

Human Posture Analysis



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Preface

Human Posture Analysis 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 Posture Analysis focuses on how human posture can affect task performance by analyzing local and global postures, preferred angles, and comfort.

Human Posture Analysis permits users to quantitatively and qualitatively analyze all aspects of manikin posture. Whole body and localized postures can be examined, scored, iterated, and optimized to determine operator comfort and performance throughout the complete range of task motion in accordance with published comfort databases.

User-friendly dialog boxes provide postural information for all segments of the manikin. Color-coding techniques ensure that problem areas can be quickly identified and iterated to optimize posture. Human Posture Analysis allows users to create specific comfort and strength libraries to meet the needs of individual applications.

[How to Use this Guide](#)
[Where to Find More Information](#)

How to Use this Guide

This book describes how to use the Human Posture Analysis 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 Posture Analysis 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 Posture Analysis and related products.



Where to Find More Information

Prior to reading this book, we recommend that you read the *Human Builder User's Guide*. We also recommend:

- *Human Measurements Editor*
- *Human Activities Analysis*
- *Conventions*



What's New?

Enhanced Functionalities

Multiple DOF coloring in the postural score analysis

Capability to color the segments based on the preferred angles data of many different DOFs.

Preferred angles Mirror/Copy, Reset, Swap

Capability to copy and modify more than one set of preferred angles in a convenient way.

Getting Started

This tutorial provides an overview of Human Posture Analysis functionalities. It provides a step-by-step scenario showing you how to use key functions.

The task described in this section is:

[Creating a Manikin](#)

Creating a Manikin



If you do not have an active product with a manikin, follow these steps to create a manikin.

If you already have an active product containing a manikin, proceed to step 4.



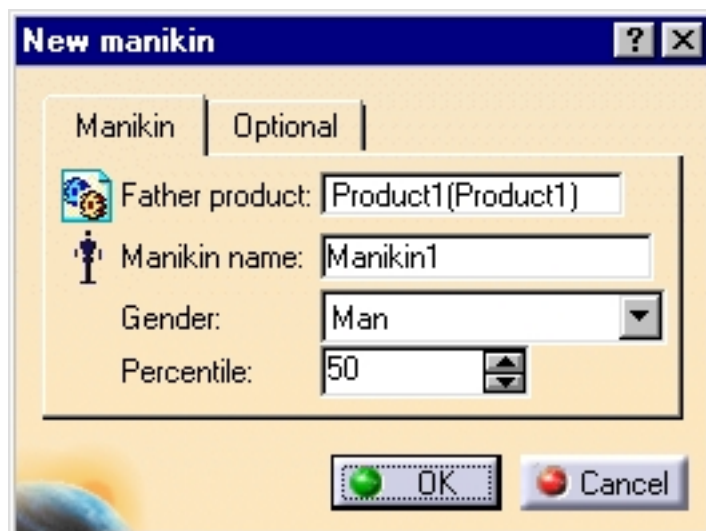
1. Go to the Start menu (see below).



2. From the Start menu, select Ergonomics Design & Analysis -> Human Posture Analysis to create a new manikin.



3. Under the Manikin tab, select the father product, enter a name for the manikin, set the gender, and the percentile.



Under the Optional tab, set the population, model-type, referential, and choose whether or not to set the referential to a compass location.



4. If you already have an active product containing a manikin, select the manikin or double-click a segment.



Basic Tasks

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

Selecting or Editing the DOF (Degree of Freedom)

Displaying and Editing Angular Limitations

Angular Limitations Undo/Redo

Direct Kinematics

Selecting Manikin Display Attributes

Library Management

Locking and Unlocking DOFs

Selecting or Editing the DOF (degrees of freedom)



This procedure describes how to select or edit the manikin's DOF (degree of freedom).



The DOF icon represents the movement being edited. For example, the DOF can be flexion/extension, abduction/adduction, rotation, etc.



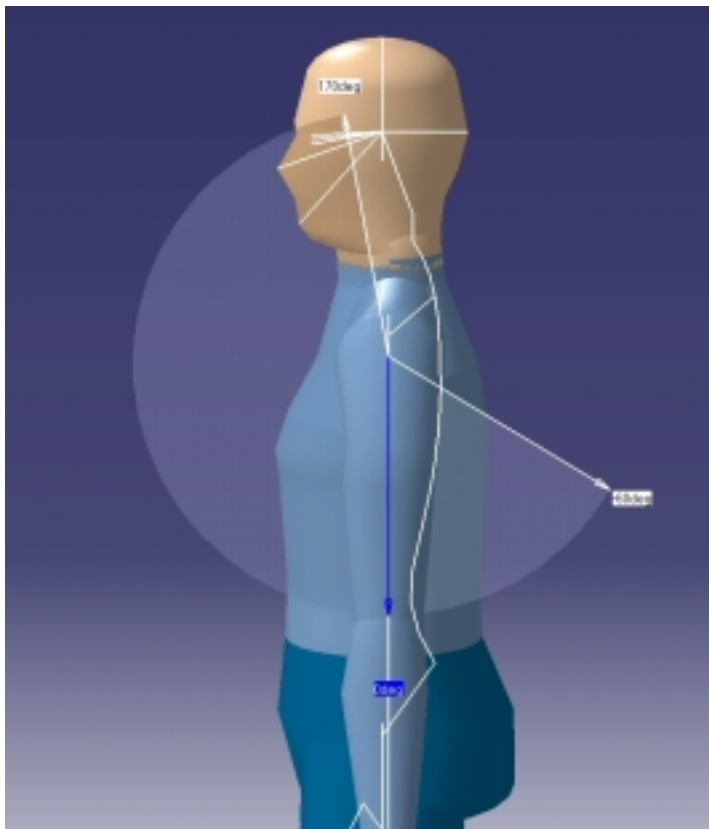
1. Click on the Activate DOF icon  to access the list of all available

DOFs corresponding to the active segment (maximum of three).

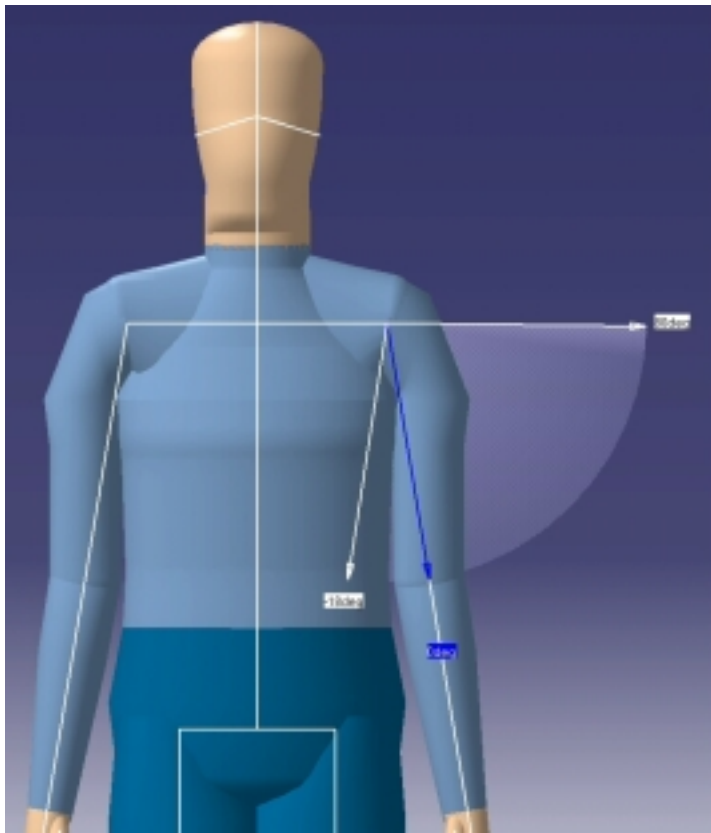
2. Click one icon to select the corresponding DOF.

3. The system automatically modifies the viewpoint of the segment by a zoom corresponding to the DOF being selected.

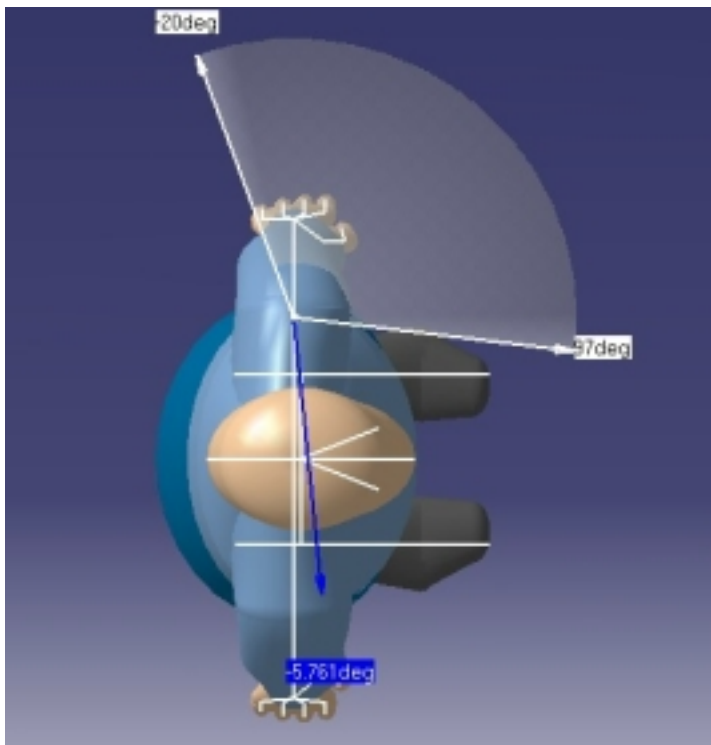
DOF1



DOF2



DOF3






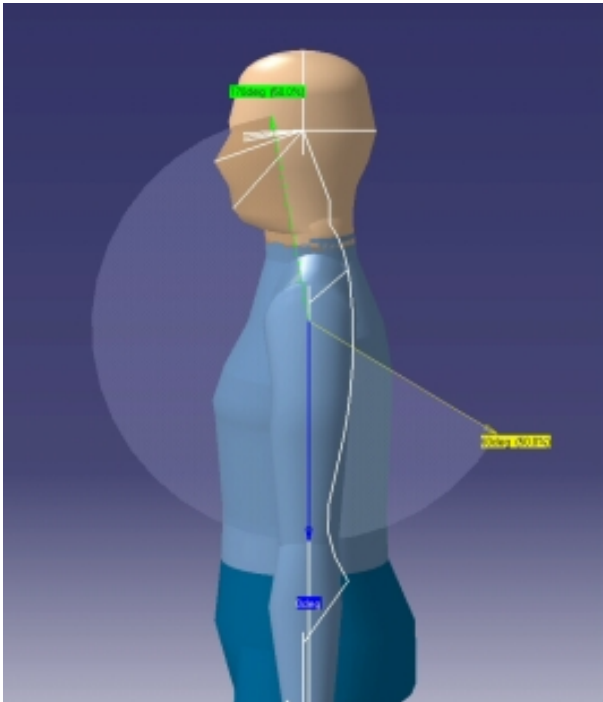
Displaying and Editing Angular Limitations



This procedure describes how to display the values of the angular limitations for the DOF (degrees of freedom) that is currently active. It also describes how to set angular limitations as a percentage.



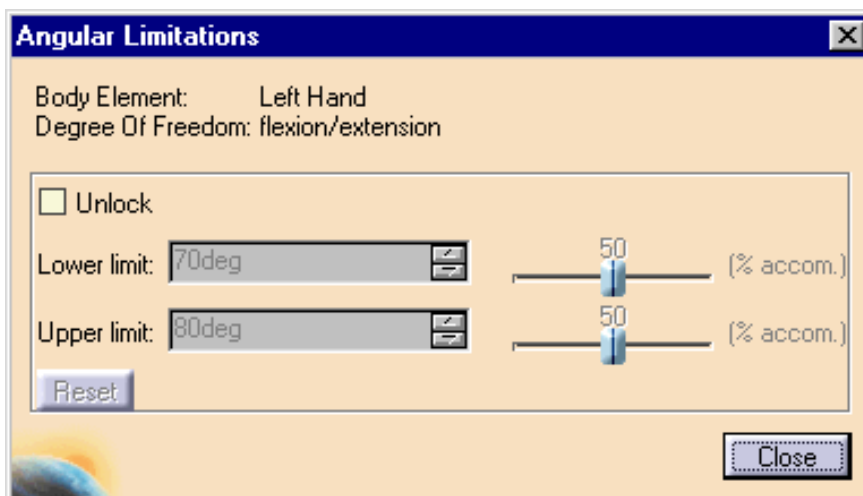
1. Select the Edit Angular Limitations icon  and then select a segment. The limits arrows are displayed. These arrows are set by default at the mean values of movement limits. The colored region represents the total range of motion for that DOF.



- The green arrow shows the upper limit.
- The yellow arrow shows the lower limit.
- The blue arrow is used to change the position of the active segment.

Selecting another segment while the command is running opens the angular limitations for the new segment and closes them for the previous one.

2. When you double-click the limits arrows, the Angular Limitations dialog box appears (see below).



Using this dialog box, you can unlock the angular limits and modify the values directly with the sliders, the spinners, or by using the left mouse button to manipulate the spinner arrows.


- Select the Reset button to return to the default values.
- Select the Close button to exit the dialog box.

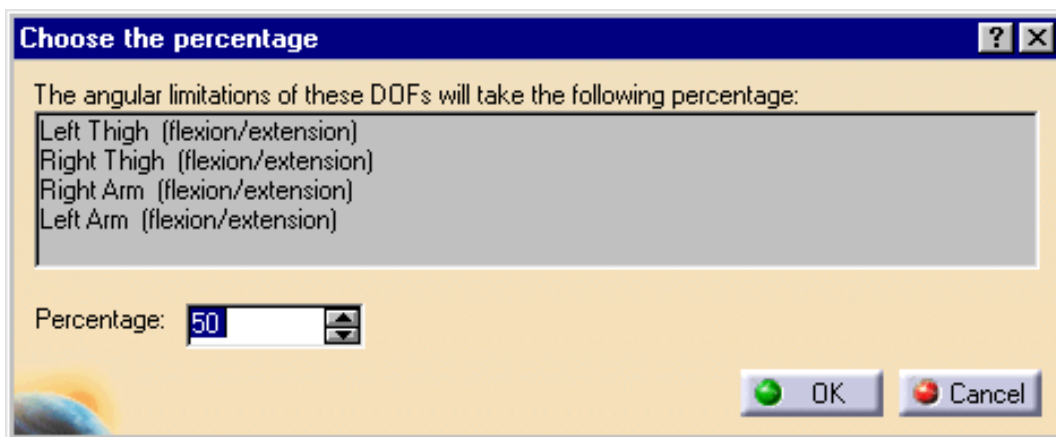
3. Select the Edit Angular Limitations icon  to close the command and hide the angular limits arrows.

Setting angular limitations as a percentage

With this command, you can change the angular limitations of one or many degrees of freedom at once according to the percentage you choose.

This percentage value represents the desired portion of population that must be able to reach the limit. At manikin creation, all angular limitations are set to limits that 50% of the population can reach. Using the Set Angular Limitations as a Percentage command, you may want to restrict (i.e., accommodate a narrower percentage of population) or widen (i.e., accommodate a larger percentage of population) these limits for a specific requirement of the population study.

1. Select a segment of the manikin. Hold down the Ctrl key on the keyboard to select more than one segment.
2. Select the Set Angular Limitations as a Percentage icon.  The following dialog box is displayed:

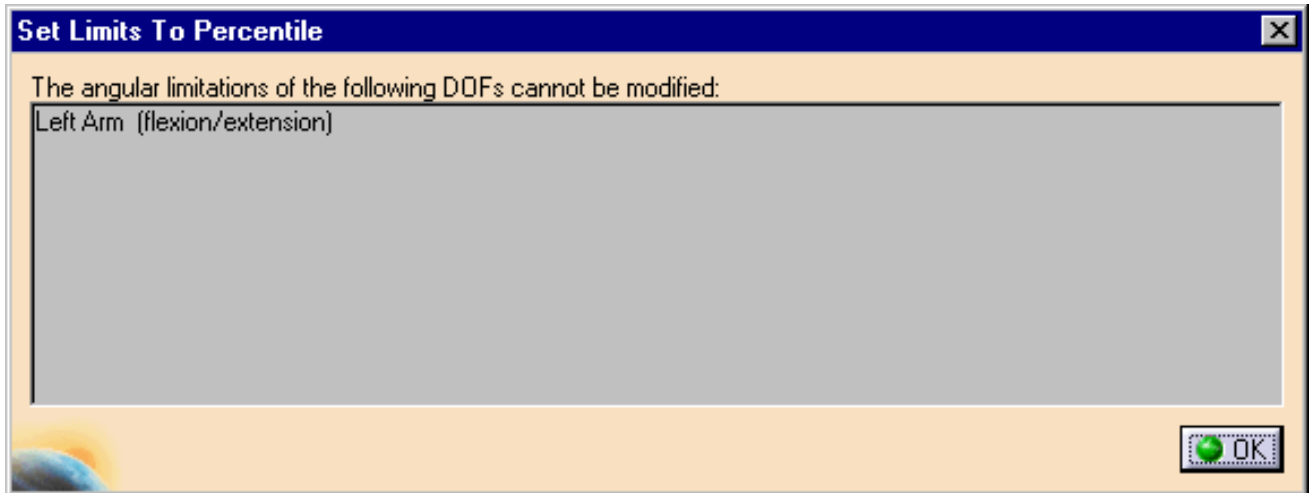


A read-only text field show the currently selected segments (or lines of sight) and their current degree of freedom.


3. Choose a percentile between 0 and 100 with the spinner.
4. Click on OK to confirm the modification of press Cancel to cancel the action. By clicking OK, both limits (min and max) of all degrees of freedom selected will take the specified percentage.




The modification cannot be done if the selected degree of freedom is locked with a value that would be outside the new limits. In this case, the following dialog box is displayed:



Angular Limitations Undo/Redo

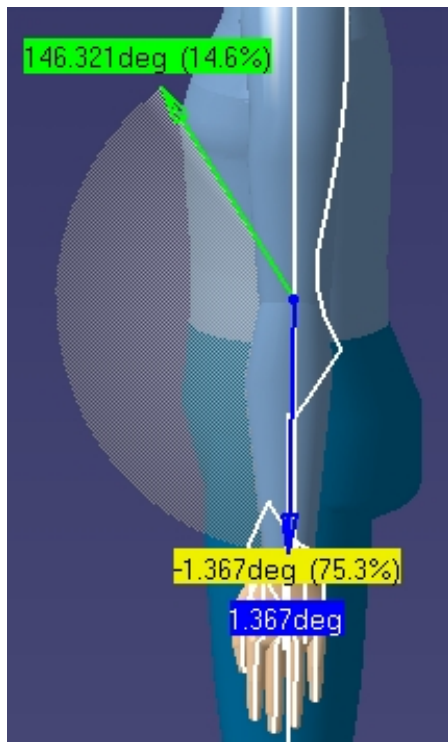
 This procedure describes how to use the Undo/Redo feature with angular limitations. Undo/Redo allows you to reverse (cancel) the last angular limitation parameters applied to the manikin.

Undo

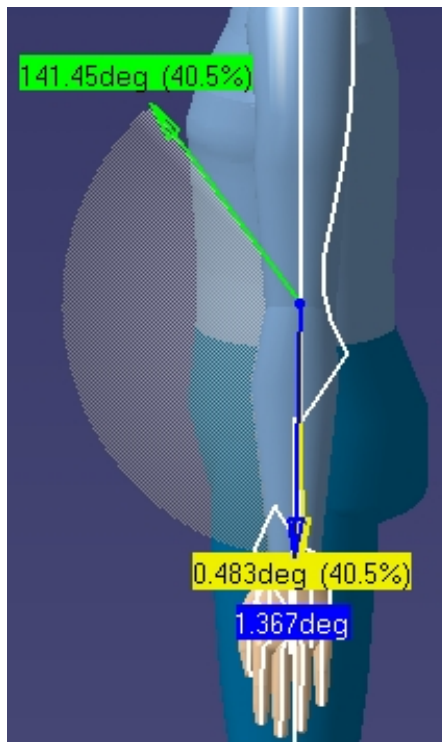
Click the Undo icon  in the Standard toolbar to execute the Undo command. To load a library of angular limitations, see the library management task, [Load Angular Limitations](#).

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

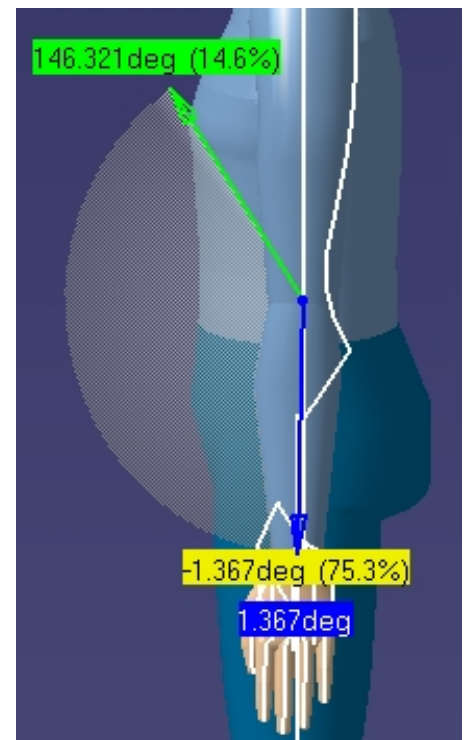
Initial angular limitations



New angular limitations applied




Undo command applied



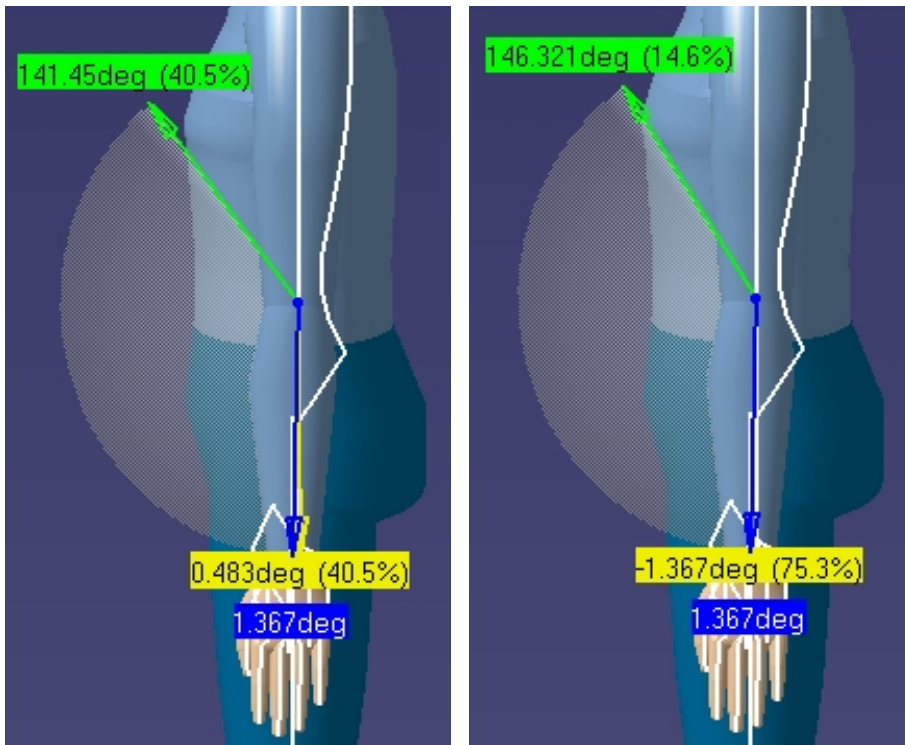
Redo


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 restore the last angular limitation parameters by invoking the Undo  command.

Redo applied

Undo applied



 In the current version of the Human Posture Analysis product, the angular limitations Undo/Redo applies to the following operations:

- Applying a set of angular limitations from a library .



Direct Kinematics



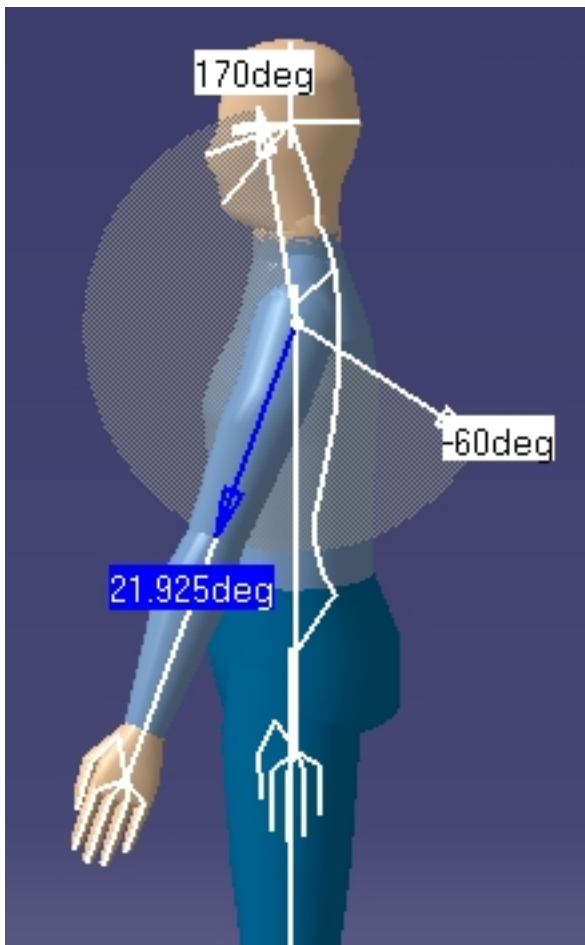
This procedure describes how to manipulate manikin segments.



When you select the Edit Angular Limitations icon  or the Edit Preferred

Angles icon  a blue arrow is displayed. You can change the position of

the active segment by manipulating the blue arrow.



The cursor changes to pickable  when it is moved over the blue arrow.

Press and hold down the left mouse button to manipulate the blue arrow and the segment.






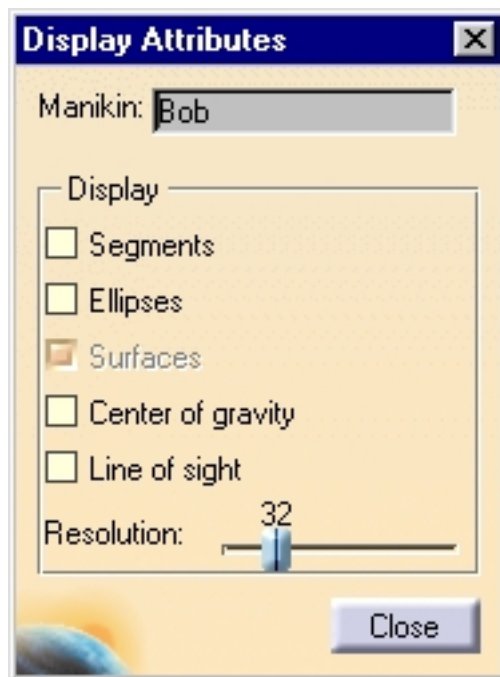
Selecting Manikin Display Attributes



This procedure describes how to access the various display attributes available for your manikin.

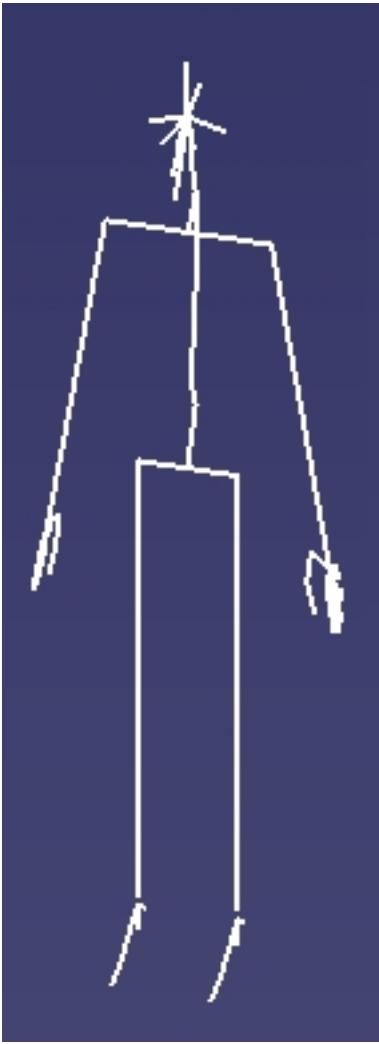


1. Select the Display Attributes icon . The Display Attributes dialog box is displayed.

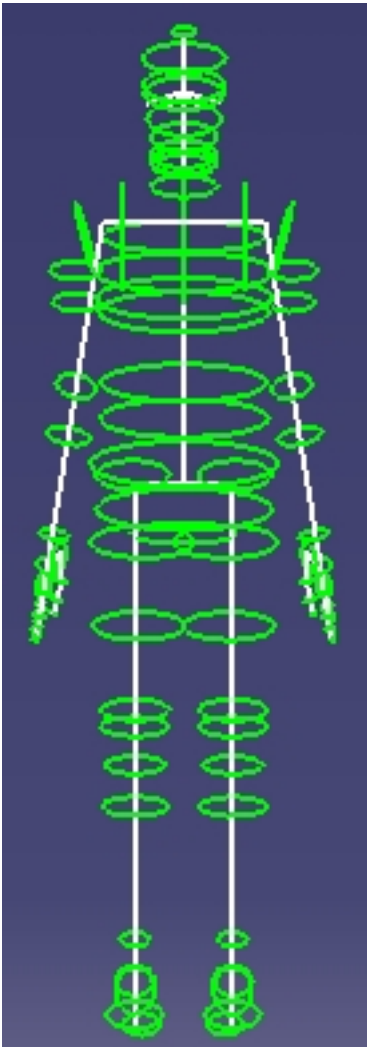


2. The manikin can be displayed using three different types of attributes: segments, ellipses, and surfaces. To change the manikin display, select the attribute type by activating the corresponding toggle button.
3. Various attribute display types can be selected at the same time.

Segments



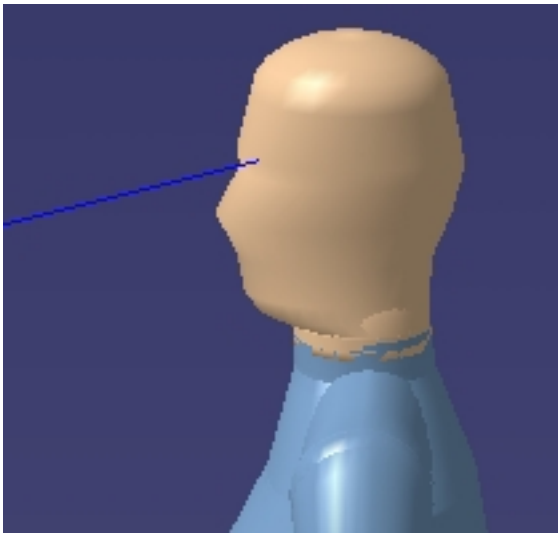
Ellipses



Surfaces



4. The line of sight is designed to facilitate the manipulation of the manikin's field of vision. It can be selected as any other segment of the manikin.



5. The center of gravity cannot be selected and manipulated. If you manipulate any segment of the manikin, the center of gravity is dynamically updated.



6. By default, the manikin display is set to surfaces with a resolution of 32. The range of this parameter is from 4 to 128.

Surface resolution: 4



Surface resolution: 128



Library Management



This procedure describes the commands that allow you to create, read, and update angular limitations and preferred angles libraries.



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

The two library management commands are:

[Load Angular Limitations](#)

[Save Angular Limitations](#)




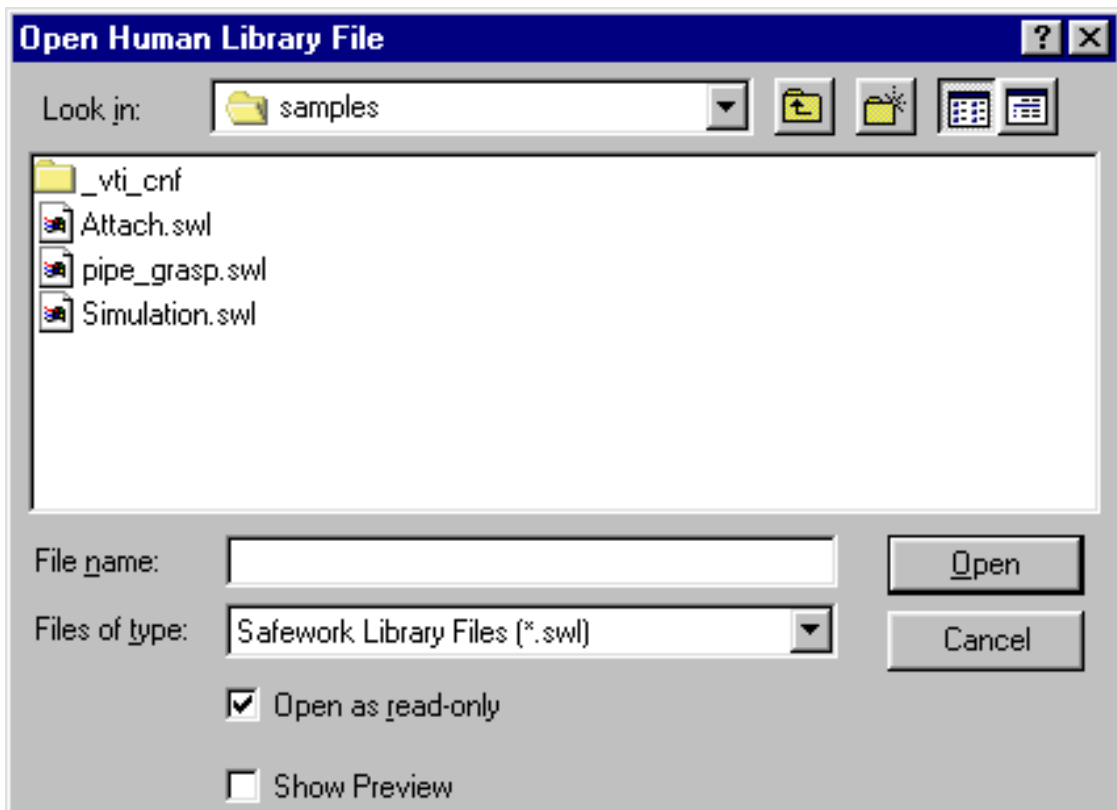
Load Angular Limitations



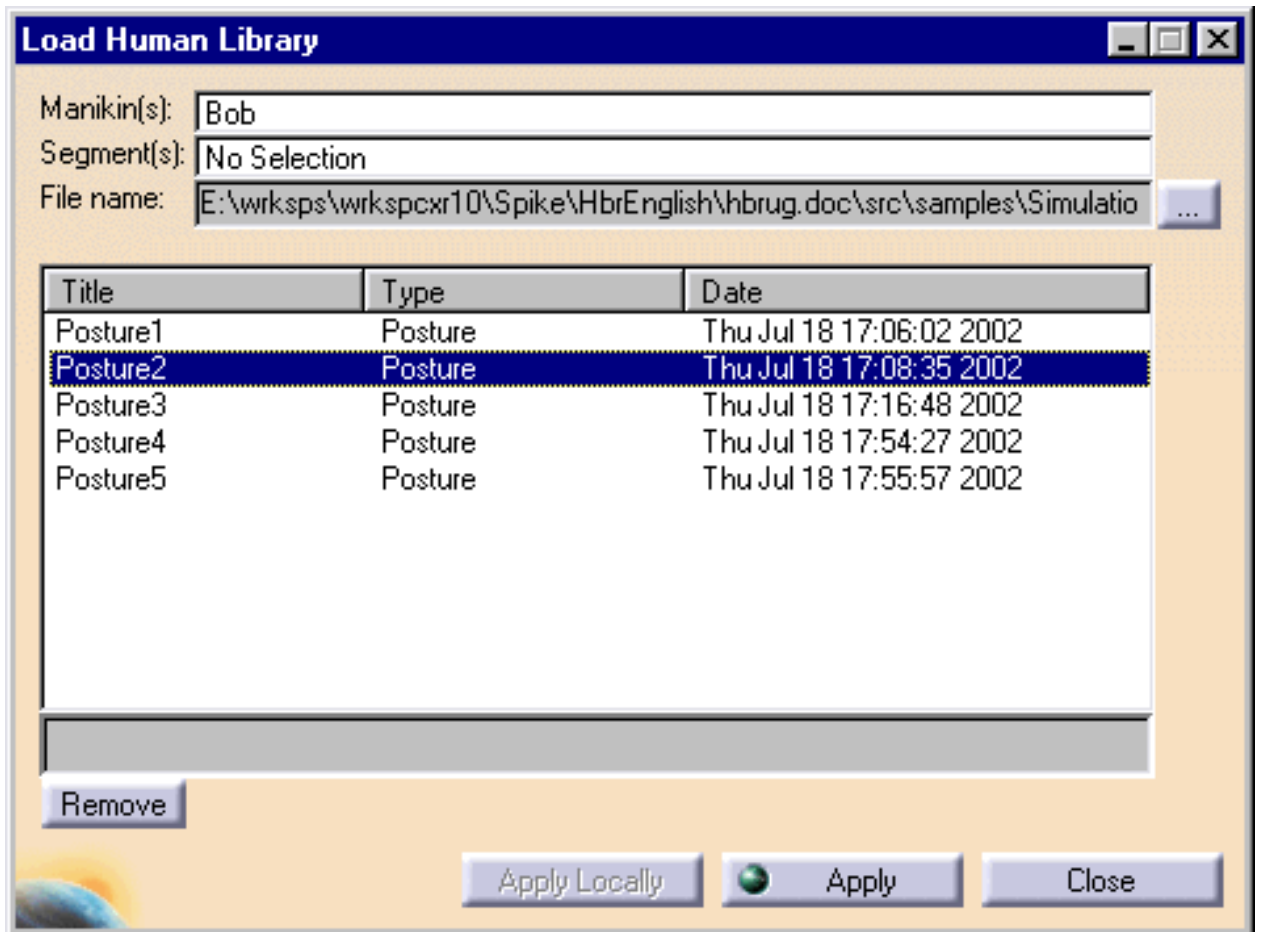
This command allows you to load an existing library file.





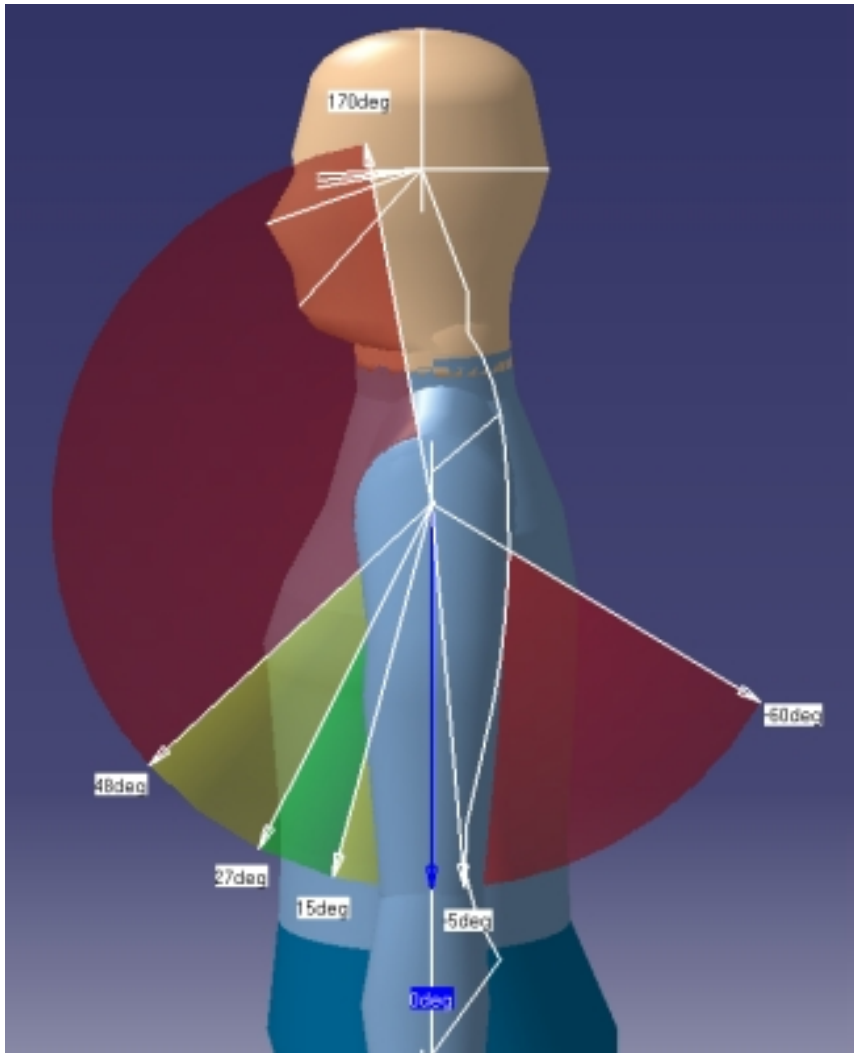
1. Select the Load Library icon . The Open Human Library File dialog box is displayed.



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



3. Select an item and click Apply (or double-click the item). The progress indicator at the bottom of the window shows the load action. Depending on the type of item selected, select the Edit Angular Limitations icon  or the Edit Preferred Angles icon  to display the newly loaded values.



4. Select an item in the list and click on Remove to remove the item.
5. Select Close to exit from the dialog box.



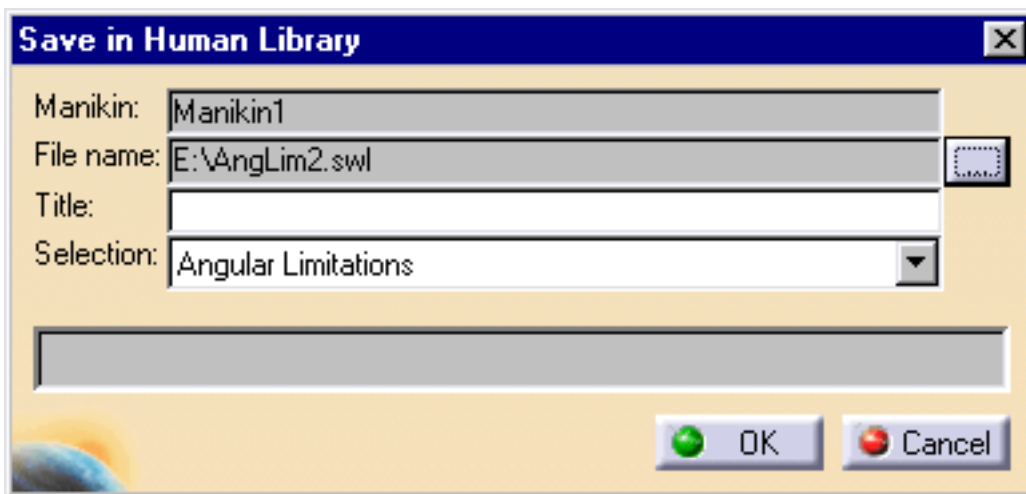
Save Angular Limitations Command



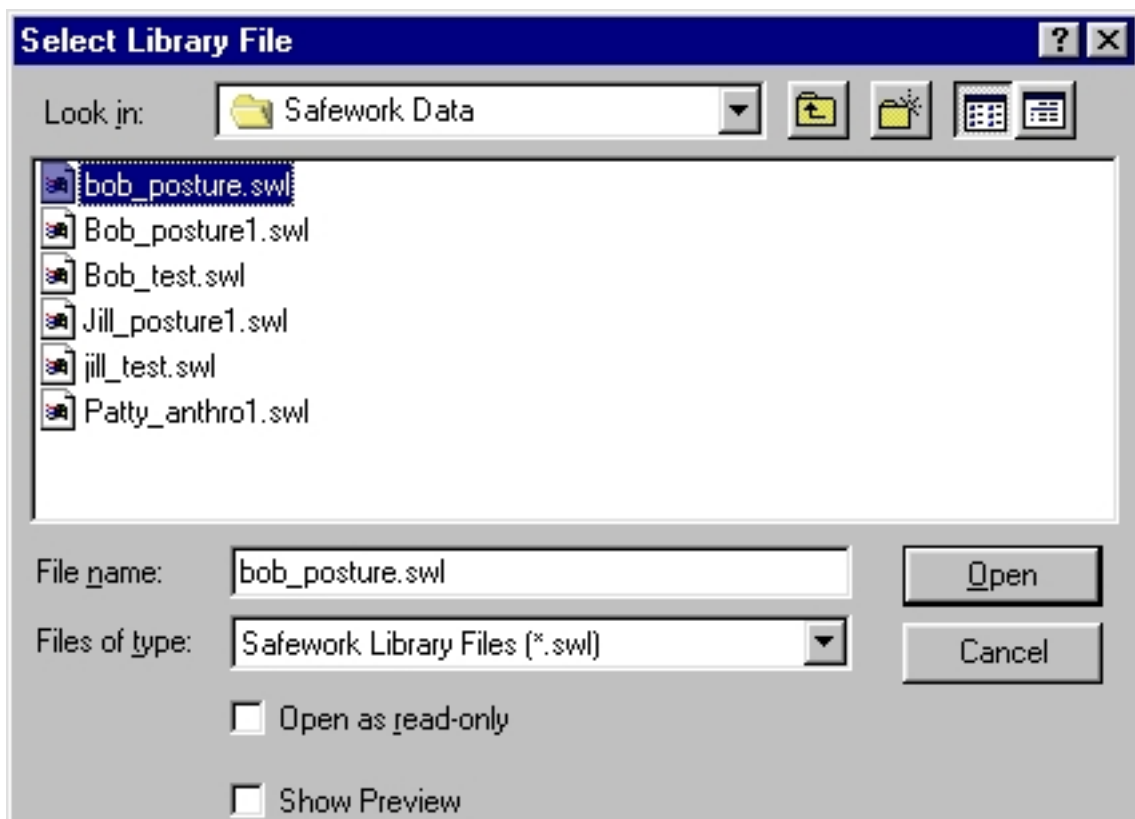
This command allows you to save the preferred angles of the angular limitations in a library file.



1. Select the Save in Library icon . The Save in Human Library dialog box is displayed.



2. Select the Browse icon.  The Select Library File dialog box is displayed.



3. Enter a file name or select one and click Open. If the file does not exist, a confirmation window is displayed to create it.
4. In the Save in Human Library dialog box, select the type to be saved from the Selection choices.
5. Click OK. The file is saved automatically and the progress indicator shows the save action. If the description is missing, an error window is displayed.



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



Locking and Unlocking Degrees of Freedom (DOF)



This task describes how to lock and unlock individual manikin degrees of freedom. Locking a degree of freedom means that the corresponding segment will not move by this DOF, either in forward kinematics or in inverse kinematics.

The Lock/Unlock command will lock/unlock the current active DOF on the selected segments. The current active degree of freedom is indicated by the DOF icon.



It is possible to lock/unlock the entire manikin for one particular degree of freedom if the Body node is selected in the specification tree when activating the lock/unlock command.

For more information on locking and unlocking degrees of freedom, read the following sections:


- [Locking DOFs](#)
- [Unlocking DOFs](#)



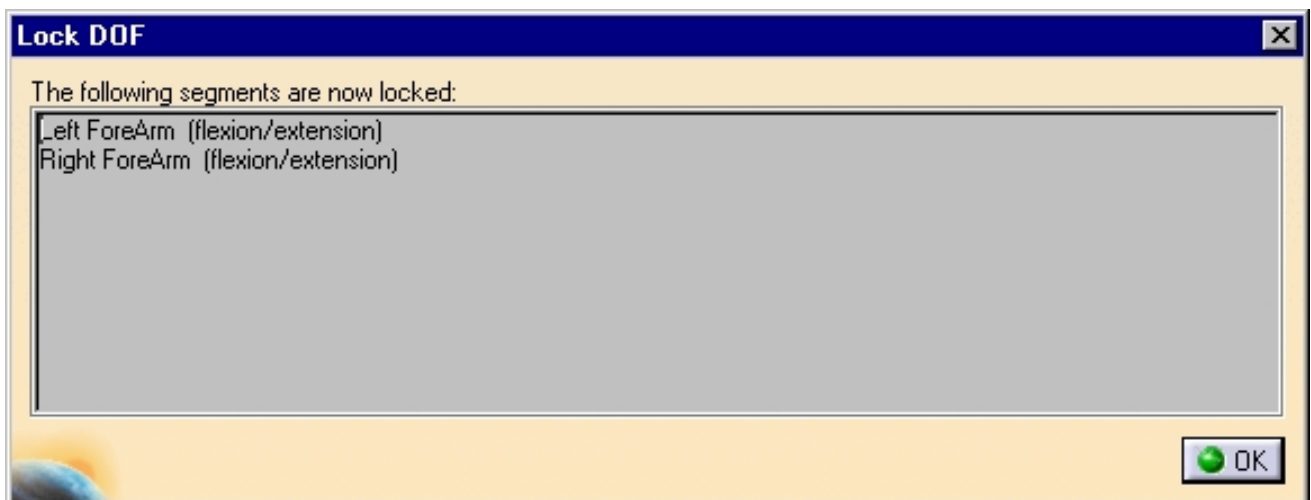
A manikin must be created or imported to complete the following procedures.



Locking DOFs

1. To lock a degree of freedom, select the lock icon  and then select the segment(s) to be locked. Multiple segments can be locked at the same time if they are pre-selected before the activation of the command.

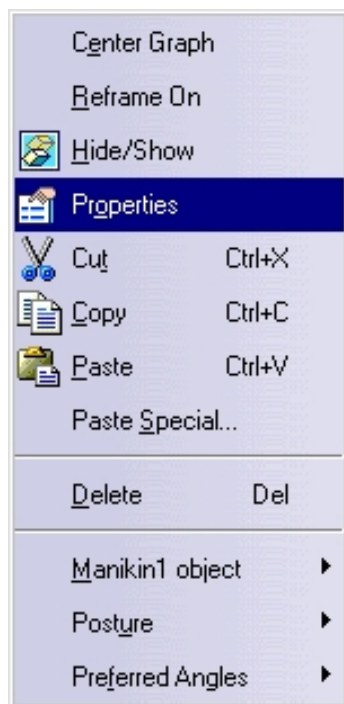
If the operation is successful, a message window will appear displaying the segments that have been locked.



2. Follow these steps to discover the existing locked segments on a specific manikin:

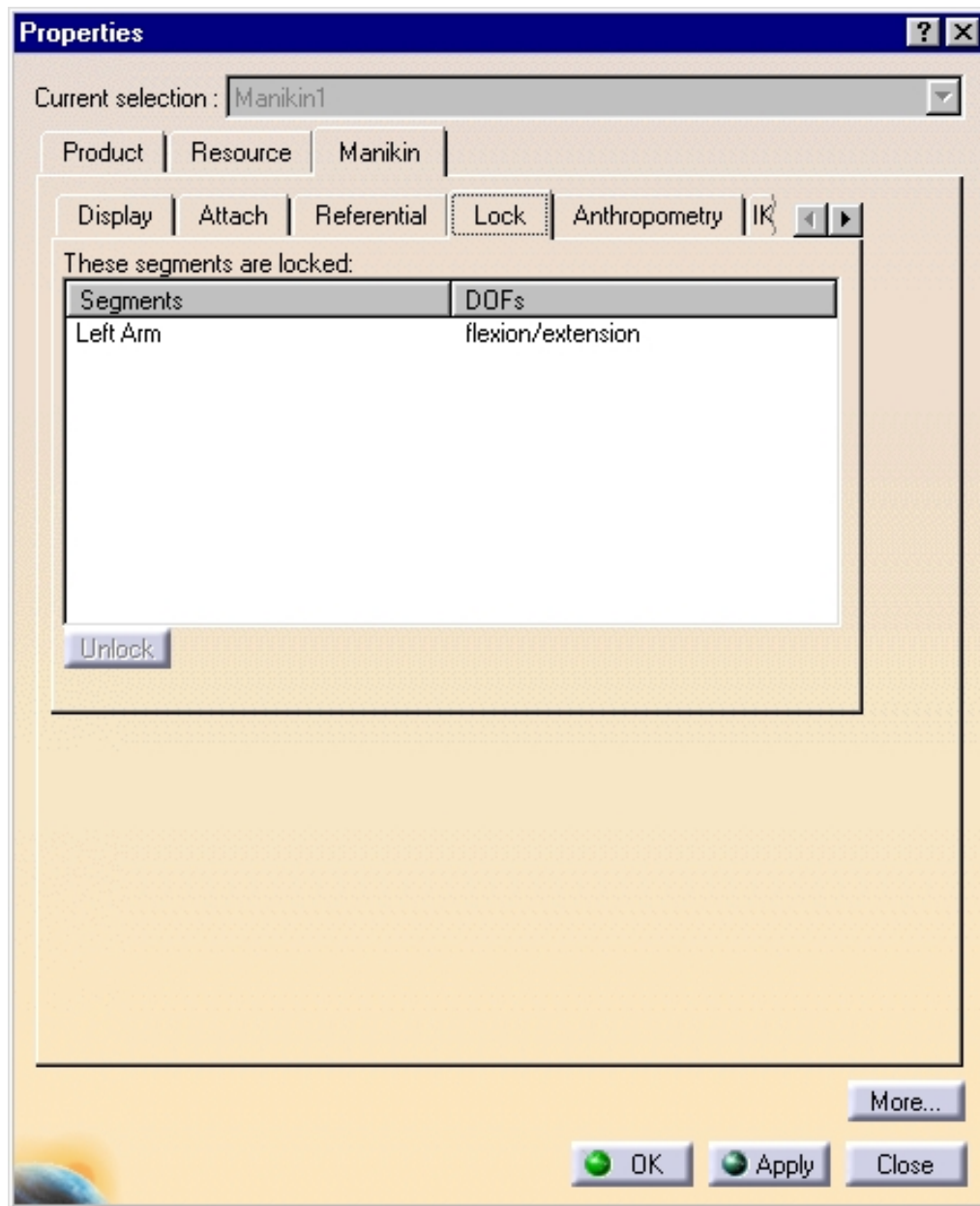
a.

Access the manikin Properties panel. To do this, right-click on the manikin from the product tree and select Properties.



OR select Edit -> Properties from the main menu.

The Properties panel appears.



- b. Select the Manikin tab which is the last tab of the panel. The Manikin tab contains six sub-tabs: Display, Attach, Referential, Lock, and Anthropometry and IK Behaviors.
- c. Select the Lock sub-tab which is dedicated to lock/unlock management. A selection list displays the names of the DOFs that are currently locked.



Unlocking DOFs

There are two ways to unlock DOFs:

- through the Properties panel
- with the Unlock icon

Unlocking DOFs through the Properties panel


1. Access the manikin Properties panel.
2. Select the Lock sub-tab of the Manikin tab.
3. Select the DOF(s) that must be unlocked.
4. Click on the Unlock button. The selected DOFs are removed from the list.

5. Press the Apply button.

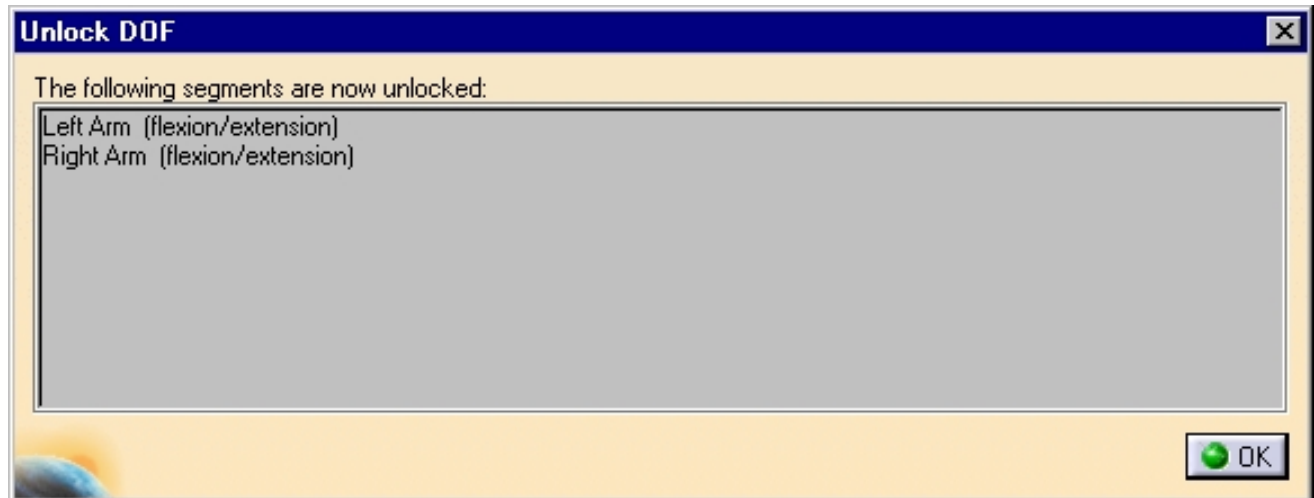


The Apply button must be clicked to unlock the selected DOFs. Failure to do so will cause the operation to remain incomplete.

Unlocking DOFs with the Unlock icon

Select the Unlock icon , then select the segment(s) to be unlocked. Multiple segments can be unlocked at the same time if they are pre-selected before activation of the command.

If the operation is successful, a message window will appear displaying the segments that have been unlocked.



Advanced Tasks

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

Editing Preferred Angles

Preferred Angles: Reset, Mirror Copy, and Swap Functionality

Using the Postural Score

Adapting Range of Motion to Keep Best Posture

Editing Preferred Angles



This procedure describes how to use the Edit Preferred Angles command.



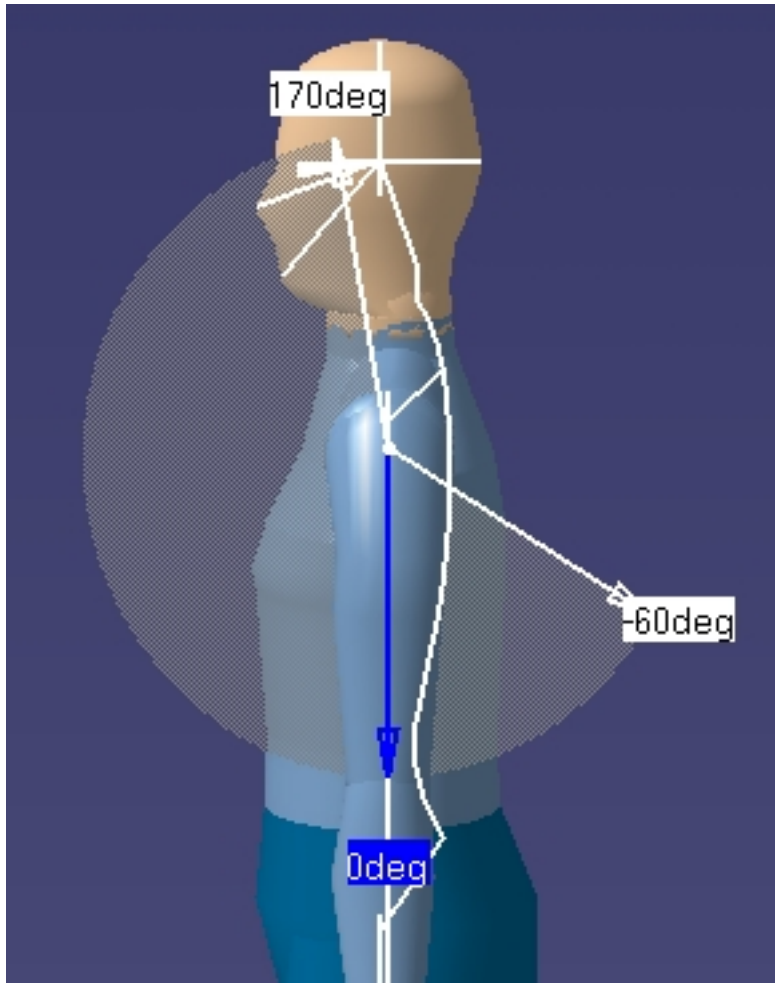
By dividing the total range of motion of the manikin into a certain number of ranges, it is possible to compute a global and a local score that quantifies the current posture. The Edit Preferred Angles command enables the user to define these ranges on individual DOFs.

Selecting another segment while the command is running opens the Preferred angles dialog box for the new segment and closes it for the previous one.

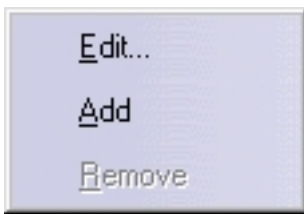


1. Select the Edit Preferred Angles icon  and then select a segment.

The white arrows are displayed.



2. With the right mouse button, click anywhere in the white range of motion region to display the contextual data.

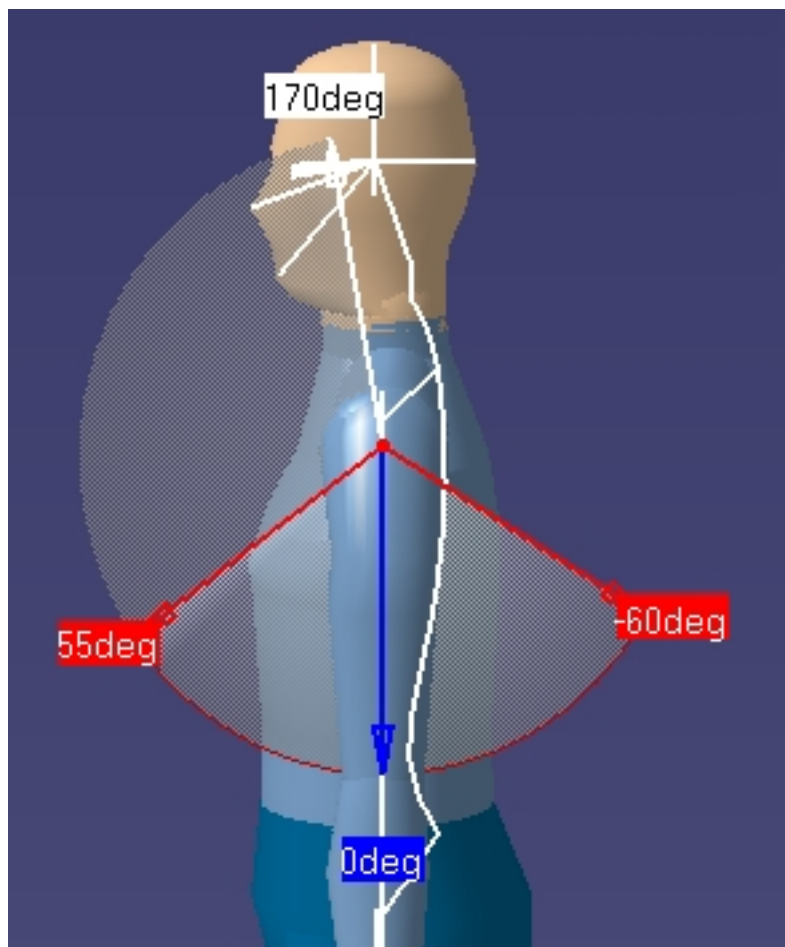


Click on an option to activate it.



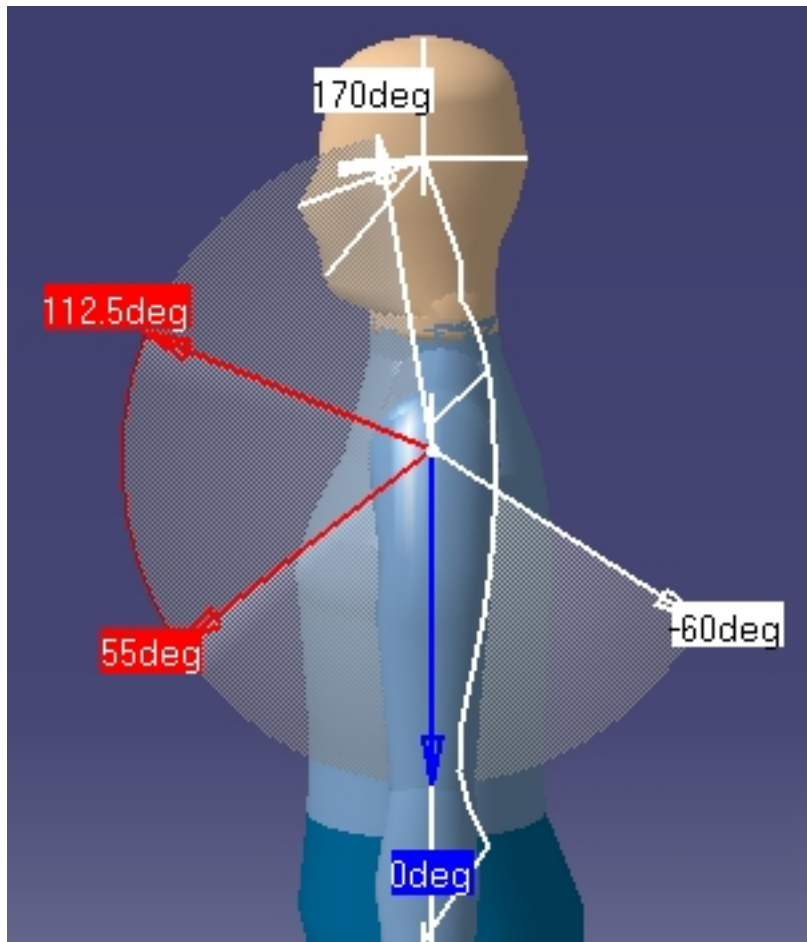
Edit...

Displays the [Preferred Angles dialog box](#), makes the perimeter zone of the preferred angle being edited become red. You can modify the values of the arrows with the mouse or with the Preferred Angles dialog box.



- **Add**

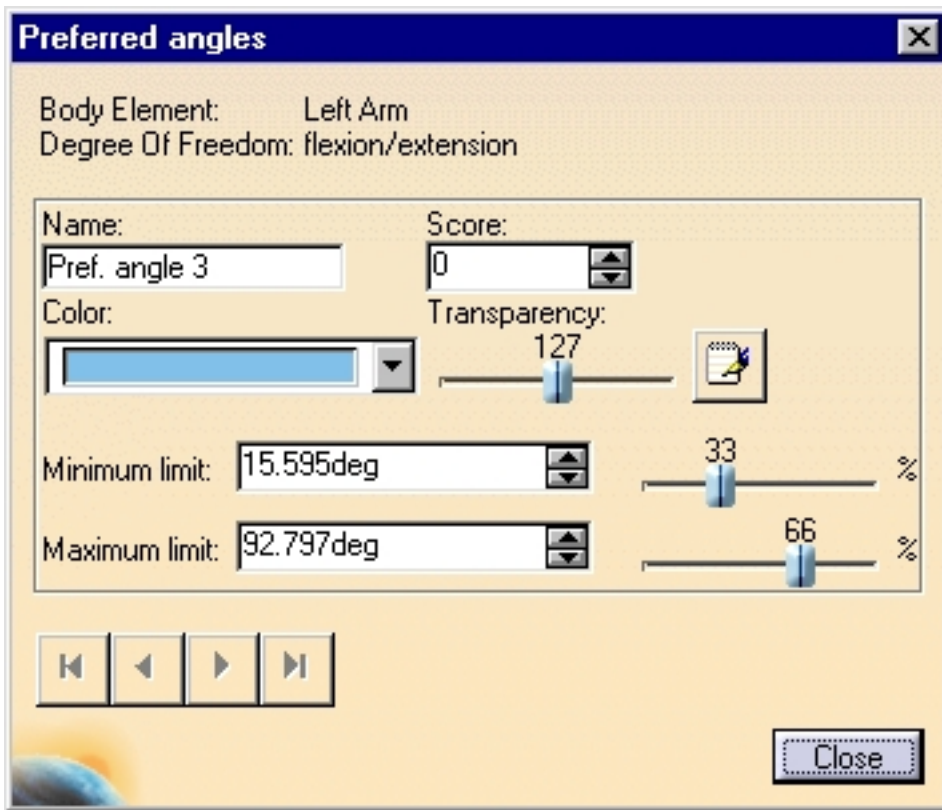
Displays the [Preferred Angles dialog box](#) and splits the selected range in half. You can modify the values of the arrows with the mouse or with the Preferred Angles dialog box.



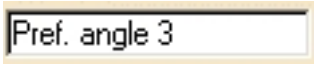



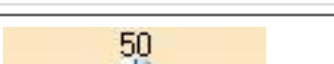
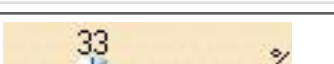


- **Remove**

Removes the selected preferred angle.

3. The Preferred Angles dialog box can be used to modify preferred angles.



This dialog box contains the following elements:

| | |
|---|--|
| | The name of the active body element |
| | The name of the active degree of freedom |
|  | An editor to rename the preferred angle |
|  | A spinner to change the score of the preferred angle |
|  | Spinners to change the values of the limits |
|  | A combo to select the preferred angle's color |
|  | A slider to modify the transparency of the graphical region |
|  | Sliders to modify the values of the limits |
|  | An icon to add or modify a memo |
|  | Navigation buttons to select a preferred angle in the list (next, previous, first, last) |

4. Click Close to exit from the Preferred Angles dialog box.
5. Click the Edit Preferred Angles icon  to cancel the command and hide the arrows.



Preferred Angles: Reset, Mirror Copy, and Swap Functionality



This procedure describes how to copy and modify more than one set of preferred angles using these functions:

- [Reset](#)
- [Mirror Copy](#)
- [Swap](#)

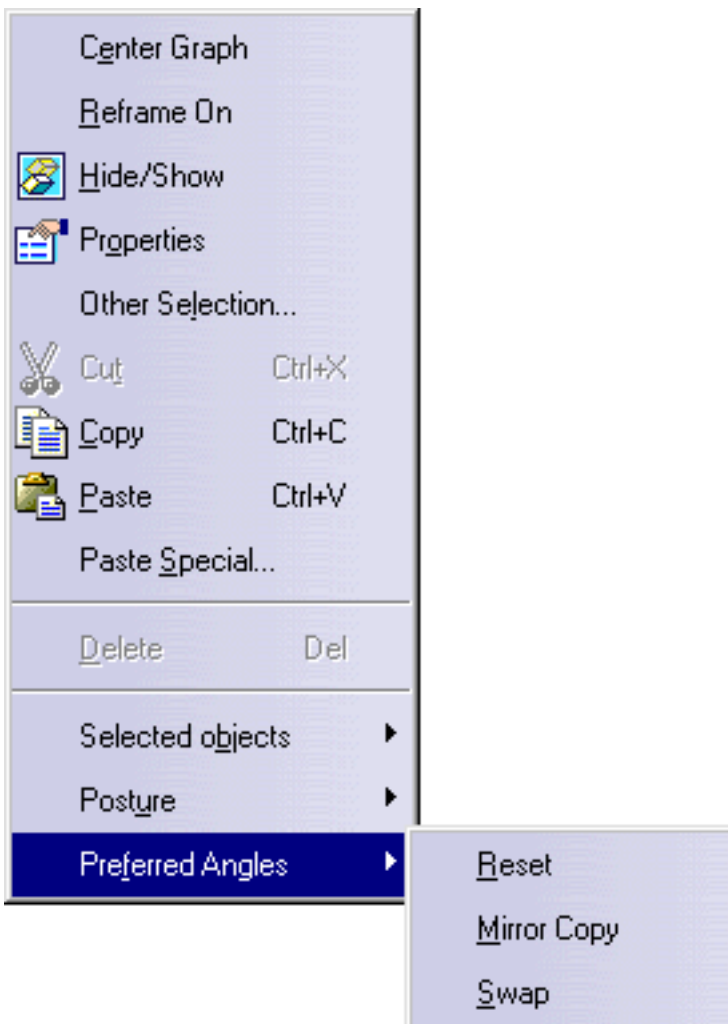


For more information on preferred angles, see [Editing Preferred Angles](#).



To access these functions, right-click on a segment, a segment node, a body, or a manikin.

The following contextual menu appears:

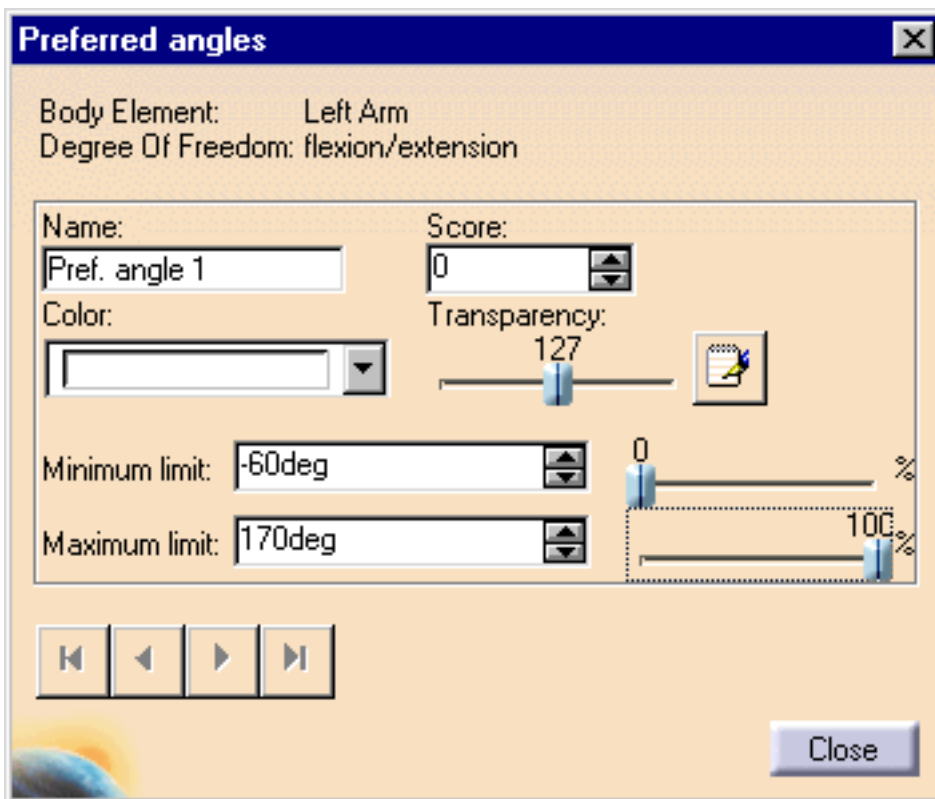


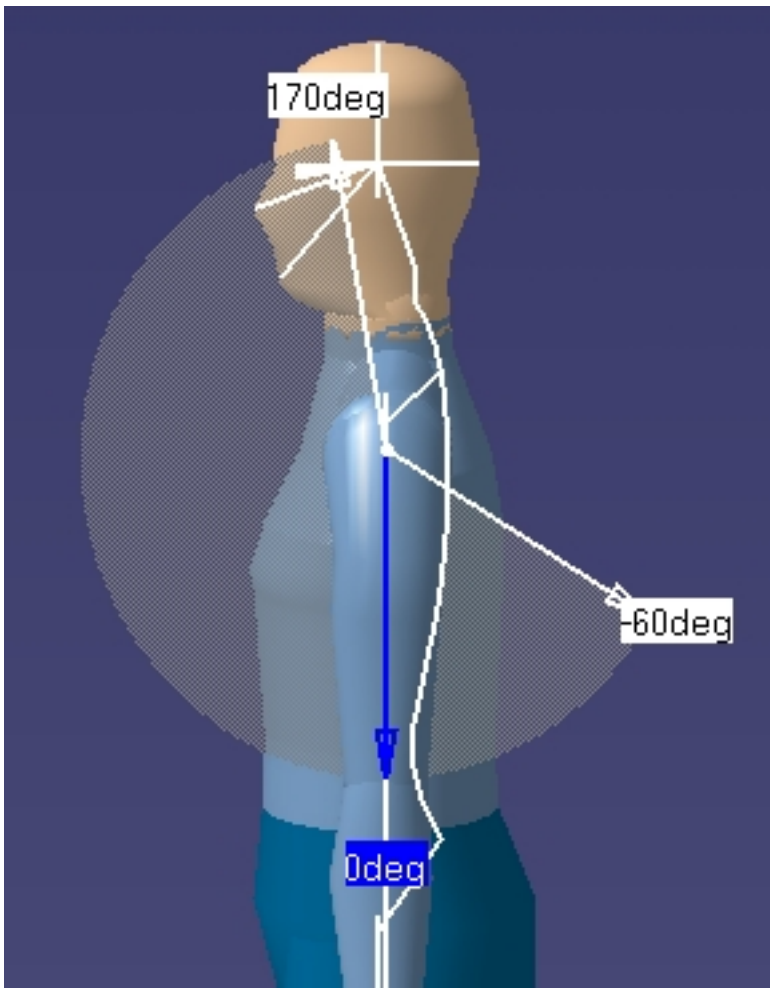
Reset

The preferred angles of the segments selected will be erased and will return to their default state.

The default state of the preferred angles in the following:

- only one preferred angle on the angular limitation range
- a score of zero
- a white color
- a transparency of 127

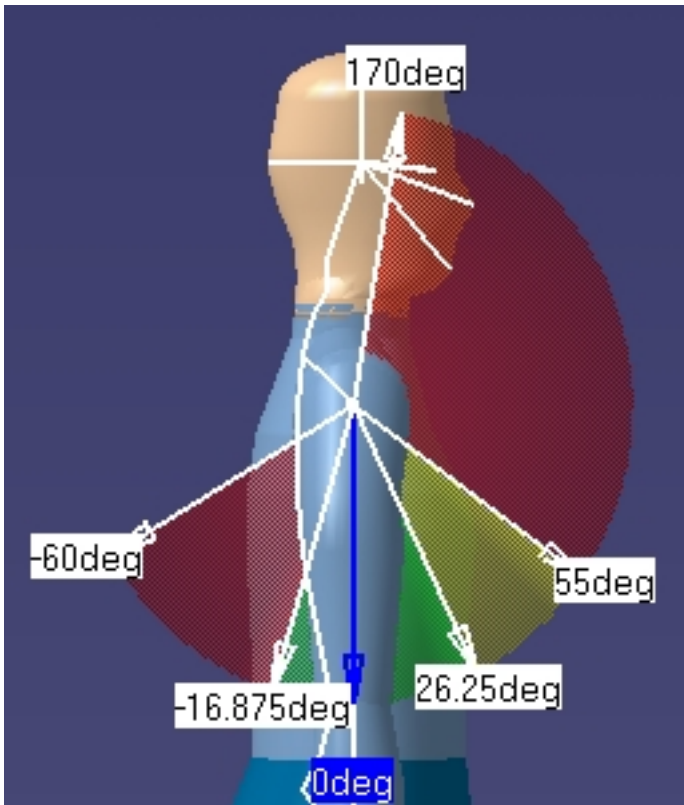
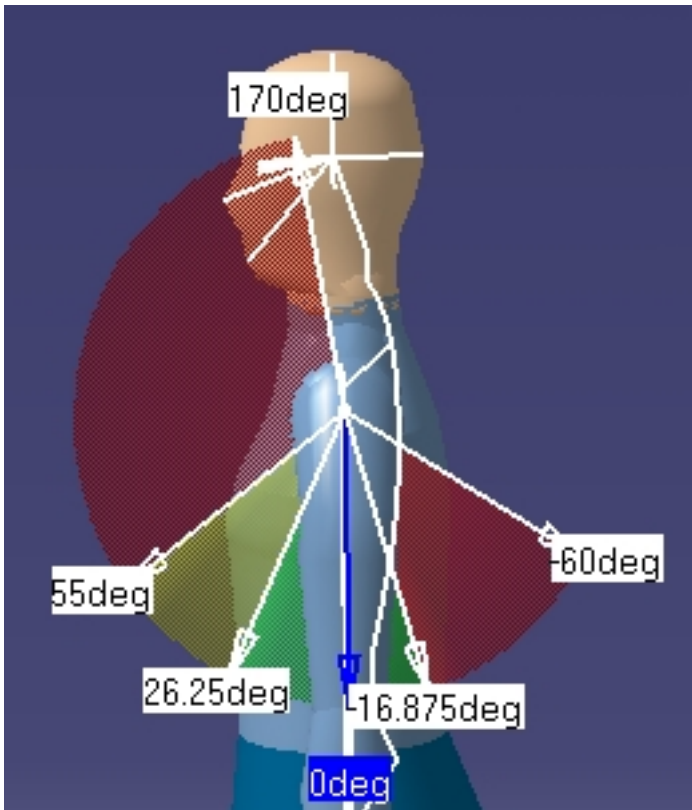




Mirror Copy

The mirror copy function will copy the preferred angles of the selected segment (in all degrees of freedom) onto the opposite side of the manikin.

Mirror copy functionality can only be applied to segments that have an equivalent segment on the other side. If there is no equivalent segment, Mirror Copy will be disabled in the contextual menu. It is also disabled in the contextual menu when you select the entire manikin or the "Body" node.



Swap

The preferred angles of each selected segment will be copied to the opposite side of the manikin and vice versa. If a segment does not have an equivalent on the opposite side, Swap will be disabled in the contextual menu.



Using the Postural Score



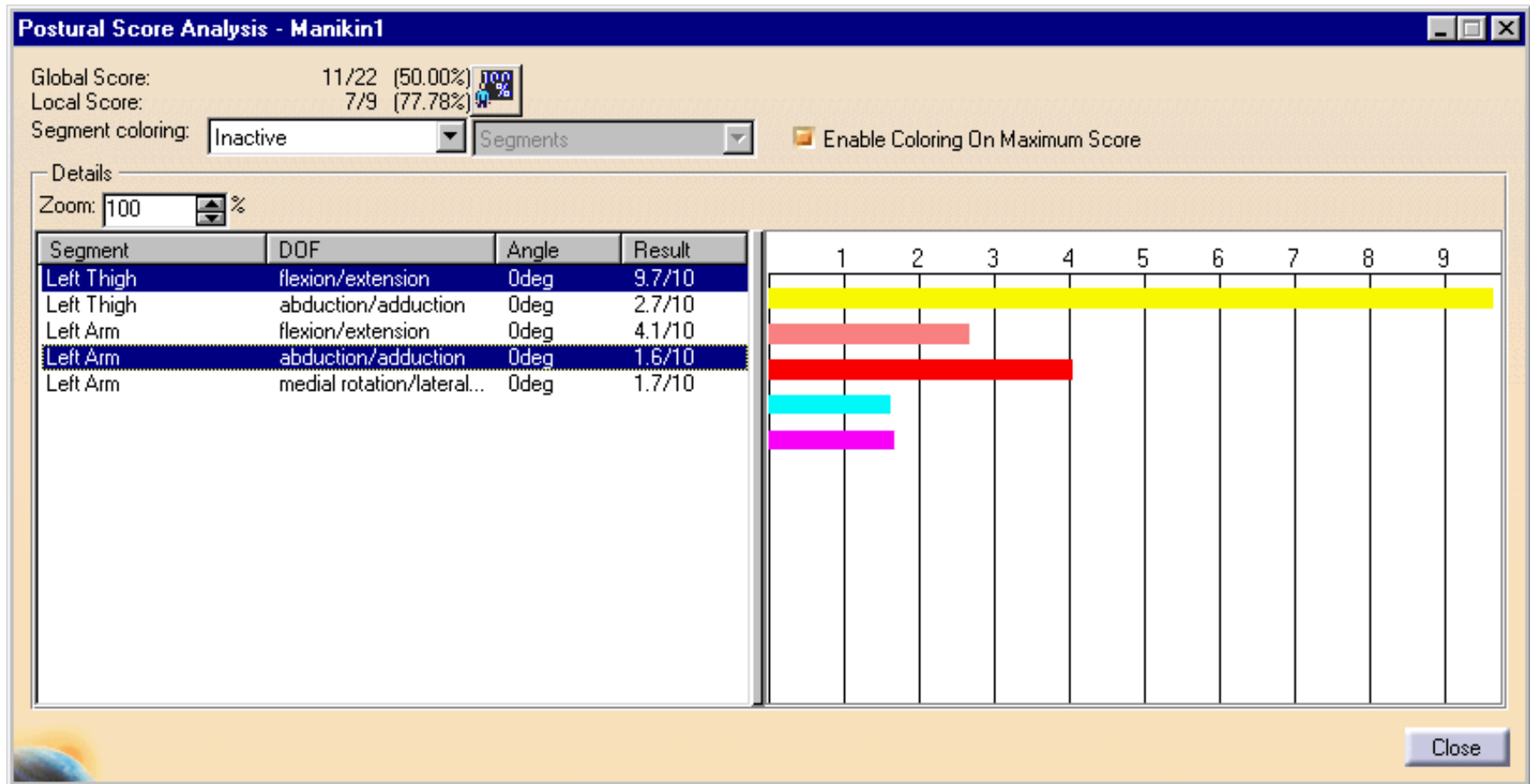
This procedure describes how to use the postural score.





The postural score feature is used to evaluate the manikin's posture. Once the preferred angles have been specified or loaded from a library, you can evaluate the posture using the postural score function.







1. Click the Postural Score Analysis icon.  The Postural Score Analysis dialog box is displayed.



Postural Score Analysis - Manikin1

Global Score: 11/22 (50.00%) 
Local Score: 7/9 (77.78%) 

Segment coloring: Inactive  Segments  Enable Coloring On Maximum Score

Details
Zoom: 100   %

| Segment | DOF | Angle | Result |
|------------|----------------------------|-------|--------|
| Left Thigh | flexion/extension | 0deg | 9.7/10 |
| Left Thigh | abduction/adduction | 0deg | 2.7/10 |
| Left Arm | flexion/extension | 0deg | 4.1/10 |
| Left Arm | abduction/adduction | 0deg | 1.6/10 |
| Left Arm | medial rotation/lateral... | 0deg | 1.7/10 |

Bar chart showing results for 9 segments (1-9):

- Segment 1: Yellow bar (9.7/10)
- Segment 2: Yellow bar (2.7/10)
- Segment 3: Pink bar (4.1/10)
- Segment 4: Red bar (1.6/10)
- Segment 5: Cyan bar (1.7/10)
- Segment 6: Magenta bar (1.7/10)
- Segment 7: No bar
- Segment 8: No bar
- Segment 9: No bar

Close

This dialog box contains the following elements:

- **Global Score**

Represents the total score of the posture for all the segments combined. In this example, the manikin scores 11 points out of a possible 22, representing 50.00%.

- **Local Score**

Represents the score of the posture for all selected items on the multi-list. In this example, the local score is 7 points out of a possible 9, representing 77.78%.

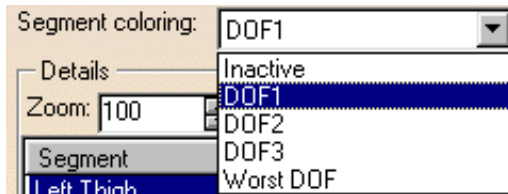
- **Optimize Posture**



The Optimize Posture icon changes the position of the body so as to maximize the global postural score of the manikin (i.e., yield a perfect score).

- **Segment Coloring**

The first combo list is used to activate or deactivate the segment coloring functionality. Using the DOF, this functionality enables the manikin's segments to change their colors to the corresponding preferred angle's color.



The second combo list is used to select the parts that will change color. It is enabled only if the segment coloring functionality is active.

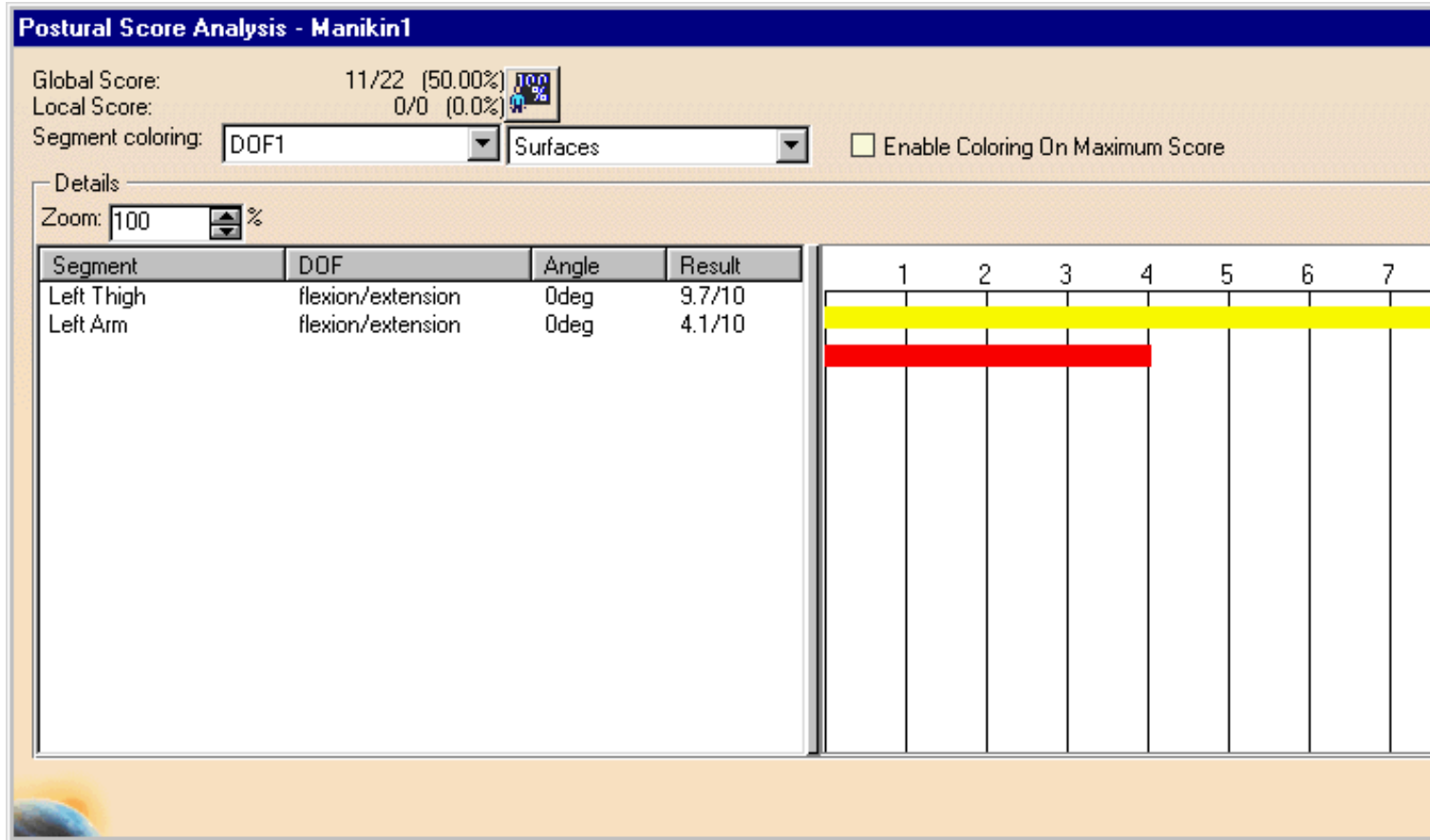


Inactive

Segment coloring will not occur

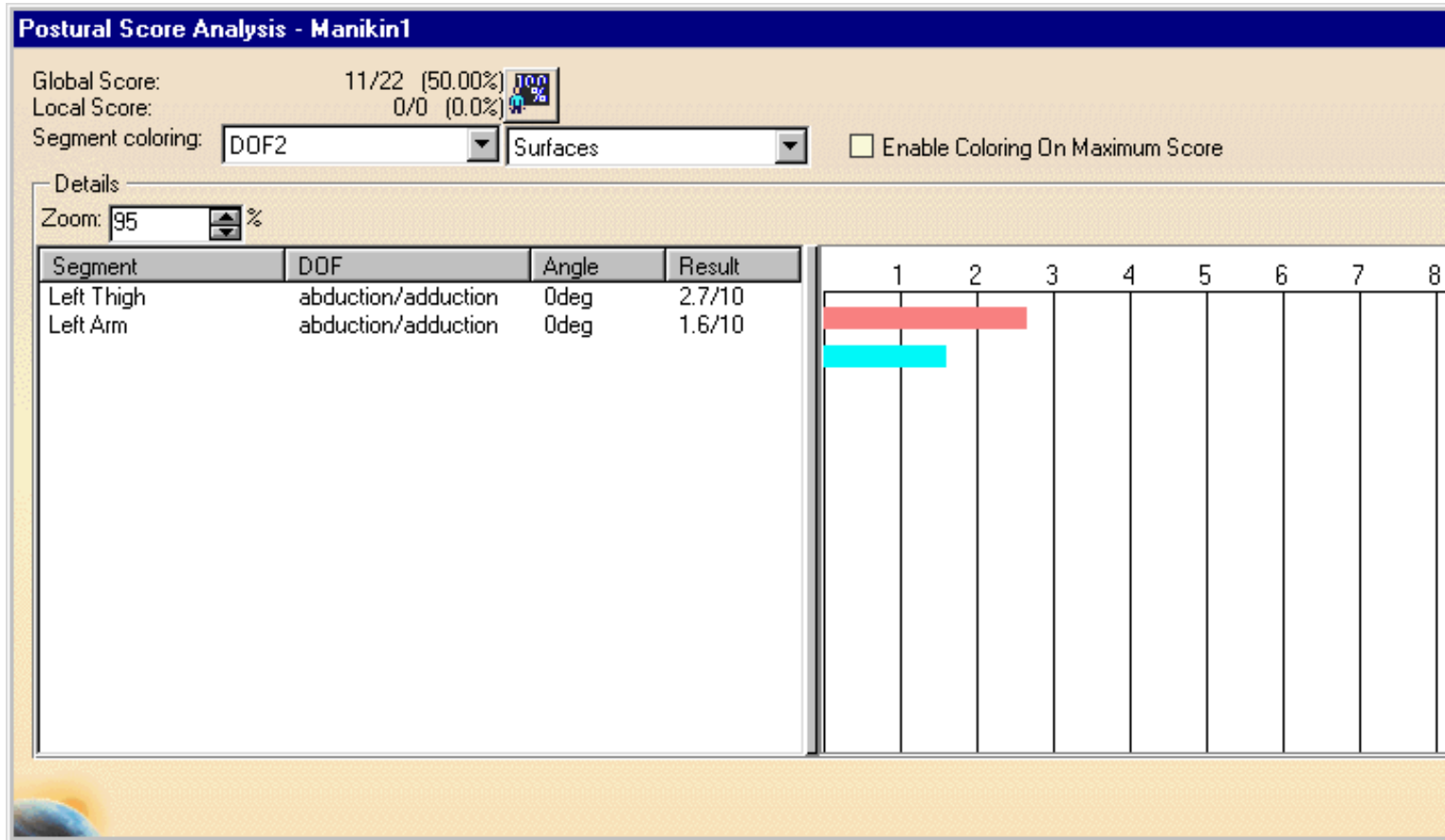
DOF1 (flexion/extension)

The color shown for each segment is the color of the preferred angle defined for DOF1 of the corresponding segment, if it exists. Otherwise, no coloring is applied.



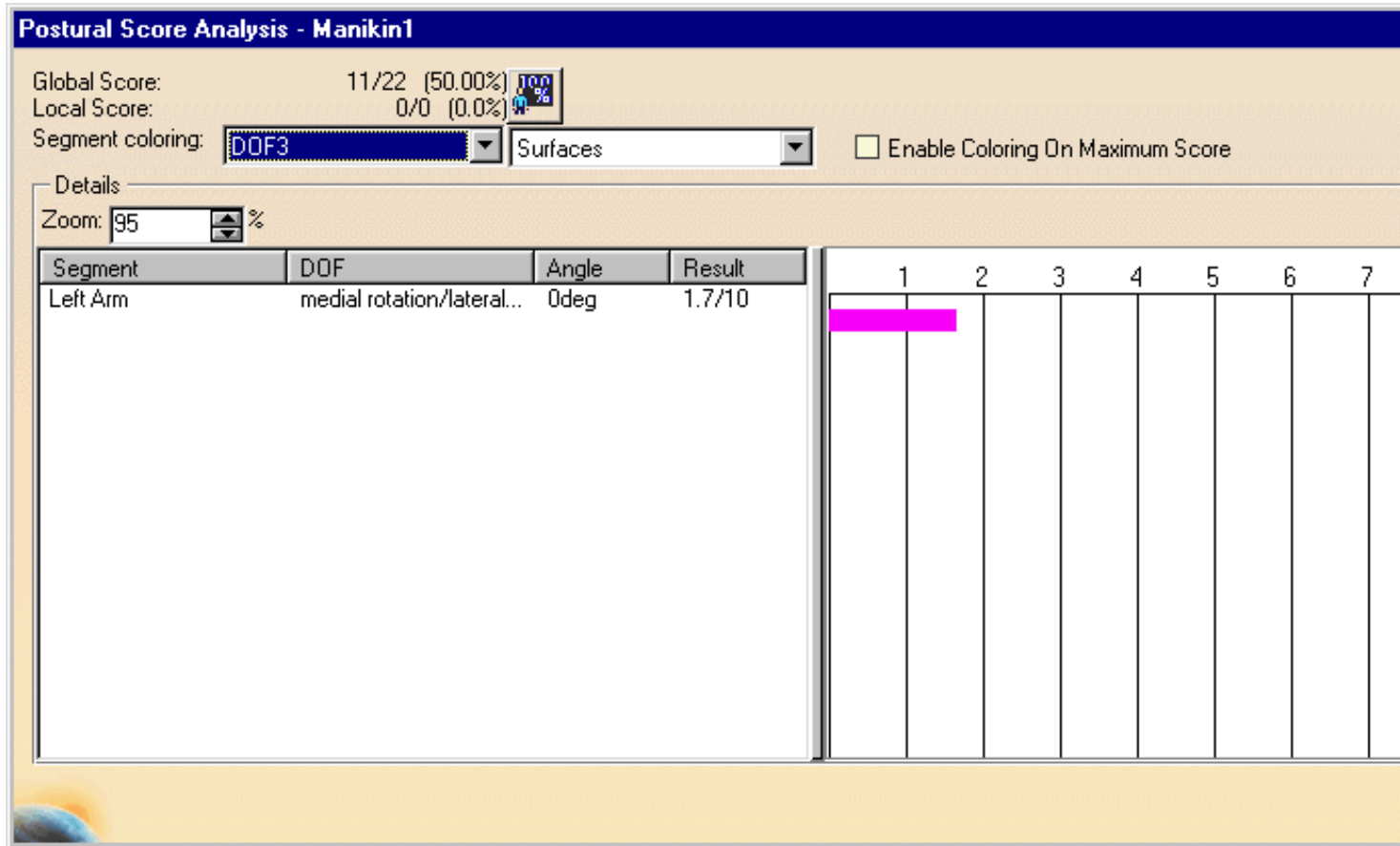
DOF2 (abduction/adduction)

The color shown for each segment is the color of the preferred angle defined for DOF2 of the corresponding segment, if it exists. Otherwise, no coloring is applied.



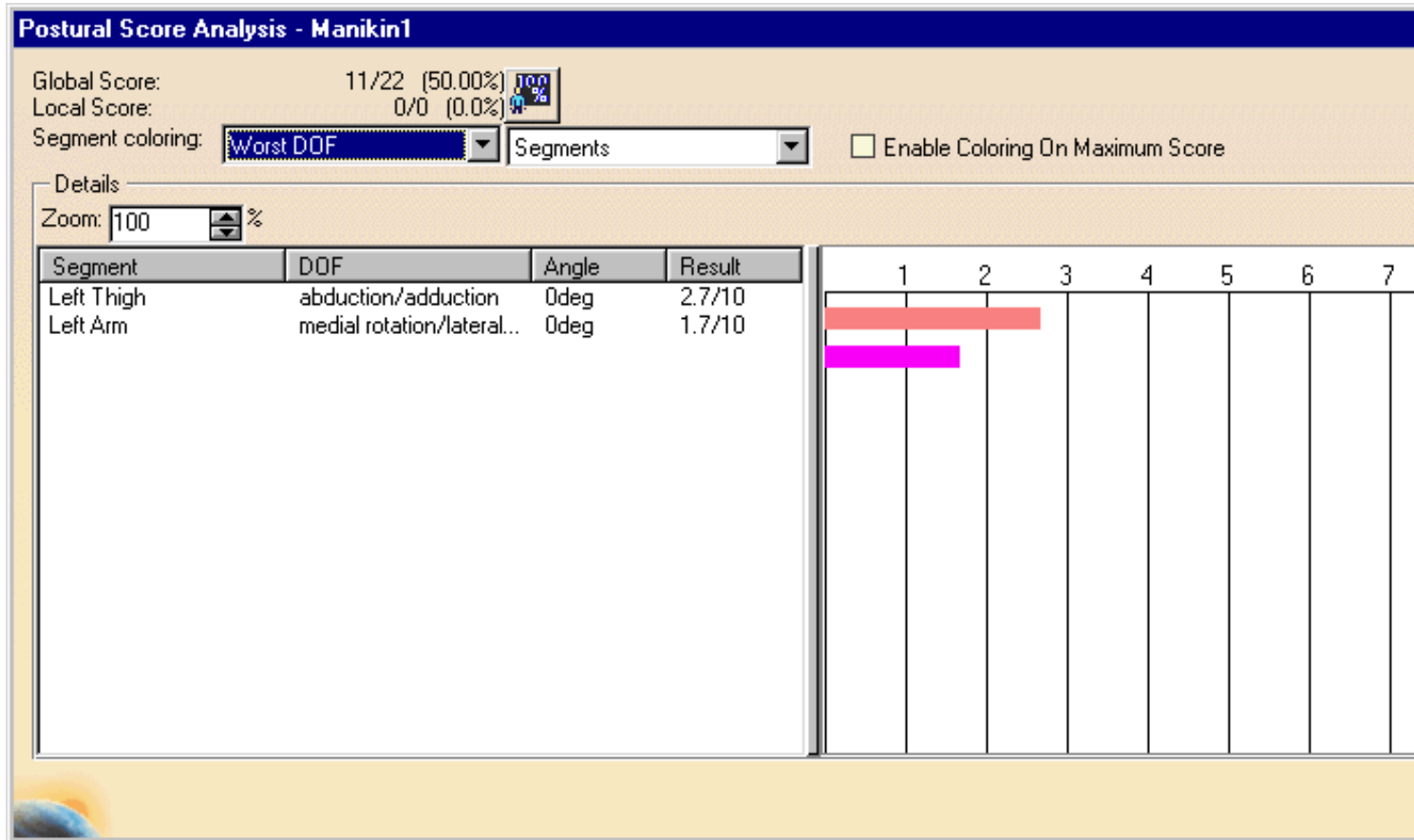
DOF3 (rotation)

The color shown for each segment is the color of the preferred angle defined for DOF3 of the corresponding segment, if it exists. Otherwise, no coloring is applied.



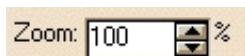
Worst DOF

The color shown for each segment is the color of the preferred angle defined for the lowest scoring DOF of the corresponding segment, if it exists. Otherwise, no coloring is applied.



Zoom

Use the Zoom field to decrease or increase the length of the viewer area to a maximum of three (3) times its original length.



- **Multi-list**

Displays all the details for the posture analysis: the segment names, the DOF names, the positions of the DOFs, and the current score/maximum score associated to the DOF.

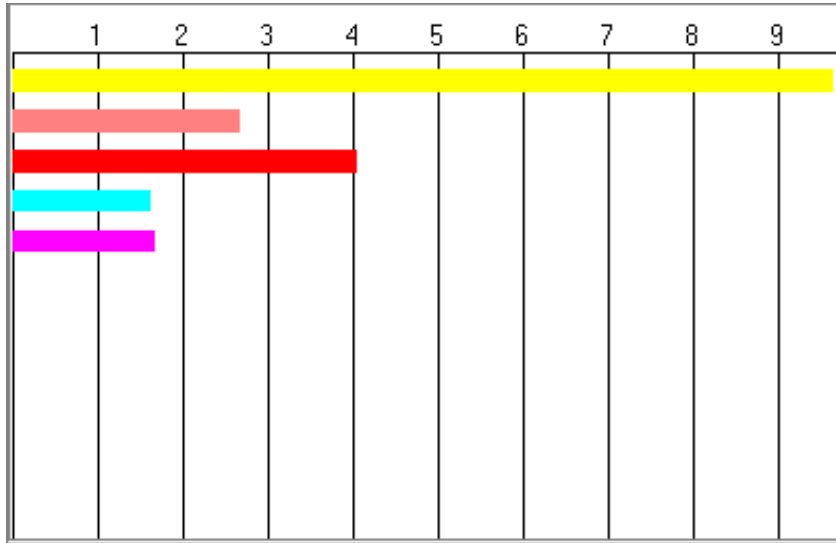
| Segment | DOF | Angle | Result |
|------------|---------------------------|-------|--------|
| Left Thigh | flexion/extension | 0deg | 9.7/10 |
| Left Thigh | abduction/adduction | 0deg | 2.7/10 |
| Left Arm | flexion/extension | 0deg | 4.1/10 |
| Left Arm | abduction/adduction | 0deg | 1.6/10 |
| Left Arm | medial rotation/lateral.. | 0deg | 1.7/10 |

The multi-list allows you select one or several items, which affects the output of the local score. The multi-selection can be done using the Shift and Ctrl keys.

- **Viewer**

The viewer displays the graphical details of the postural score. Each bar represents the Result value and color of the preferred angle corresponding to the degree of freedom shown in the multi-list beside the bar.

All scores displayed by the bars are normalized and put into a 0 to 10 scale before being displayed. The result column in the multi-list is always equal to the bar length in the viewer.



2. Select Close to exit from the Postural Score Analysis dialog box.



Adapting Range of Motion to Keep Best Posture



The purpose of this task is to set the angular limitations of the selected segments so that these limitations correspond to the best range of motion, that is, the range of motion where the postural score is the highest.



Please refer to [Editing Preferred Angles](#) for information on how to create preferred angles and assign scores to individual ranges of motion.



1. To optimize the range of motion of any particular set of segments, first select the desired segment(s) and then click on the Optimize Posture icon.



For each selected segment and for the current active degree of freedom, the command looks for all preferred angles created that have been assigned scores. The command then sets the angular limitations to the range containing the highest score.



When this command is run, the posture of the segment(s) may change in order to reflect the new angular limitations.

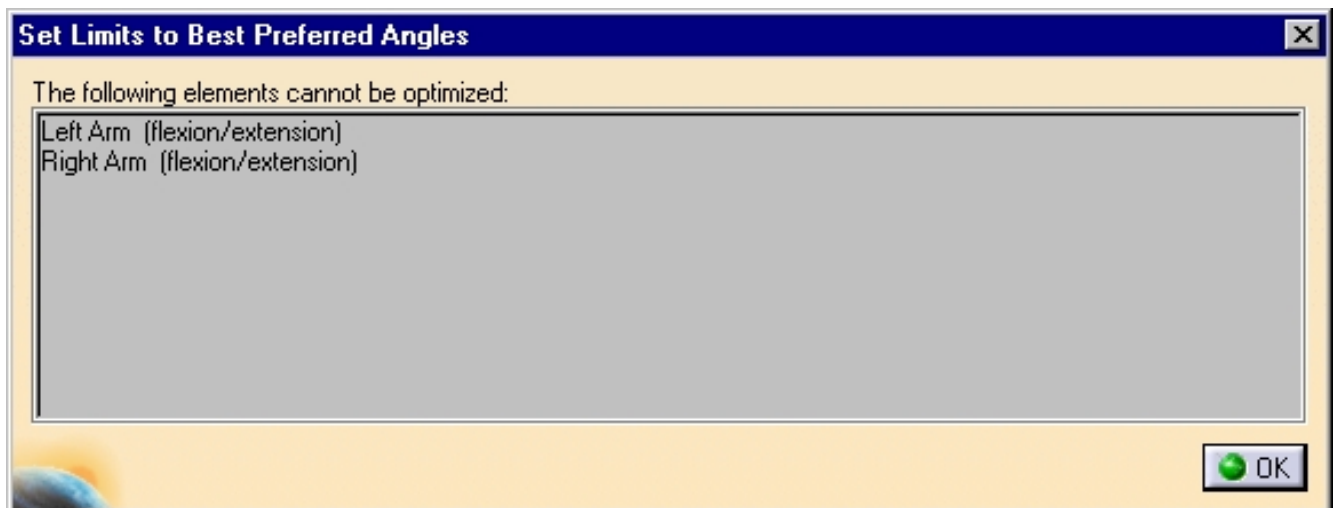


It is possible to use this command to optimize the posture of the manikin as a whole. To do this, select the Body node in the specification tree before activation the Optimize Posture command.

This is particularly useful if the manikin's movements must be restricted to the "comfort zone". The postural score of such a manikin will stay at its highest, no matter how the manikin is moved. For more details, please refer to [Using the Postural Score](#).



It is possible that some or all of the selected segments may contain no preferred angle information or some of the angles may be locked. In these cases, and these cases only, the Optimize Posture command might fail. If the command fails for a subset of the selected segments, a message window will appear displaying the list of segments for which the optimization failed.



2. To reset the angular limitations of a manikin, select the segments that must be reset and click on the Reset to Default Angular Limitations icon.

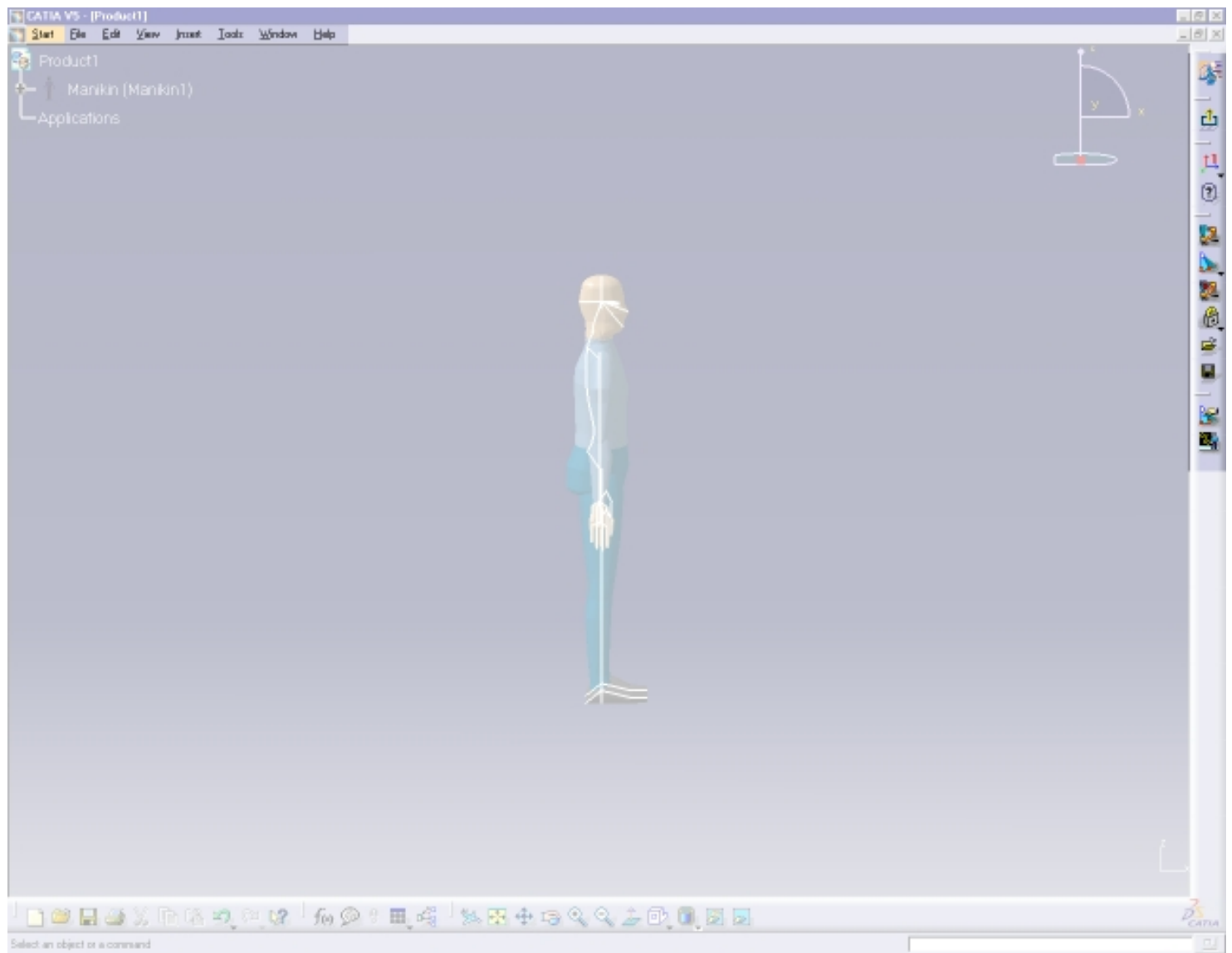




Workbench Description

The Human Posture Analysis Version 5 application window looks like this.

Click the hotspots to see the related documentation.

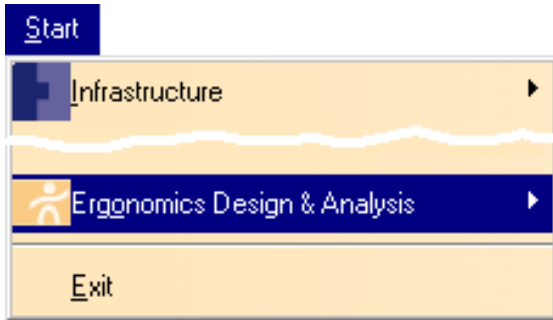


- Human Posture Analysis Menu Bar
- Current Workbench
- Return to Previous Workbench
- Utilities Toolbar
- Angular Limitations Toolbar
- Preferred Angle Toolbar

Human Posture Analysis Menu Bar



Start

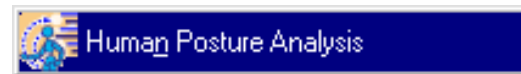


For

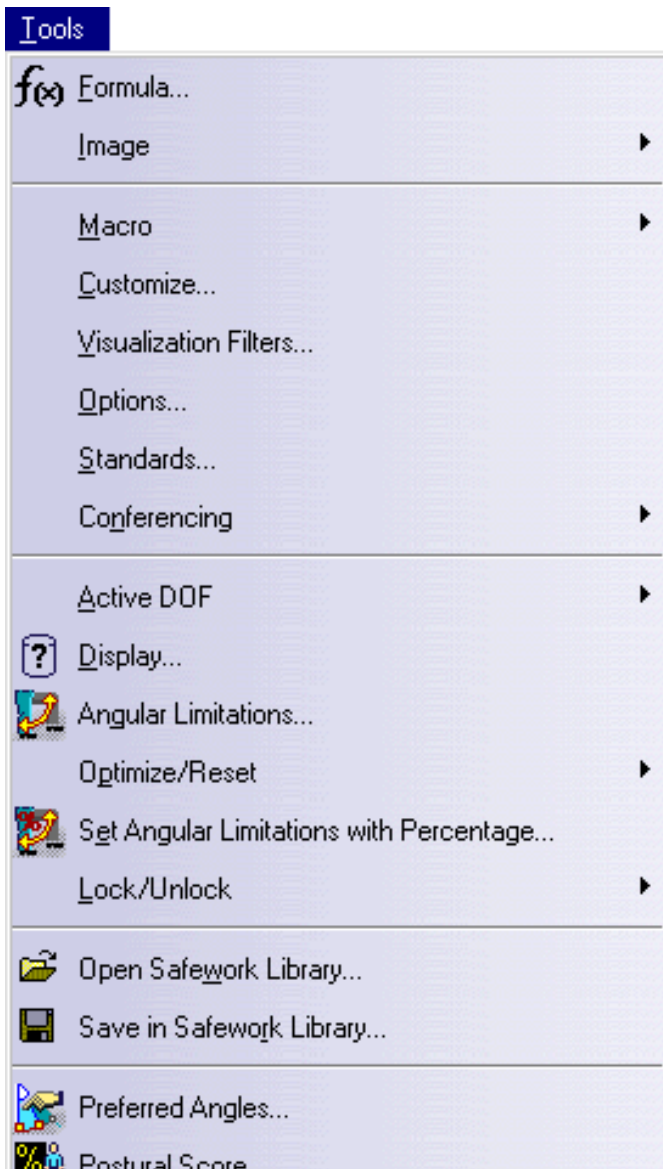
Human Posture Analysis

See

[Creating a Manikin](#)

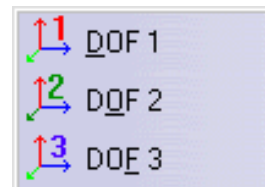


Tools



For

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See

[Selecting the DOF](#)

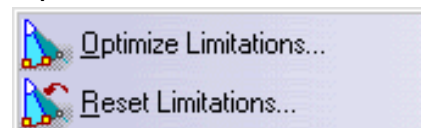
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[Selecting Manikin Display Attributes](#)

Angular Limitations

[Displaying and Editing Angular Limitations](#)

Optimize/Reset ->



[Adapting Range of Motion to Keep Best Posture](#)



Set Angular Limitations with Percentage

[Displaying and Editing Angular Limitations](#)

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[Locking and Unlocking DOFs](#)

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Current Workbench



Shows the icon of the current workbench. When selected, a welcome dialog box is displayed.



Return to Previous Workbench



Exits the current workbench and returns you to the previous workbench.



Utilities Toolbar



See [Selecting the DOF](#)



See [Selecting Manikin Display Attributes](#)



Angular Limitations Toolbar



See [Displaying and Editing Angular Limitations](#)



See [Adapting Range of Motion to Keep Best Posture](#)



See [Adapting Range of Motion to Keep Best Posture](#)



See [Displaying and Editing Angular Limitations](#)



See [Locking and Unlocking DOFs](#)



See [Locking and Unlocking DOFs](#)



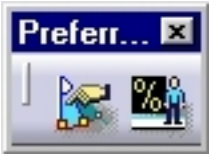
See [Library Management](#)



See [Library Management](#)



Preferred Angle Toolbar



See [Editing Preferred Angles](#)



See [Using the Postural Score](#)



Glossary

A

angular limitations The manikin's joint limitations.

anthropometry The study of proportional relationships between the shape, weight and size of body segments.

D

degree(s) of freedom Each linear or rotary movement along or about a given axis. Manikin segments can have up to three DOFs.

DOF degree(s) of freedom

L

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.

P

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).

R

range of motion

The range of translation and rotation of a joint for each of its degrees of freedom.

S

segment

A section of the manikin such as forearm, neck, thigh, ankle, etc.


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