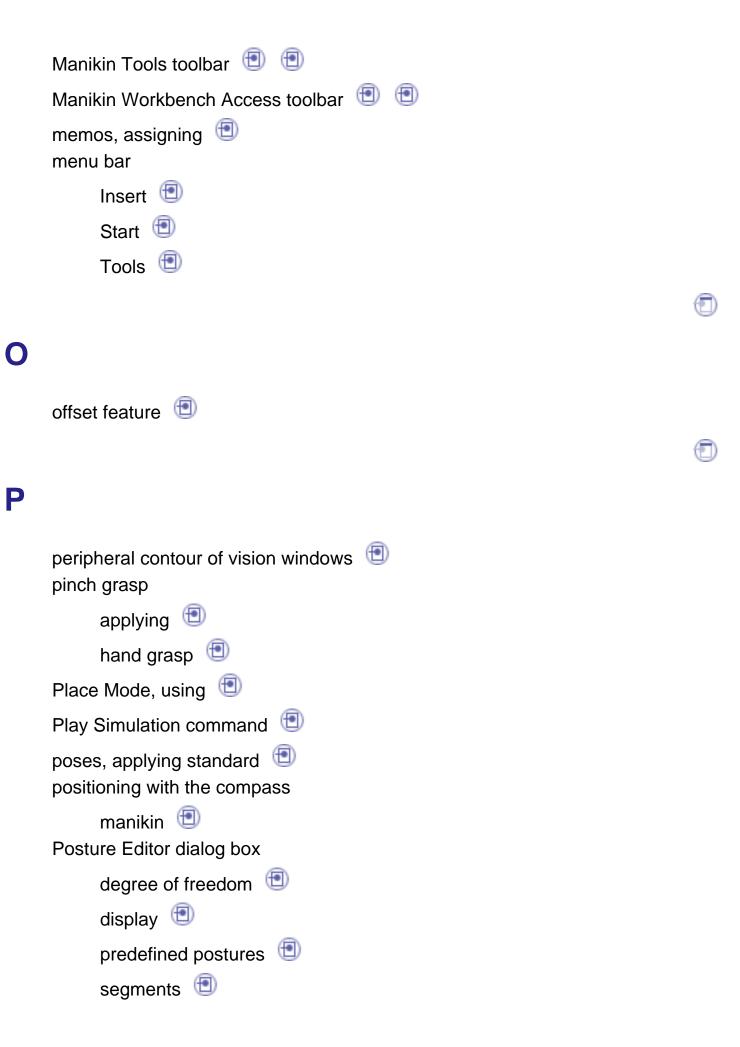


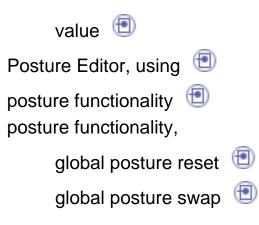
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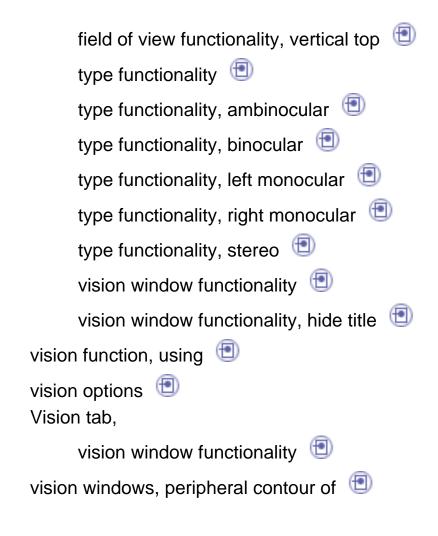
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whole manikin graphical properties workbench description

