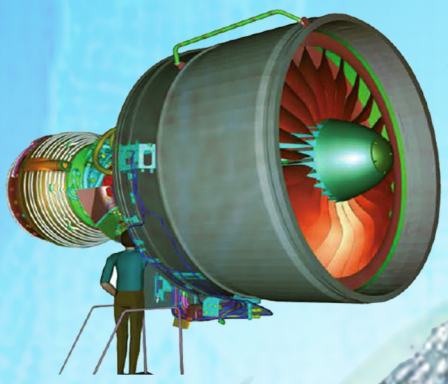
UGS TECNOMATIX JACK 5.0
User Manual and Examples

PURDUE UNIVERSITY

UGS The PLM Company



USER MANUAL AND EXAMPLES

UGS Tecnomatix Jack 5.0

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ABOUT USER MANUAL

This software manual is intended for use in introducing students to the operation and applications of DHM (Digital Human Modeling) and CAD (Computer-Aided Design) systems.

The purpose of this manual is to be a reference/guide to someone using the UGS Tecnmomatix Jack 5.0 software.

This user manual covers Jack 5.0 tools and menu commands. It explains each tool and menu command in details with pictorial examples. It also covers frequently used industrial applications and demonstrates those details through step by step method. Appendix A provides the installation and software launch procedure, and demonstrates how to open a sample environment file.

This software manual was written in year 2006 as a research credit work by H. Onan Demirel. The author has made a substantial effort to ensure that each user tools and menu commands are covered and detailed examples are worked out step by step methodology, but there is no such thing as fully explained/covered software. Author's approach is not the only approach for worked examples. Users may/should investigate different problem solving approaches. The manual has met the expectations of covering all necessary information for introductory level DHM courses and laboratory applications. For further information related faculty member, manufacturers published books or other software manuals should be consulted.

No warranty whatsoever either implied or express, is made concerning its absolutely correct functioning of tools and menu command coverage.

UGS TECNOMATIX JACK 5.0 USER MANUAL DISCLAMIER

Neither should the information provided by this software manual be used as commercial product development/evaluation purposes. All demonstrations were chosen arbitrarily for educational usage and do not intend to express any commercial benefit.

The information in this document is subject to change without notice.

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DIGITAL HUMAN MODELING (DHM)

What is Digital Human Modeling?

Digital Human Modeling facilitates design by reducing the need for prototypes, and can be defined as "A digital representation of the human inserted into a simulation or virtual environment to facilitate prediction of safety and/or performance. It includes visualizations and the math & science in the background (Sundin, 2006). DHM applications have potential to enable engineers to incorporate ergonomics & human factors engineering principles earlier in the design process (Duffy, 2004; Chaffin, 2005). It also provides real cost savings to the industry. ($8.8 Million avoided in injury costs, Brazier, et. al. 2003)

Digital Human Modeling helps organizations to design safer and efficient products while optimizing the productivity and cost. DHM applications help engineers to improve ergonomics and human factors in design and product development.

Traditionally DHM applications have been utilized by manufacturing and design industry. However, technological developments and advancement in the computer applications expands the application areas of DHM. There is still need of improvements for next generation Digital Human Models.

Benefits of DHM Software

Simulation tools help engineers and scientist to replicate the operation of complex systems by using computer software. Advance computer integration in engineering is necessary for understanding the complex systems ranging from building jet engines to simulationing earthquake shocks. A highly complex system, human body, is investigated and analyzed by Digital Human Simulation software. UGS Tecnomatix Jack 5.0 software makes this integration possible and provides solution for complex engineering design and analysis problems.

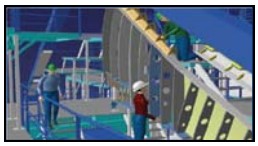
Potentials and Some Applications of DHM

Product Development

- Motion capture can be used to drive the DHM and facilitate reduction of injuries & comfort prediction through virtual interactive design of work stations and some new products.

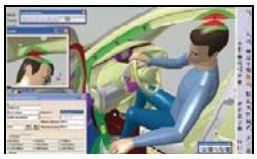
Advance Manufacturing

- Design of complex system and their interaction with the humans can be simulated through DHM software. Ergonomics analysis of the working conditions (postures reach & move motions) can be evaluated too.



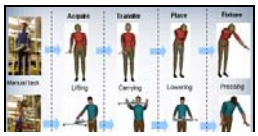
Transportation Design

- Automotive, aerospace, marine... vehicles can be design and checked for human safety and comfort prior to prototyping and production.

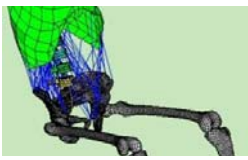


Injury Risk Prediction

- Physical activity of the workers can be evaluated and future improvements can be assessed by the help of DHM.



Healthcare Sector

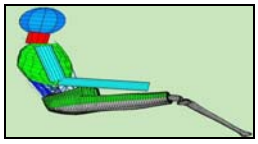


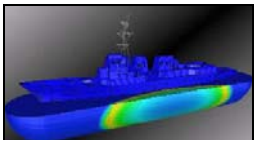
- Integration of Finite Element Analysis (FEA) and DHM expands the development and training of advance robotic surgery tools.

PLM (Product Life-cycle Management)

- Integration of PLM and DHM increases the engineering design and analysis capabilities.

Military Application





- Safer military equipment can be designed; ergonomics and interior design can be improved to increase the effectiveness of the military personnel.

Chapter

1

UGS TECNOMATIX JACK 5.0

User Manual and Examples

FILE menu

File Menu

File Menu allows users to access typical file operations such as opening and saving files. Also some advance file operation features such as import/export files, screen capture...etc. is available. **Figure 1** contains all necessary file operation aids and **Figure 2** holds the frequently used file operation tools.

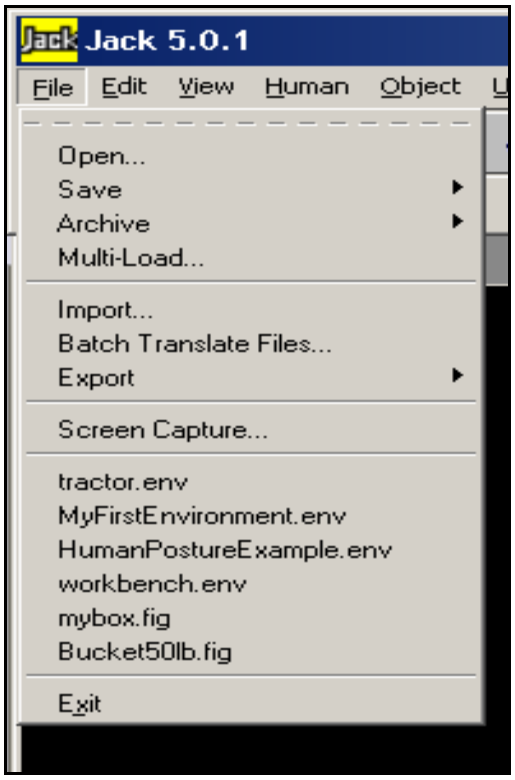
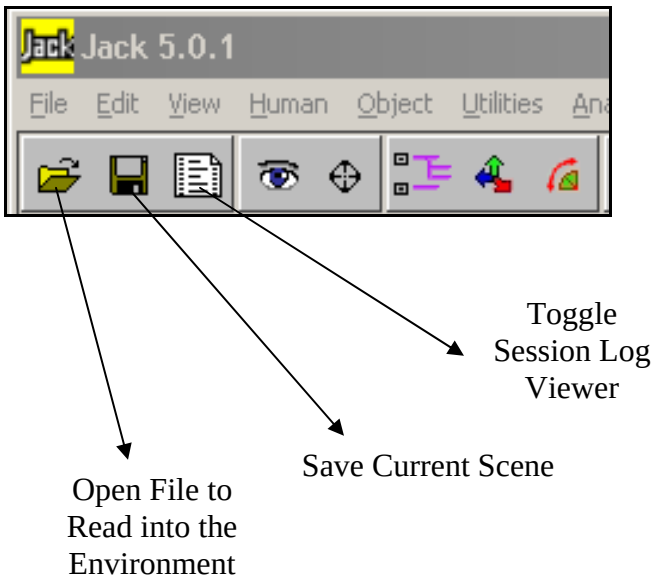


Figure 1: *File Menu & Operations*

Figure 2: *Standard Toolbar*



For more information please check;

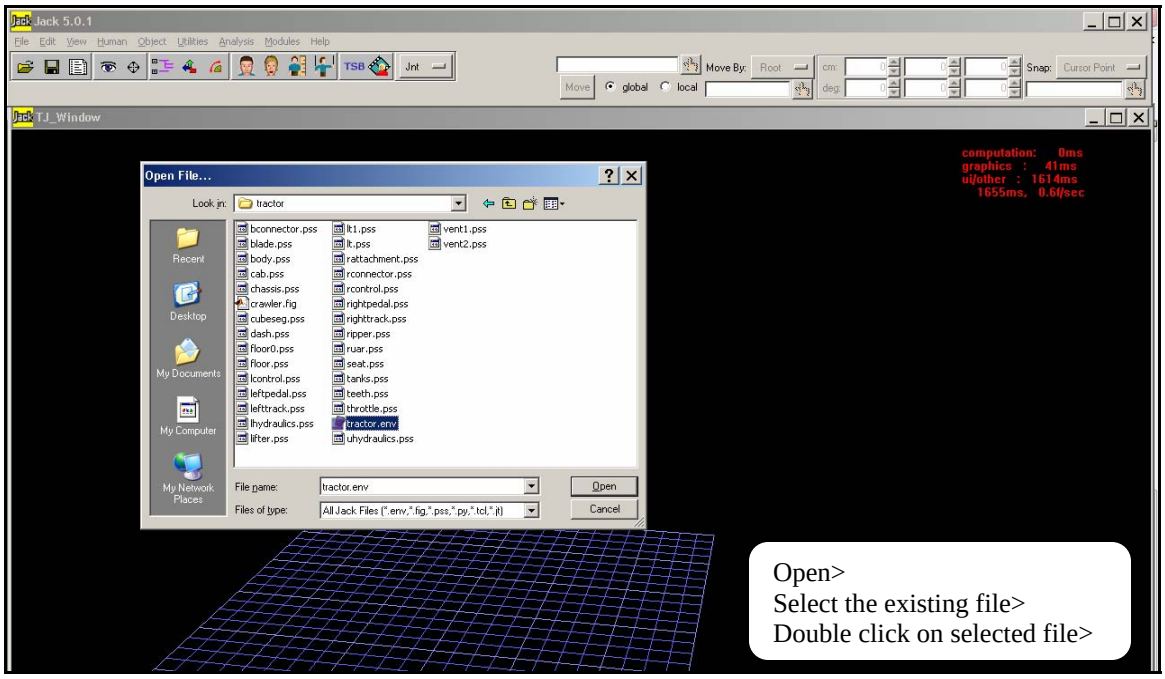
UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

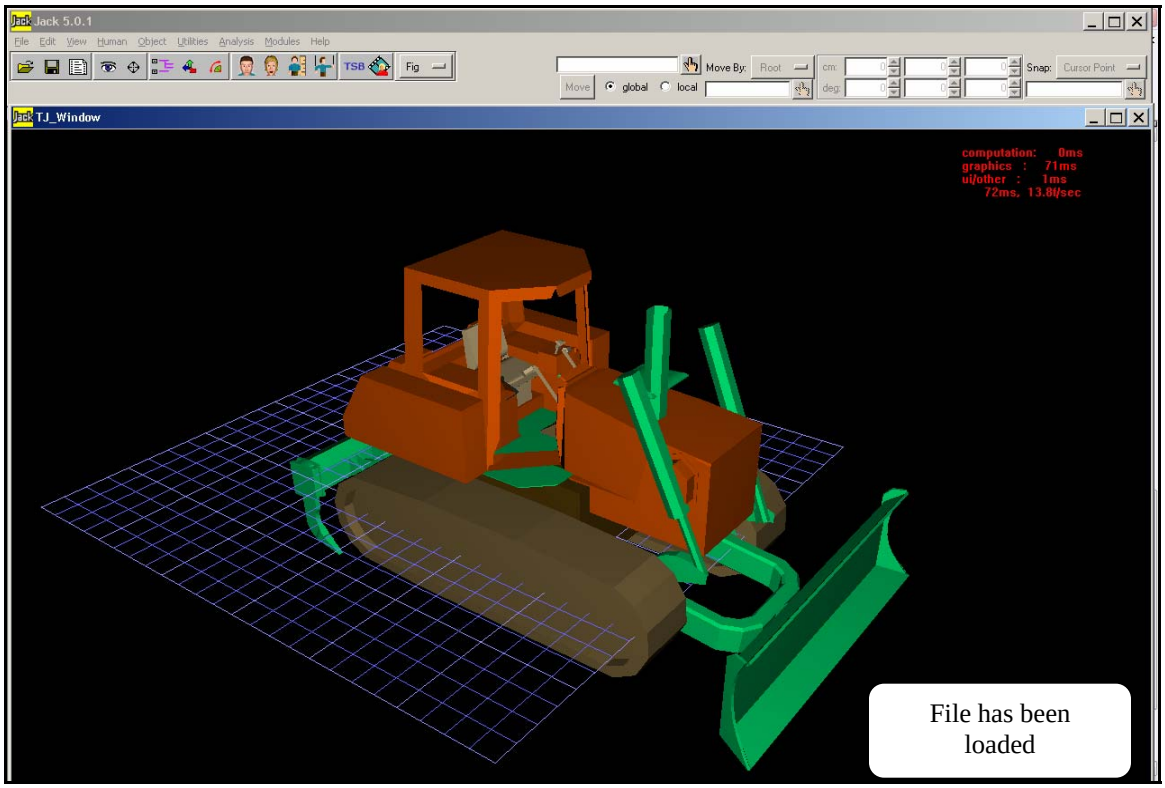
Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

Open

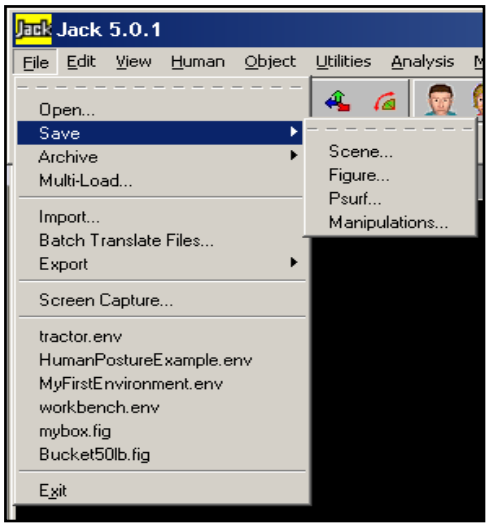
Open command helps the user to load the existing files into the Jack 5. Click Open command and choose an existing file from the existing directory.





Save

Save command saves the current working file into its existing directory or saves the working file as a Scene, Figure Psurf.

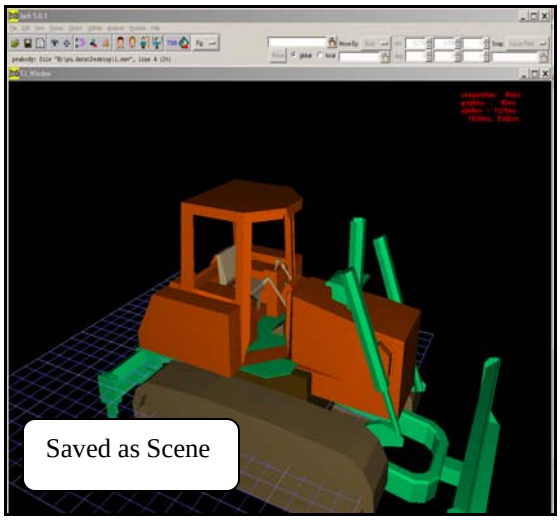


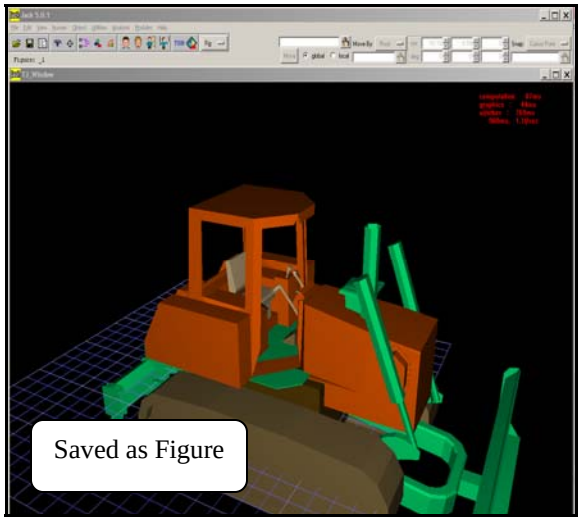
Scene: Scene command will save your file as an environment file (.env)

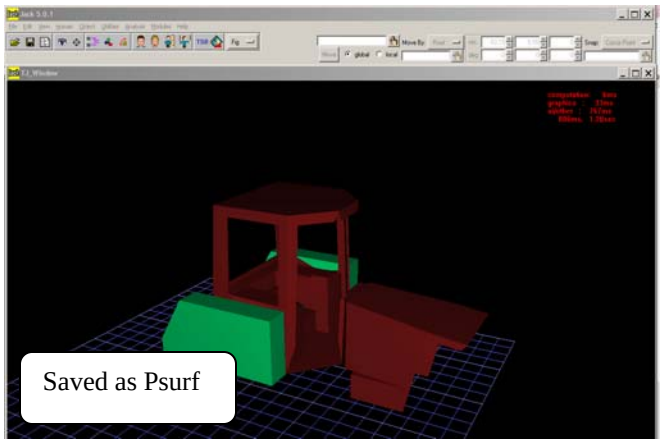
Figure: Figure command will save your files as a figure (.fig) where you can use saved figure files to make an assembly.

Psurf: Psurf lets user to select individual components (parts) of an environment and save it as a surface files (.pss).

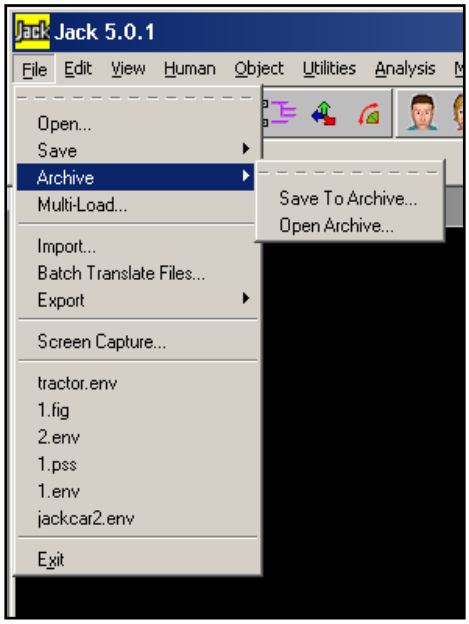
Manipulations: You can go back and forth between Scene and Figure saving options.



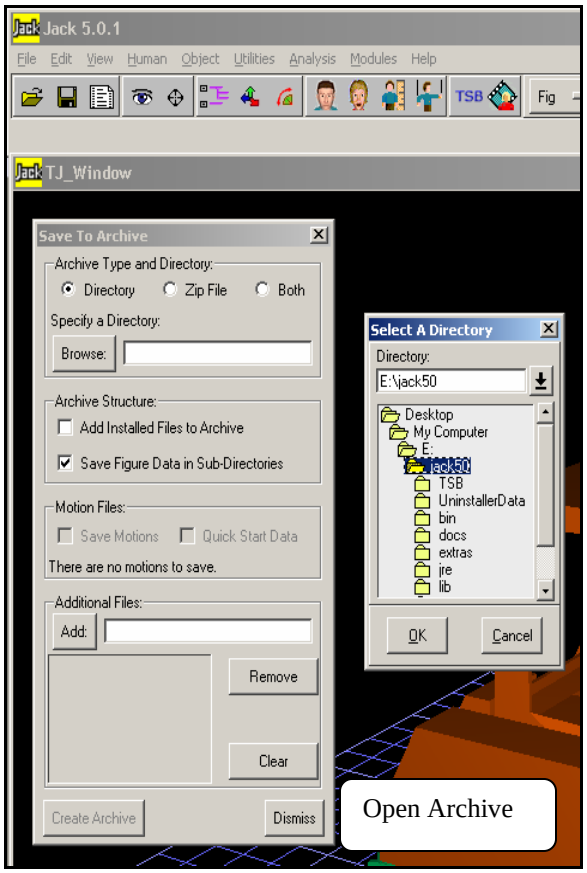


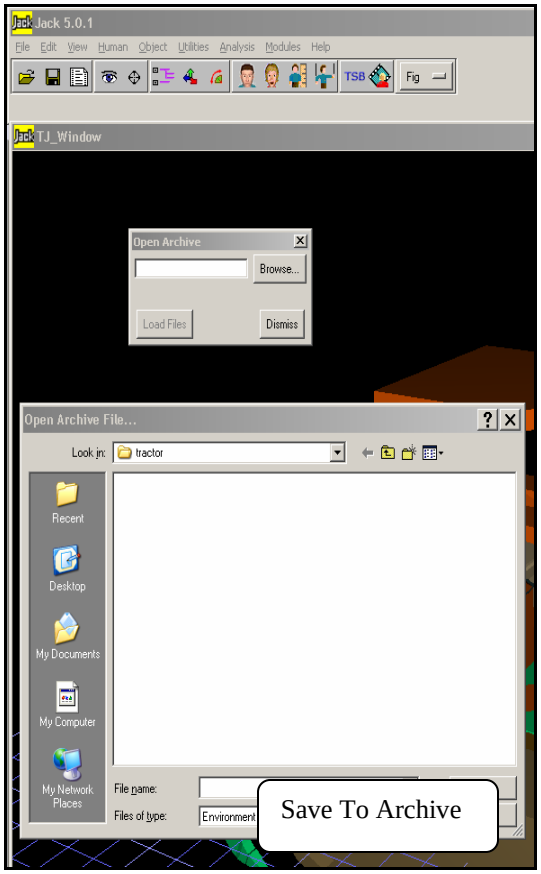


Archive

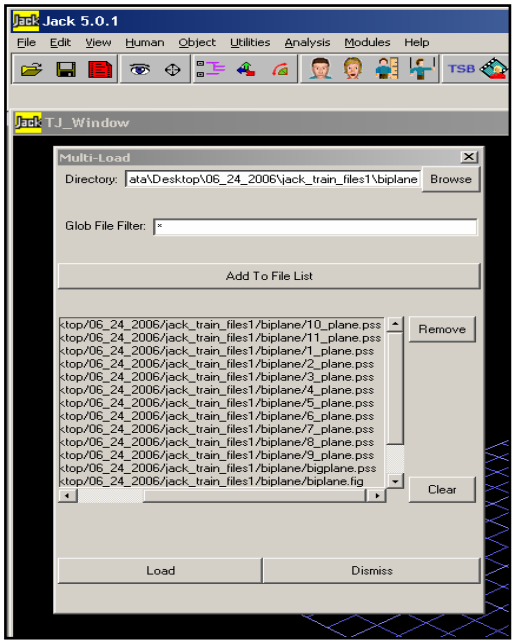


Archive command helps user to utilize advance file saving features. You can create an archive folder to keep related items or assemblies together. You can customize and modify your archive files & folders and keep adding new files quickly without losing extra time.

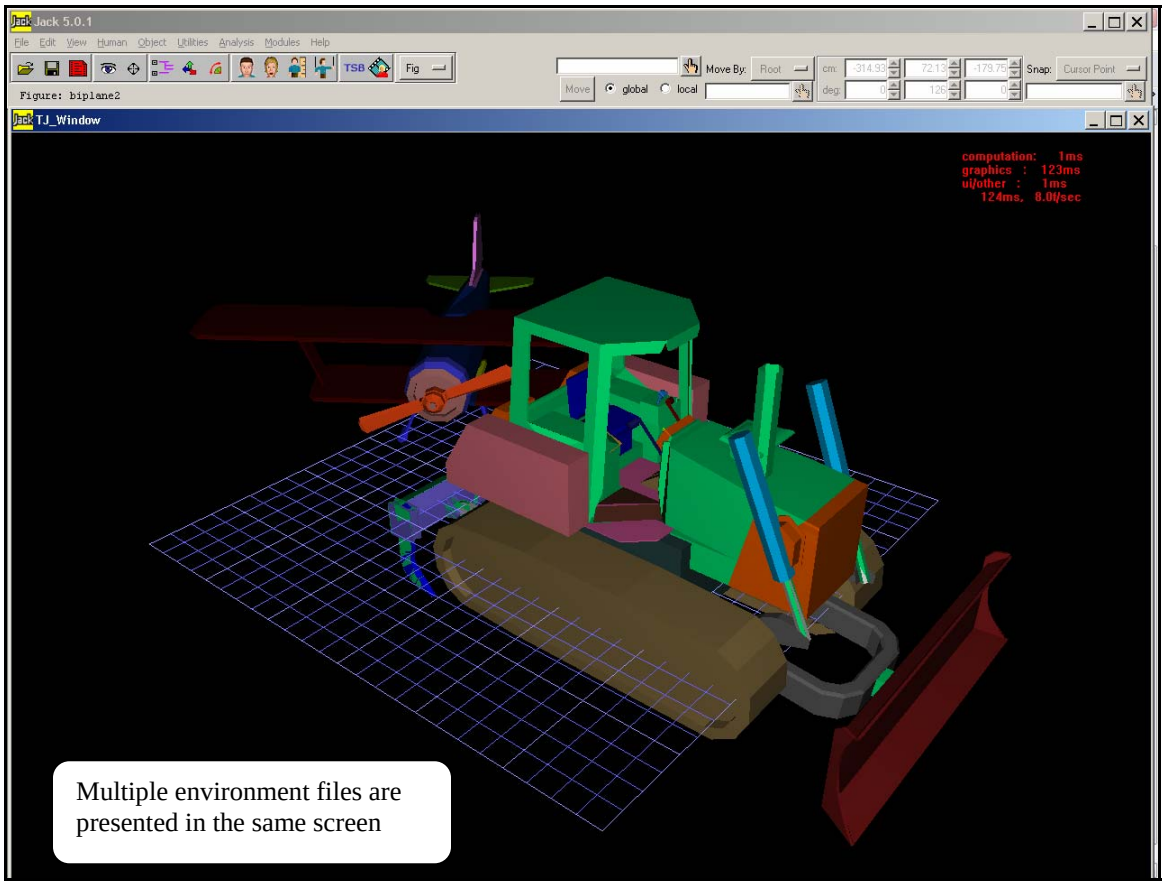




Multi-Load



Multi-Load command allows you to access multiple environment/part files and load them to Jack by creating a file list. You can add/remove environments as well as sub-files inside the environment folders by using file list.

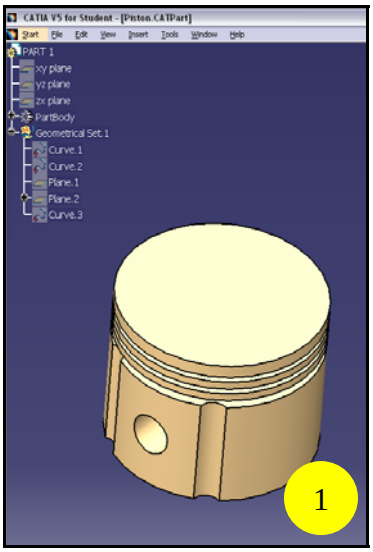


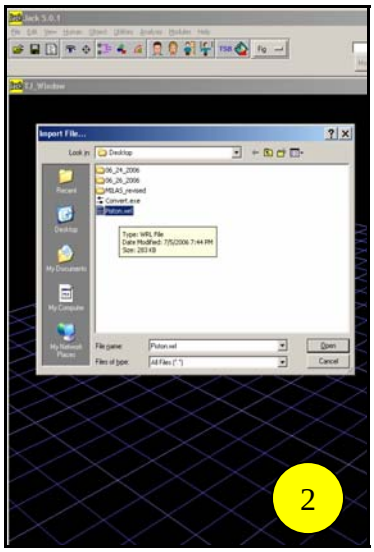
Import

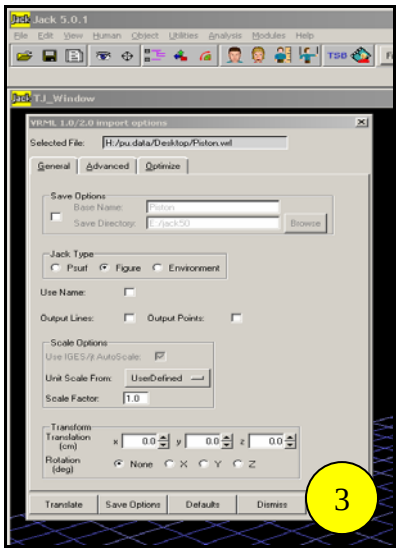
Import command lets users to load files from external sources. You can import CAD files, Images, Textures, VR files...etc from other software by using common file share extension in Import menu. **Figure 3** shows available Import file extension in Jack software.

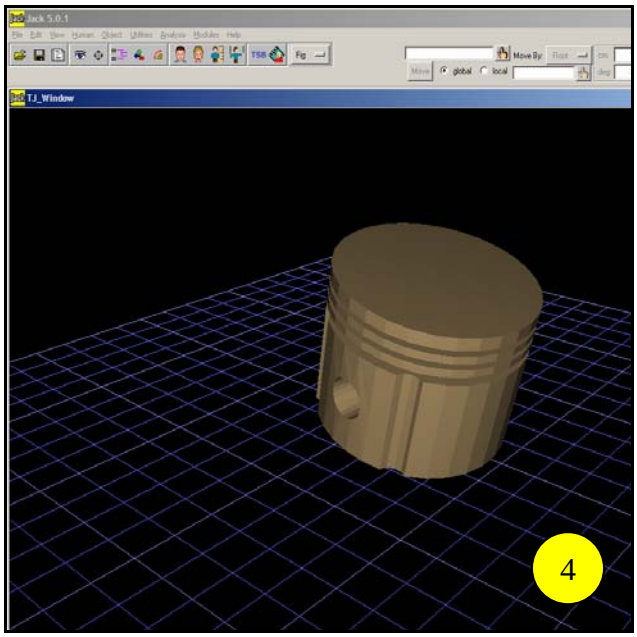
IGES 5.3 (*.igs,*.iges,*.IGS,*.IGES)
VRML 1.0/2.0 (*.wrl,*.WRL)
Optimizer 1.1 (*.csb)
DirectModel (*.jt,*.JT)
StereoLithography/PSurf (*.stl,*.STL,*.pss)
Deneb IGRIP Part Files (*.*)

Figure 3: *Import file extension*









Step by step Import file (-igs)

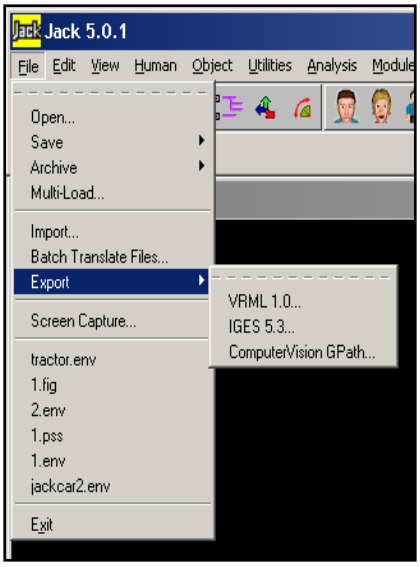
1) CAD part (This part was created in CATIA V5. Also, any 3D CAD program can be used.)

2) Save CAD part as –igs, -stl or –wrl. (-wrl extension is used in this example.)

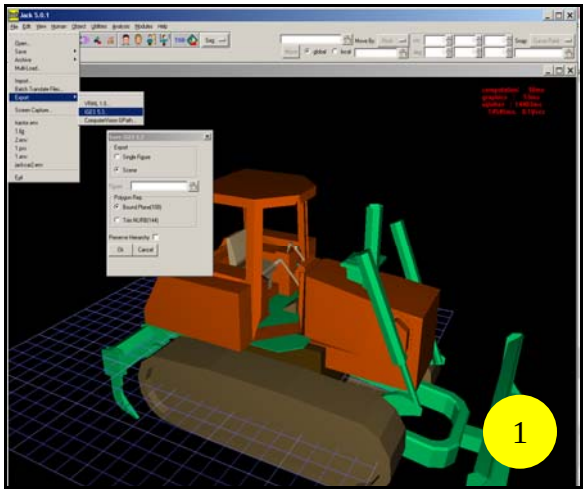
3) Go to Jack 5, click Import and select the file you have already saved in Step 2. When VRML pop-up window appears, click Translate.

4) Ignore the process pop-up windows. Your CAD file should be visible in Jack screen.

Export



Export command allows users to export files to an external source. You can export Jack files to CAD softwares, VR softwares, Image editing softwares…etc. by using common file share extension found in Export menu. You can either use VRML, IGES or ComputerVision Gpath to export Jack files.

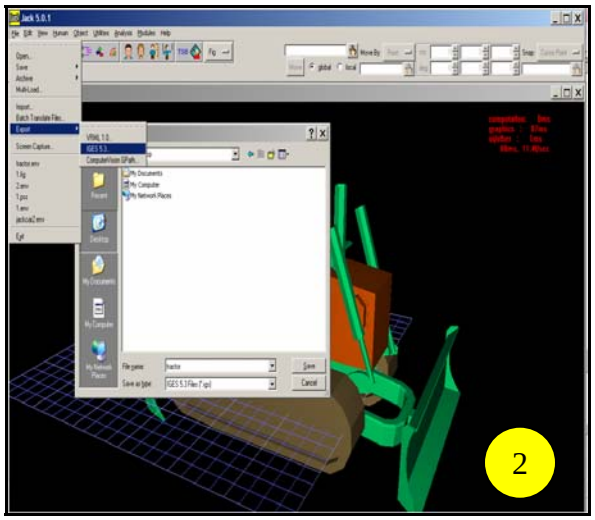


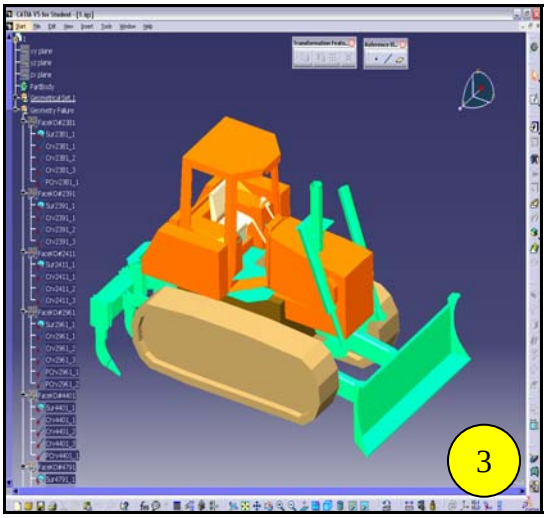
Step by Step Export File (-IGES)

1) Open a Jack 5 environment. Click Export > IGES> OK

2) Give a new name to the file you want to export and click Save.

3) Open the external software and open the file that you have already saved in Step 2. (In this example, CATIA V5 software was used to upload the file.)

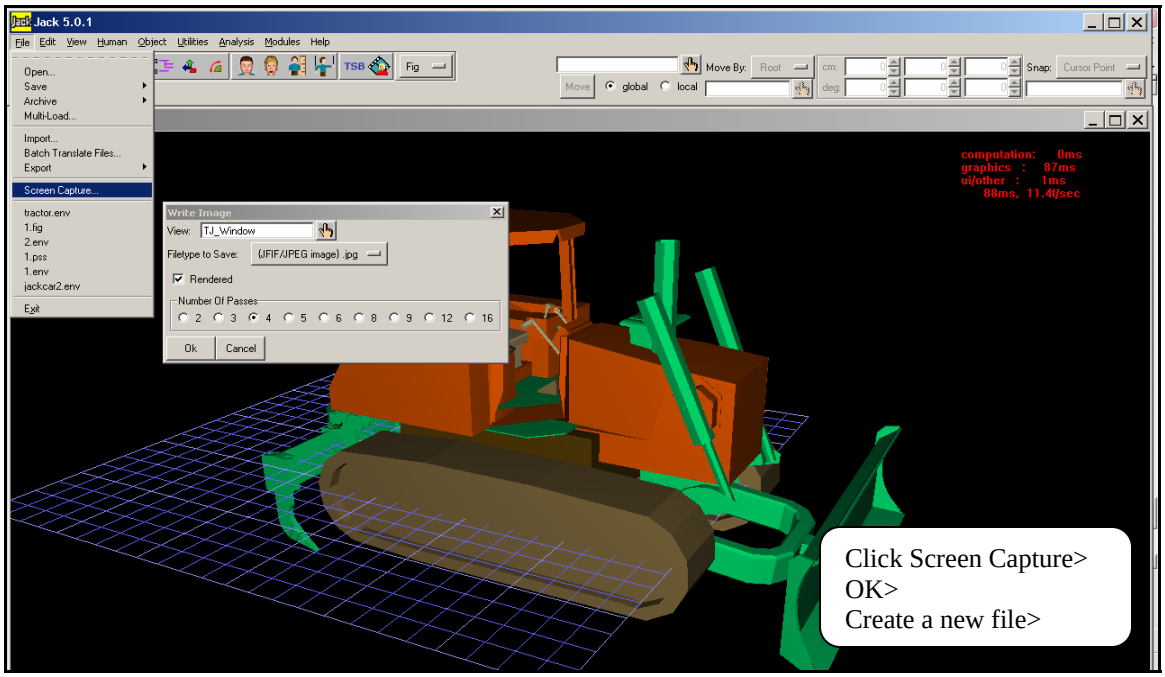


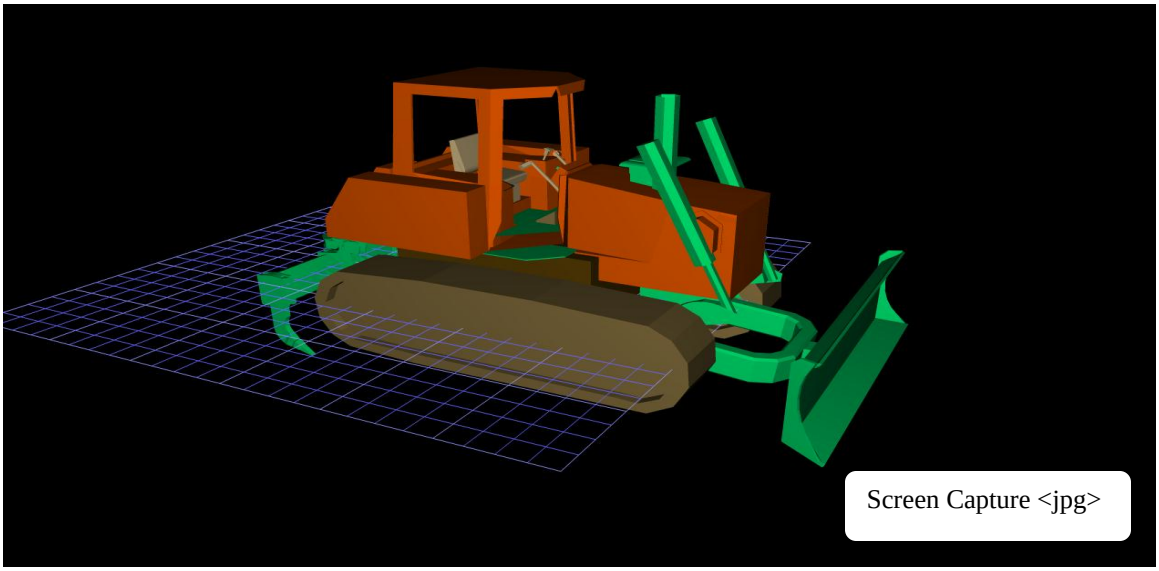


Screen Capture

Screen Capture let you to snapshot the Jack environment. This is a very useful tool to capture images of your design and analysis. This tool makes the visual data transfer available. You can use the captured images to create documentation and presentations.

You can capture and save your images in JPG, TIF, PPM and BMP formats.





Exit

You can safely exit the Jack software by clicking the exit button.

Chapter

2

UGS TECNOMATIX JACK 5.0

User Manual and Examples

EDIT menu

Edit Menu

Edit Menu allows users to access typical modification (editing) operations such as scaling, applying textures & materials. Also, System Defaults which holds the settings of the default working environment is embedded in File menu. **Figure 1** contains all editing operations under the Edit menu.

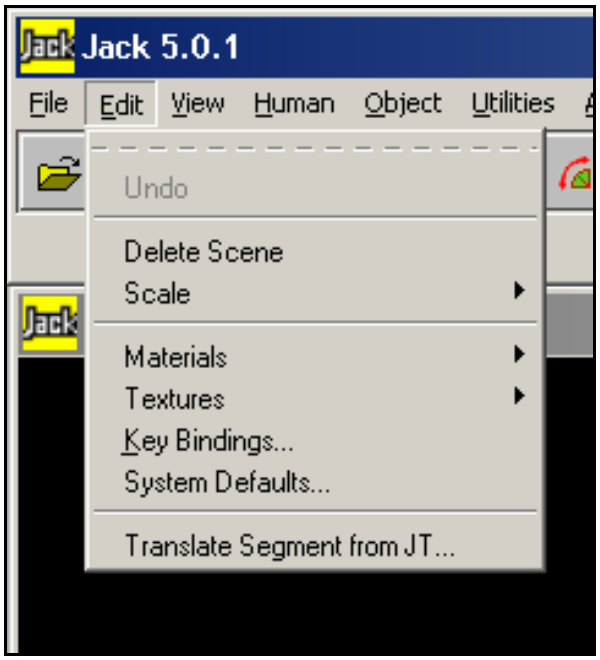


Figure 1: *Edit Menu*

For more information please check;

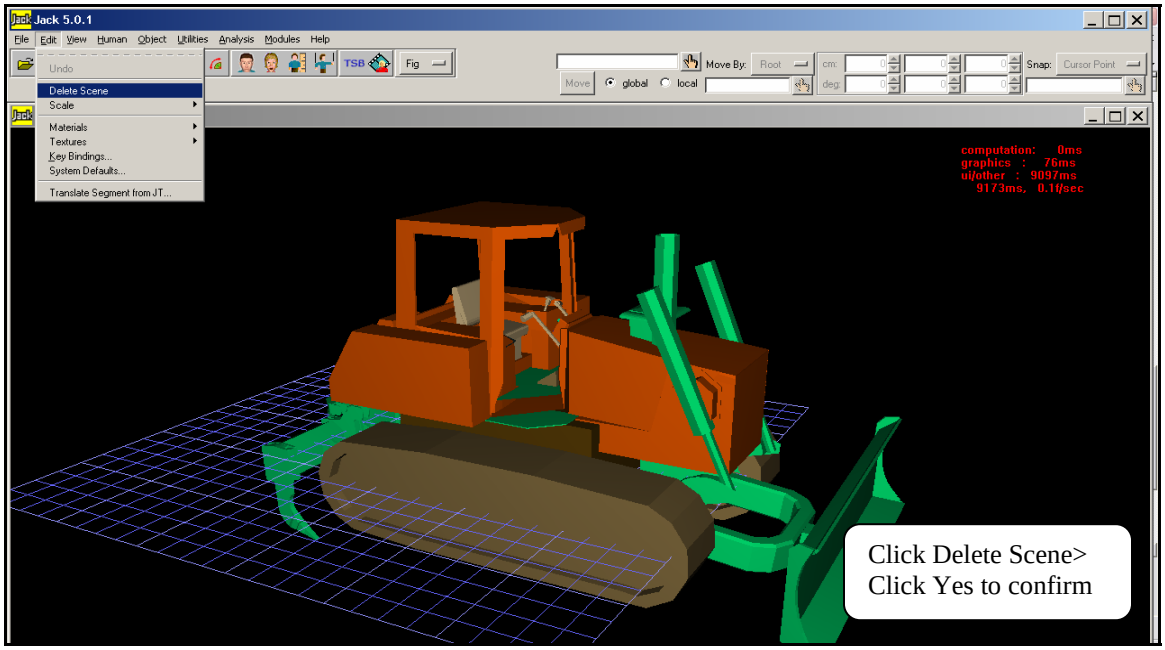
UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

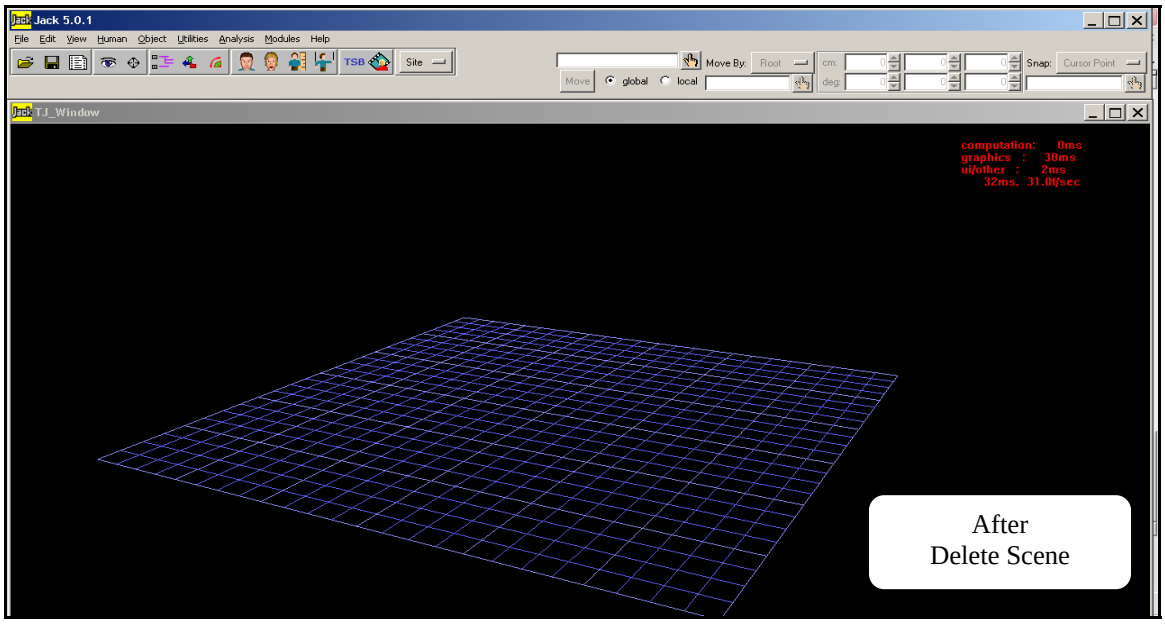
Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

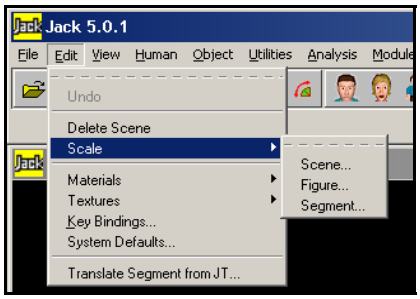
Delete Scene

Delete Scene erases (deletes) all the visible & hidden objects in the working screen. Regardless of their location and visibility, all the objects in the view screen will be deleted after selecting Delete Scene command. This command is similar to “Close” operation found in many CAD softwares. Instead of closing an environment, you can delete the environment from the view screen.



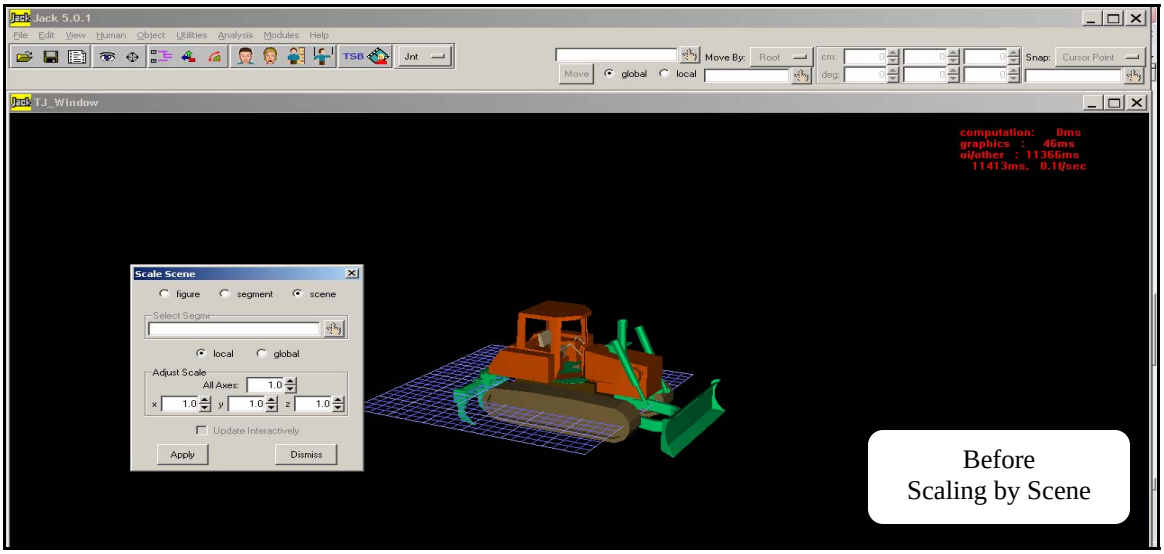


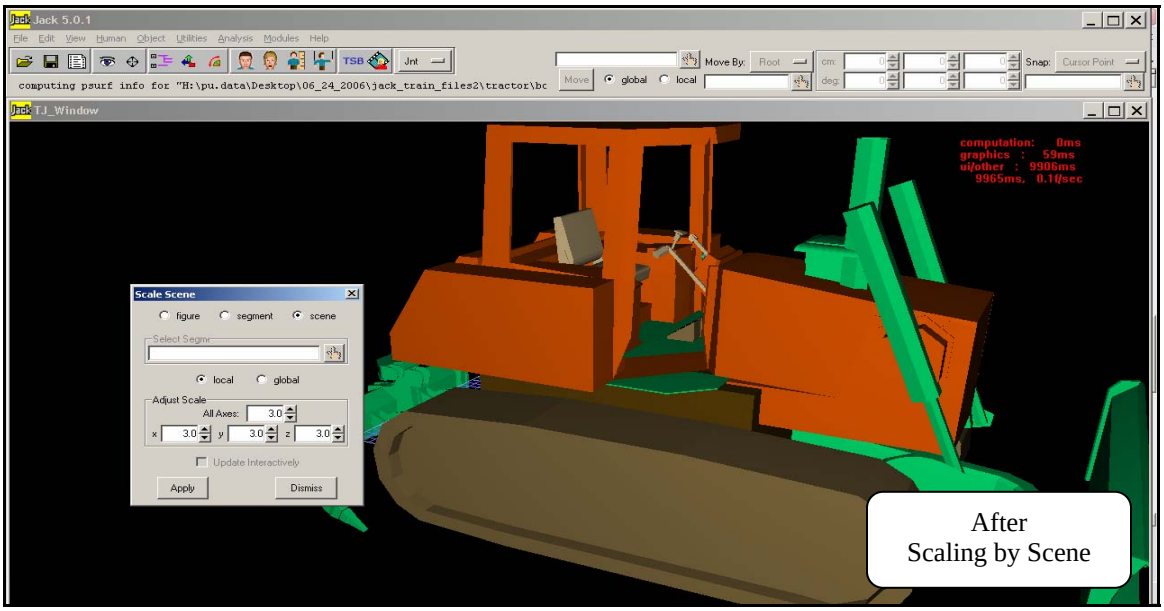
Scale



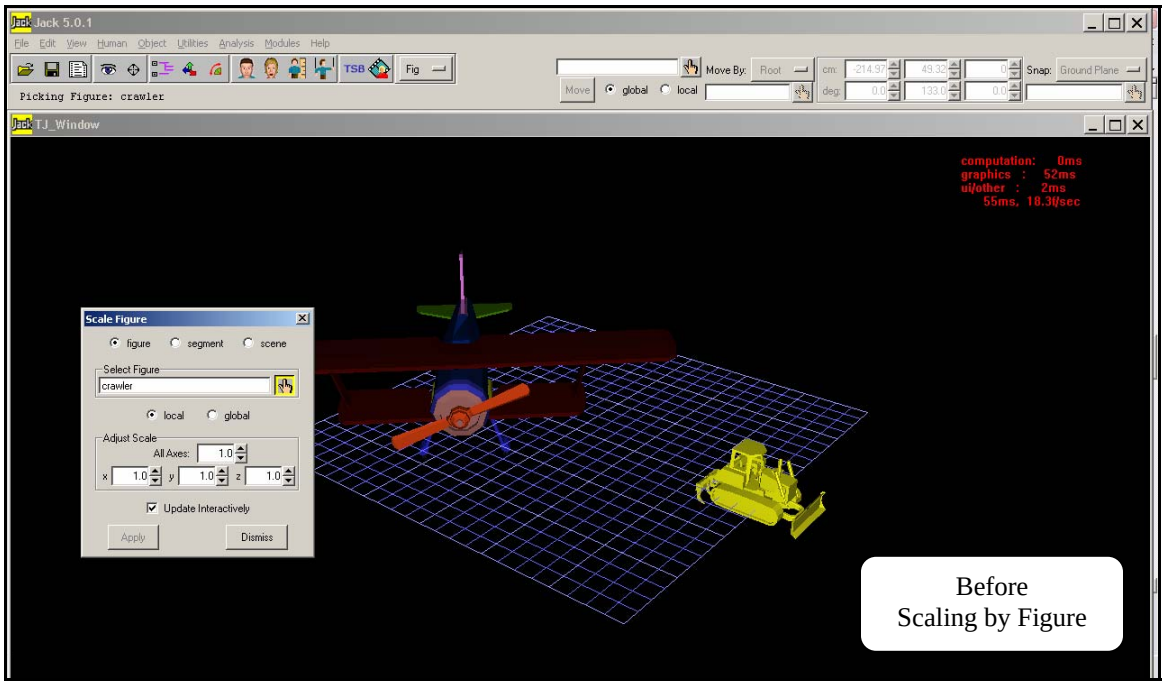
Scale command allows you to increase/decrease the size of the working object. You can scale by Scene, Figure and Segment. This tool is a useful visualization aid where you can increase the object size independently in three dimensions.

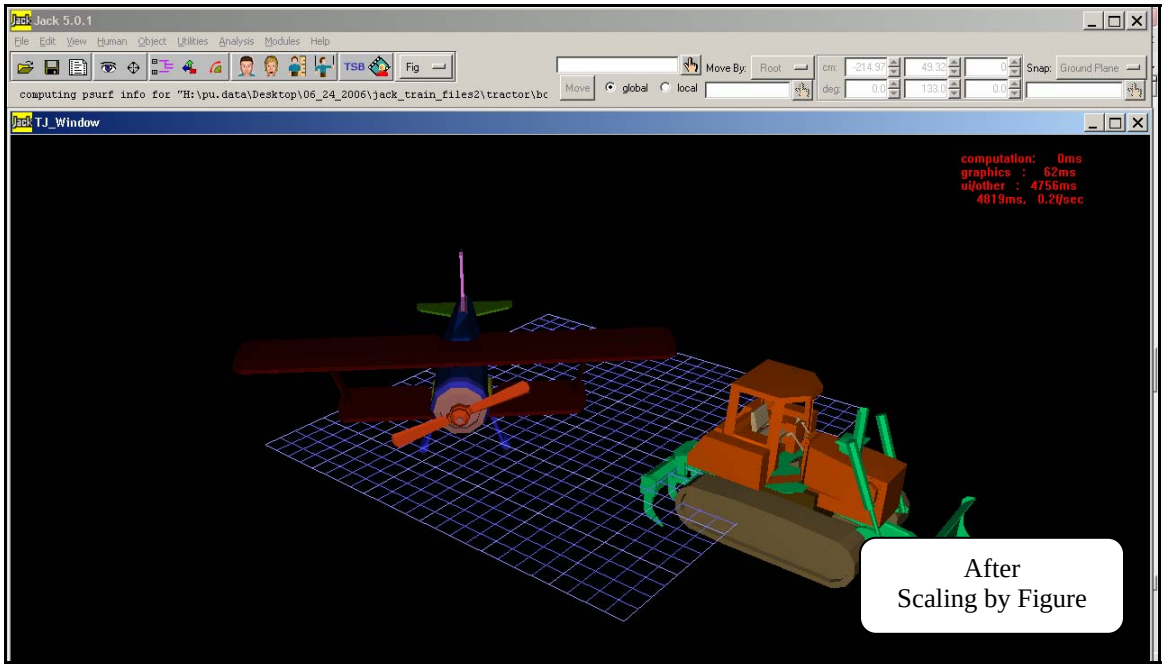
1) **Scaling by Scene;**
   Scales the screen view. Enter the scale factor you want and click Apply.



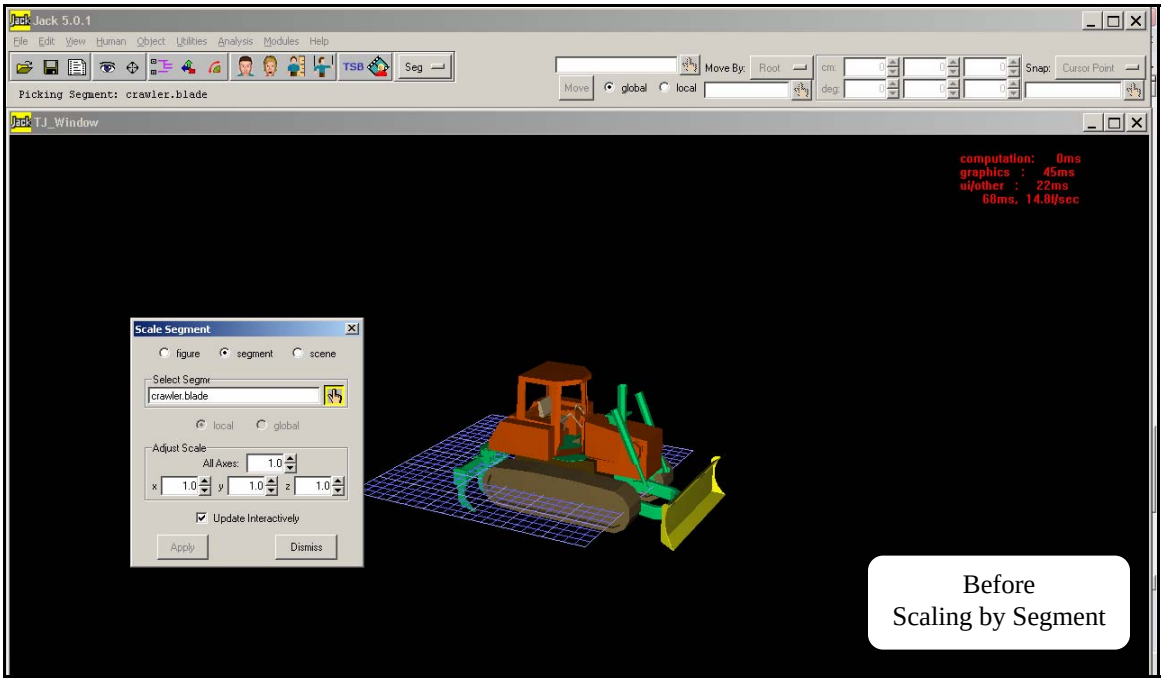


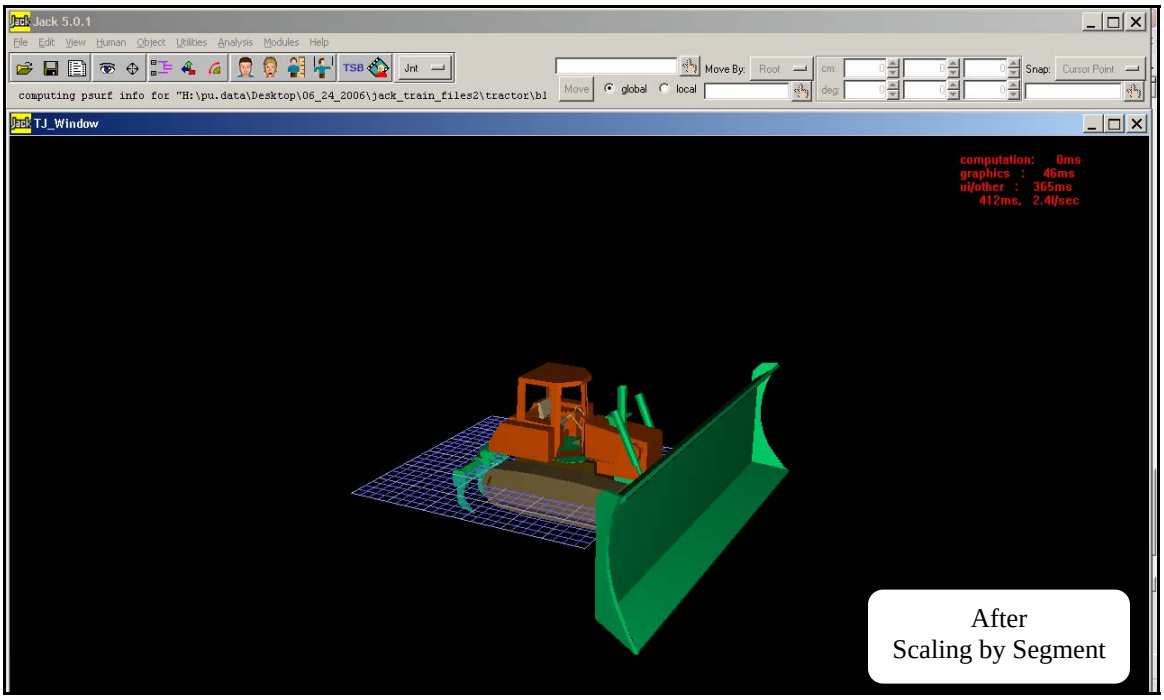
2) **Scaling by Figure;**
Scales the selected figures. Select a figure, and enter scaling factor.



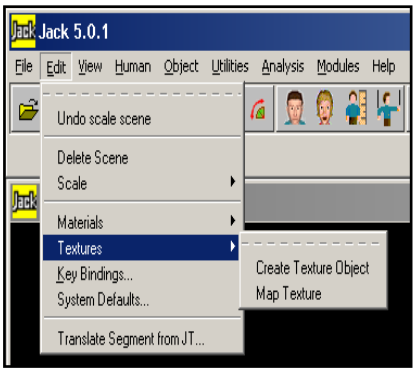


3) **Scaling by Segment;**
Scales the individual segments of a figure. Select a segment, and enter the scaling factor.

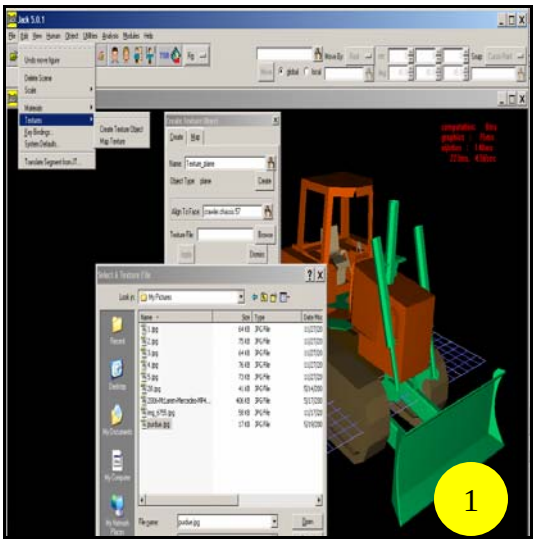




Textures Menu



Textures command allows you to apply textures to your designs. You can create textures and map them to the surfaces you want. This is a good visual aid for a better realistic rendering.



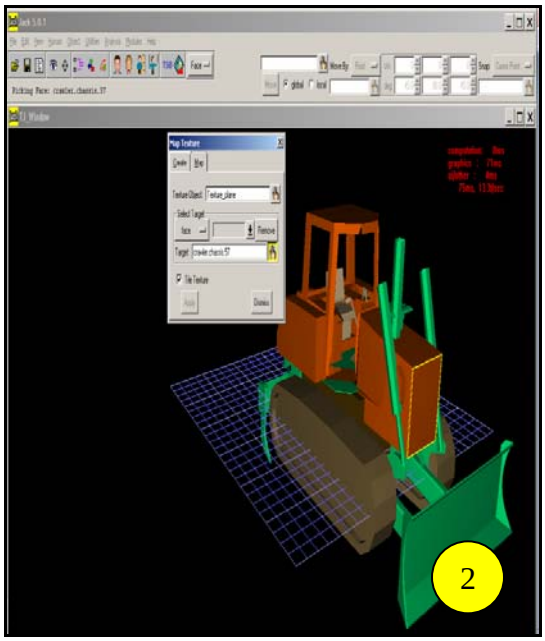
Step by Step Mapping Texture

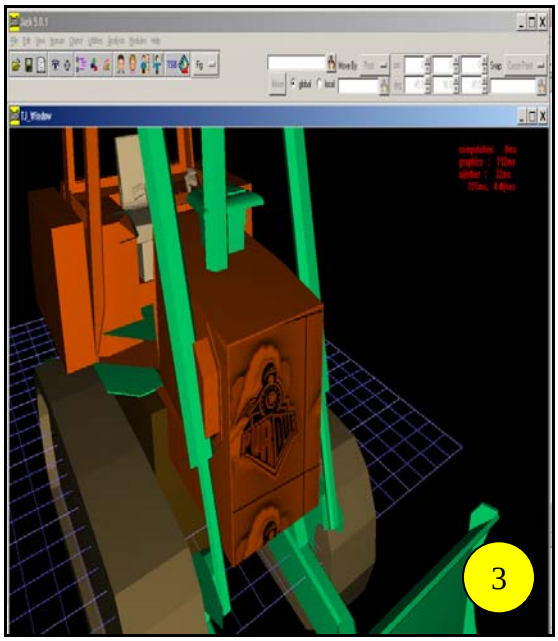
1) Open a Jack 5 environment.

Click Textures >
Create Texture Object>
Create>
Align To face (Select the face) >
Browse (select the texture file)

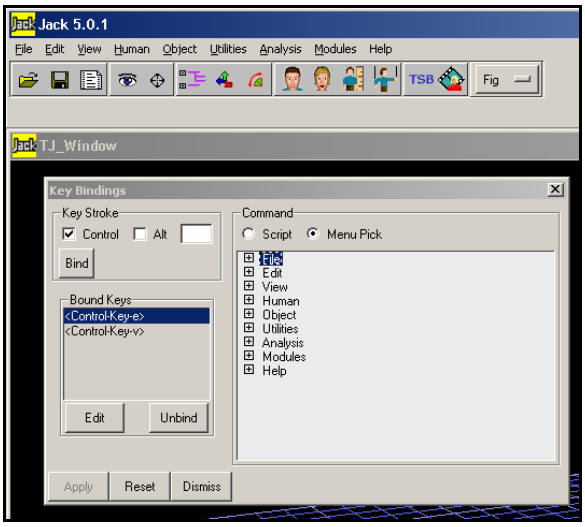
2) Create Texture tab will switch to Map Texture. Select the Target surface and click Apply.

3) The Purdue logo is applied to the selected surface.



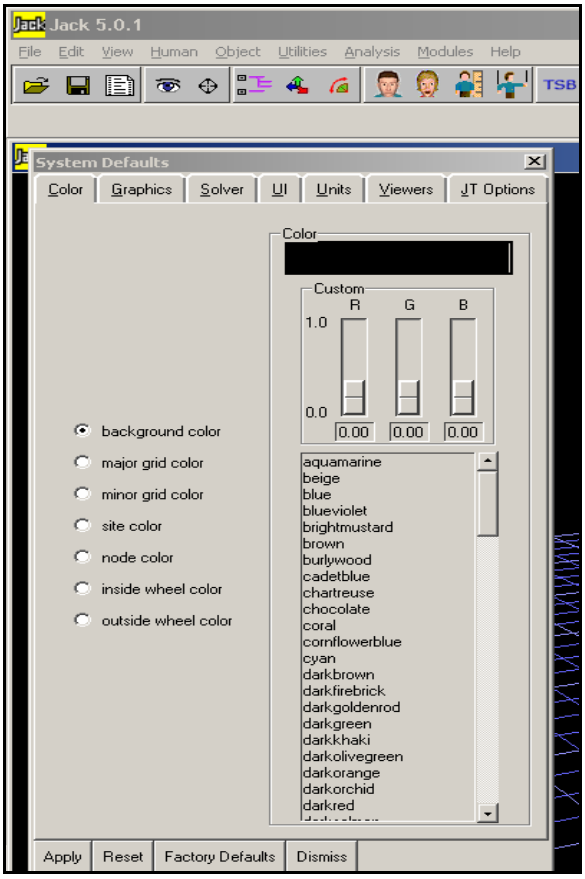


Key Bindings



Key Bindings feature assigns shortcut keys to several menu operations. You can assign special key features to your most frequently used menu commands. This user friendly feature saves time in long term use of the software.

System Defaults



System Defaults holds the settings of the default working environment. You can change the settings of the default environment. You change the Color, Graphics, Units, and Viewers…etc. by clicking each tab. This allows you to customize your setting depending on your needs.

Chapter

3

UGS TECNOMATIX JACK 5.0

User Manual and Examples

VIEW menu

View Menu

Jack 5 has several viewing tools that allow you to change your view of the geometry or change the orientation of it. **Figure 1** contains all necessary viewing aids and **Figure 2** holds the frequently used viewing tools.

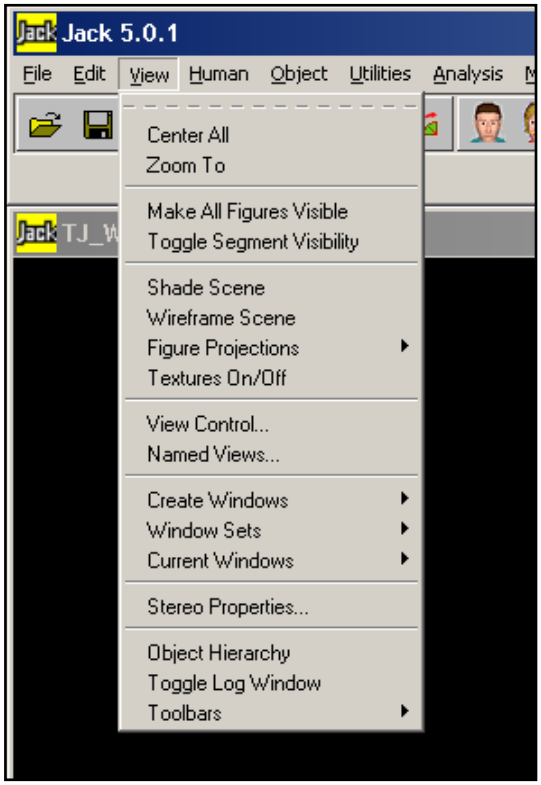
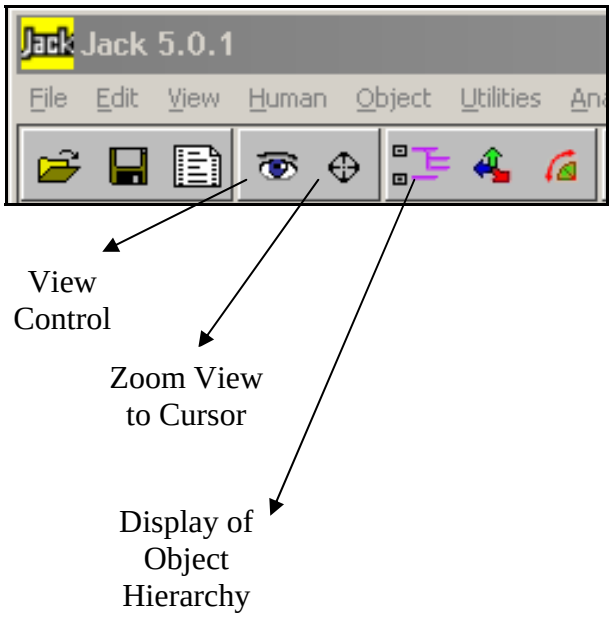


Figure 1: *View Menu & Viewing Tools*

Figure 2: *View Toolbar*



For more information please check;

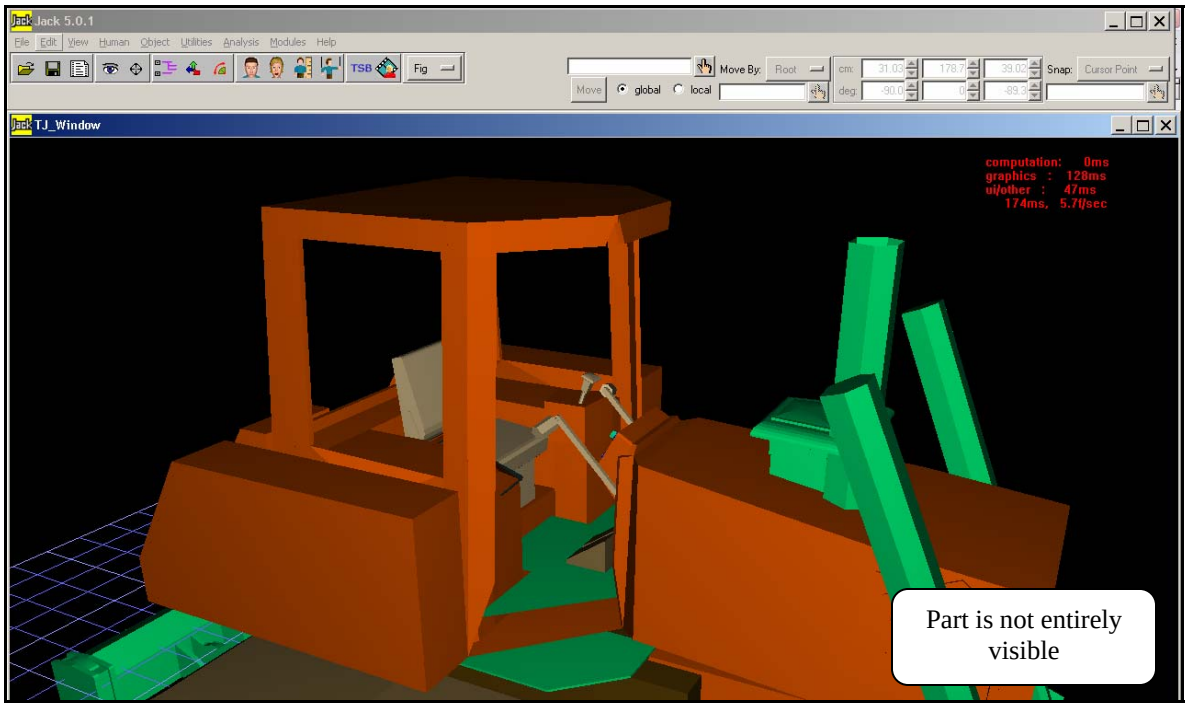
UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

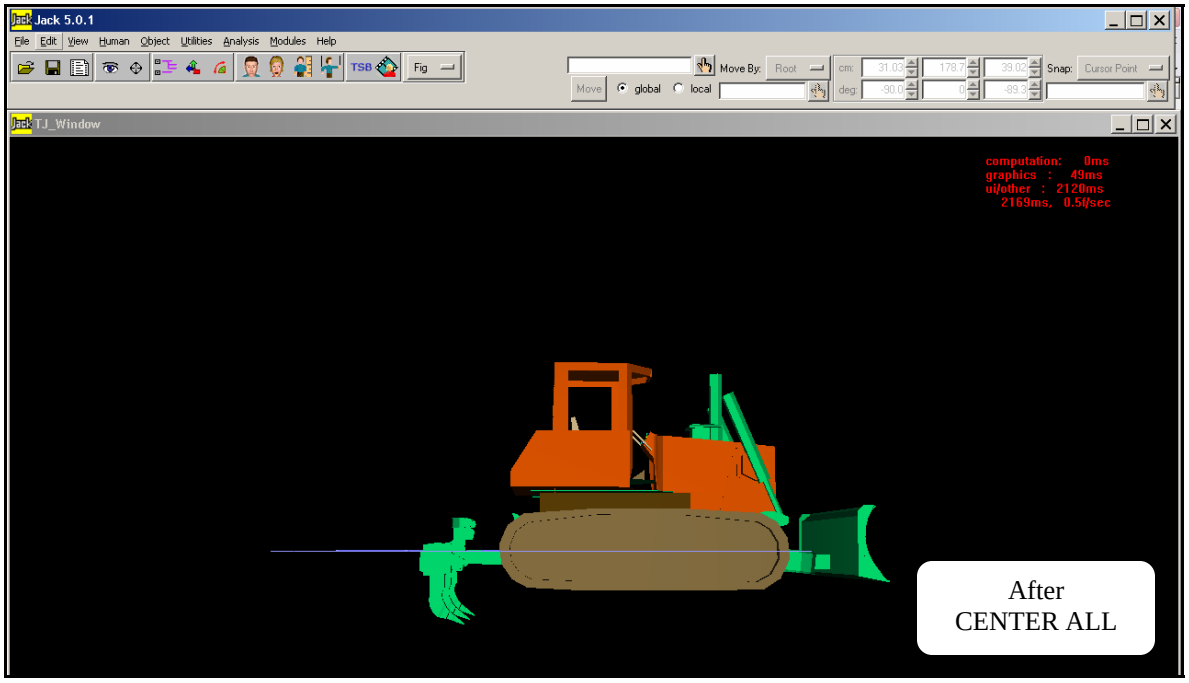
Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

Center All

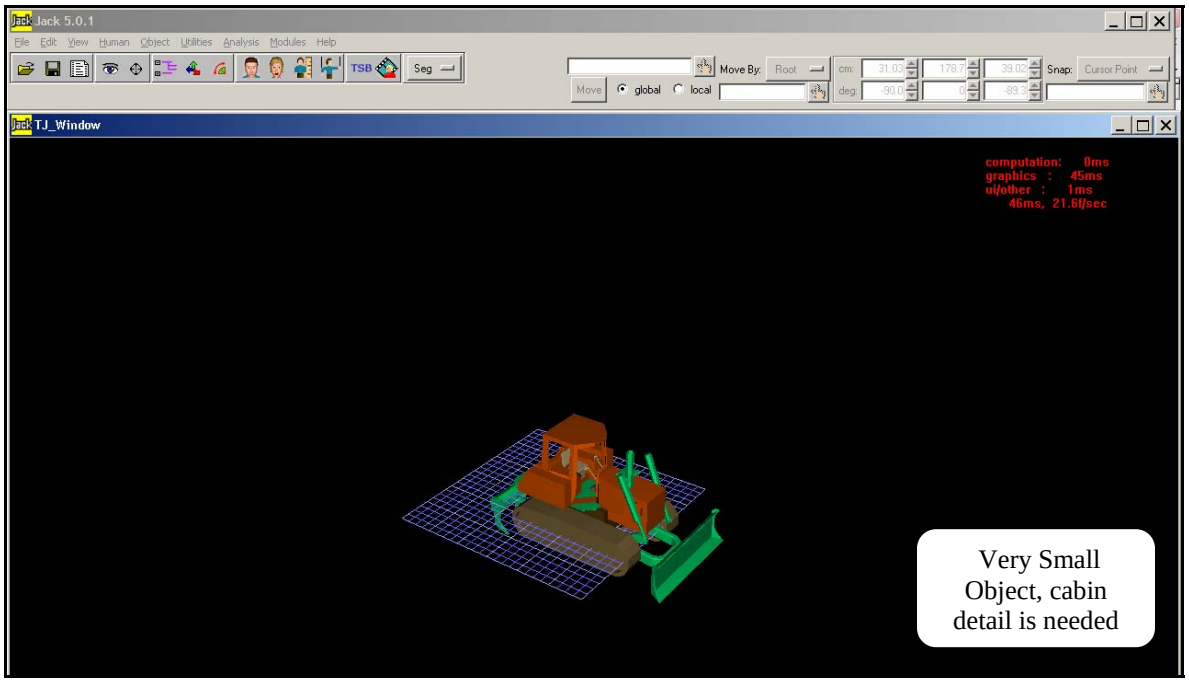
Center All command either moves your viewpoint closer or further away from the part so that the entire part is displayed as large as possible right in the center of the geometry area.

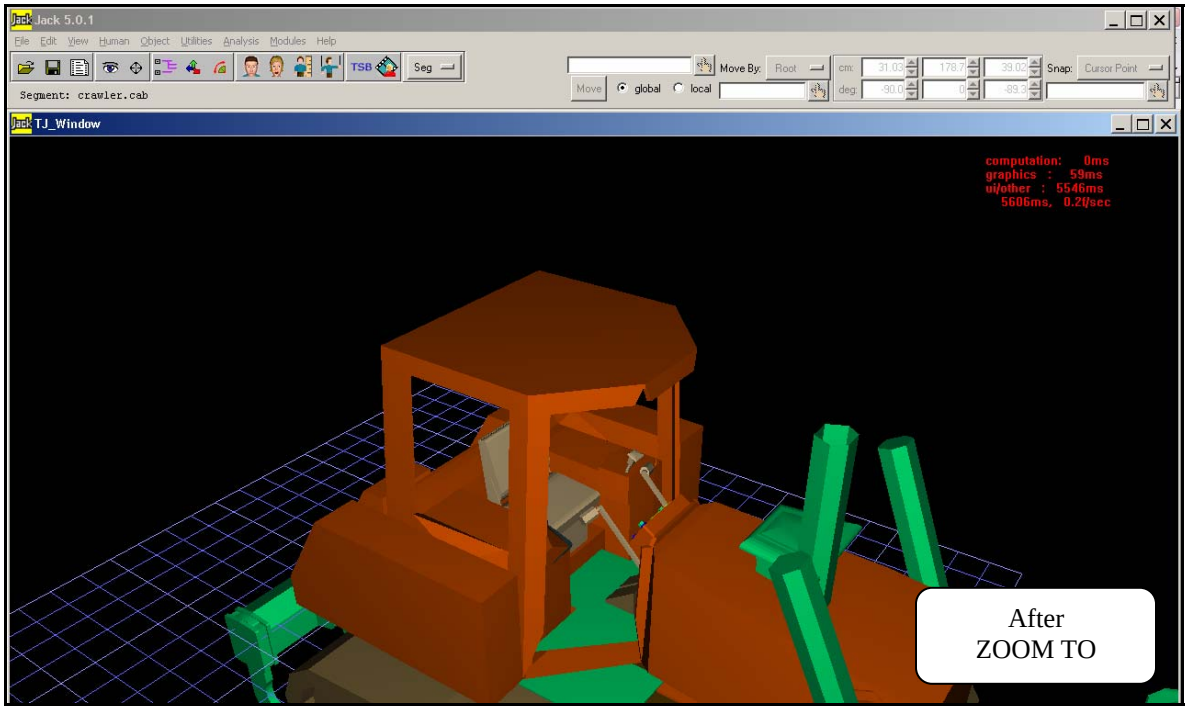




Zoom To

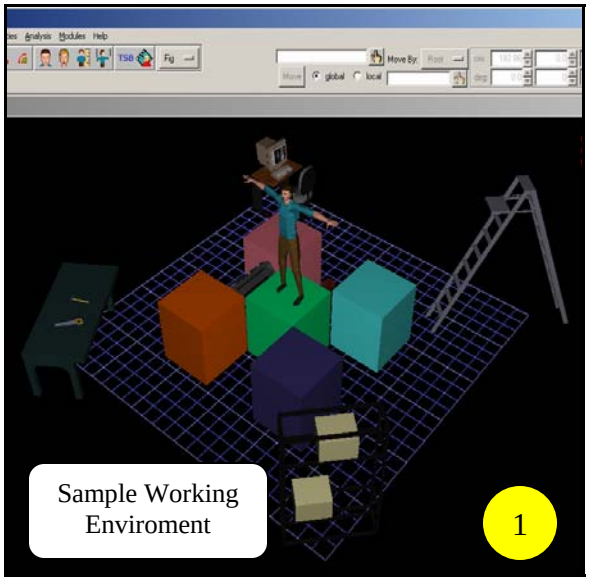
Zoom To command lets you define a zoom area by clicking the left mouse button. Drag your mouse and click on the area you want to zoom in, specified area will appear closer.

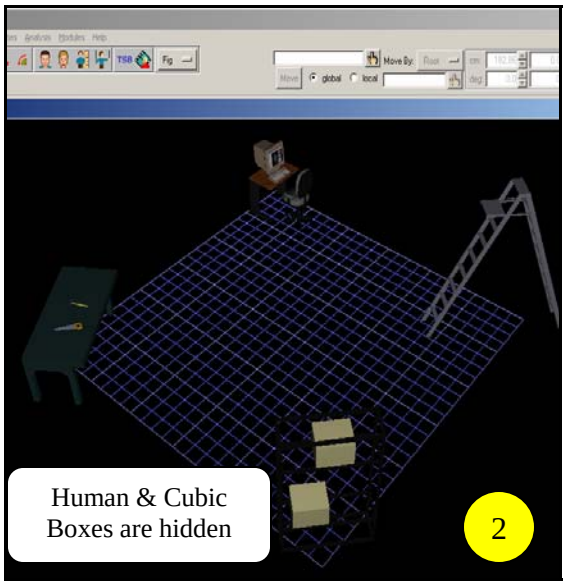


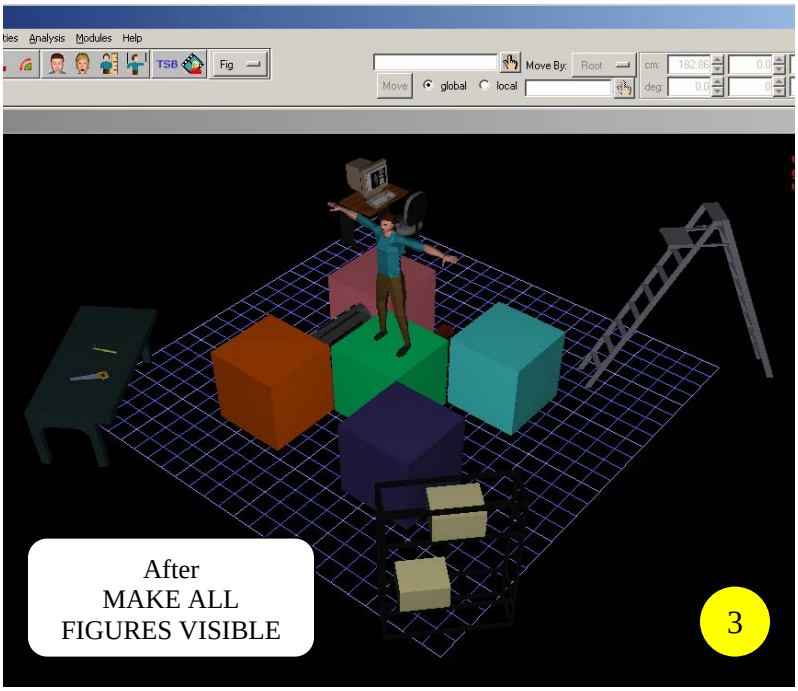


Make All Figures Visible

You can hide/show individual parts on the view screen by dragging the mouse on any desired part and clicking the right button of the mouse. Make All Figures Visible command makes all the parts (including hidden parts) visible on the view screen. It's an advantage for the users to hide/show some parts while working in complex geometries.

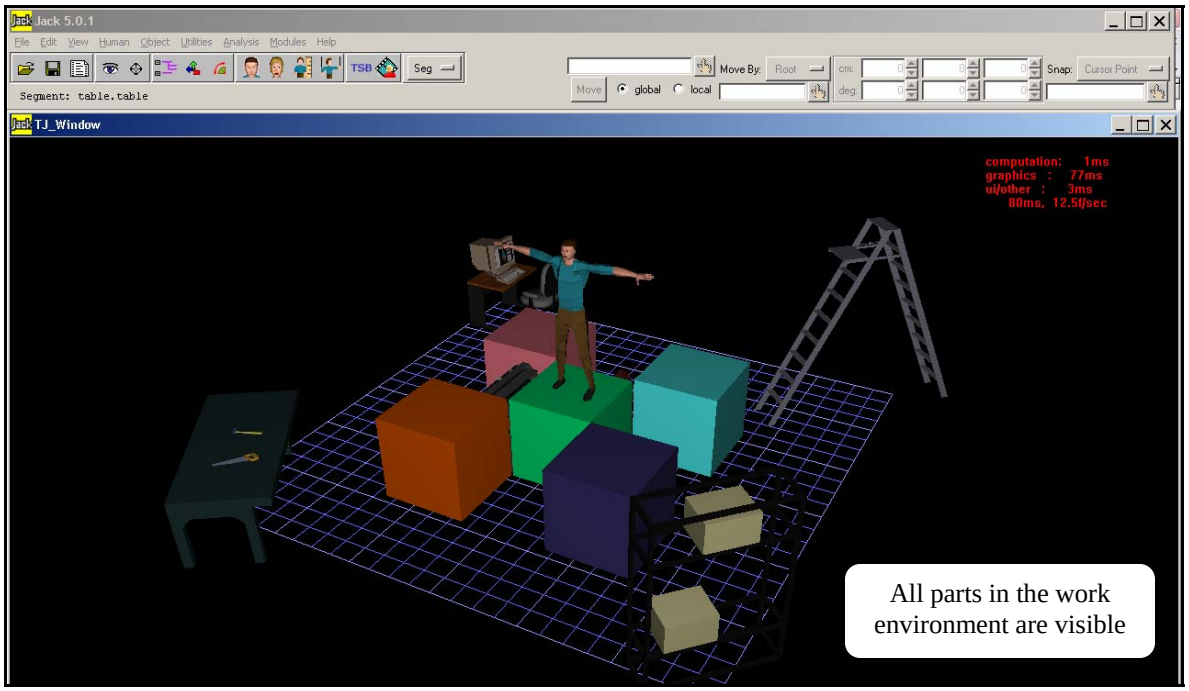


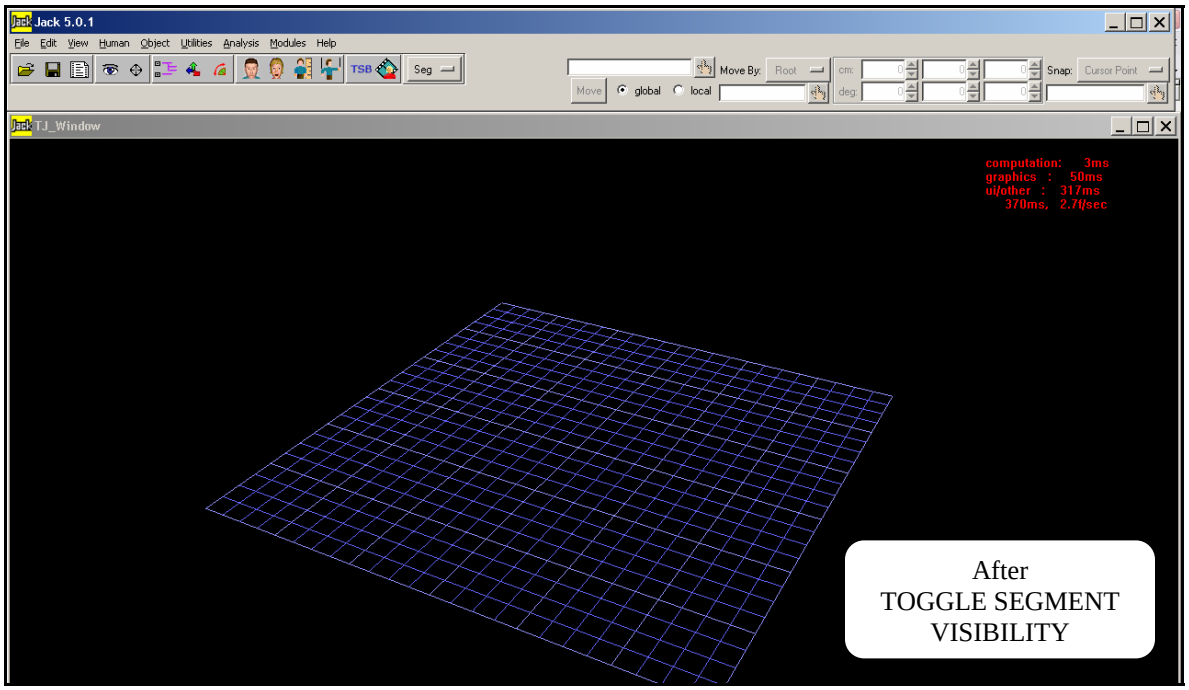




Toggle Segment Visibility

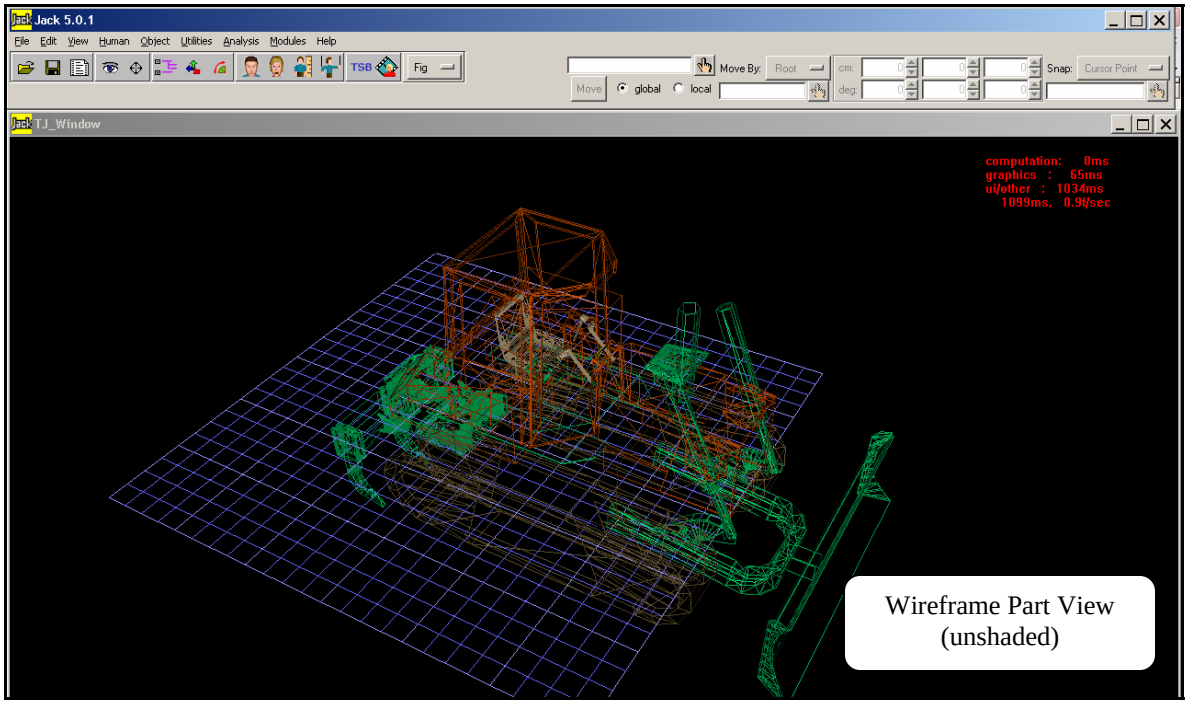
Toggle Segment Visibility hides/shows all the parts in the screen. Instead of hiding each part one by one, this command quickly hides entire working environment in the screen. By clicking the Toggle Segment Visibility command you can switch back the hidden/visible screen view.

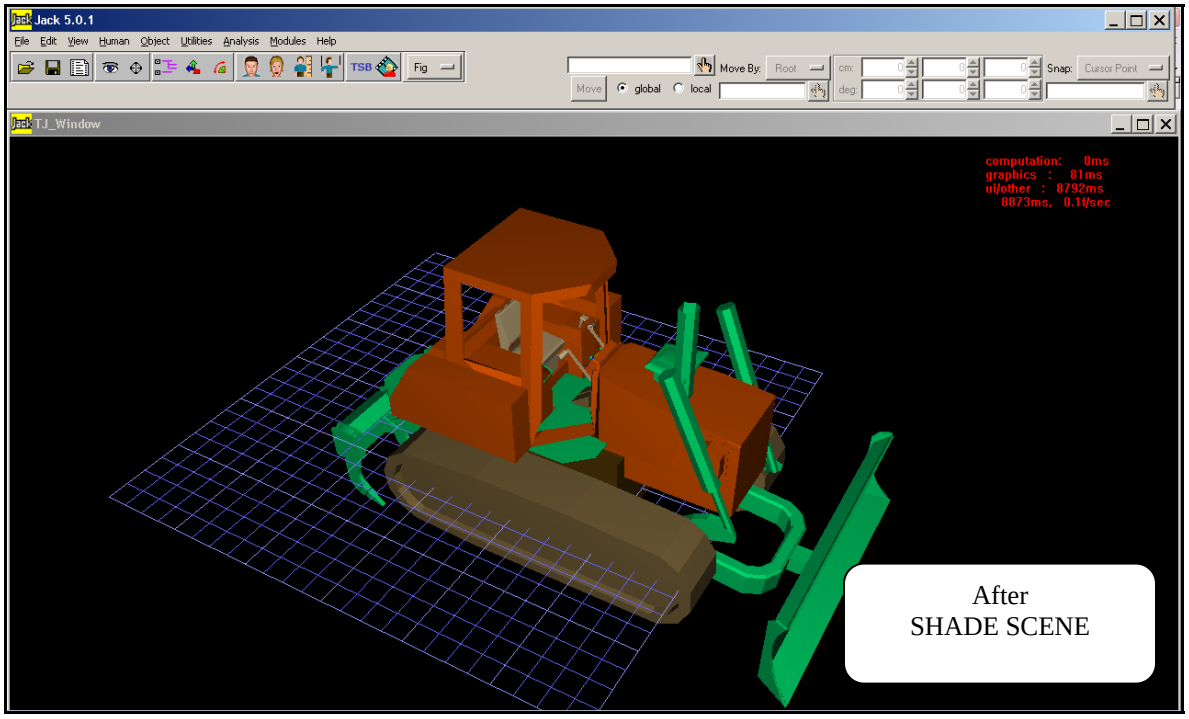




Shade Scene

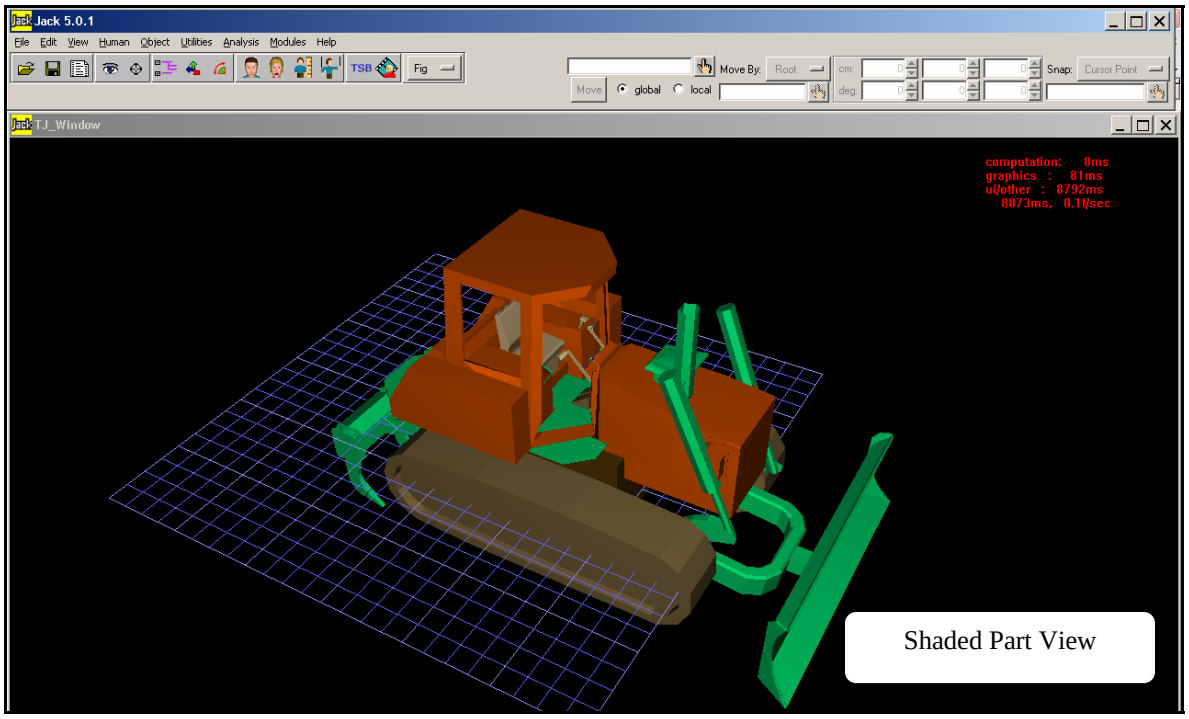
Shade Scene command shades all surfaces of a work environment. The advantage of using the shading is that parts on the screen are easier to visualize. The drawback of using shading is the complex geometry slows down the response time.





Wireframe Scene

Wireframe Scene command displays lines and vertices of the part, like the skeleton of a human body. This command typically used when working with very large and complex parts. This will increase the response time comparing to Shaded Scene mode. The drawback is that in the Wireframe Scene it is hard to visualize a part.



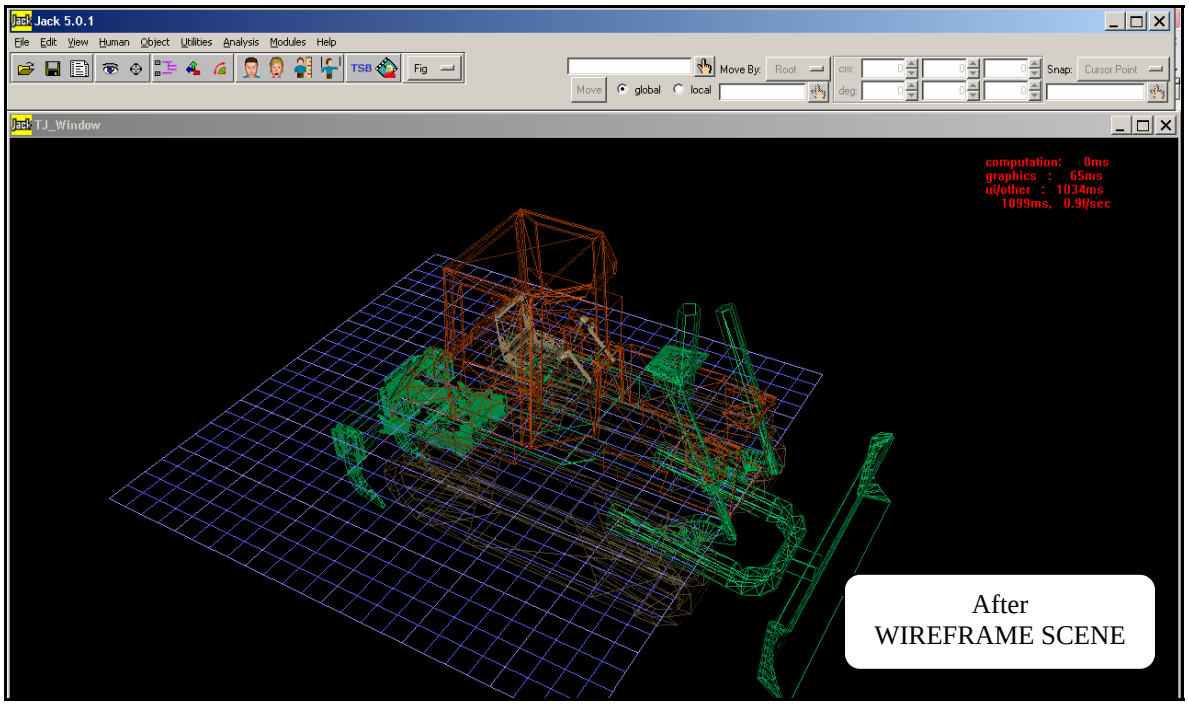


Figure Projections

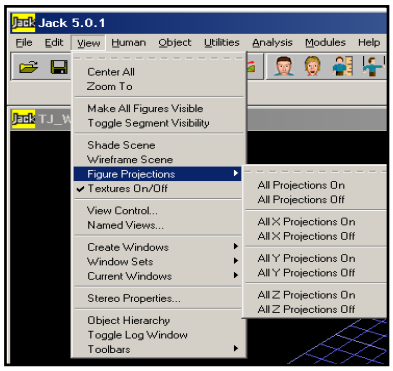
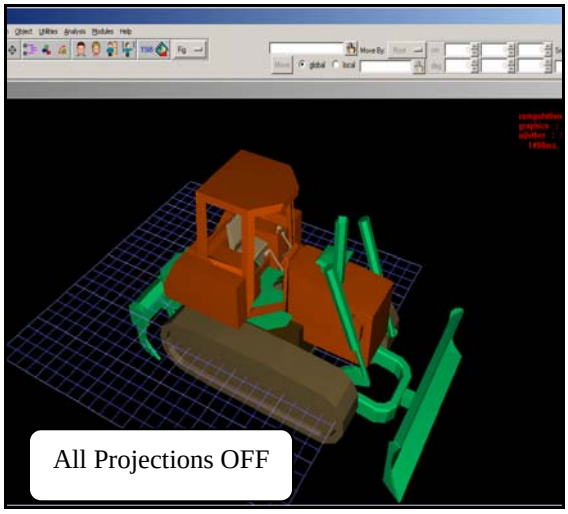
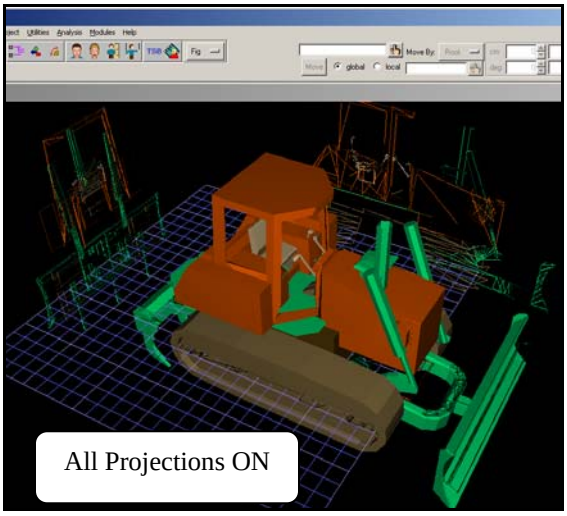


Figure Projections command displays the projections of a part in selected axis systems. This command is typically used to form a simple part draft by using axis projection.

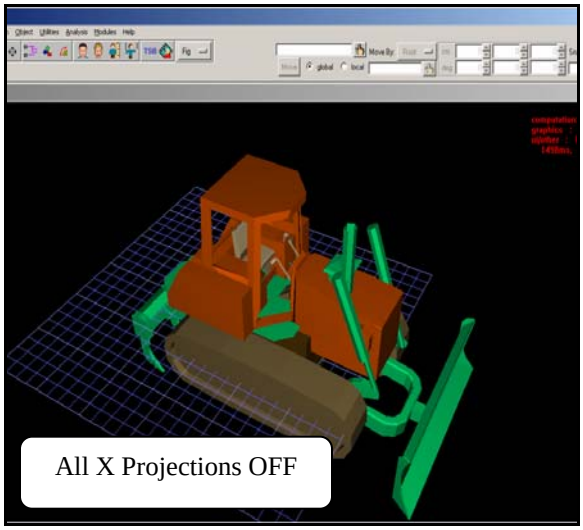
*** Below only All Projections & X-axis Projection features were analyzed. Y & Z axis projections can be displayed in same manner.*

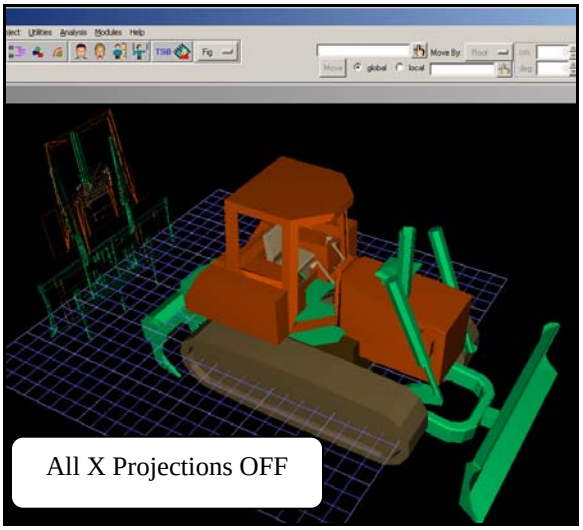
All Projections On / All Projections Off





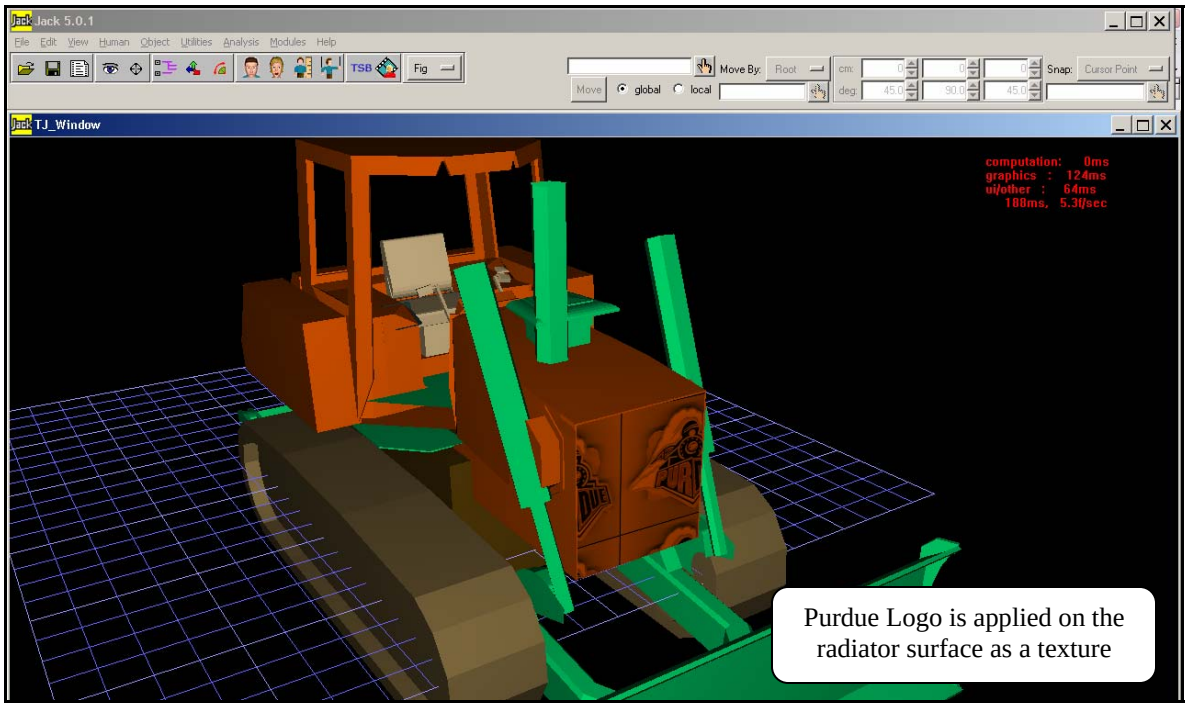
All X Projections On / All Y Projections Off

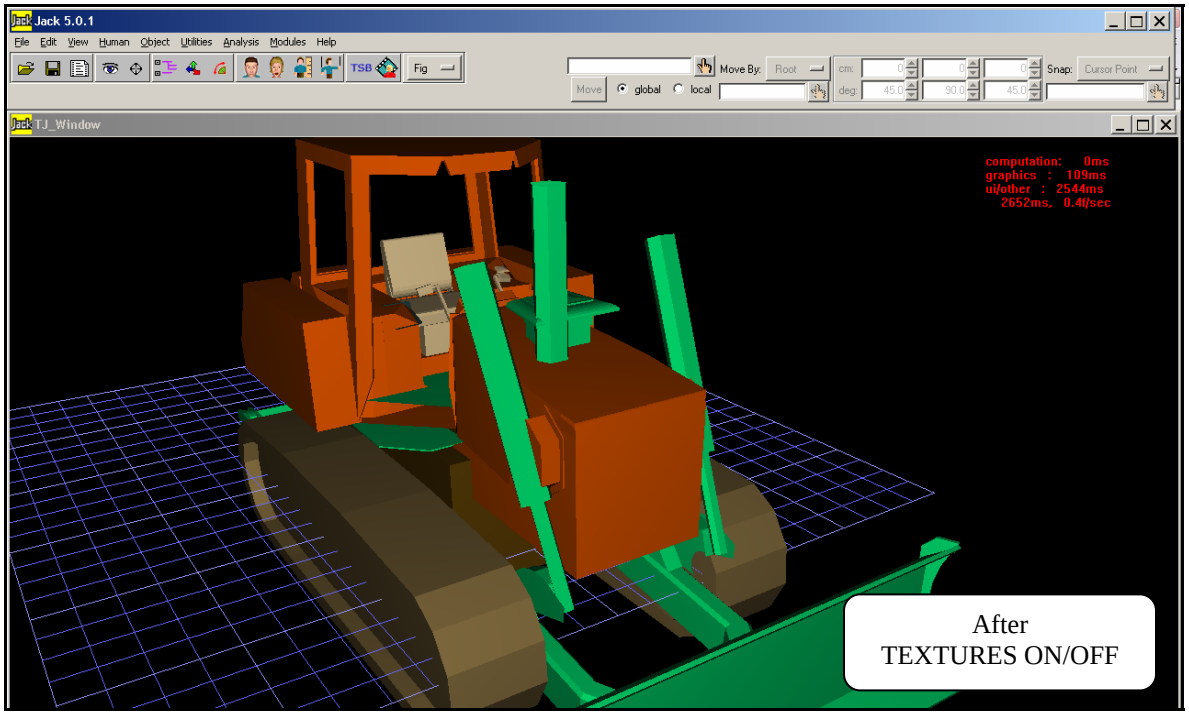




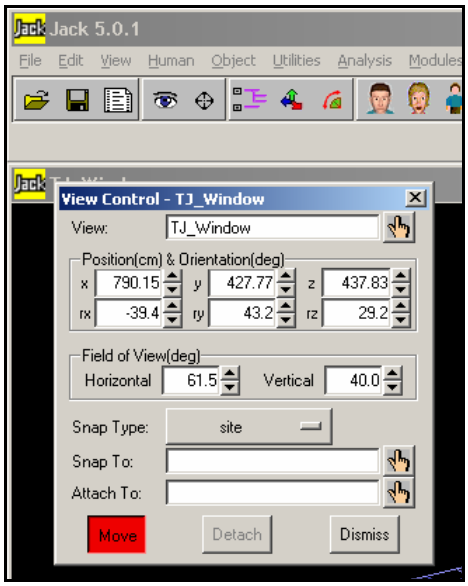
Textures On/Off

Textures On/Off command hides/shows the applied textures on parts. Textures increase the quality of the graphics and add realistic visual effects. The drawback of extra textures is reduction in the response speed. Turning off textures can also simplify visual effects of the working environment.





View Control



View Control command dynamically manipulates the viewing position around the part.

By choosing any axis orientation, you can change the viewpoint position around the part by manipulating its coordinates using the up/down arrows in *Position & Orientation*.

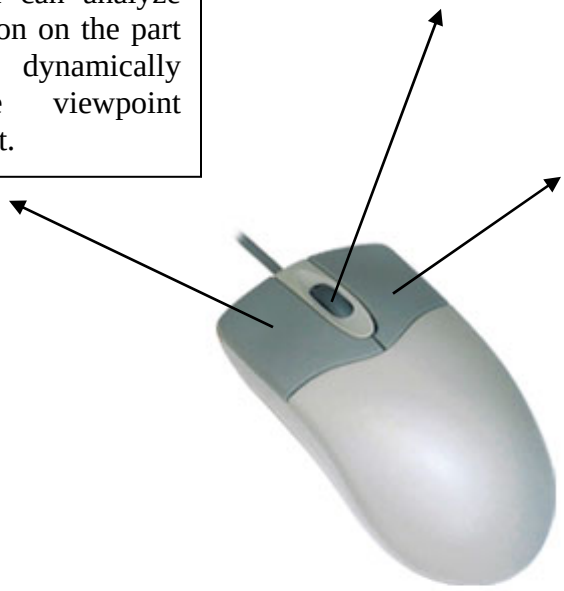
In addition you can zoom in/zoom out the part by using up/down arrows in *Field of View*.

Also, you can choose a snap type to move the part from a selected coordinate point on part to another selected coordinate point.

Pan: is used to move the viewpoint around the part from either left to right or up or down, or combinations of both. You can think pan as rotation in 2D plane.

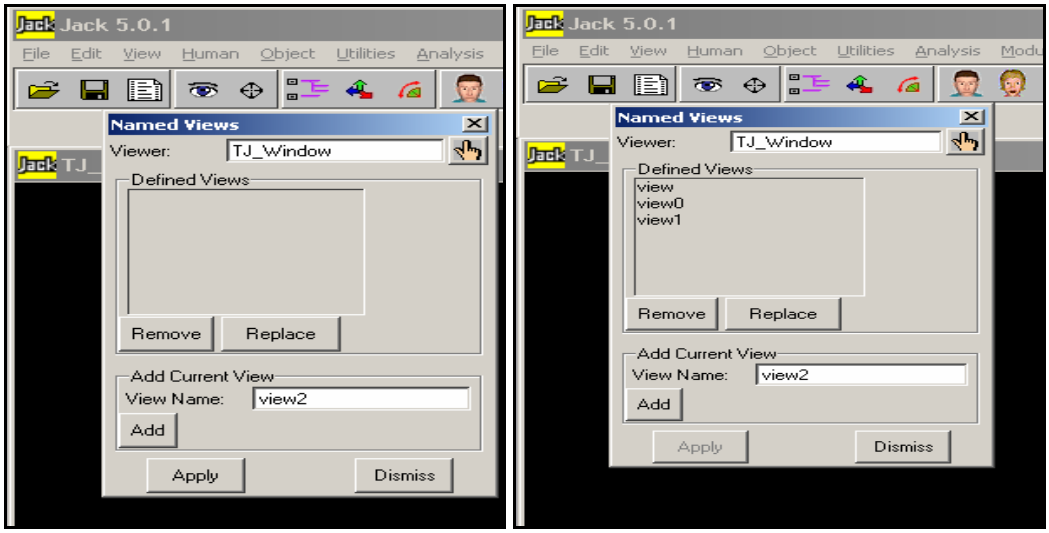
Rotate: is used to revolve viewpoint location around the part. You can analyze the visualization on the part in details by dynamically rotation the viewpoint around the part.

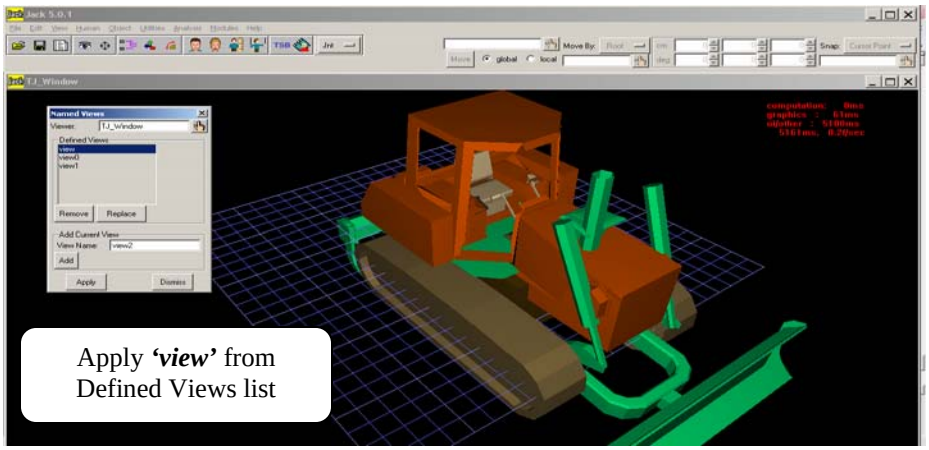
Zoom: you can zoom in/out to the part by dragging the mouse cursor on the screen while keep holding the right button.

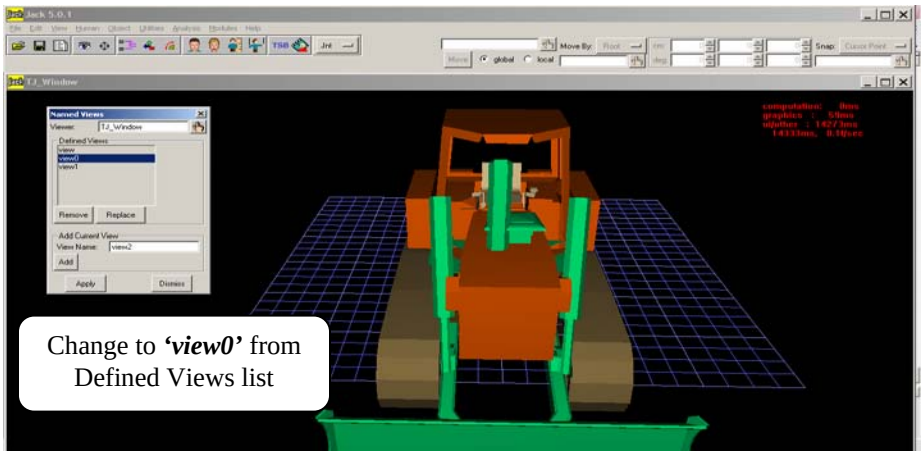


Named Views

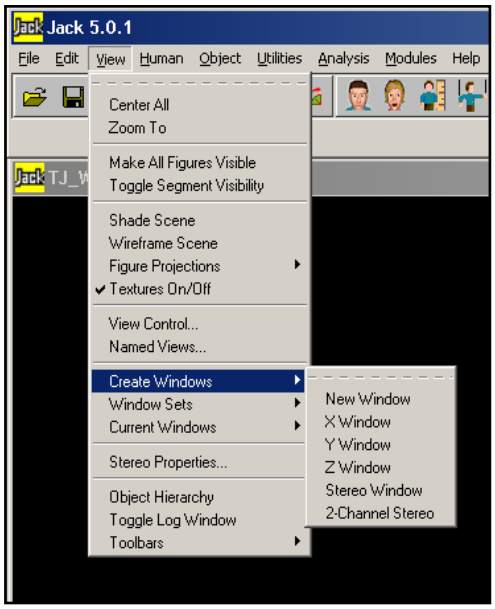
Named Views command allows users to specify views and save them in order. You can add/remove views and change between any views quickly. This saves extra time and let you to have better visual control on complex geometry.



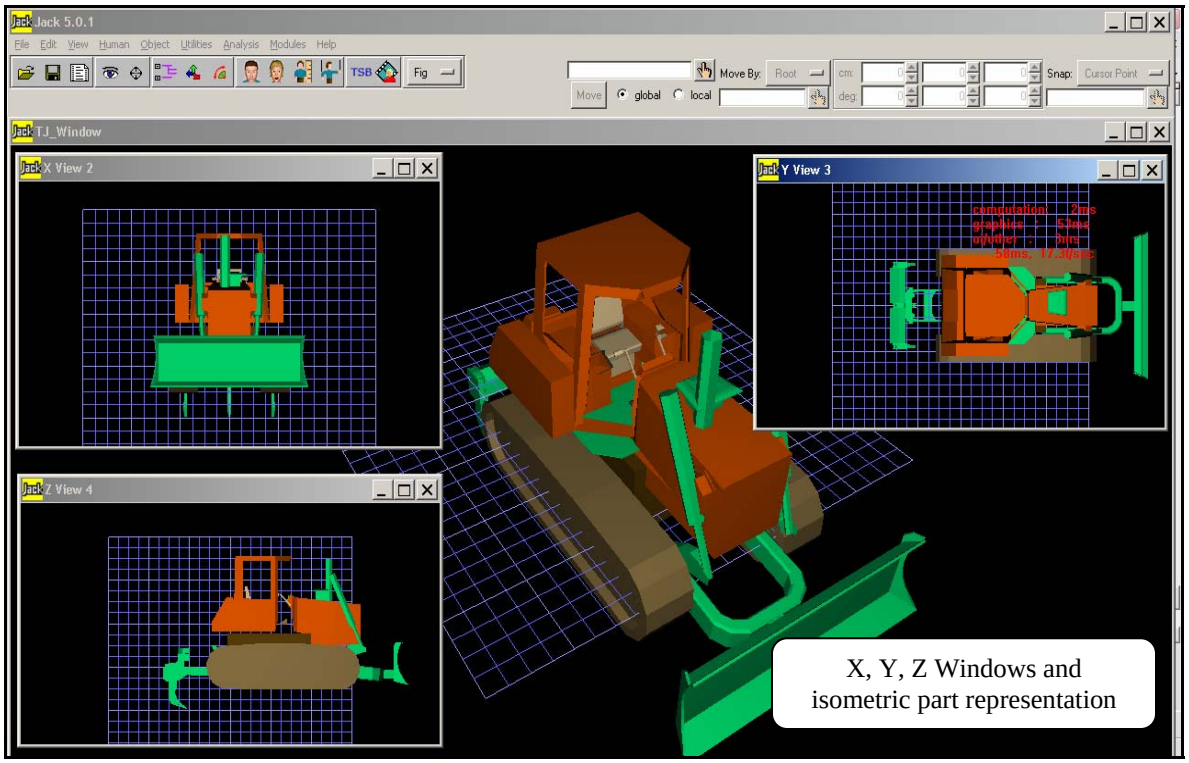




Create Windows

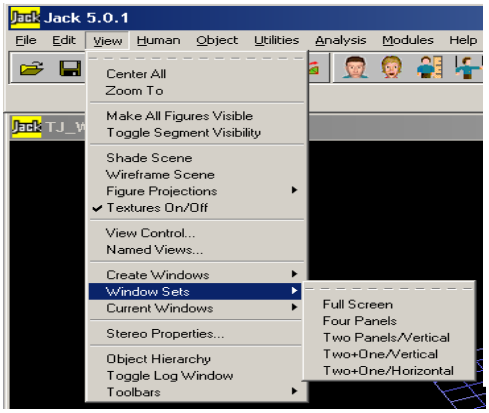


Create Windows command displays additional window frames as a visual aid. Selected part can be represented in different views by defining a specific axis window. Top, side & front views as well as the isometric view can be displayed in single screen view.

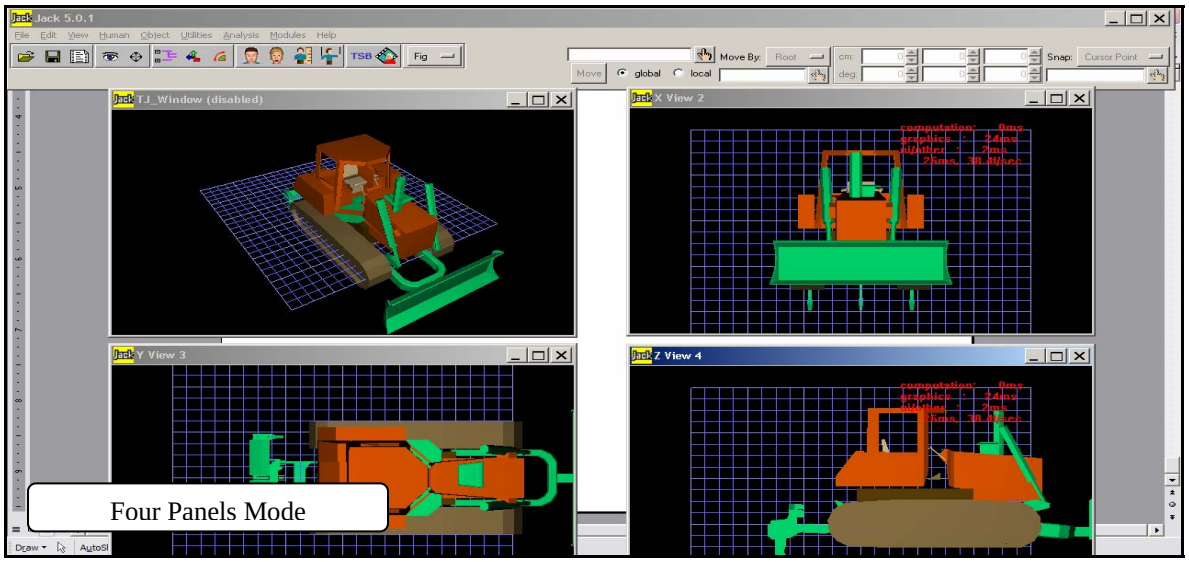


X, Y, Z Windows and isometric part representation

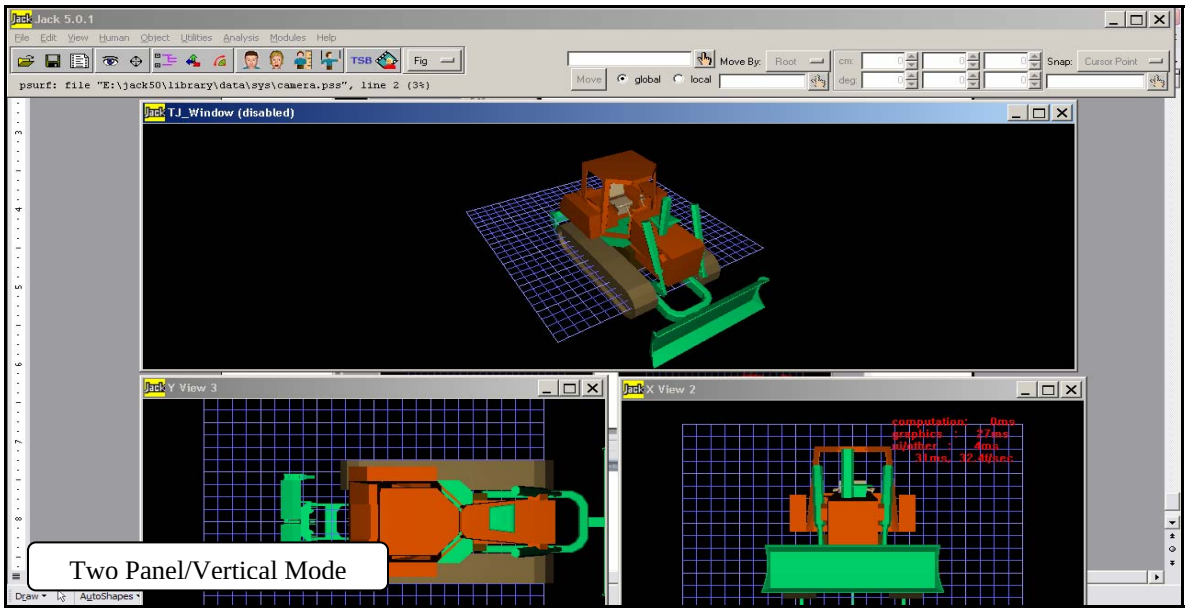
Window Sets



Window Sets command divides the screen view into individual screens, each include different part presentation. This command allows users to analyze the geometrical aspects of the design quickly. You can set your screen to Full Screen mode and change it quickly to Four Panels which displays the X, Y, Z axis orientation displays and the isometric display.

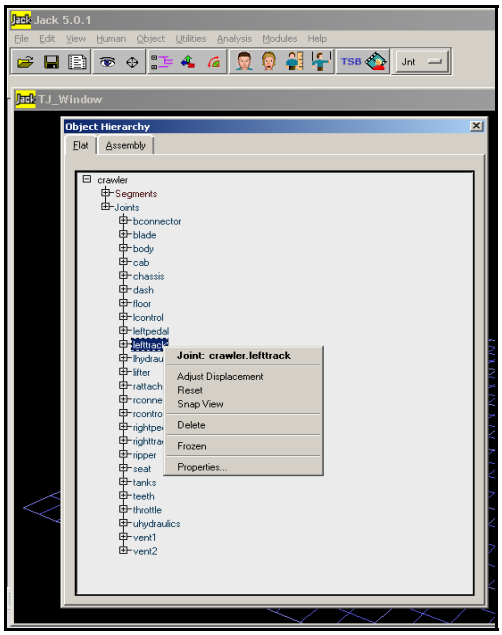


Four Panels Mode



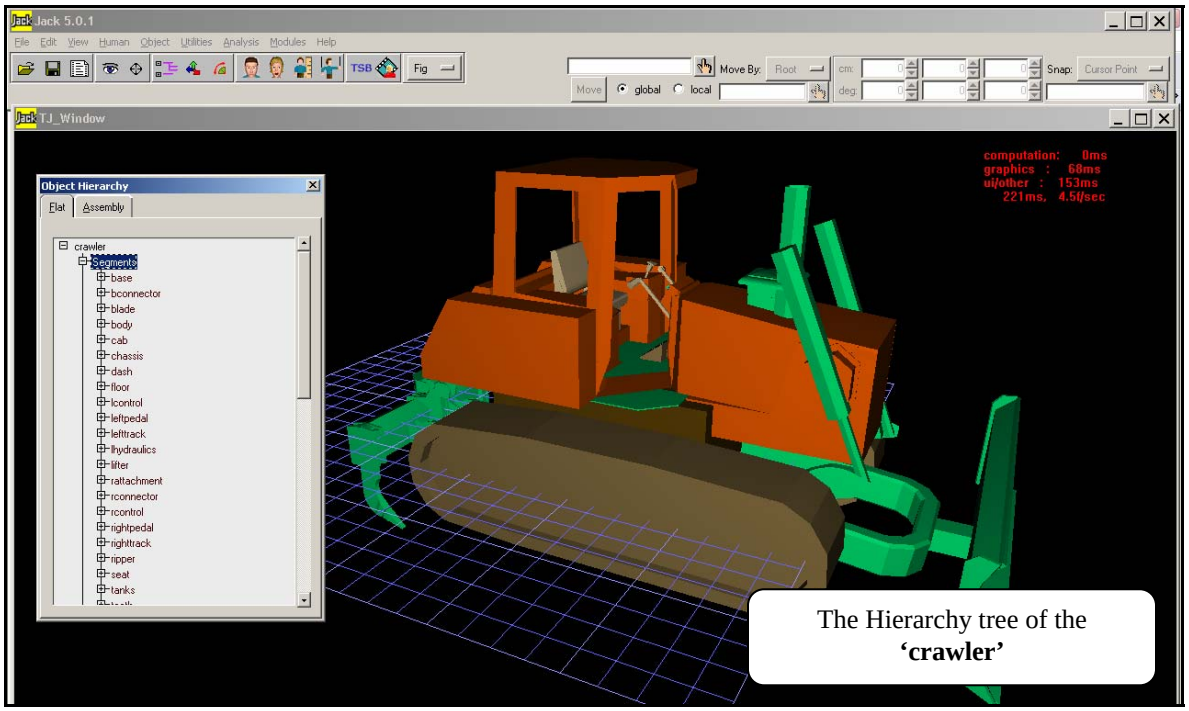
Two Panel/Vertical Mode

Object Hierarchy



Object Hierarchy displays the design features, sub-parts and any applications that take place during construction and analyses of the part. This application can be imagined as the BOM (bill of material) or the assembly tree of a part which includes sub-parts.

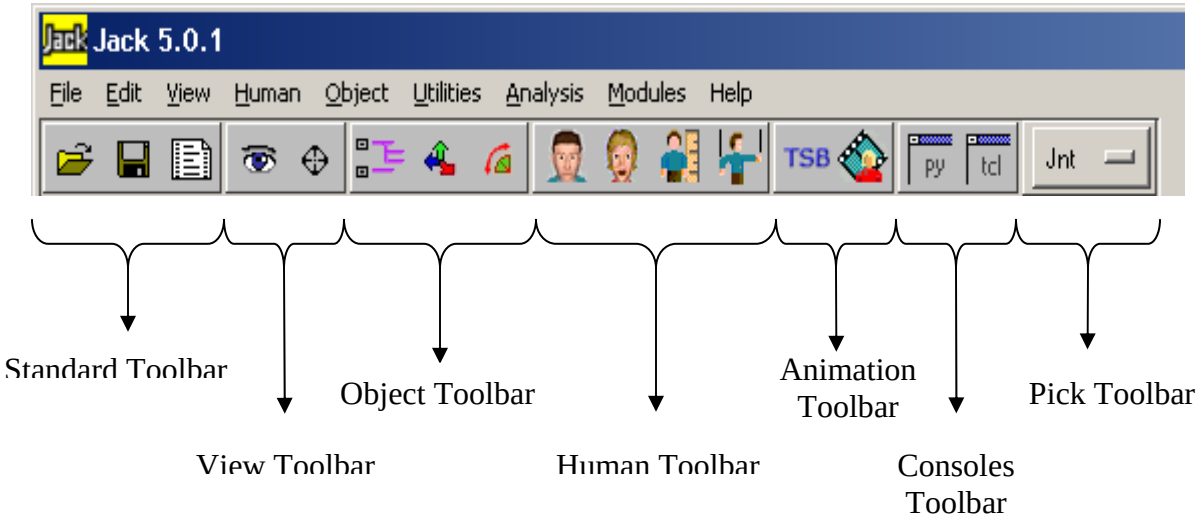
Each individual part can be deleted, scaled, moved…etc by selection. This gives the user independence to modify the part.



The Hierarchy tree of the **'crawler'**

Toolbars

Toolbar command hides/shows the shortcut to the toolbars.



Chapter

4

UGS TECNOMATIX JACK 5.0

User Manual and Examples

HUMAN menu

Human Menu

Human Menu allows users to create/construct human models, modify them and adjust their properties. **Figure 1** contains all necessary human construction aids and **Figure 2** holds the frequently used Human Menu tools.

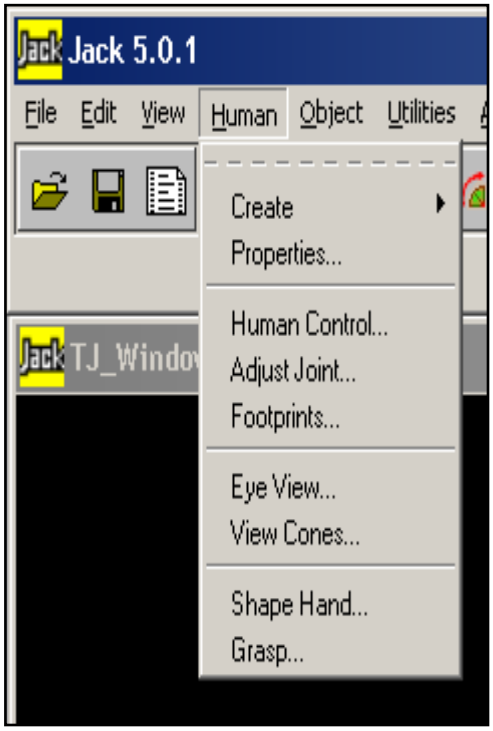
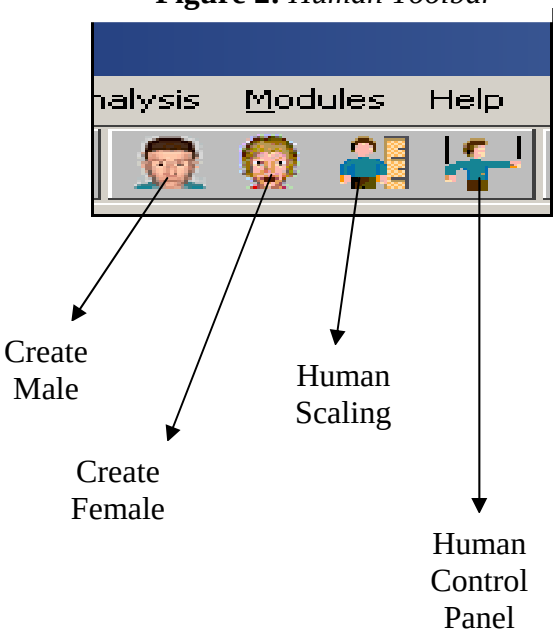


Figure 1: *Human Menu & Tools*

Figure 2: *Human Toolbar*



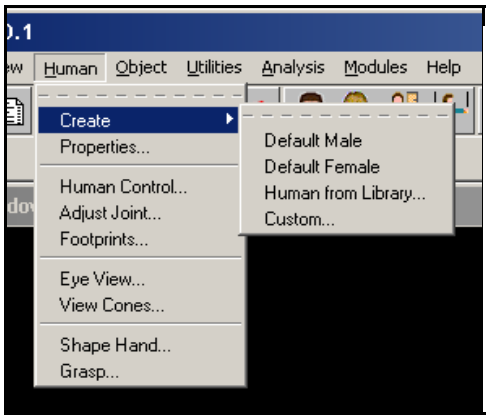
For more information please check;

UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

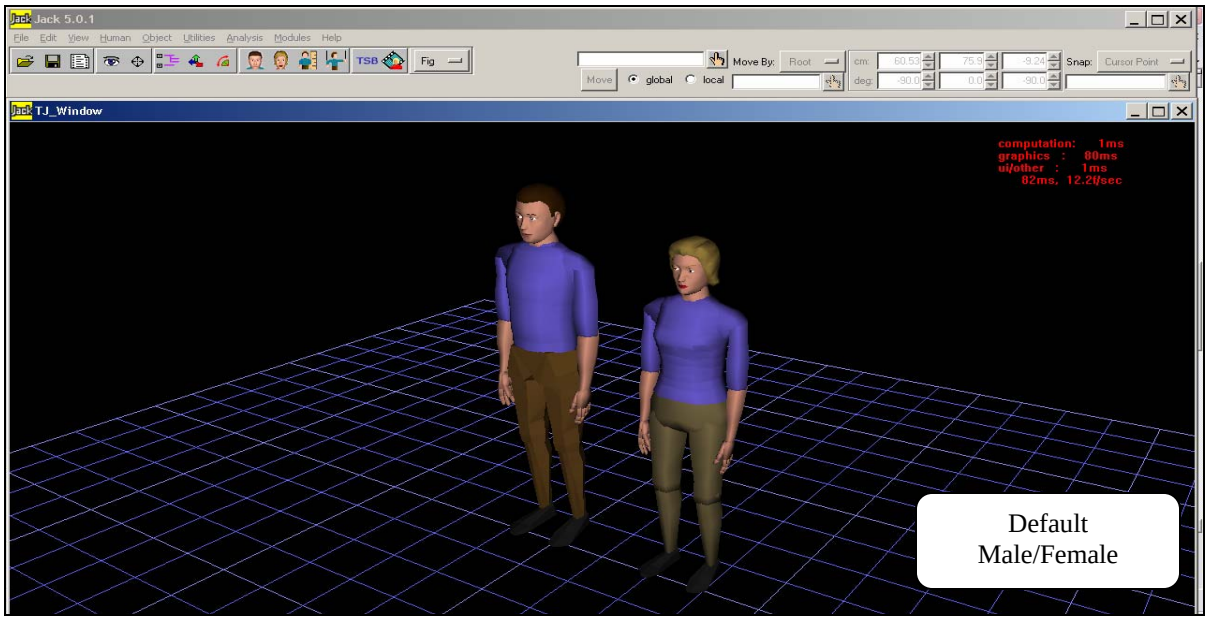
Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

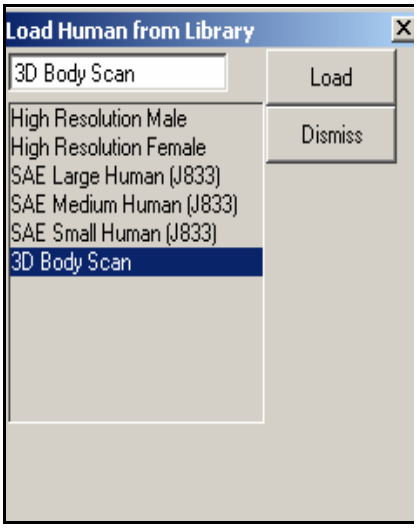
Create

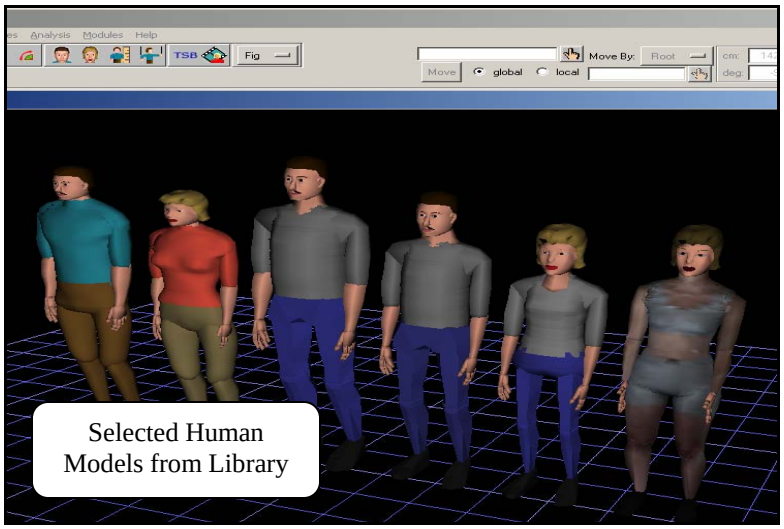


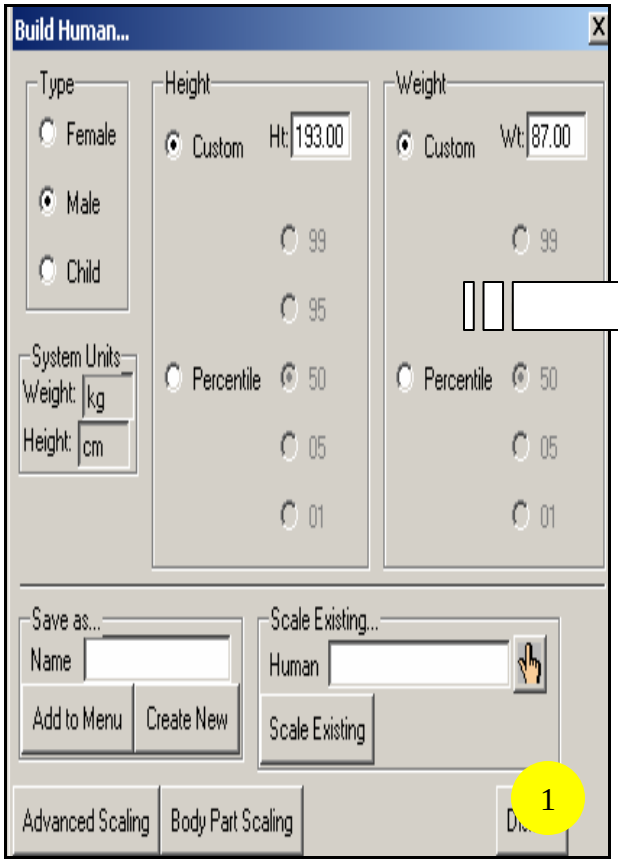
Create command is used for launching human bodies (male/female) to Jack 5 view screen.

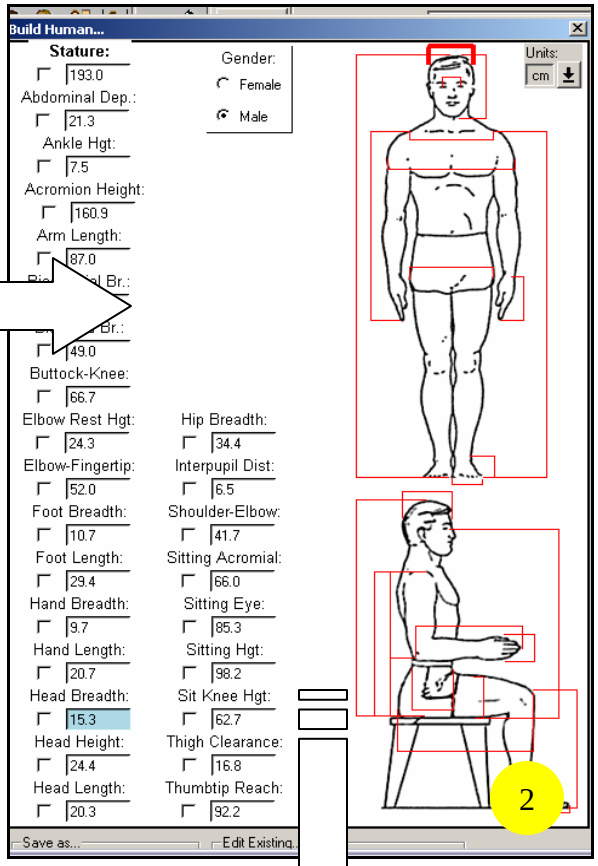
You can launch default bodies, or bodies from library. In addition, you can create custom bodies with specific measurements and properties.

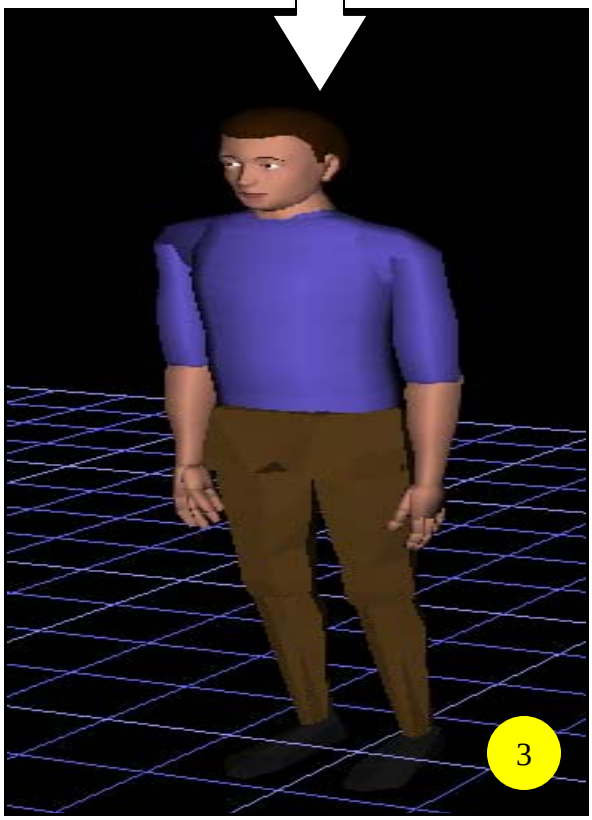












Step by Step Custom Human Creation

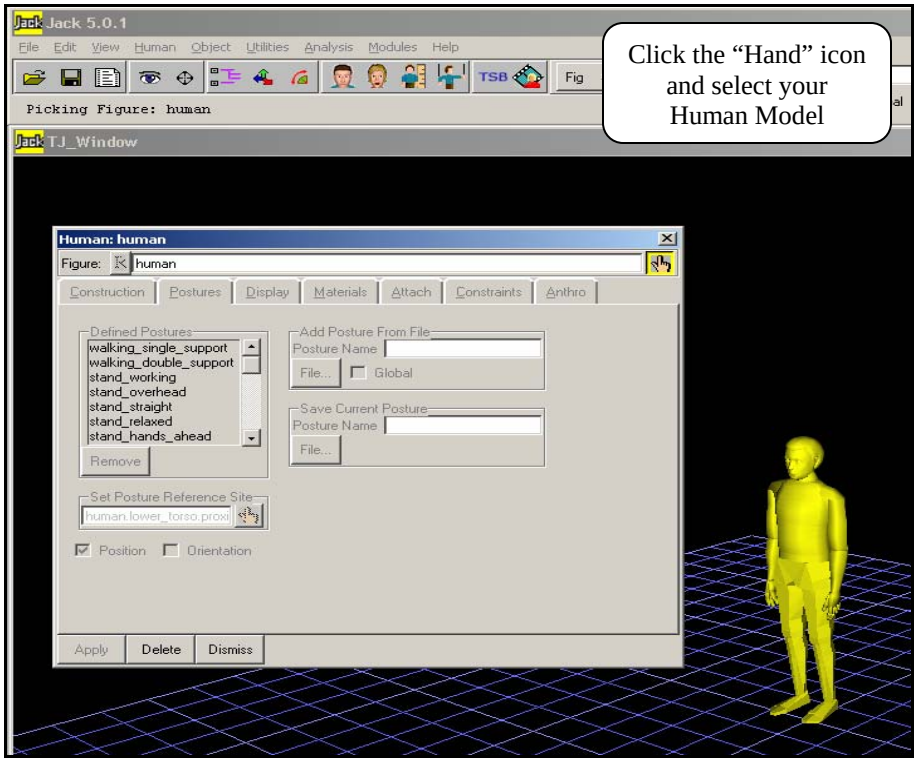
1) Enter type, weight, height and name your human.

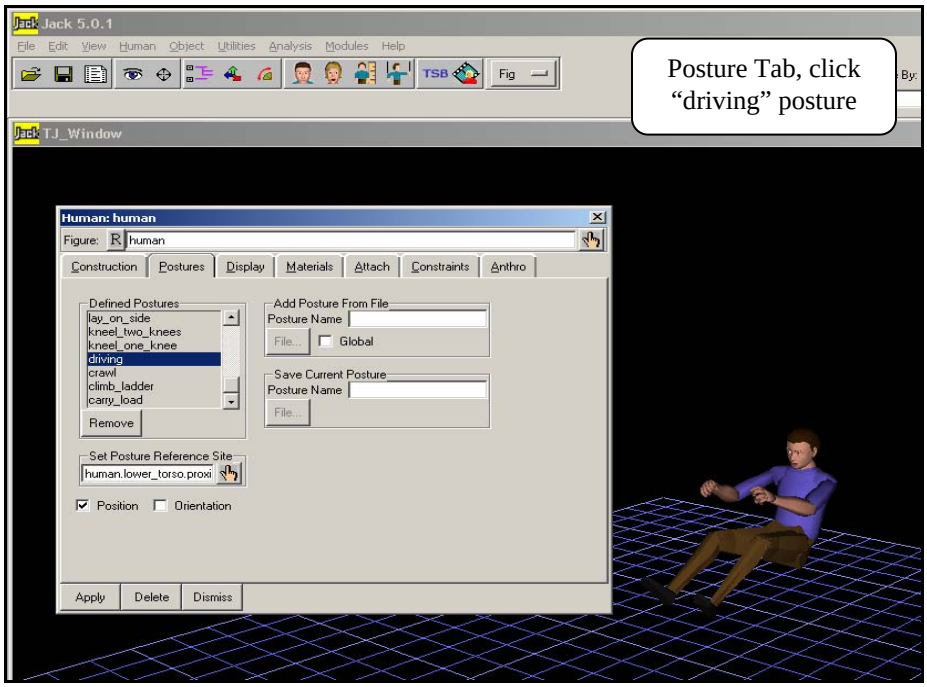
2) Go, “Advance Scaling” to modify desired body dimensions.

3) The custom human will appear automatically.

Properties

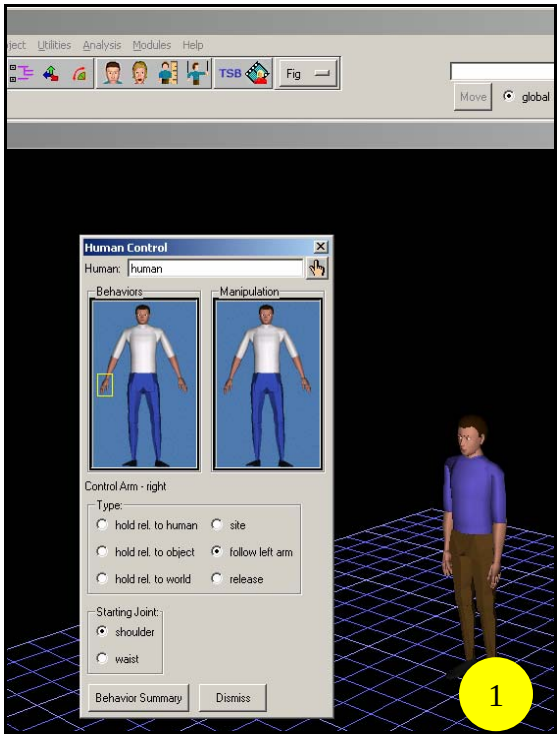
Properties menu controls the construction, posture, display, materials and anthropometric features of the created human model. You can easily change the characteristics of your human model by using properties box.

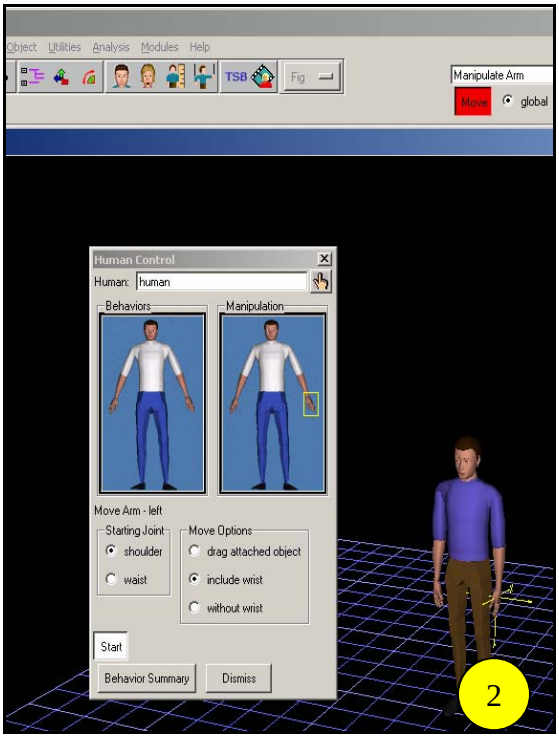


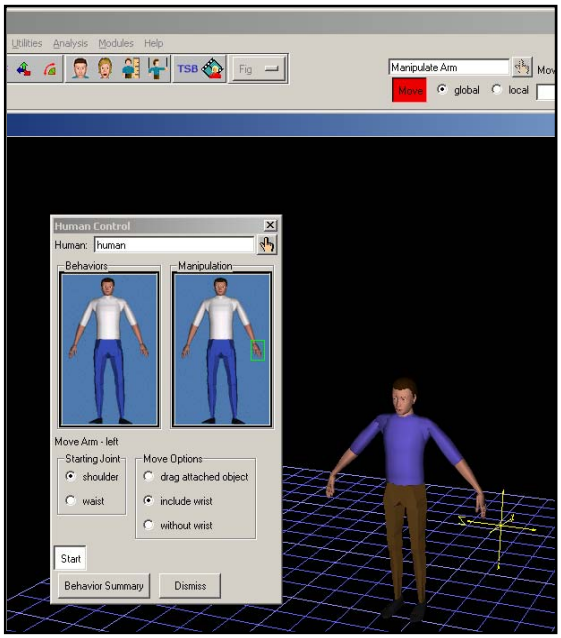


Human Control

Human Control is a user friendly human behavior & posture modification tool where you can apply desired posture characteristics by choosing body joints. Below demonstration will show how to manipulate hand & arm motion in couple different styles.





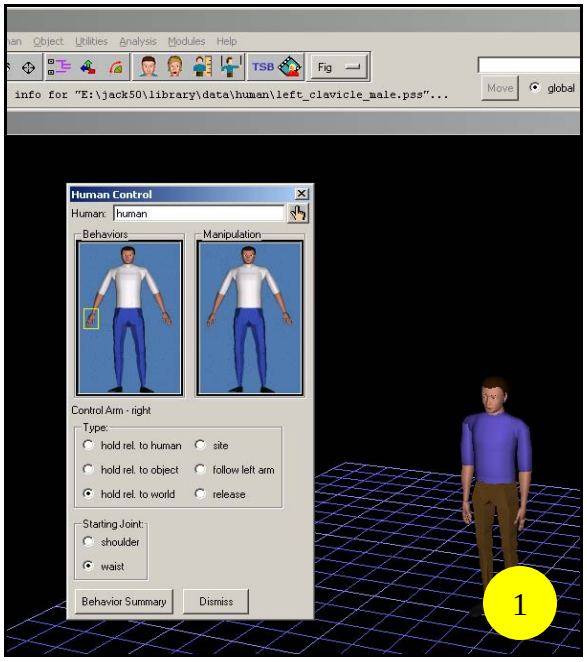


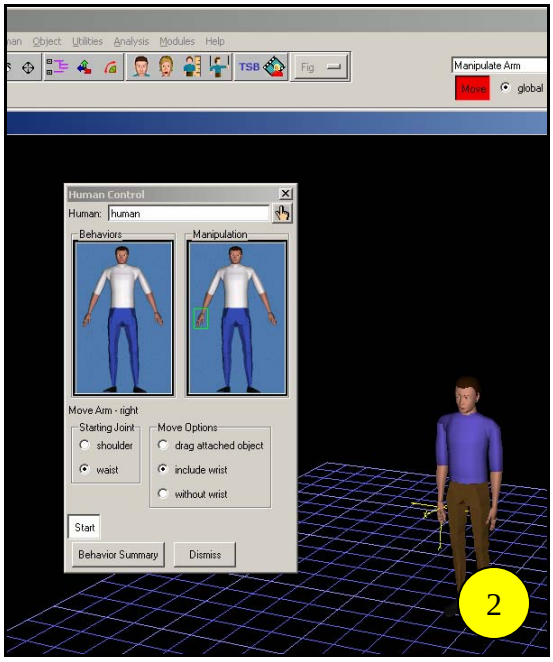
Step by Step Human Control

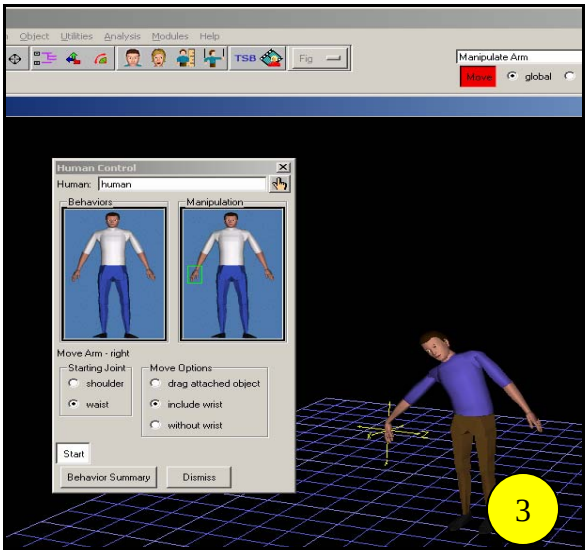
1) Select the Right Arm on the Behavior Box. Click “Follow the Left Arm” and “Shoulder”.

2) Select the Left Arm on the Manipulation Box. Click “shoulder”. “include wrist” and “Start”.

2) Drag the yellow coordinate axis tool into desired positions. You’ll see that left arm is following the right arm.







Step by Step Human Control

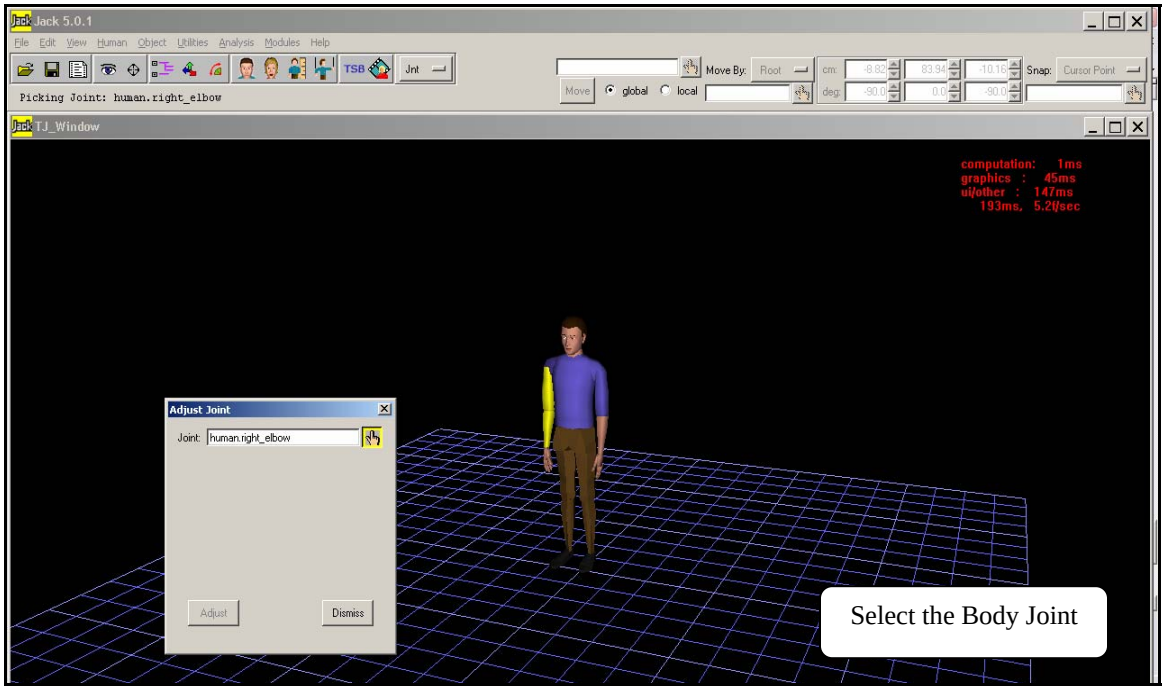
1) Select the Right Arm on the Behavior Box. Click “Hold rel. to World” and “Waist”.

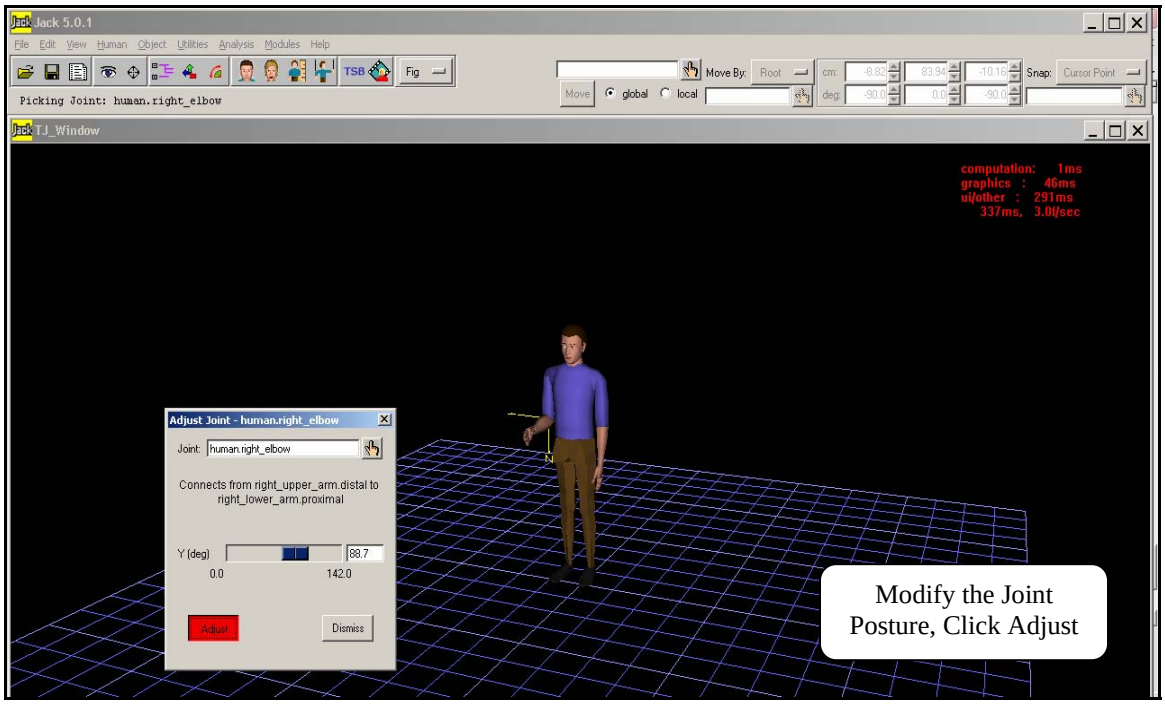
2) Select the Right Arm on the Manipulation Box. Click “waist”. “include wrist” and “Start”.

3) Drag the yellow coordinate Axis tool into desired positions. You’ll see that right arm is moving realistically with the coordination of waist.

Adjust Joint

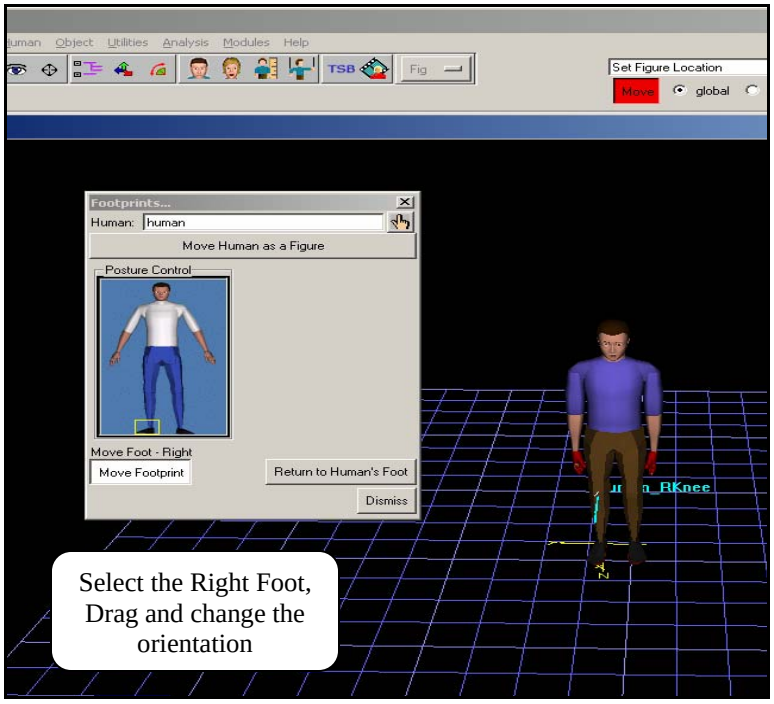
You can adjust human body joints by using Adjust Joint Command. Select the desired joint, use the appeared coordinate axis and drag (or use the manipulation bar) it until you get the desired posture. Click Adjust to fix the joint location.

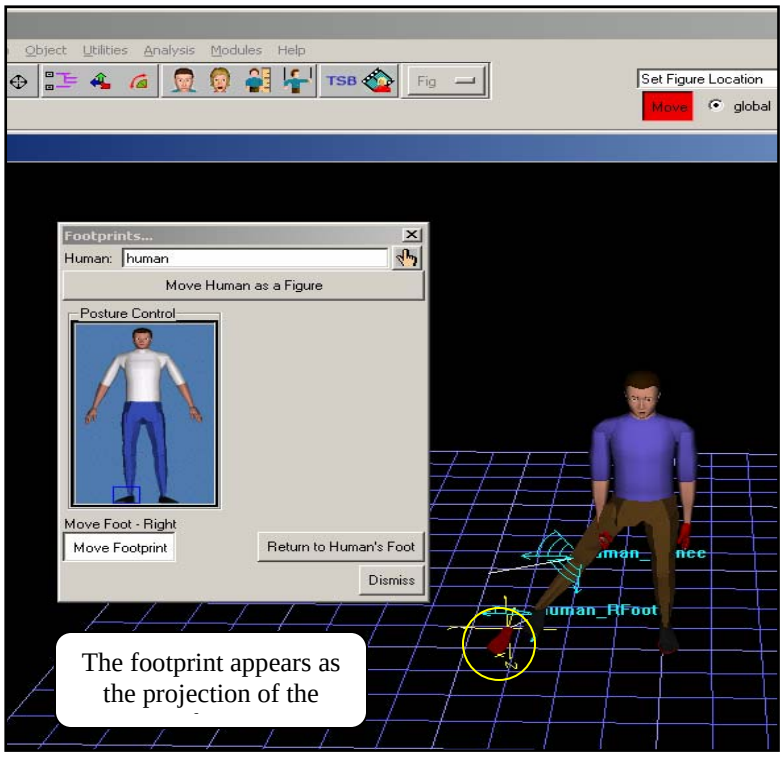




Footprint

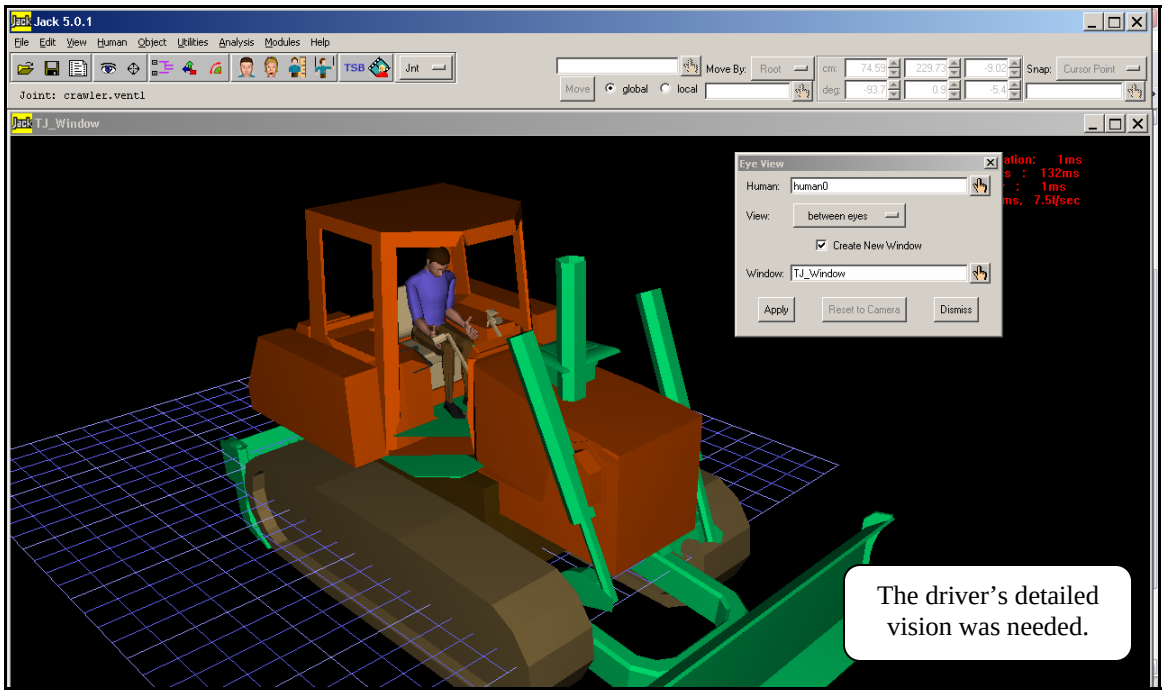
Footprint command helps you to create quick footprints and foot movements, as well as waist, head, arm and shoulder movements. Also, you can choose “Move Human as A Figure” command to move your human model as full body all in once in coordinate axis.





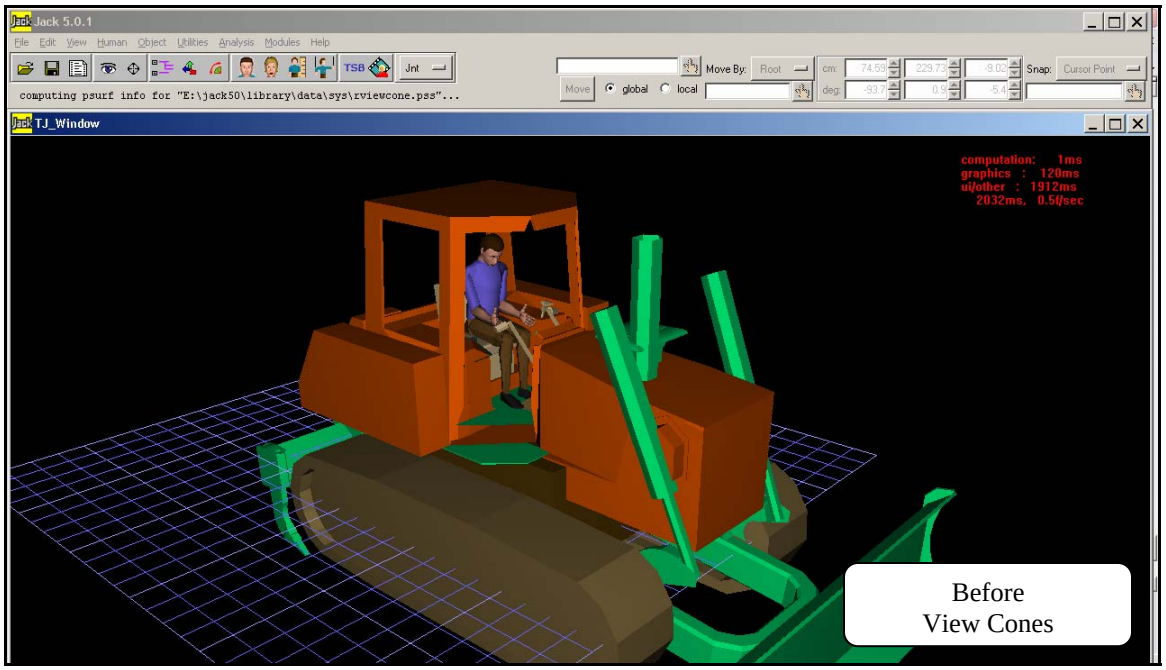
Eye View

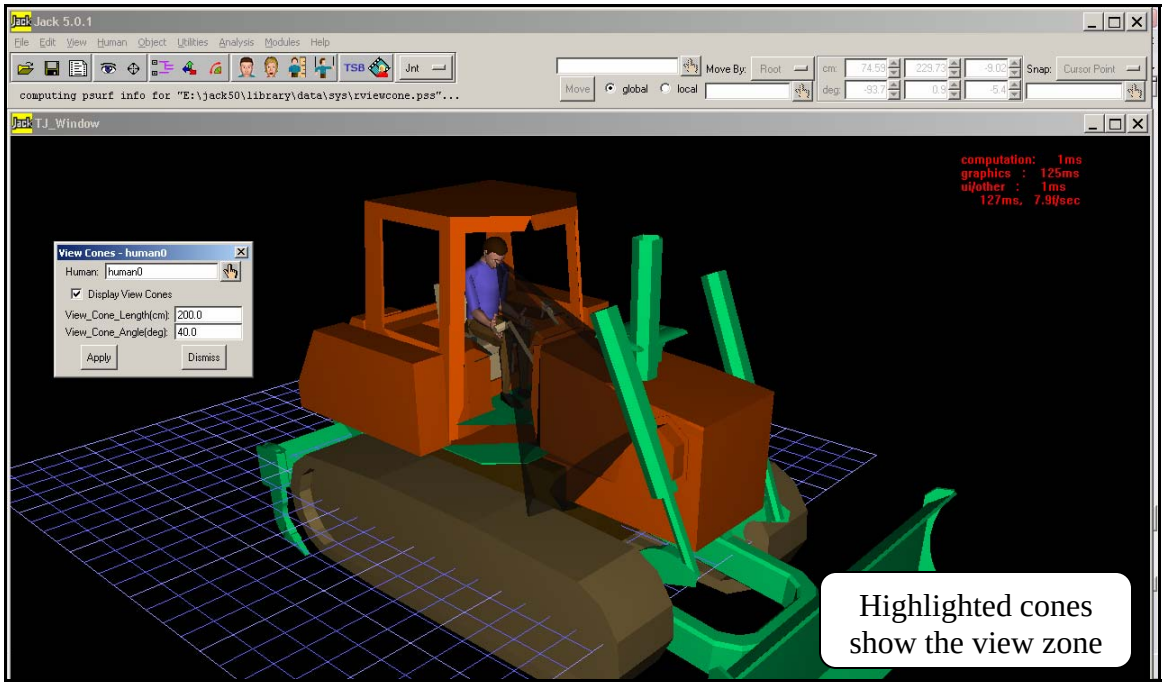
Eye view provides a snapshot views from eye view of the human model. You can choose “between eyes, left eye, right eye and both eyes” features to get better vision analysis.



View Cones

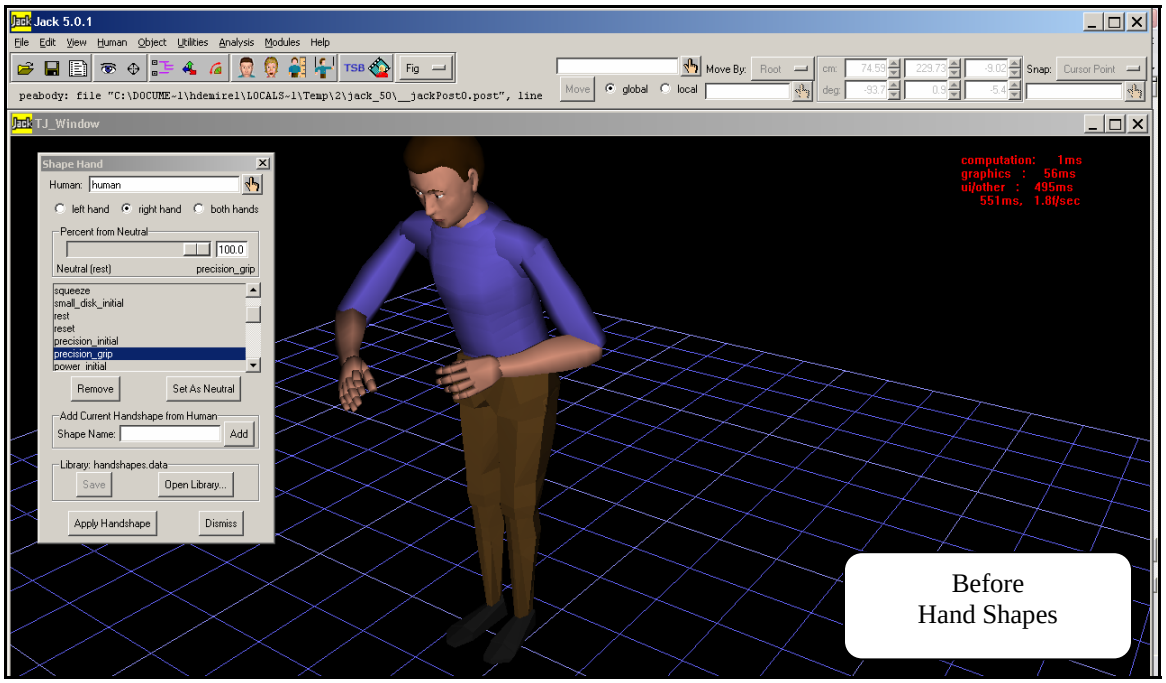
View Cones command help users to observe the maximum available eye reach zones. The area inside the highlighted view cones signifies what the human model is capable to view.

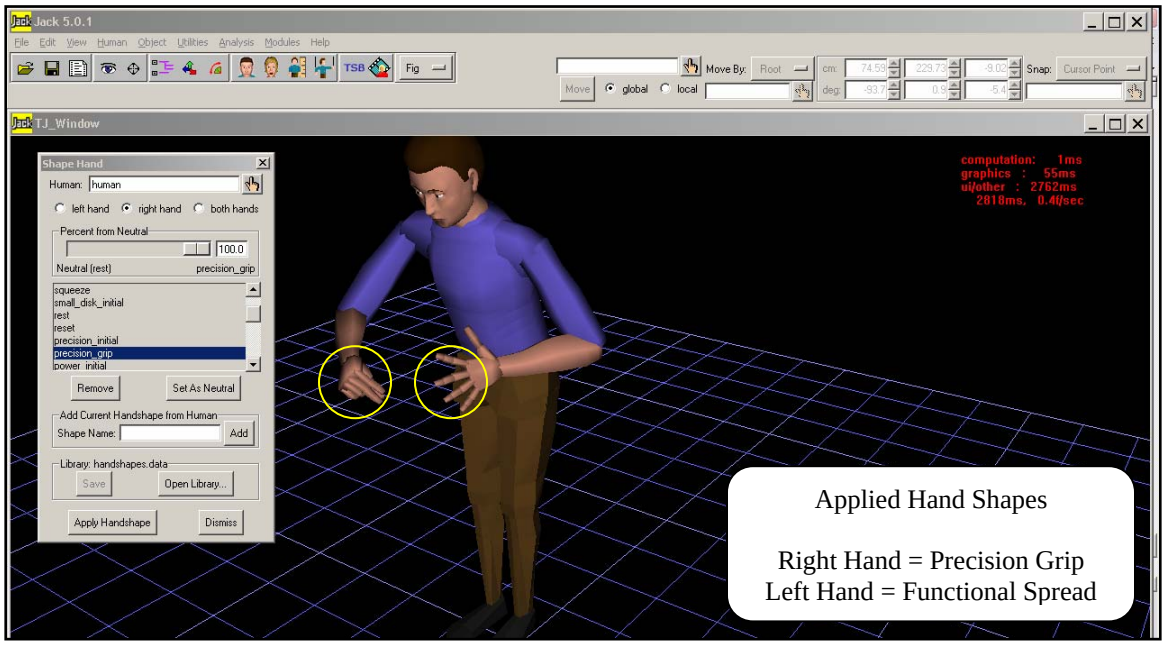




Shape Hand

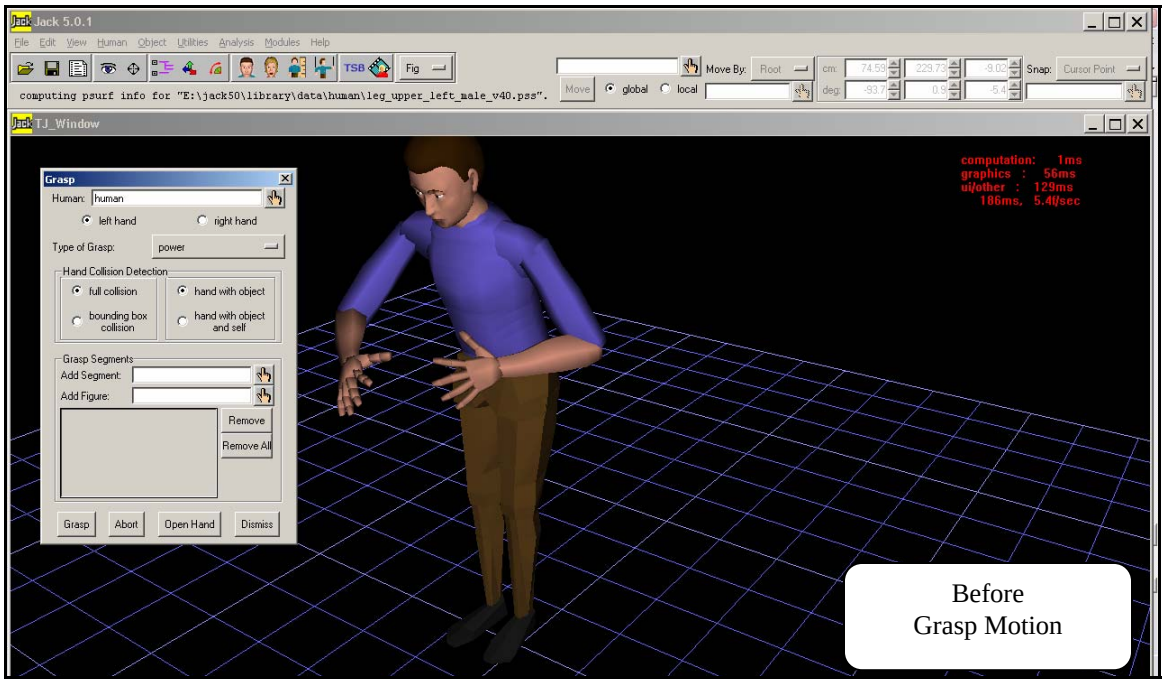
Shape Hand command applies hand shapes in many different types from pinch to grasp. You can select a suitable hand shape and apply for left, right or both hands very quickly.

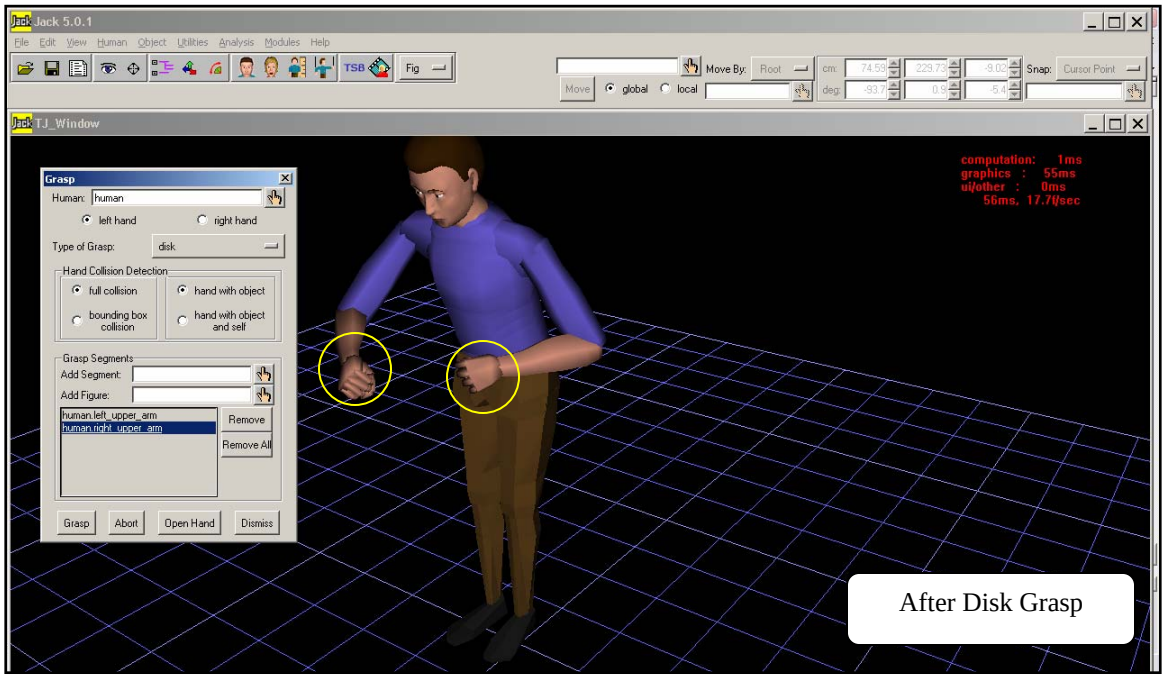




Grasp

Grasp command works similar to Hand Shapes command however Grasp command is focused on detailed grasping motions. You can obtain detailed and quick grasp analysis by using this command. You can use Open Hand and Grasp commands repeatedly for better observations.





Chapter

5

UGS TECNOMATIX JACK 5.0

User Manual and Examples

OBJECT menu

Object Menu

Object Menu helps users to create different types of environmental objects. You can create geometries, surfaces, simple solids and CAD models. In addition, you can change/modify you geometry parameters and features. **Figure 1** contains all necessary object tools.

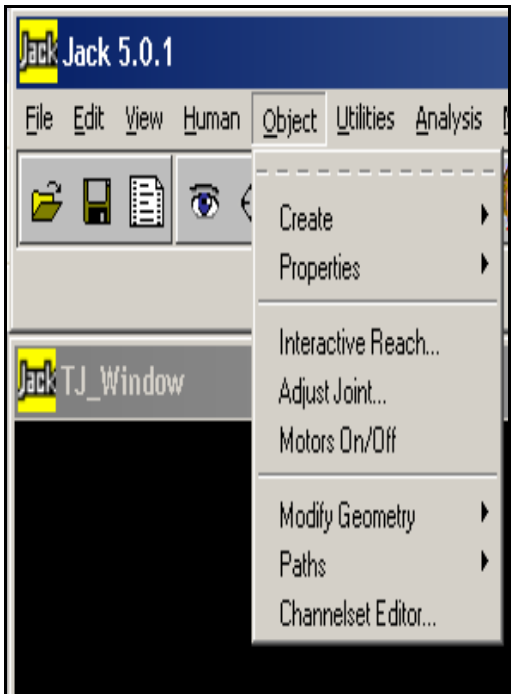


Figure 1: *Object Menu*

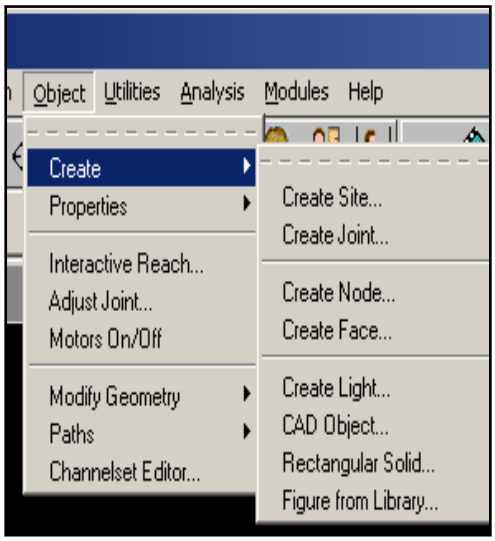
For more information please check;

UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

Create

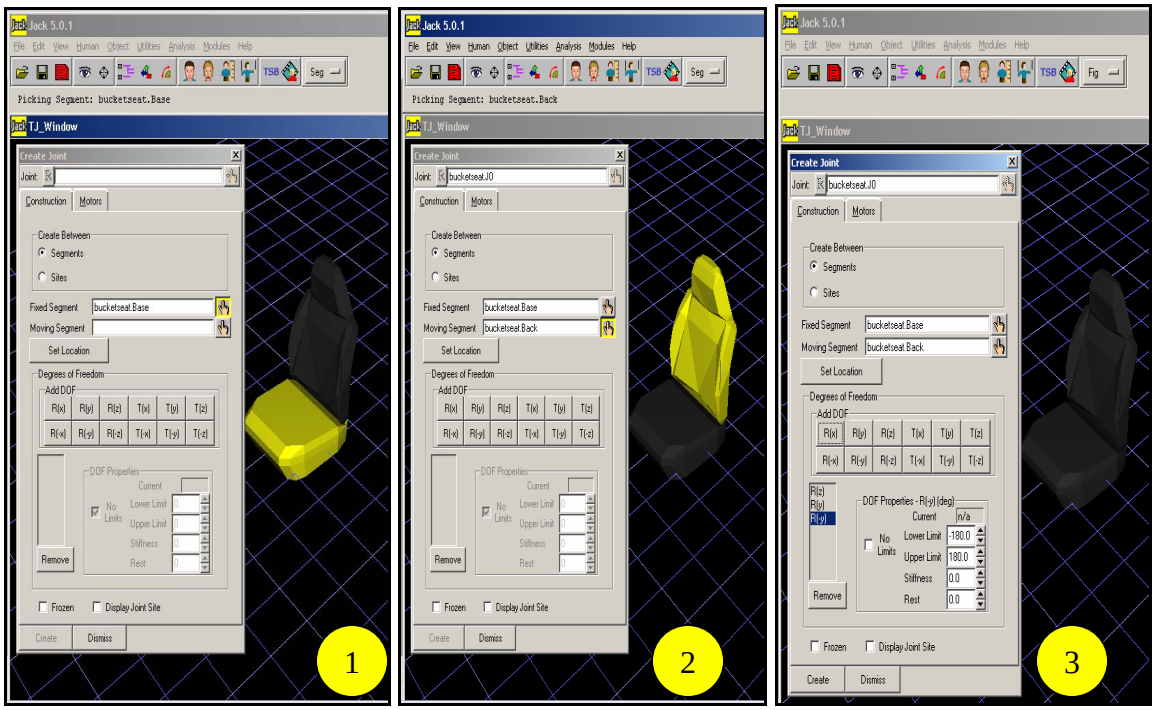


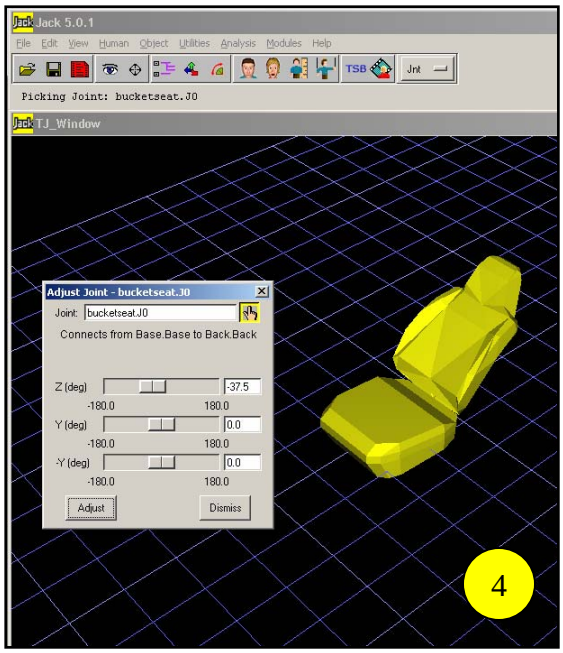
Create command holds several useful tools which users can form/modify surfaces, nodes and faces on the object bodies.

In addition Create command allows users to create simple CAD objects rapidly.

Create Joint

You can join two individual segments by using the “Create Joint” command.





1) Click the bucket seat base as “Fixed Segment”

2) Click the bucket seat back as “Moving Segment”

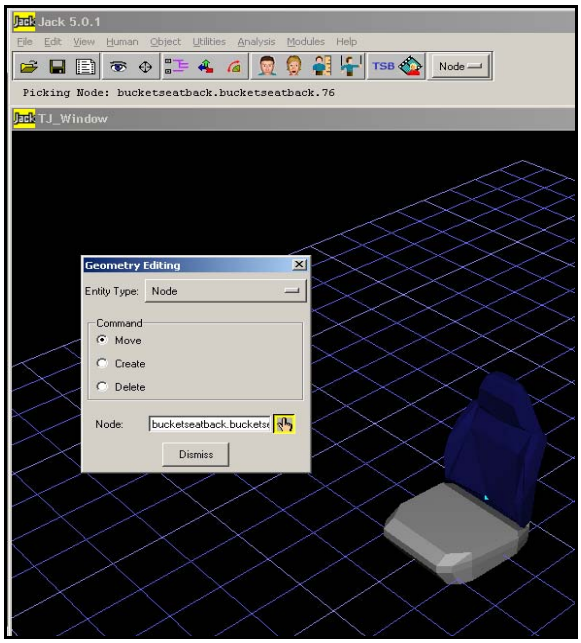
3) Choose any degrees of freedom (coordinate systems that you want the motion/adjustment takes place)

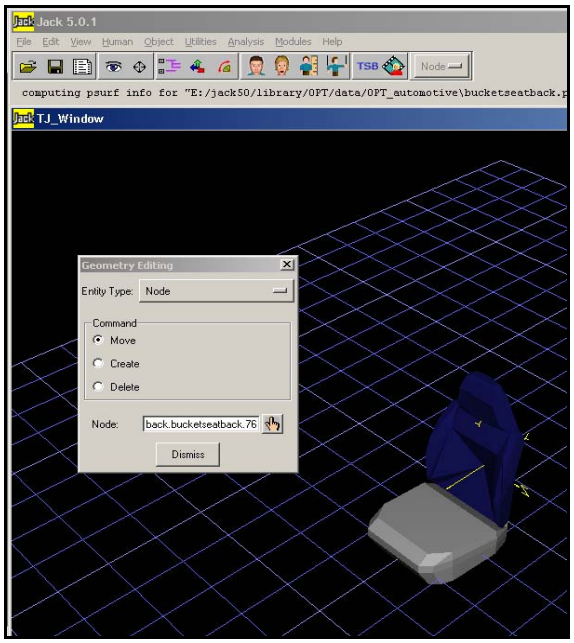
4) Click “Adjust Joint” command from Object Menu and then click on the bucket seat figure.

5) Now you can move the bucket seat back part back & forth by changing the Z (deg).

Create Node

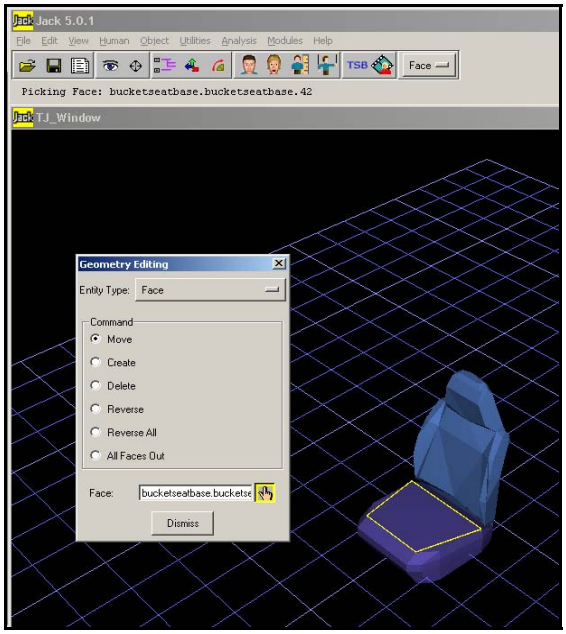
This command lets user to create/move nodes on the figure. When you are in the node mode, you can only select and modify nodes.

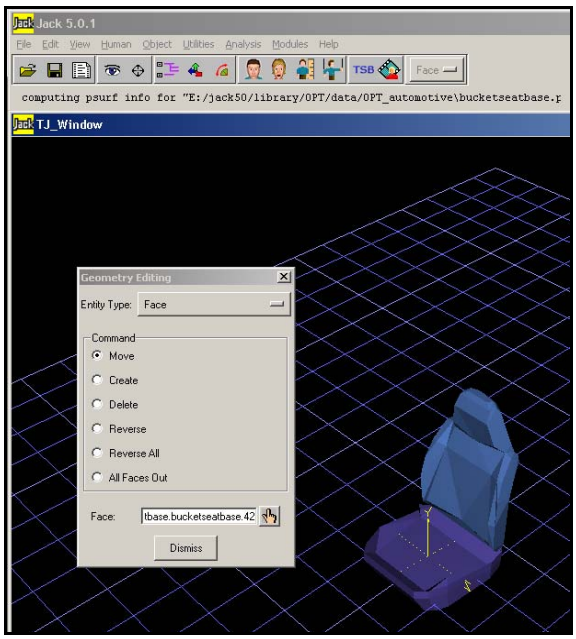




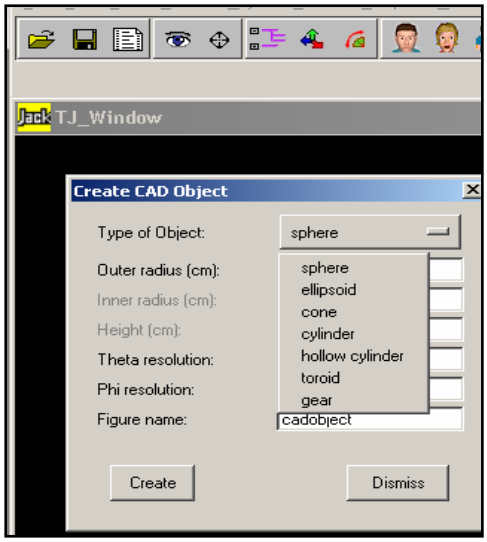
Create Face

This command allows users to create/move faces on the figure. When you are in the face mode, you can only select and modify faces.





CAD Object



CAD object command helps you to create simple CAD solids. The command menu allows the user to input some object parameters. (Diameter, length, width…etc).

When you click "Create" button, you need to save your file in a desired directory. This will help you to recall the same file anytime you need for future design works.

1) Sphere
2) Toroid
3) Cone
4) Gear

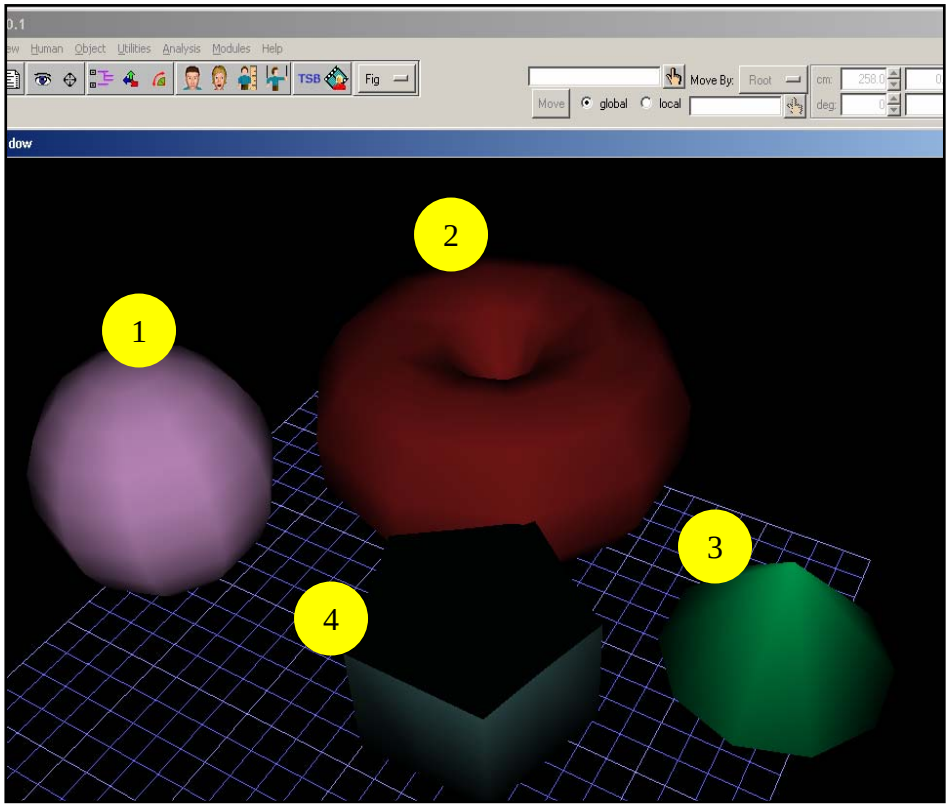
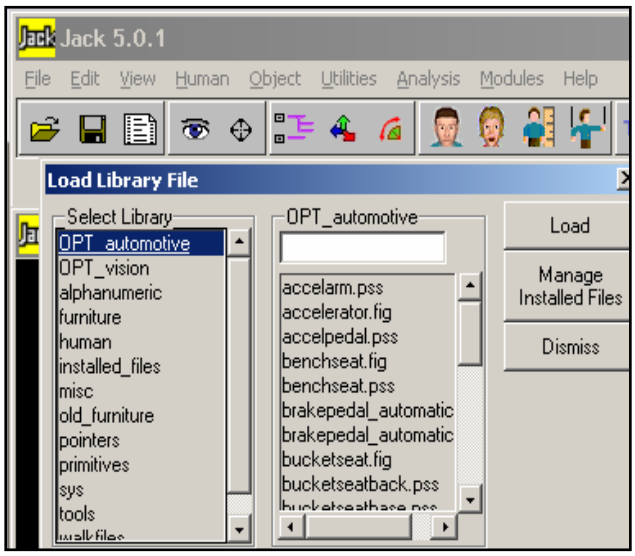
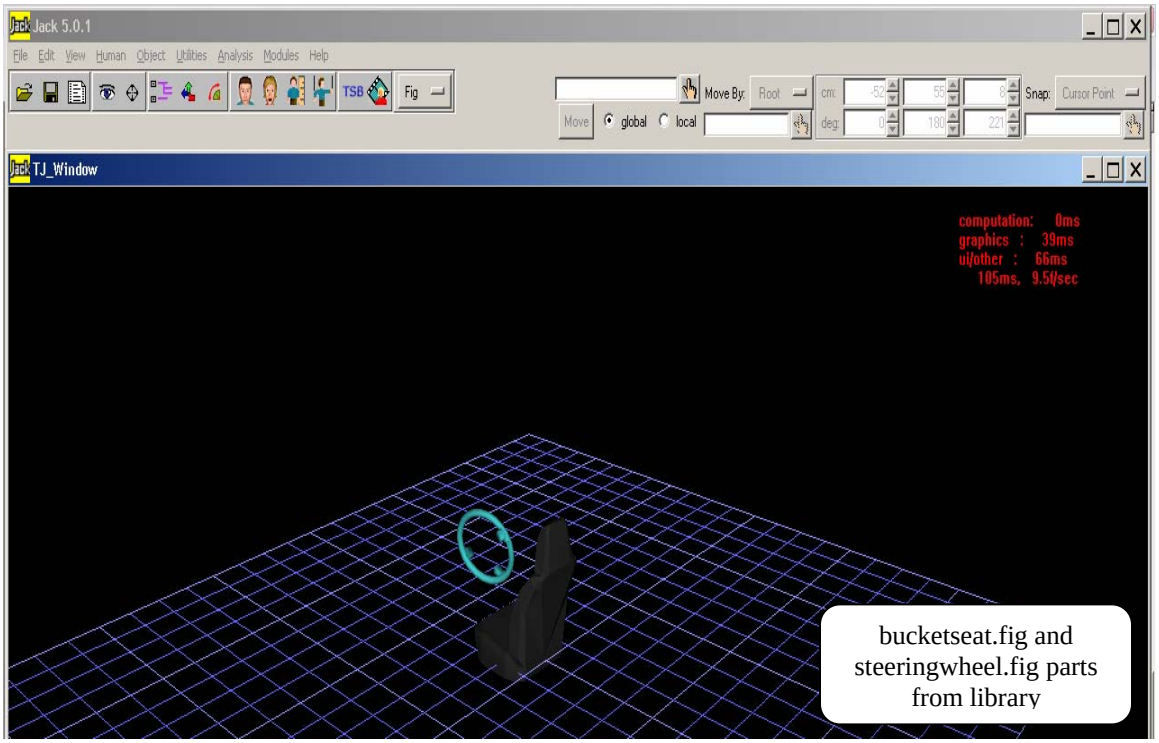


Figure from Library



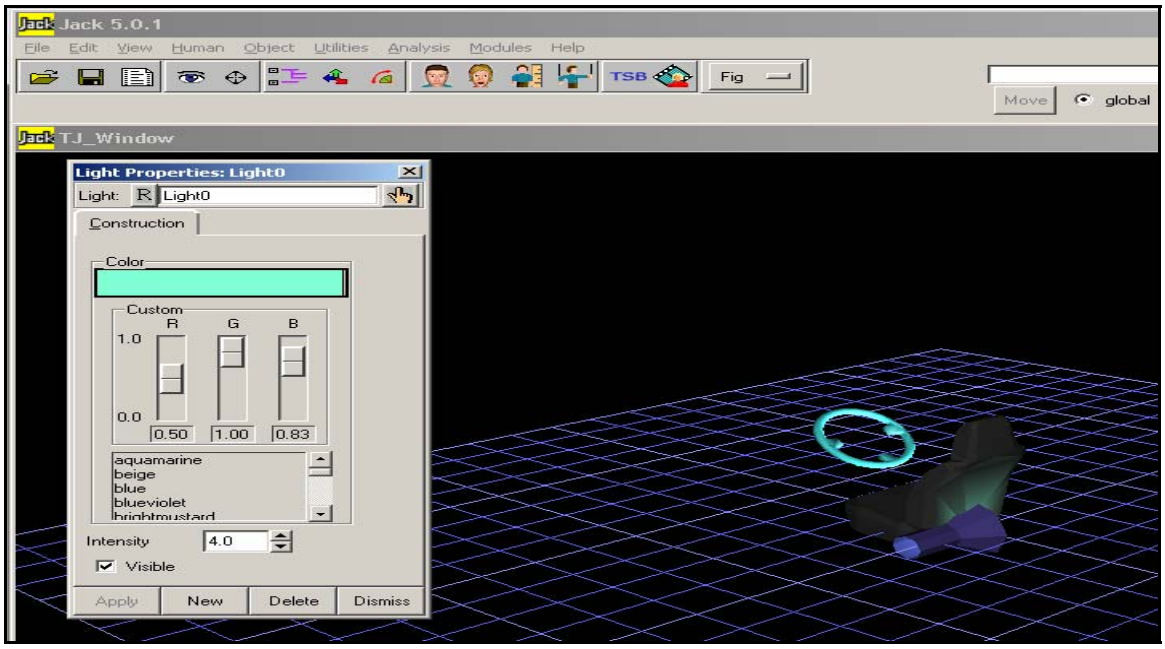
By using Figure from Library command you can get already constructed figures from Figure Library.

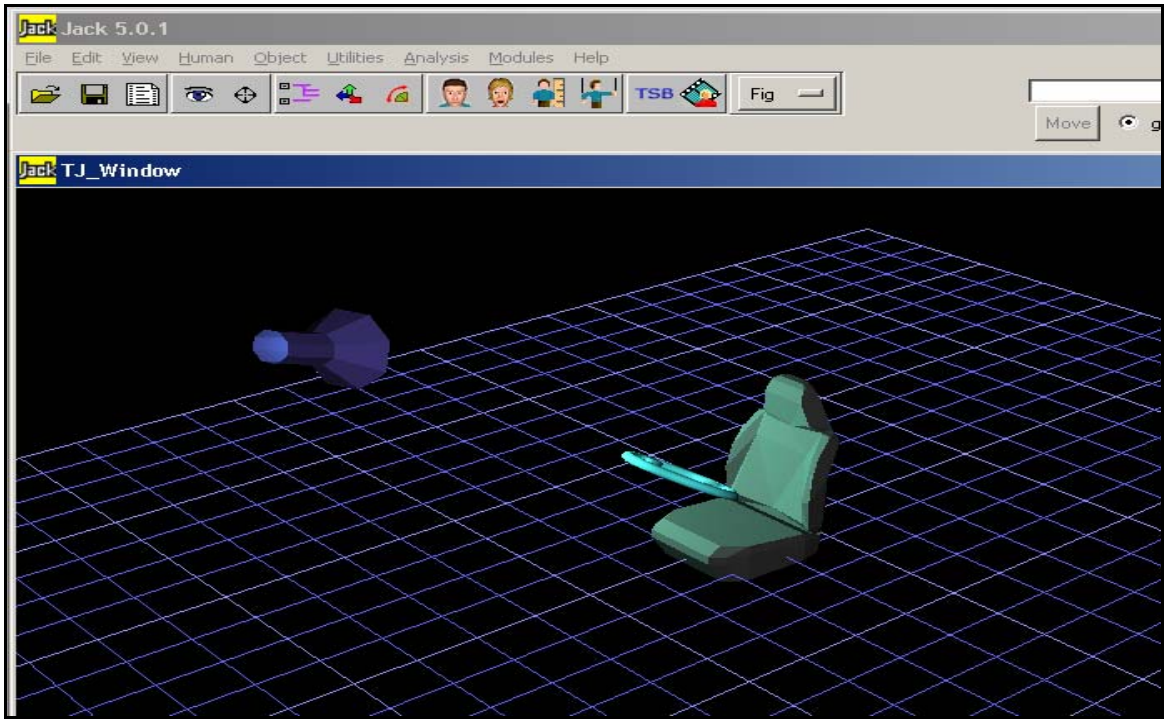
You can choose any library and obtain desired figures by clicking “Load” button.



Create Light

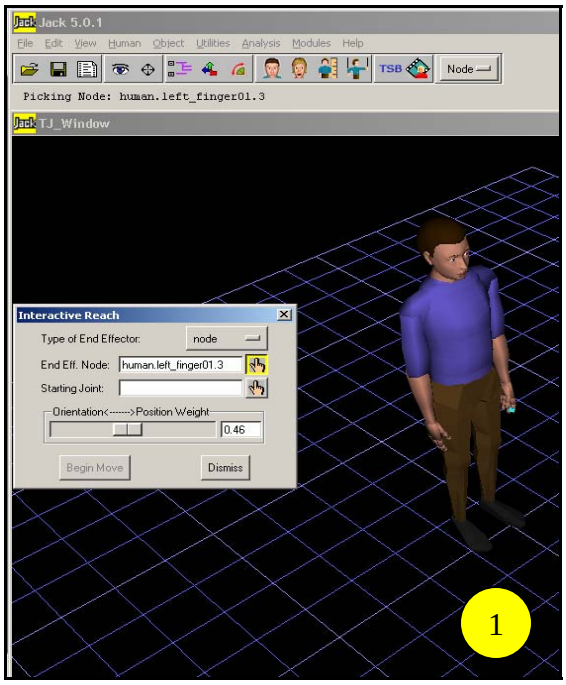
You can improve the visual quality of your working environment by adding lights. You can choose or select default colors to apply in your lighting settings. In addition, you can increase/decrease the intensity level too. When you click “Apply” button a torch will appear on the screen. You can edit the location of the torch to get best lighting effects.

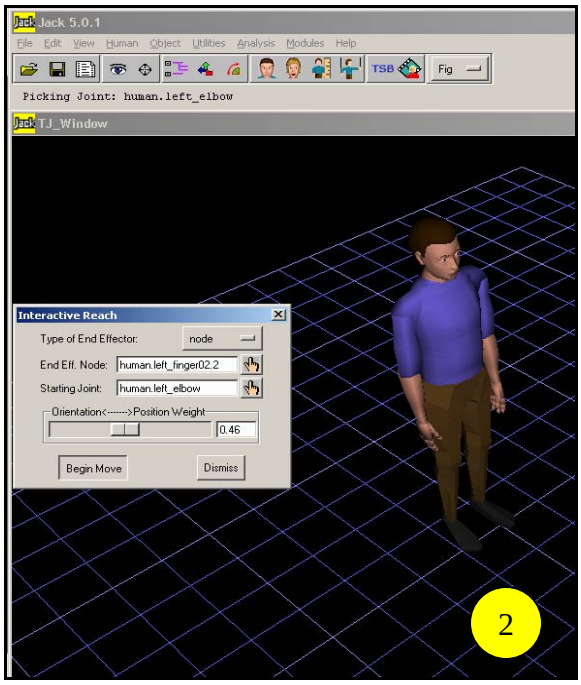


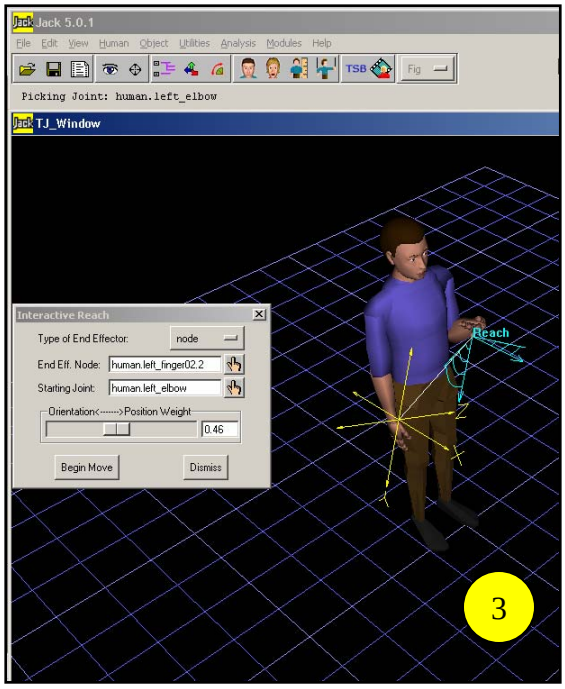


Interactive Reach

Interactive Reach command helps users to form reach motions by defining End Effective Node and Starting Joint. The command works similar to Adjust Joint command but the reach motions are real-time. Also, you can manipulate the motions in 3D coordinate system.







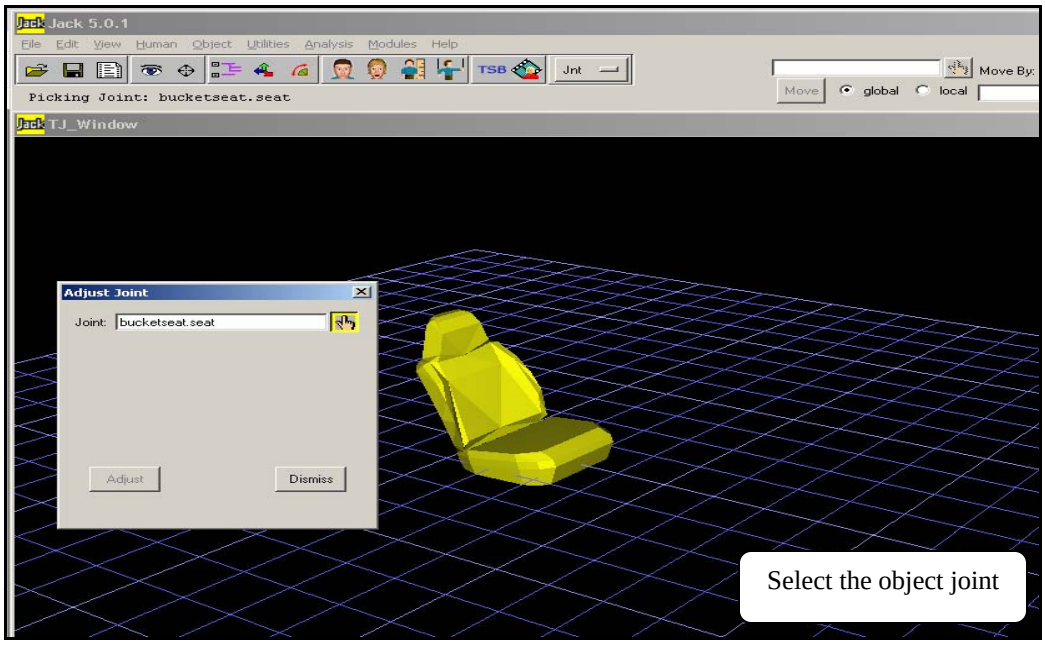
1) Select the finger tip of the human figure for “End Eff. Node”

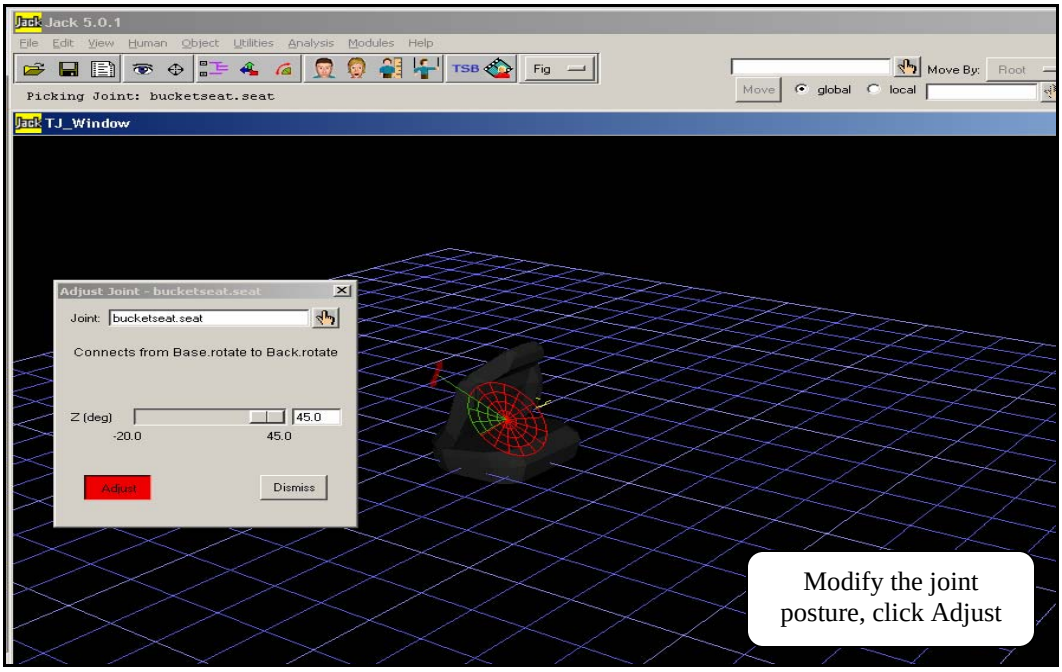
2) Select the elbow joint as “Starting Joint”

3) A coordinate system indicator icon will appear after you click “Begin Move”. Drag the coordinate system icon and observe the joint motions respect to elbow.

Adjust Joint

You can adjust object joints by using Adjust Joint Command. Select the desired joint, use the coordinate axis and drag (or use the manipulation bar) it until you get the desired posture. Click Adjust to fix the joint location.





Chapter

5

UGS TECNOMATIX JACK 5.0

User Manual and Examples

UTULITIES menu

Utilities Menu

Utilities Menu contains measurement, collision detection and constraint rules. This menu helps users to analyze the object geometry and to create dimensional relations between objects. **Figure 1** show the commands of Utilities Menu.

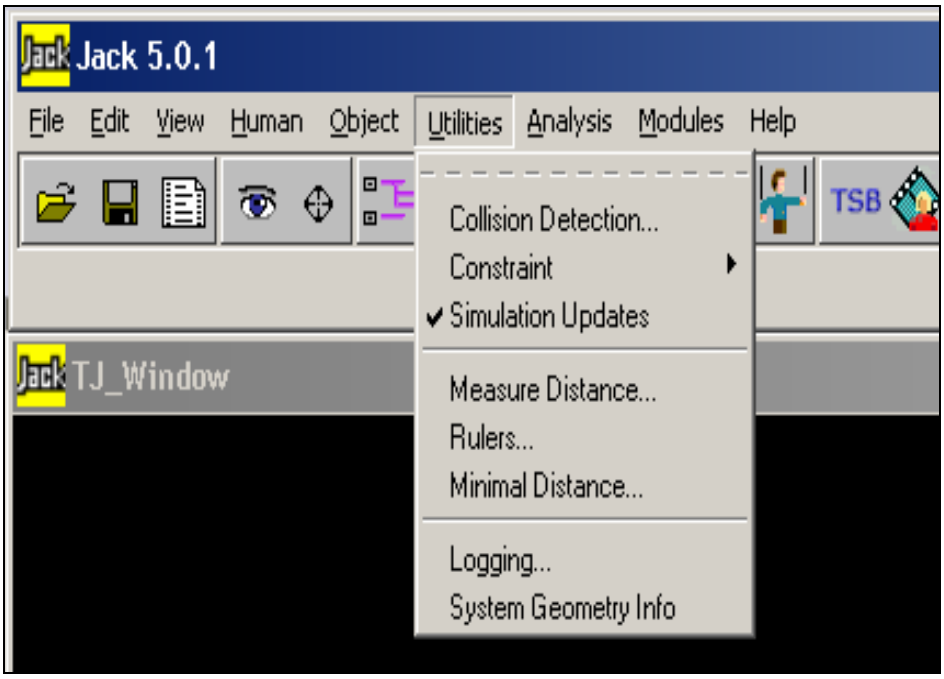


Figure 1: *Utilities Menu*

For more information please check;

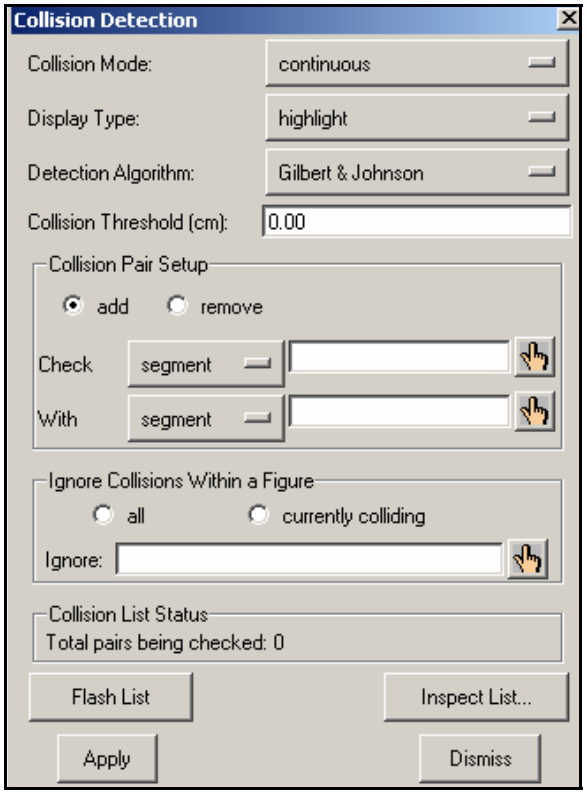
UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

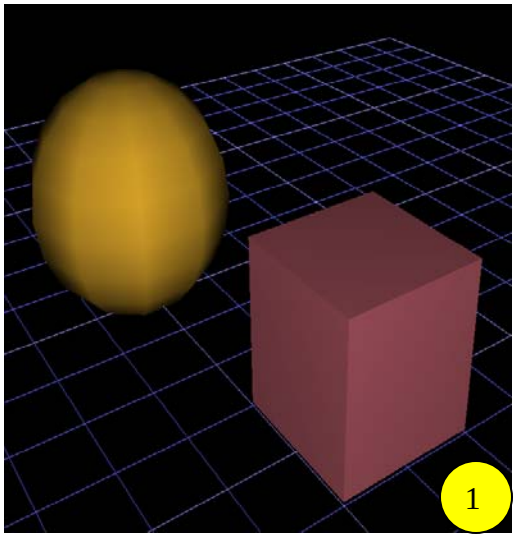
Collision Detection

Collision Detection is a very useful to for detecting and highlighting collisions between objects in the environment. Collision Detection tool helps users to check their designs for task feasibility.



Jack provides several different collision modes and detection algorithms where users make the selection depending on their accuracy and speed needs. You should use slower collision methods only in cases where accurate "concave" geometry task are required.

Collision Method	Speed	Accuracy
Bounding box	High	Low
Bounding sphere	High	Low
Gilbert and Johnson	Medium	Medium
Moore and Whelhem	Low	High
Modified M & W	Low	High



1) We will use a sphere and a cube CAD object to perform sample collision detection analysis.

You can create CAD objects by;

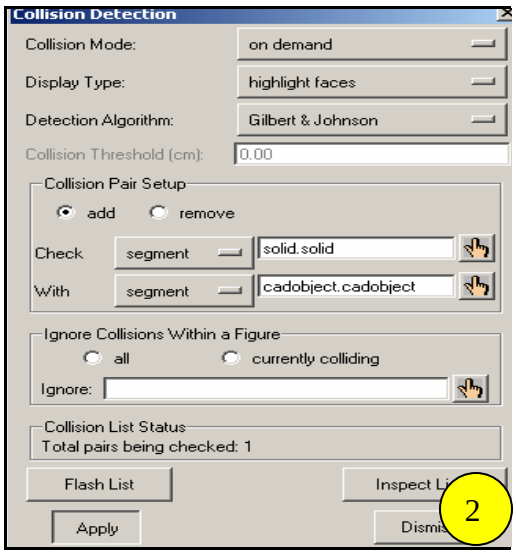
Object → Create → CAD Object

2) Go Utilities → Collision Detection

When the Collision Detection window opens, make your choices for Collision Mode, Display Type, and Detection Algorithm.

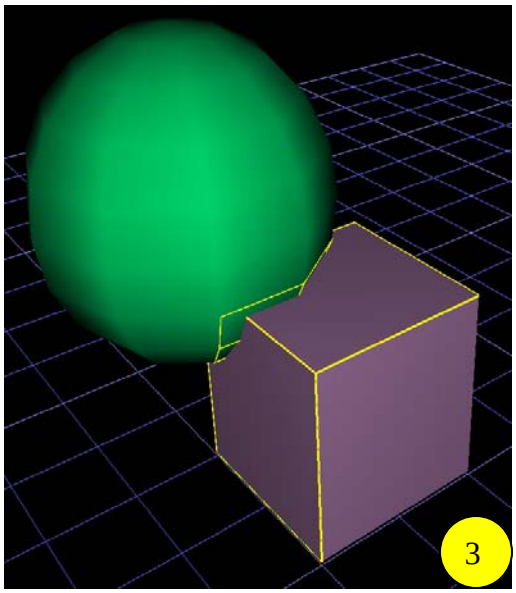
From Collision Pair Setup option; select Add, and select the sphere and cube object by using hand icon.

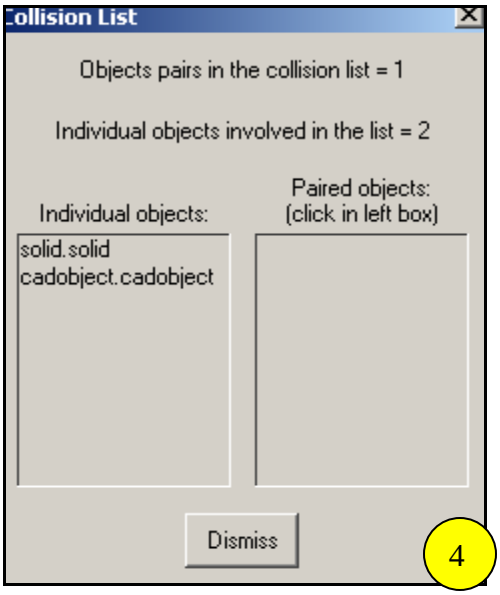
Click Apply.



3) After you click Apply, the collided fraction between parts are highlighted as seen in the figure.

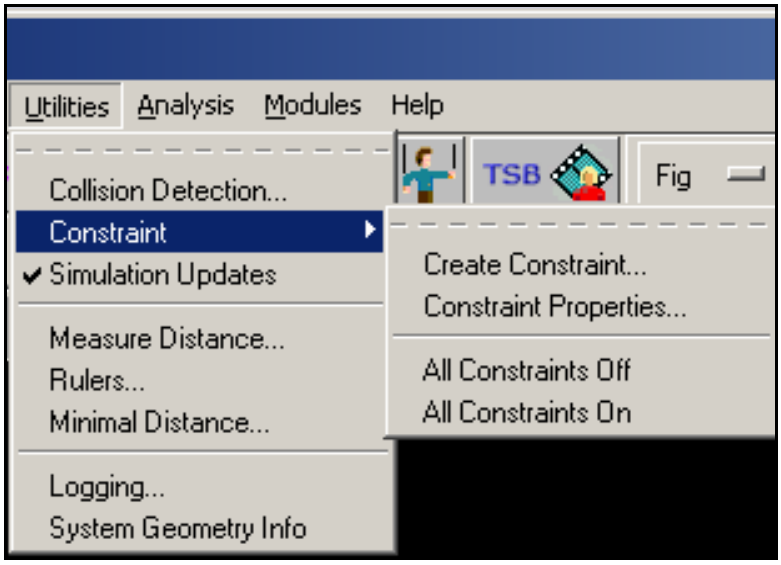
4) You can also obtain a collision list by clicking Inspect List button. This will show information about the collided objects.

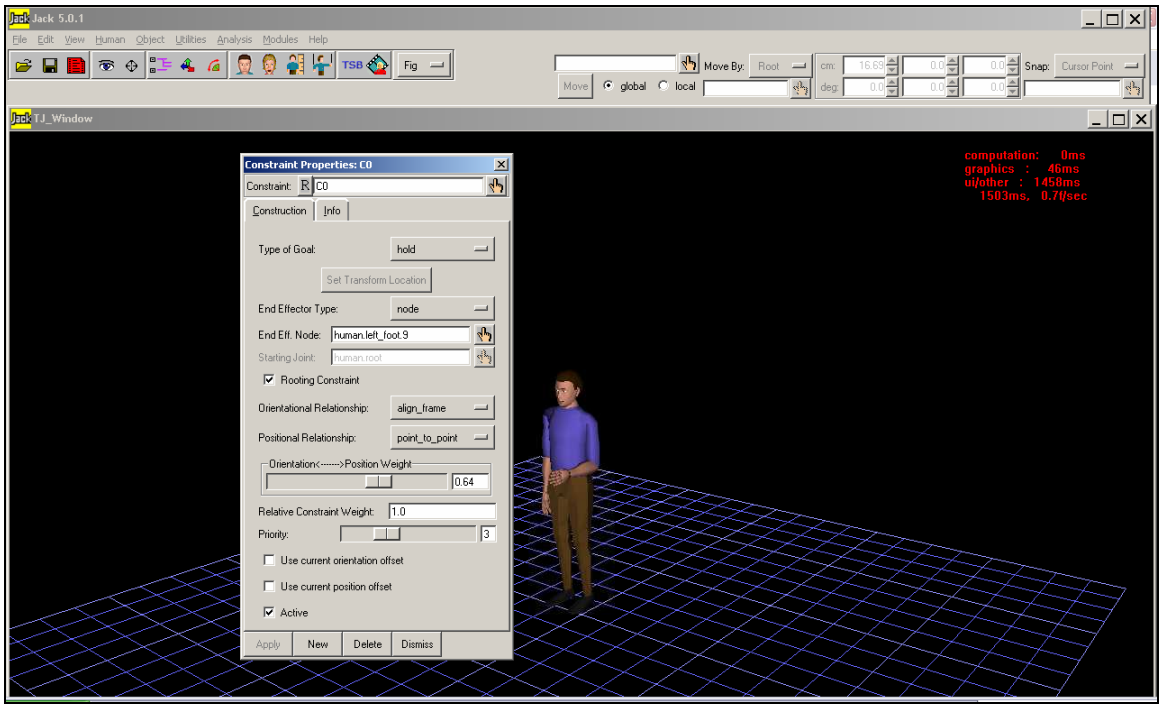




Constraint

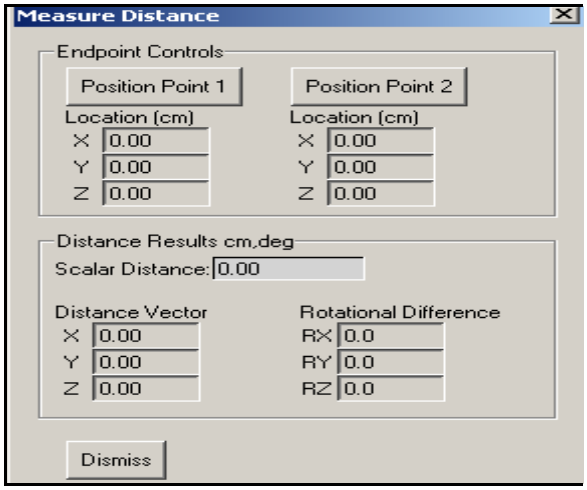
You can add/remove object and human constraints by using Constraint tool. Also, one can turn on/off all constraints of an environment file inserted on the view screen.





Measure Distance

Measure Distance is a convenient way of measuring scalar distances of a two points in a space. You can position two points in a space; the Measure Distance module will automatically calculate scalar distance and rotational difference from user defined XYZ coordinates.



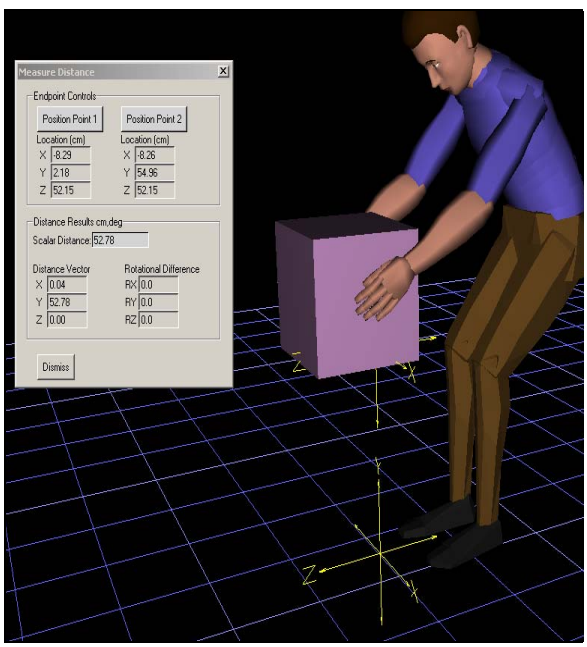


Figure on left hand side demonstrates how one can use the coordinate axis. (Position 1 and Position Point 2) In this way, you can get a scalar distance by two points.

In this example, the scalar distance between bottom face of the box and the floors is measured.

→Click Position Point 1.
A Coordinate Axis will appear automatically.

→Manually drag & position the axis to a desired place on the floor.

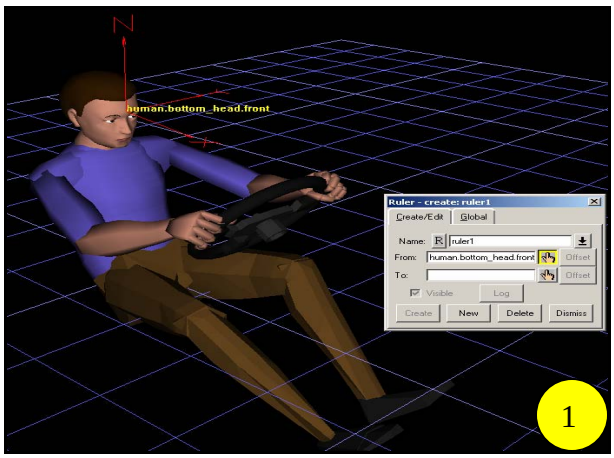
→Click Position Point 2.

→Manually drag & position the axis to a desired place on the bottom face of the box.

You need to manually drag & position the coordinate axis. In this case Position Point 1 is located on the floor and the Position Point 2 is located on the bottom face of the box.

Rulers

Ruler tool dynamically displays the distance between two points. Selected points can be segments or sites on the objects. Dynamic display feature allows user to see the measurements even the objects have been moved.



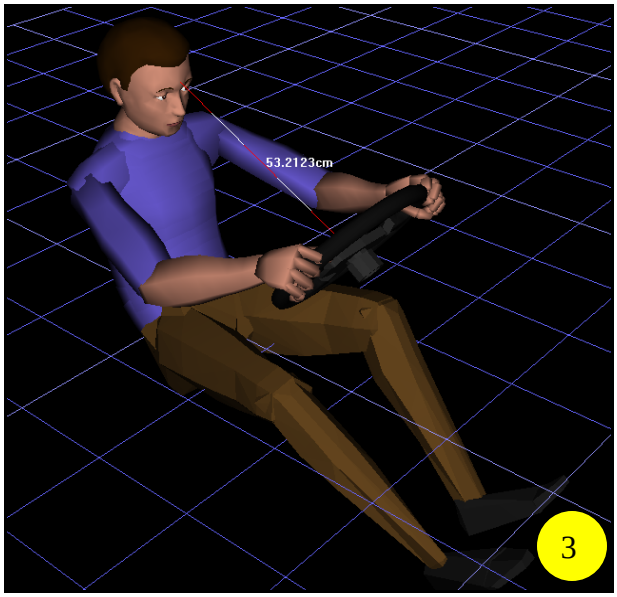


Figure on left hand side demonstrates how one can use the ruler tool to dynamically display the distance between to segments of sites.

In this example, the distance between frontal head and the steering wheel base is measured.

1) Click hand tool at From.

A Coordinate Axis will appear automatically.

Manually position the axis to a desired segment on the forehead of the manikin.

2) Click hand tool at To.

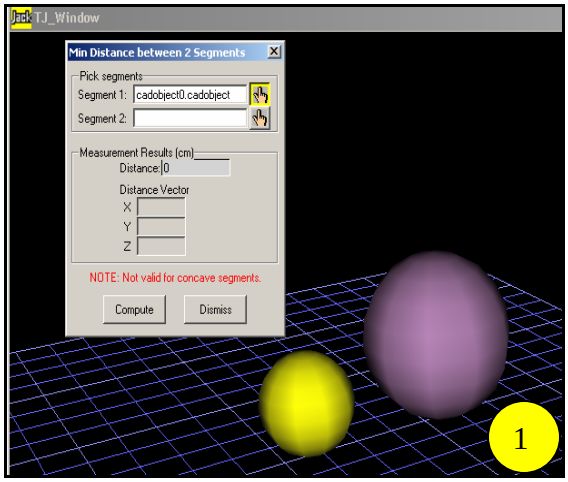
A Coordinate Axis will appear automatically.

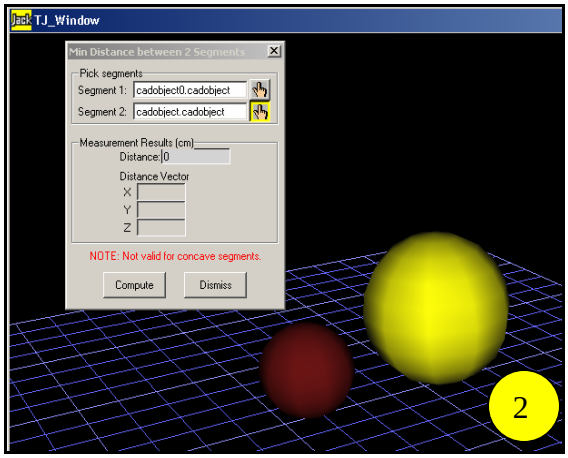
Manually position the axis to a desired place on the wheel base.

3) You can see that the distance displays on the red & white line that appears between two segments.

Minimal Distance

Minimal Distance tool allow users to find the minimum distance between two segments. When you pick two segments, Minimal Distance module automatically calculates the minimum distance and the displays the coordinates of the distance vector.





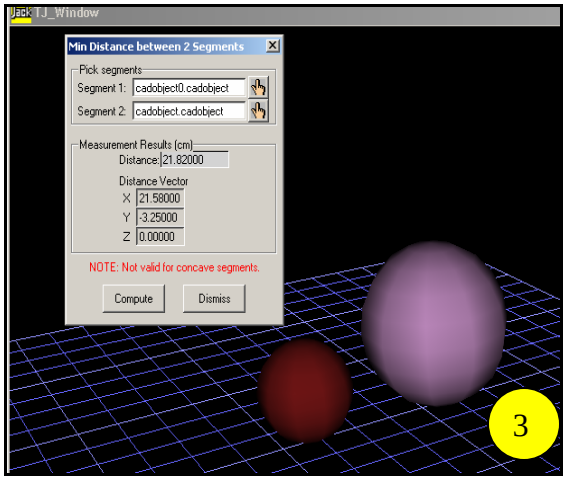


Figure on left hand side demonstrates how one can use the Minimum Distance tool to find the minimum distance between to segments.

In this example, the minimum distance between two spheres CAD objects is measured.

1) Click hand tool at Segment 1.
   Select the small sphere.

2) Click hand tool at Segment 2.
   Select the large sphere.

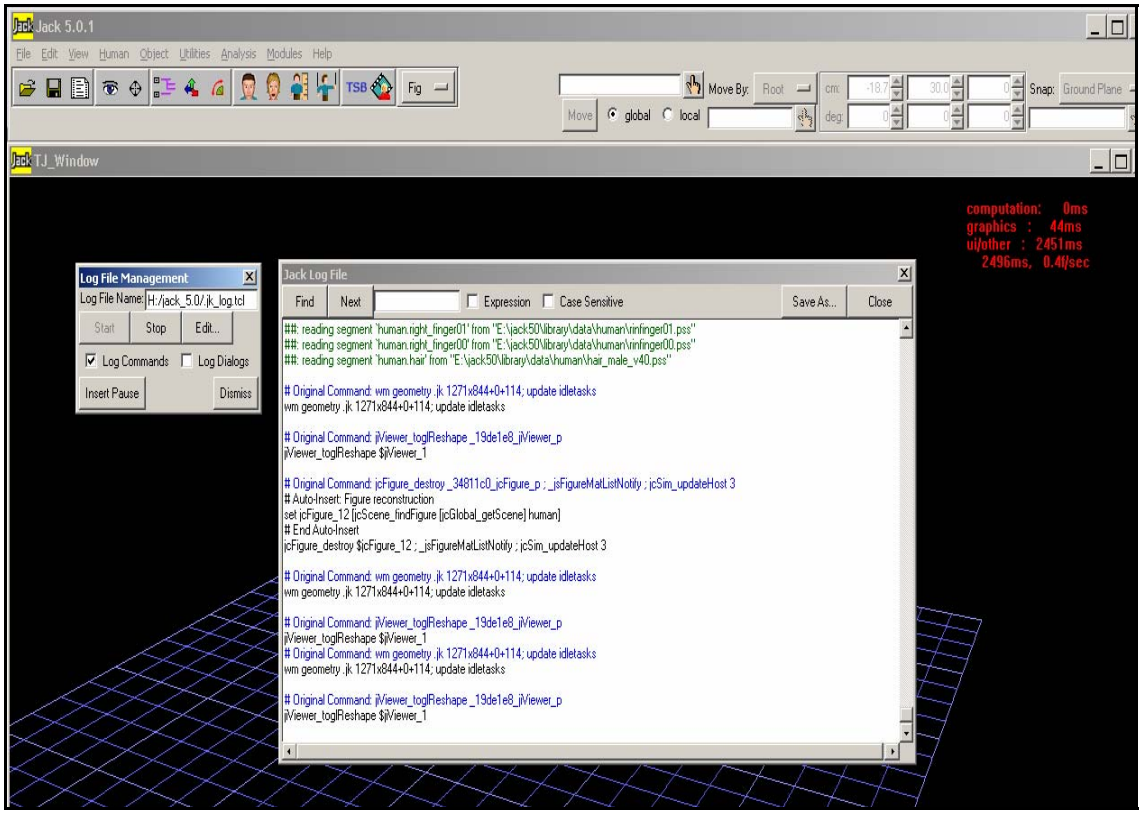
3) Click Compute.

   You can see both the distance Between two spheres and the distance vector with XYZ coordinates.

Logging

Logging command allows user to display and to edit the Jack Log File which keeps the information about used commands, environments, assemblies...etc.

Picture below shows the Log File Management window and the Jack Log File.
You can display Jack Log File by clicking on Edit button at Log File Management window.

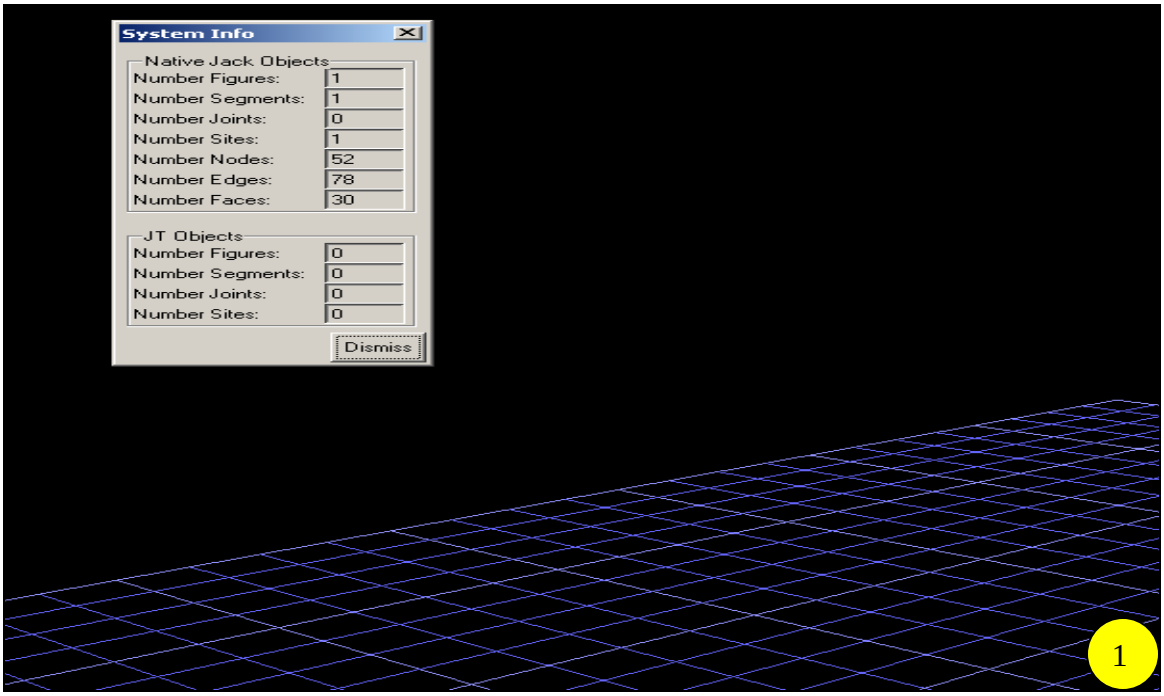


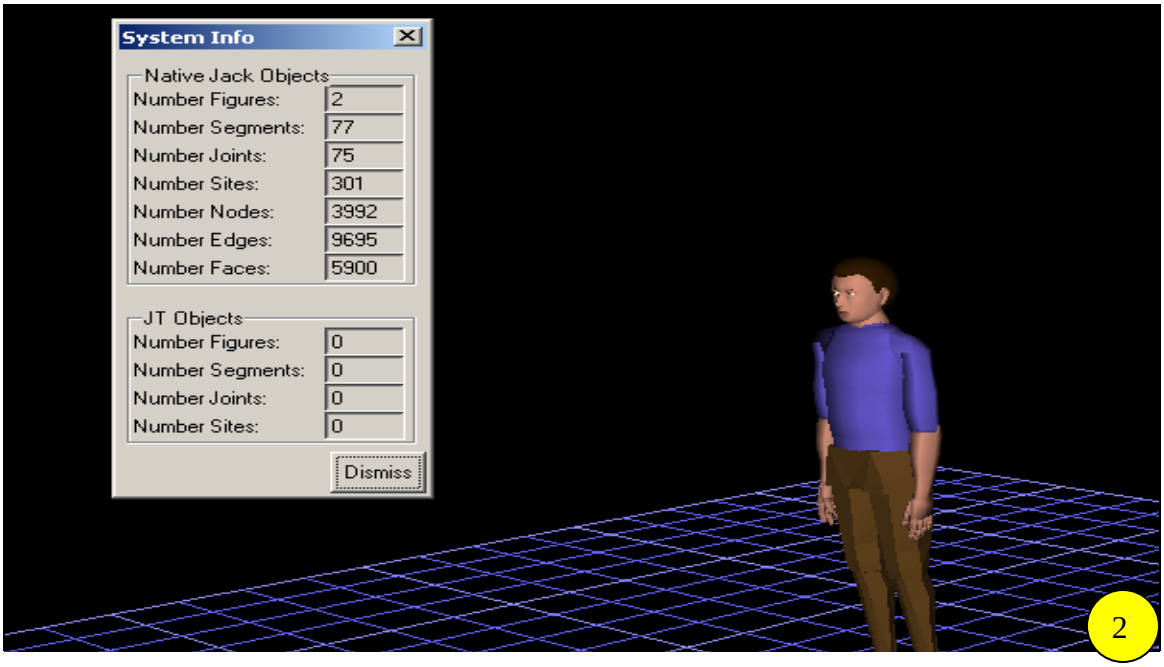
System Geometry Info

System Geometry Info displays an information box about the Native Jack Objects present on the environment.

1) System Info at environment 1 shows the information about the default Native Jack objects.

2) System Info at environment 1 shows the information after a manikin is added on the environment.





Chapter

7

UGS TECNOMATIX JACK 5.0

User Manual and Examples

ANALYSIS menu

Analysis Menu

Analysis Menu helps users to develop industry standard applied ergonomic analysis. Occupant Packaging Toolkit option is focus on driver ergonomics and visual assessment. Task Analysis Toolkit is used for industrial work/task assessment. In both toolkit options, users can develop a detailed analysis for design verifications and object – human interactions. **Figure 1** and **Figure 2** contains all necessary object tools.

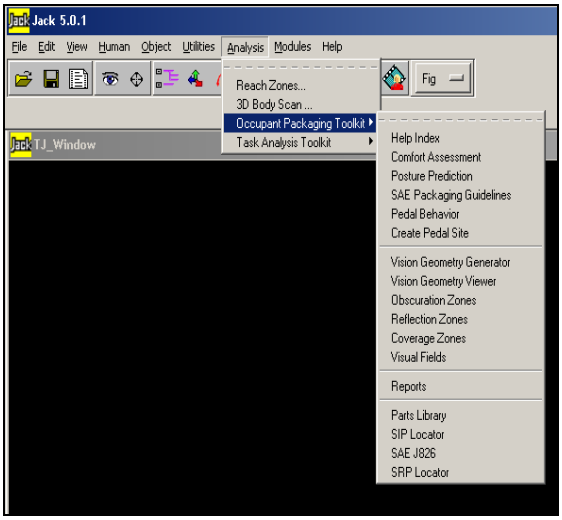


Figure 1: *Occupant Packaging*

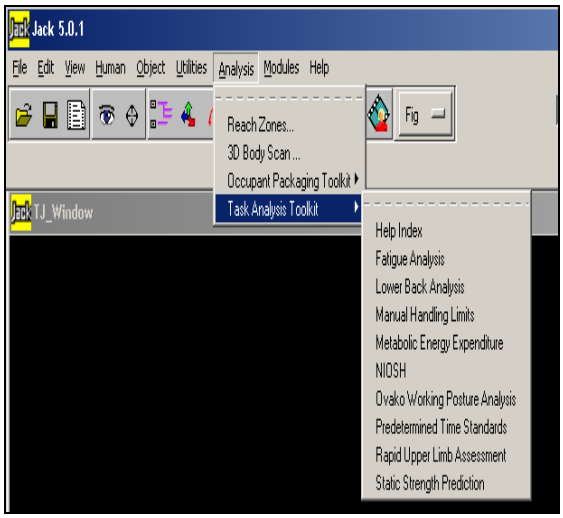


Figure 2: *Task Analysis*

For more information please check;

UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

Chapter

7

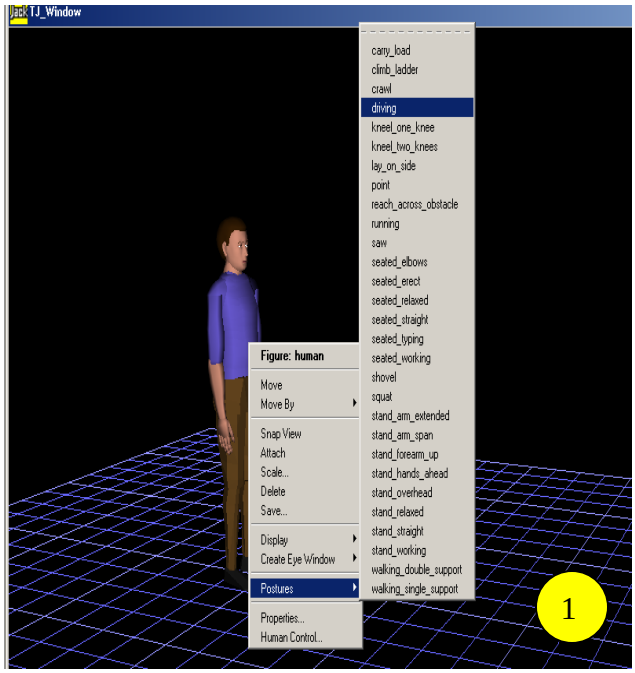
UGS TECNOMATIX JACK 5.0

User Manual and Examples

Occupant Packaging Toolkit

Comfort Assessment

Comfort Assessment tool helps users to determine if they have positioned a human model in a comfortable posture based on joint angles and overall posture. It contains five different decision criteria (comfort models). In addition users can customize their own comfort ranges for individual joints by selection under the customize menu. Dynamic bars show the analysis results; also users can create an output report.



This example demonstrates a step by step Comfort Assessment example.

1) First of all, we need to create a Jack human posture to apply the Comfort Assessment.

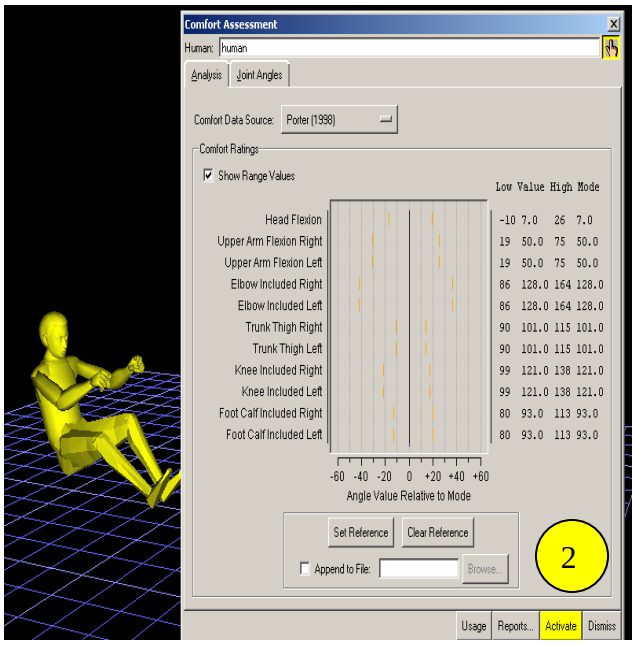
→Insert a Jack human.

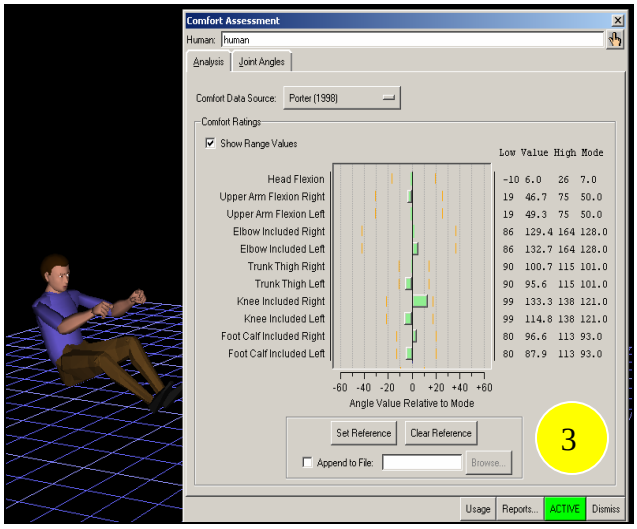
→ Right click on the Jack human, go to Postures, select driving posture.

2) Go to the Analysis, go Occupant Packaging Toolkit, select Comfort Assessment.

When the Comfort Analyses Window opens;

→ Click on the Hand tool and select the Jack human model.

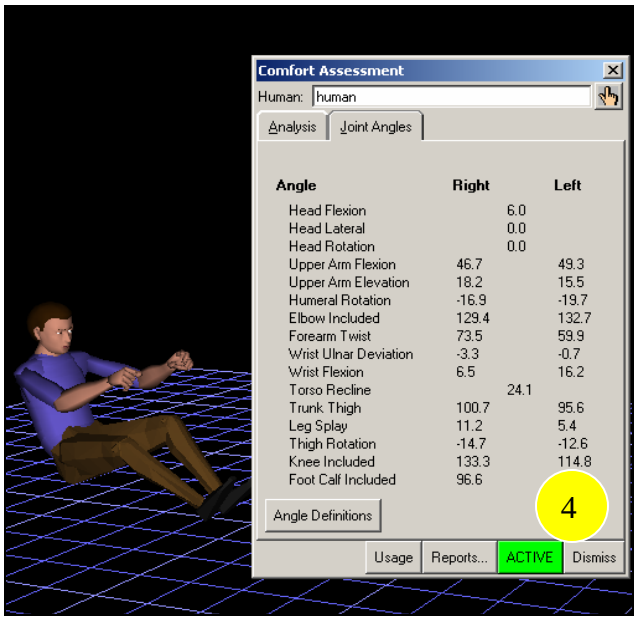




3) When you select the Jack human model, you need to choose comfort data source. In this example, we use the Porter 1988.

→ Click Active.

Now you should see the joint angle values appeared as a bar chart.

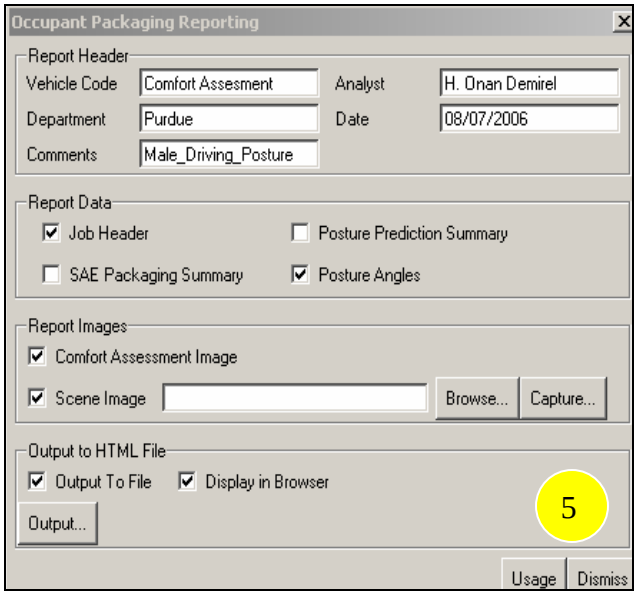


4) You can also see the joint angle values by clicking the Joint Angles tab.

From the Angles information you can see the Left & Right position angles of the joints.

5) In addition to bar chart and Joint Angle information tab, you can create an outsource report file by clicking Reports next to Active button in the Comfort Assessment main menu.

Fill the Report Header, Select the Report Data you want to create, select the Report Images (optional), select the Output to File option and click Output button.



Note *= In this example, we only worked on Comfort Assesment which includes Posture Angles. If you select all choices in the Report Data, Posture Prediction Summary and SAE Packaging summary won't appear on the report*

6) Report output. (next page)

Occupant Packaging Report

Vehicle Code: Comfort Assesment
Analyst: H. Onan Demirel
Department: Purdue
Date: 08/07/2006
Comments: Male_Driving_Posture

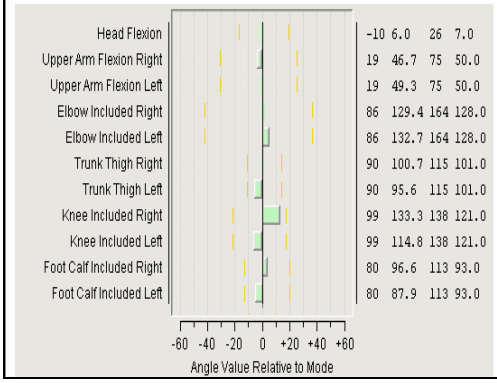
Human Figure Posture Details:

Comfort ratings based on: Porter (1998)

Angle	Right		Left
Head Flexion		6.0	
Head Lateral		0.0	
Head Rotation		0.0	
Upper Arm Flexion	46.7		49.3
Upper Arm Elevation	18.2		15.5
Humeral Rotation	-16.9		-19.7
Elbow Included	129.4		132.7
Forearm Twist	73.5		59.9
Wrist Ulnar Deviation	-3.3		-0.7
Wrist Flexion	6.5		16.2
Torso Recline		24.1	
Trunk Thigh	100.7		95.6
Leg Splay	11.2		5.4
Thigh Rotation	-14.7		-12.6
Knee Included	133.3		114.8
Foot Calf Included	96.6		87.9

Green = within comfort range
Yellow = outside of comfort range
Black = not part of Porter (1998) data source

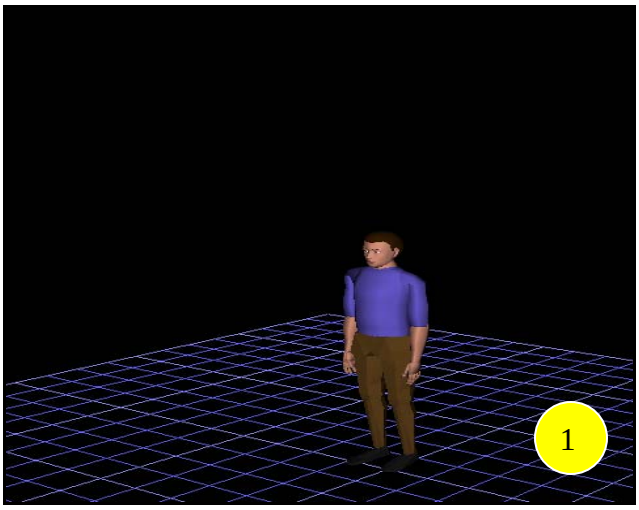
Comfort ratings based on: Porter (1998)

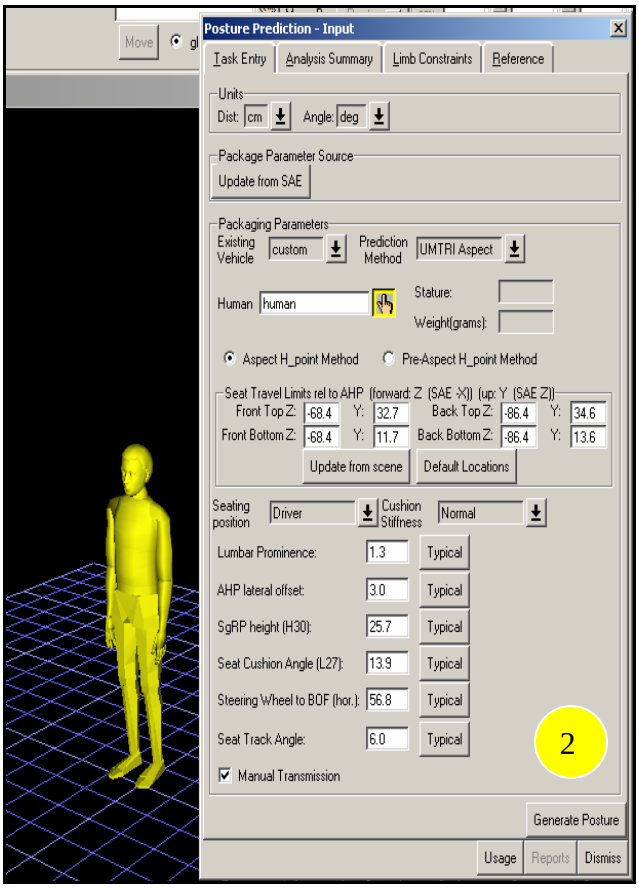


6

Posture Prediction

Posture Prediction tool helps users to assign predefined driving and seating postures to a Jack human model. This tool saves lots of time and effort. In addition, you can easily modify the variables on the Posture Prediction window and analyze the changes by creating a report output.





This example demonstrates a step by step Comfort Assessment application.

1) First of all, we need to create a Jack human model.

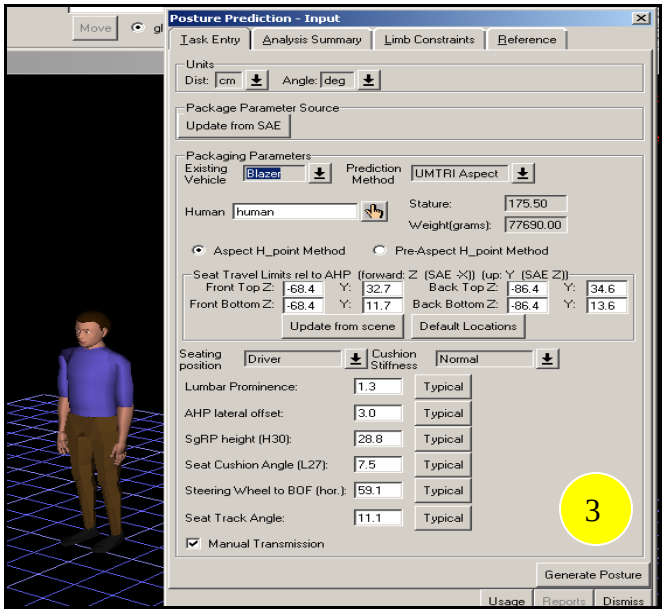
   →Insert a Jack human.

2) Go to the Analyses, go Occupant Packaging Toolkit, select Posture Prediction.

   When the Comfort Analyses Window opens;

   → Click on the Hand tool under Packaging Paramaters and select the Jack human model.

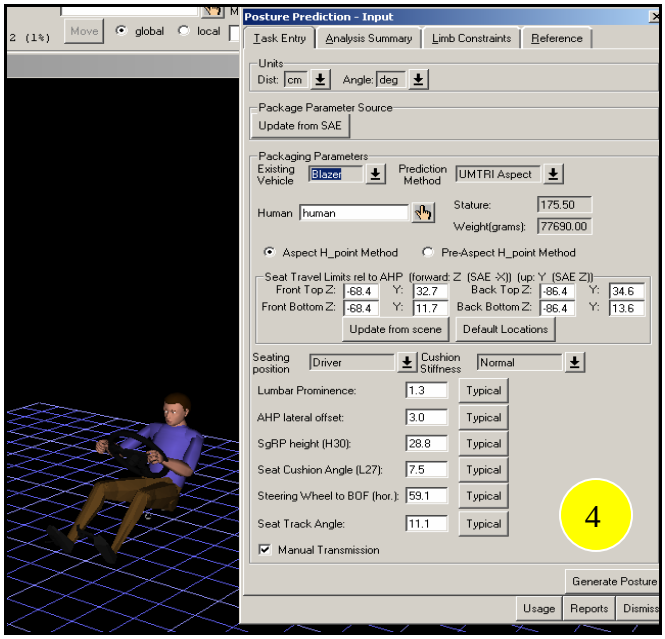
   When you click on the human model Stature and Weight option will be filled up automatically.



3) When you select the Jack human model, you need to choose the Existing Vehicle and Prediction method.

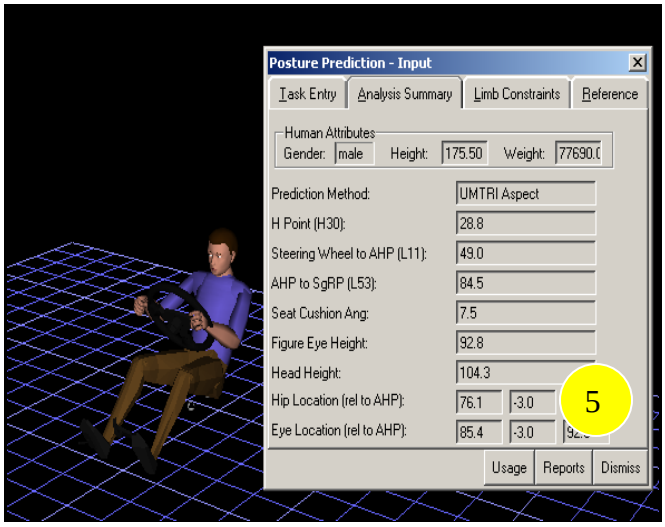
Also, you may choose a Seating Position , Cushion Stiffness, and Manual Trasnmission option after Selecting the Packaging Parameters.

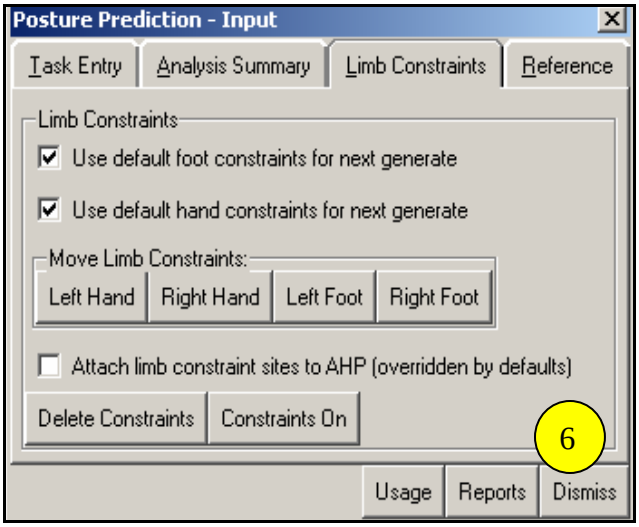
→ Click Generate.

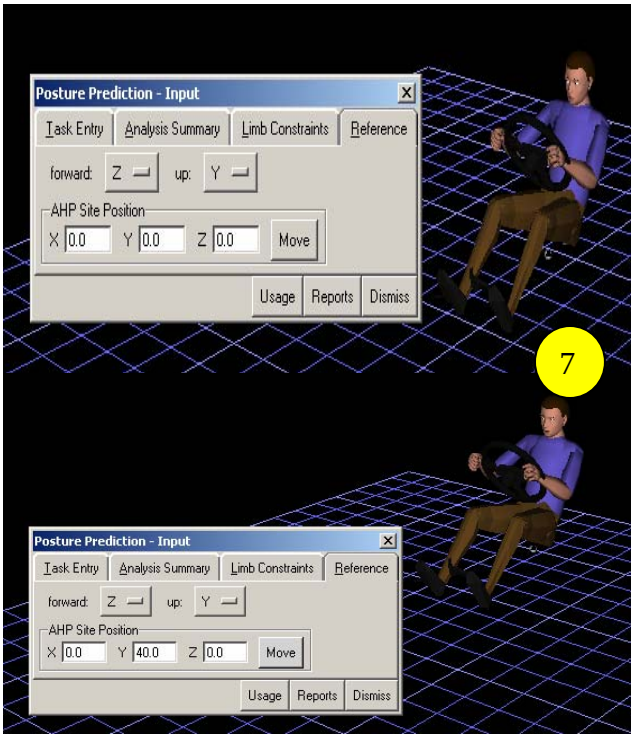


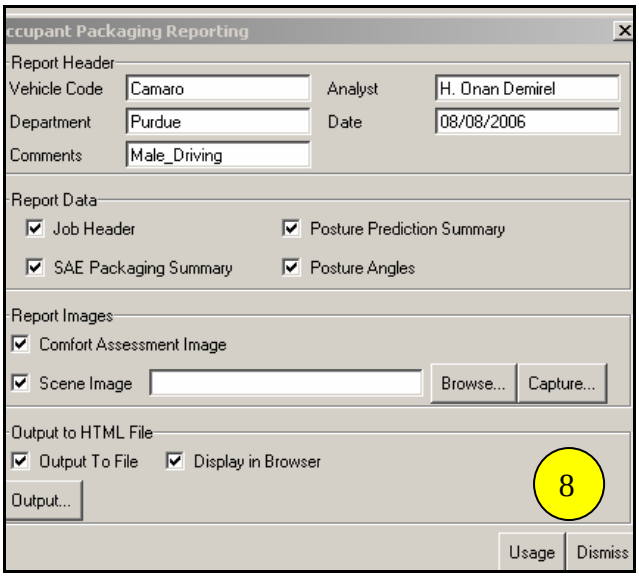
4) Now you should observe that Jack human model automatically positioned into a predefined posture. In addition a steering wheel is positioned on the environment.

5) You can also see a brief summary of the selections by clicking on the Analysis Summary tab.









6) If you need special segment or joint constraints or you want to delete/add constraints; you can control these actions under Limb Constraints tab.

7) Reference option helps users to change the orientation of the driver as a single part.

   We increase the Y position value to 40.0 and go back to Task Entry tab and click on the Generate Posture button to activate the changes. This changed the orientation of the driver in the Y coordinate.

8) In addition to analysis summary information tab, you can create an outsource report file by clicking Reports next to Dismiss button in the Posture Prediction main menu.

   Fill the Report Header, Select the Report Data you want to create, select the Report images (optional), select the Output to File option and click Output button.

Note *= In this example, we only worked on Posture Prediction. If you select all choices in the Report Data, some of the analysis may not appear on the report.*

9) Report output. (next page)

Occupant Packaging Report

Vehicle Code: Camaro
Analyst: H. Onan Demirel
Department: Purdue
Date: 08/08/2006
Comments: Male_Driving

Posture prediction: (UMTRI Aspect)
(cm or deg from AHP)

Human: male (175.50 cm, 77.69 kg)

Packaging Parameters Used:	(H30): Vertical SgRP to Heel Pt.	28.8
	(L11): Horizontal BOF to SWC.	49.0
	(L27): Cushion Angle.	7.5
	Seat Track Angle.	11.1
	Transmission Type.	manual
Predicted Posture Information:	Figure Eye Height:	92.80
	Top of Head Height:	104.30
	Figure Hip location:	76.10, -3.00, 30.00
	Computed H-point:	82.50, -3.00, 29.20
	Figure Hip - H-point:	-6.40, 0.00, 0.80
	Computed Eye location:	85.40, -3.00, 92.80

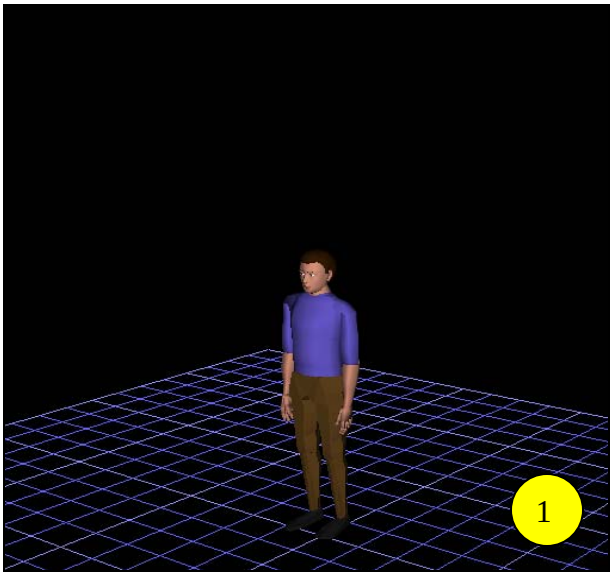
9

Create Pedal Site & Create Pedal Behavior

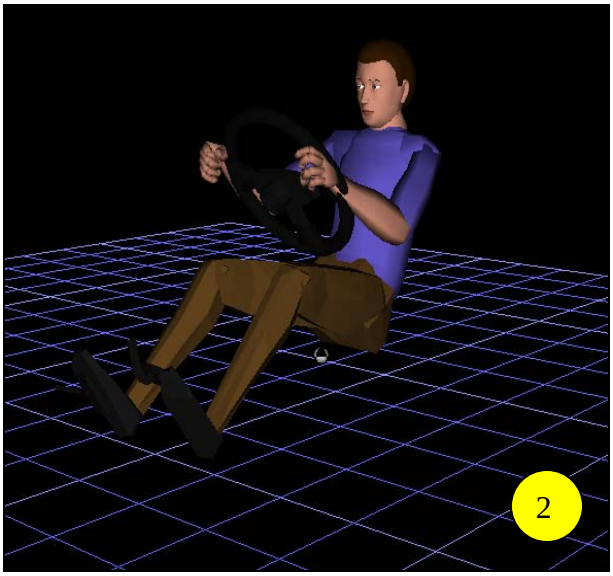
Create Pedal site and Create Pedal Behavior commands allow users to work on vehicle ergonomics where precise pedal and foot movements are needed. You can assign the pedal movement between gas, brake and clutch.

Both commands can be used interchangeably. Below example demonstrates a pedal movement from gas to brake. We will start by creating a pedal site and than we will assign a pedal behavior.

Create Pedal Site

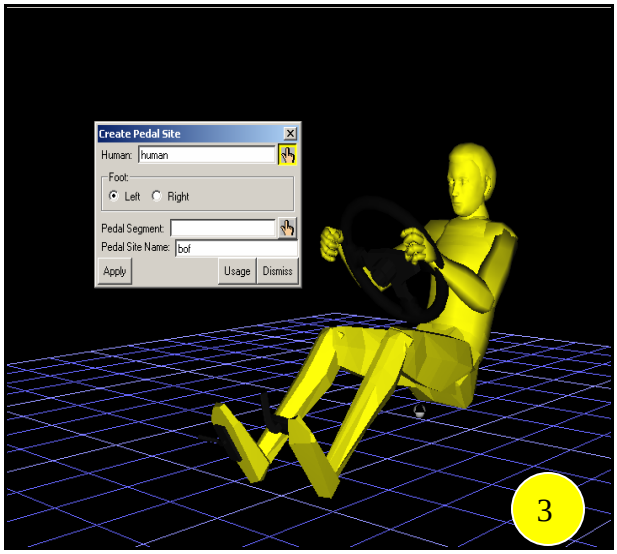


1) Create a Jack human model



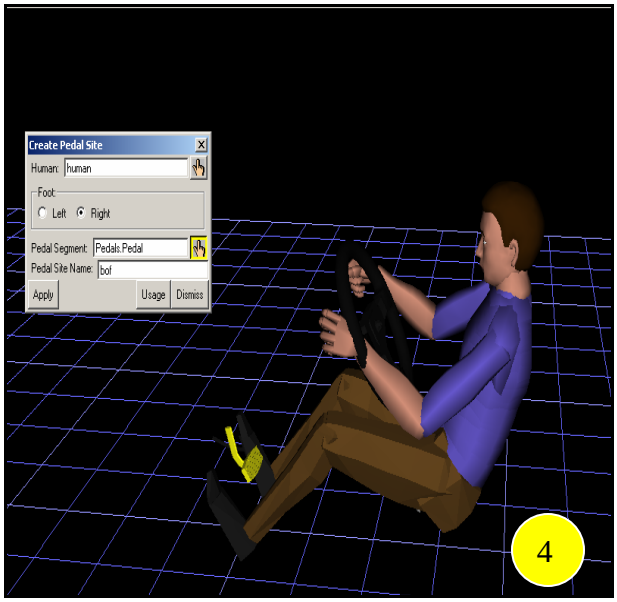
2) A sample driving posture is applied to a Jack human model by using Posture Prediction.

   Driving posture on left hand side will be used to observe the application of pedal site and pedal behavior.



3) → Go Analysis
→ Occupant Packaging Tools
→ Create Pedal Site

When the Create Pedal Site window opens, click on the hand icon and select the Jack human model.



4) Select the Right foot under the Foot option.

Click on the hand icon next to Pedal Segment option, and click to select the brake pedal on the screen.

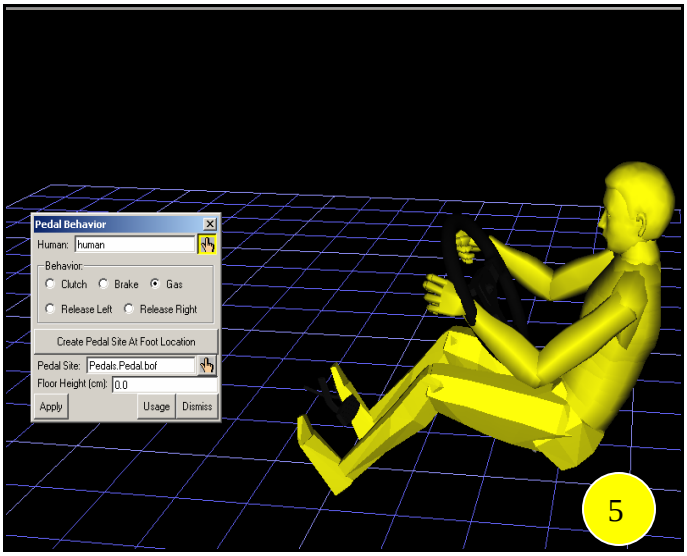
A pedal site name is automatically created. You can also name the pedal site by typing a specific name on Pedal Site Name option.

Note = Remember, we are trying to demonstrate a foot movement from gas to brake pedal, that's why the right foot and the brake pedal is selected.

So far, we established a relationship between the right foot and the brake pedal. You can assign movements to both foot and the control pedals by using Crate Pedal Site command.

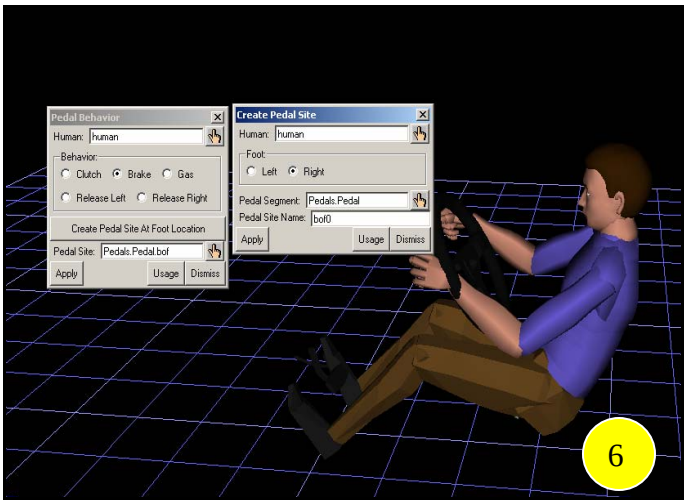
Next, we will finalize/animate the movements by using Create Pedal Behavior tool. Each specific movement (brake, gas, clutch) is limited by dimensional tolerances and constraints. Jack software animates a realistic pedal movement by using these tolerances and constraints.

Create Pedal Behavior



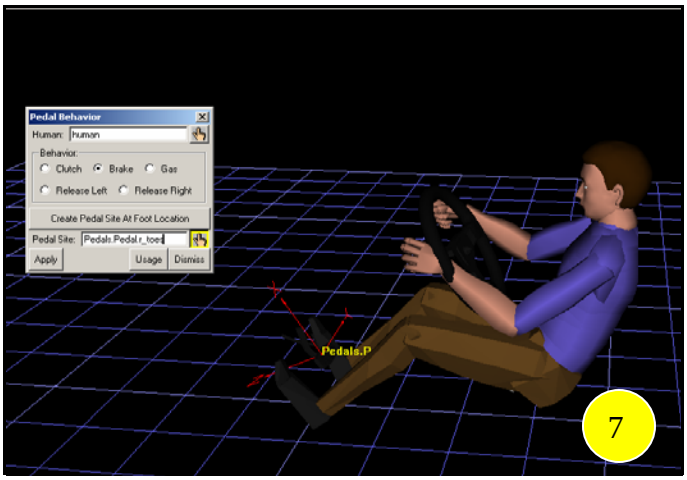
5) → Go Analysis
→ Occupant Packaging Tools
→ Create Pedal Behavior

When the Create Pedal Behavior window opens, click on the hand icon and select the Jack human model.



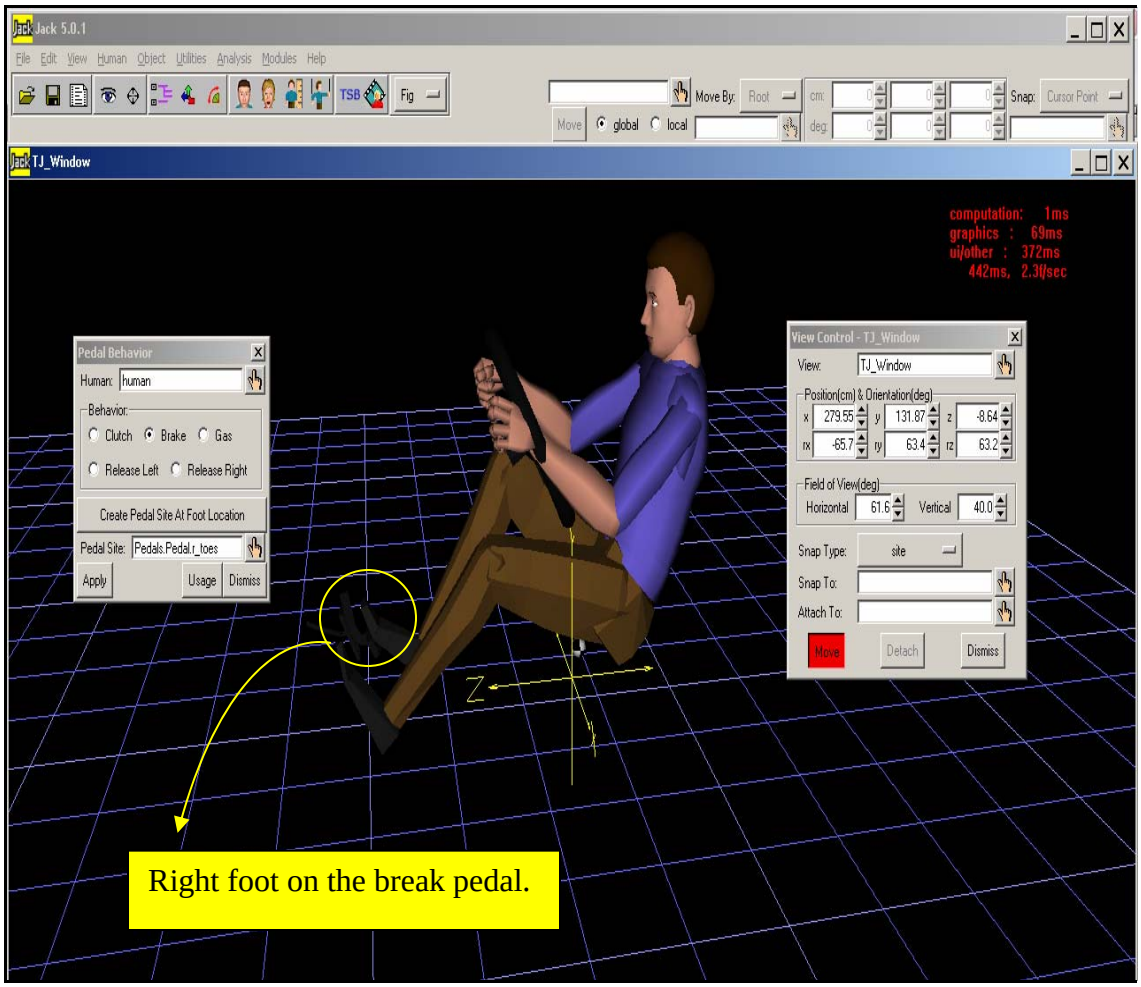
6) →Select Brake under Behavior option.

** Just in case click on the Create Pedal Site Foot Location button to ensure that you have previously created a pedal site.



7) → Click on the hand icon next to Pedal Site option. After that, click on the surface of the brake pedal.

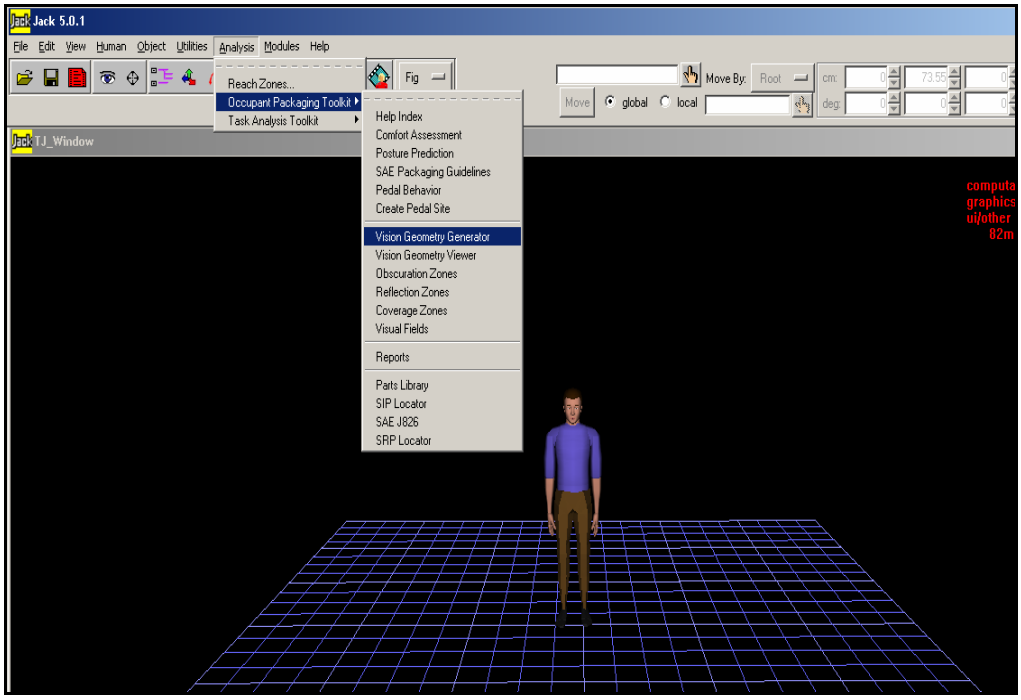
→ Click Apply.



Note: After you click Apply on Step 7, you should observe that the right foot has moved to the assigned break pedal. Since the background and the pedals are in same black color, you may need to move the human model in 3D coordinate system to clearly observe the location of the foot.

Vision Geometry Generator

Vision Geometry Generator tool allows users to evaluate digital concept vehicle models for visualization related human factors issues. This tool helps users to create vision geometry/postures for human model inserted in digital vehicles. You can assign vision geometry/postures on a custom vehicle model or you can choose predefined models from list of vehicles.

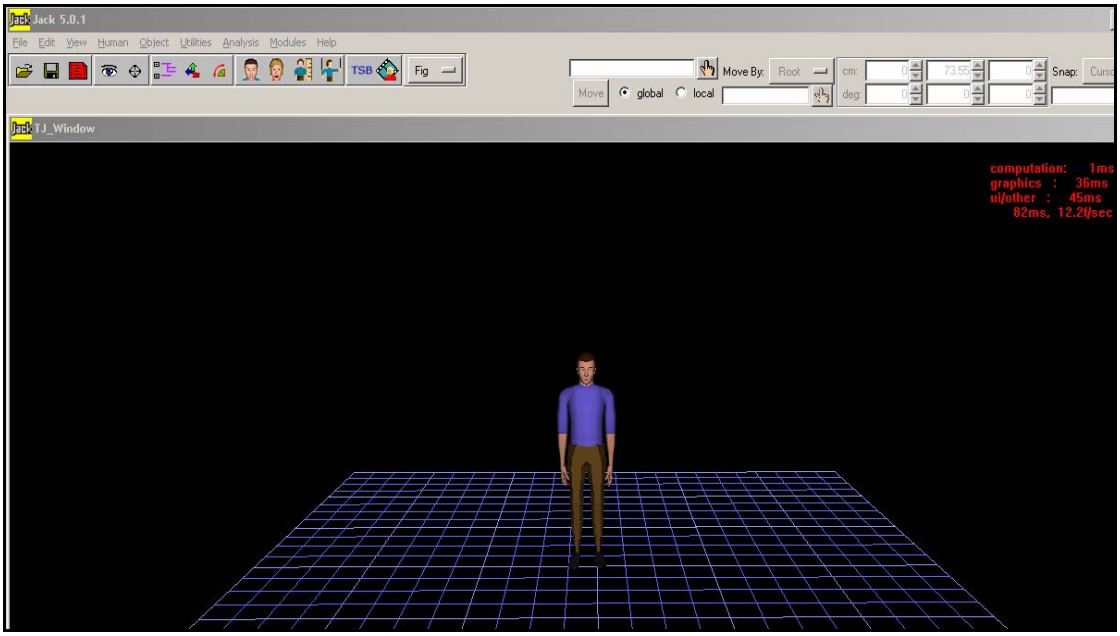


Analysis Menu *– Vision Geometry Generator*

Below example demonstrates a vision/posture assignment to a human model in a predefined vehicle.

Step 1: Build Human

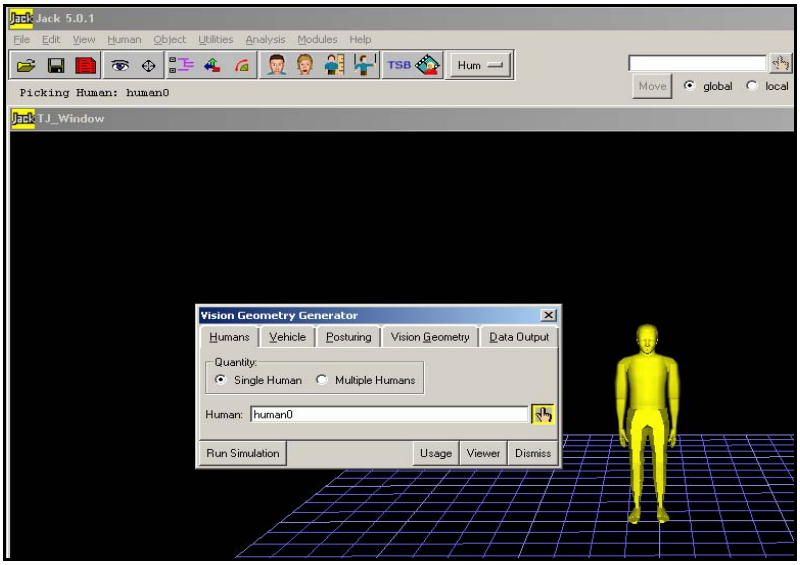
Insert a human model to the Jack environment. Anthropometry Information is not important in this case.



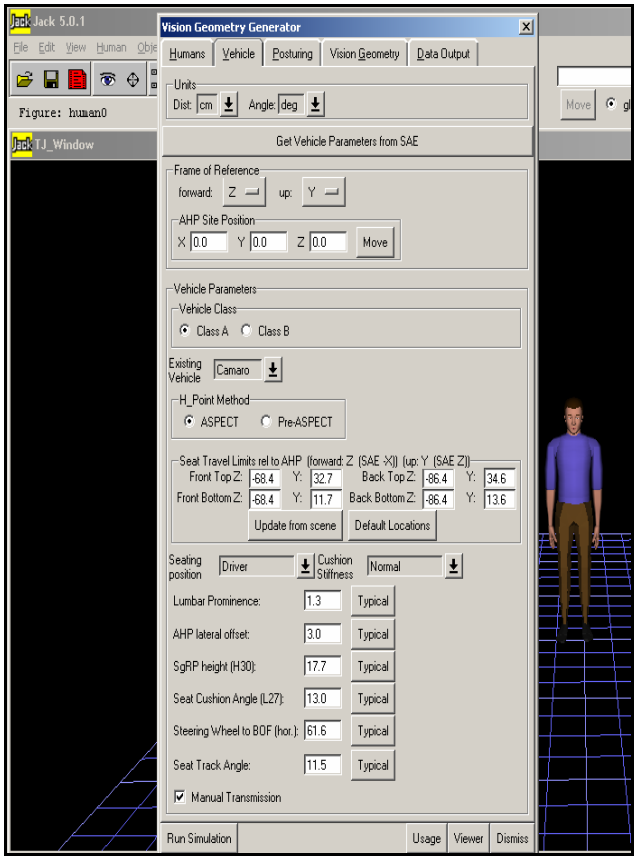
Step 2: Vision Geometry Generator

Go, Analysis → Occupant Packaging Toolkit → Vision Geometry Generator

1) First, start with the Human tab. Select the human model by using the hand icon.



2) Select the vehicle parameters under the Vehicle tab.

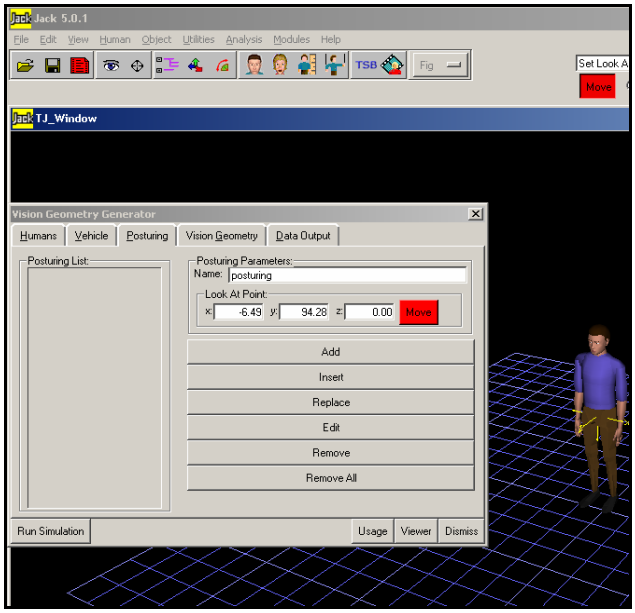


We are going to use the default settings for the vehicle parameter.

However, from the Existing Vehicle list, we choose the Camaro.

Existing Vehicle; Camaro

3) Under the Posturing Tab and define a Look At Point by moving the coordinate system icon.



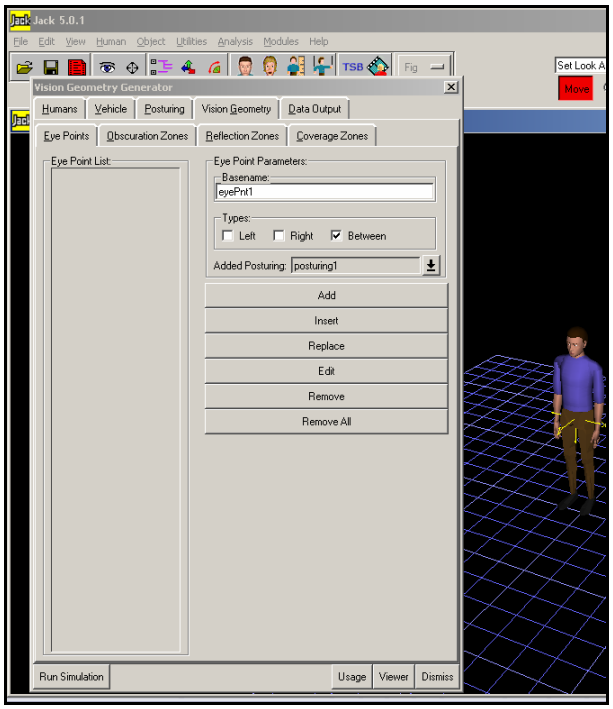
Click Move button on the Look At Point option.

Drag and move the coordinate system icon and place it somewhere close to the human waist.

This will be the view (look at view) when the human model gets its driving position.

When you are done, click Add.

4) Next, click on the Vision Geometry tab.

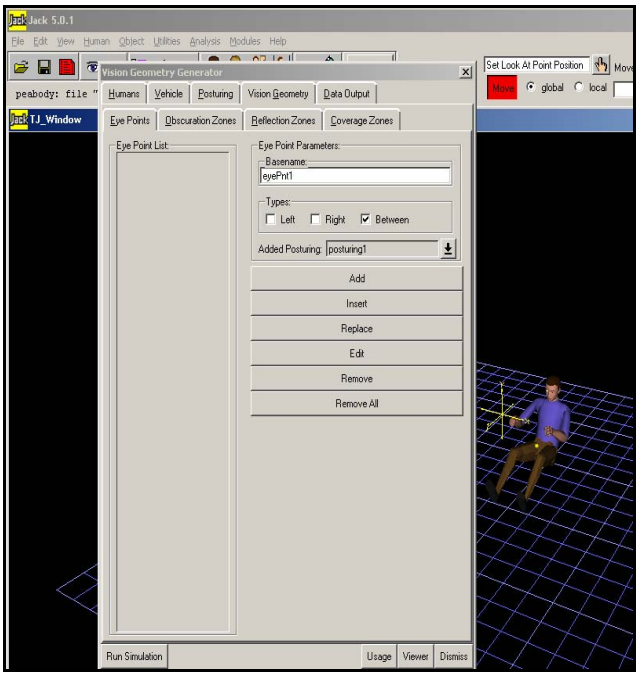


Choose Between under eye point parameters.

From the Added Posturing list, choose the Posturing1. This adds the already created Look At Point parameter (posturring1) to the system.

When you are done, click Add.

4) Run the simulation.

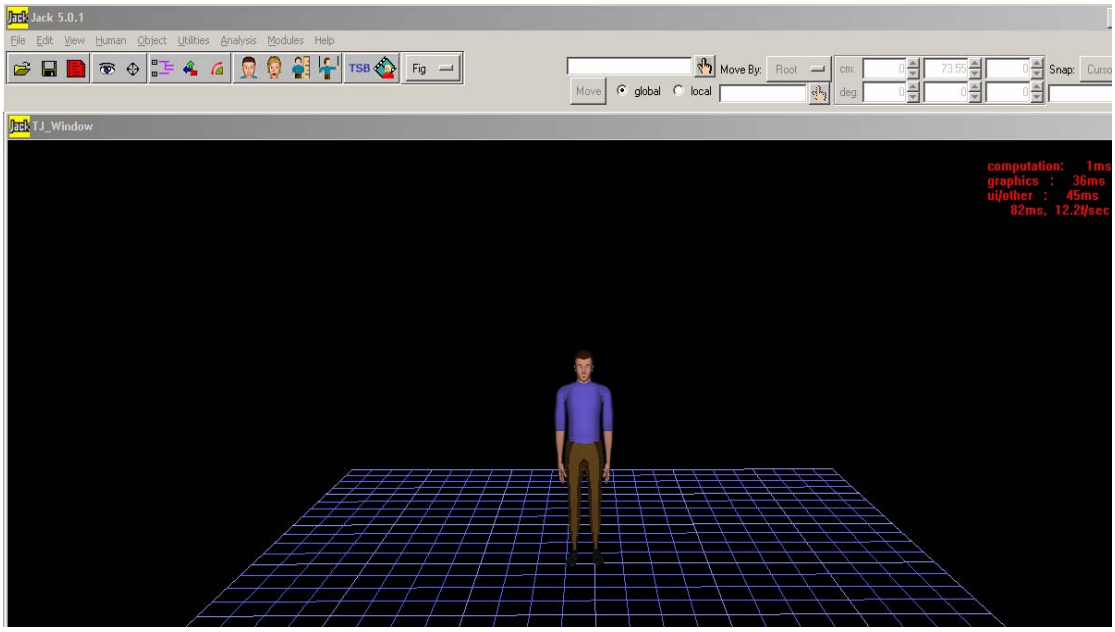


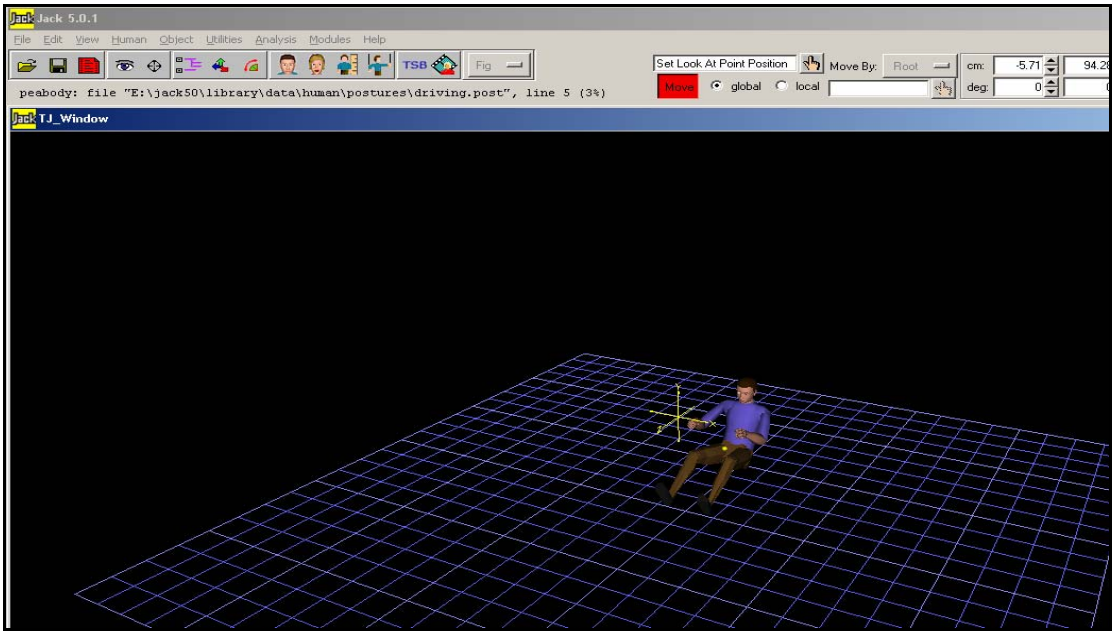
Click on Run Simulation button on left hand side.

You should observe that the human model takes a predefined driving posture and his sight of view is aligned with the coordinate system icon.

Step 3: Output File

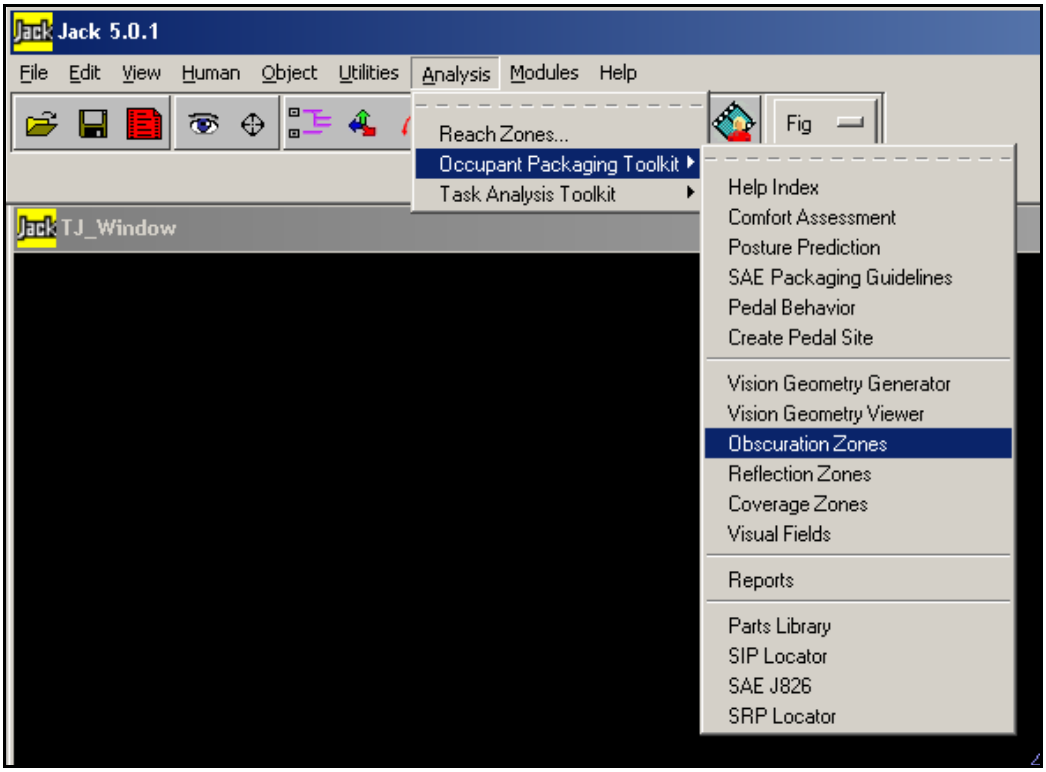
You can also assign an output file for further analysis. Click on the Data Output Tab, choose a file, units and output name for your output file.





Obscuration Zones

Obscuration Zones tool allows user to create geometry representative of sight for the obscurations from objects. You can assign the human eye to an object with direct line of sight and observe the obscuration areas for your design analysis.



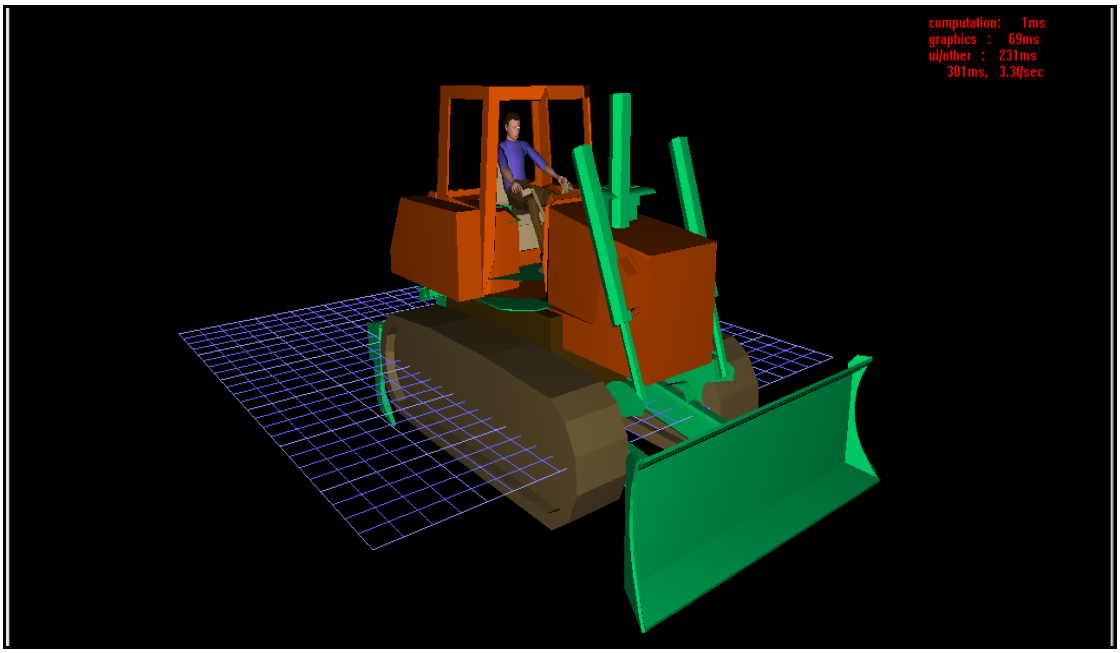
Analysis Menu *– Obscuration Zones*

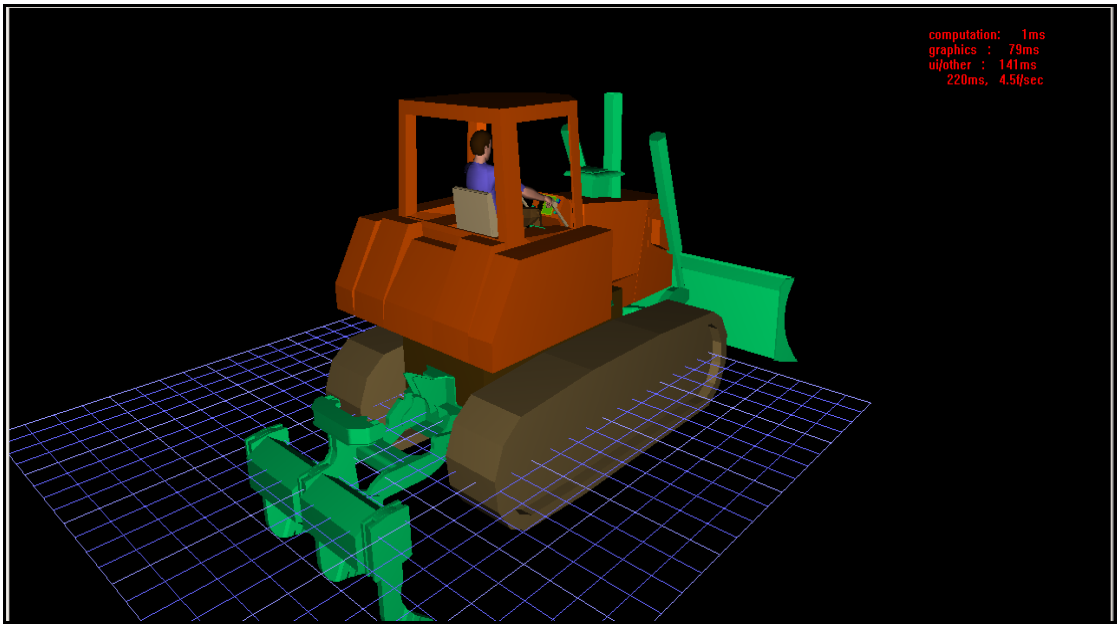
Below example demonstrates an obscuration sight from the exhaust pipe of a tractor. The driver sight is blocked by the exhaust pipe. We can evaluate if the amount of obscuration area exceeds the visual limits of the design.

Step 1: Build Human and Object

We started the animation by creating the basic animation components; digital human model and objects.

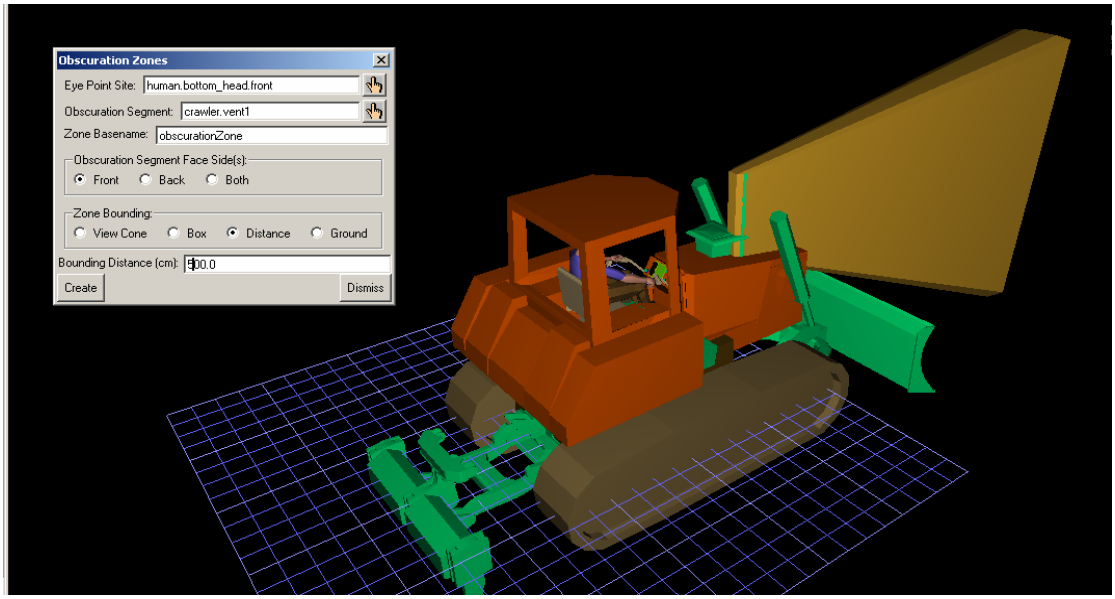
First, insert the crane model from sample environment folders. After that create a human model. Anthropometry Information is not important in this case. After you've inserted the human model, right click on it, go *postures* and choose *driving* posture.

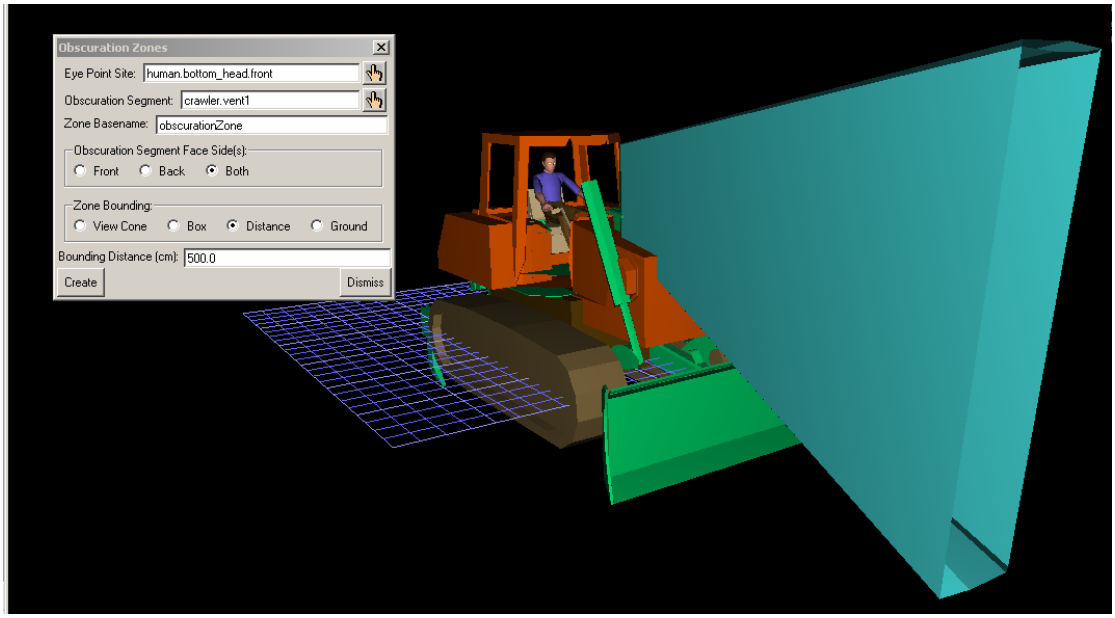




Step 2: Perform Obscuration Zones Analysis

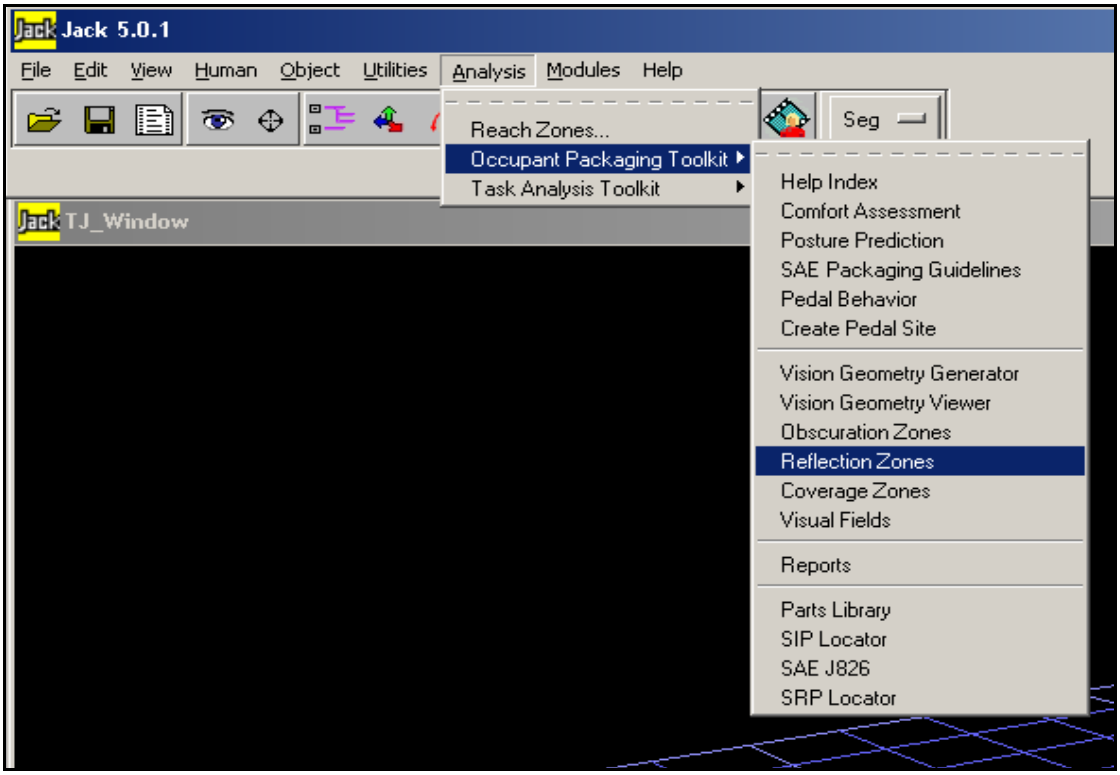
After you've setup the environment components, click on the Obscuration Zones.
When the menu is activated, select the Eye Point Site and Obscuration Segment by using the hand icon. The obscuration segment is the exhaust pipe. And the Eye Point site is selected as the front head. After that, choose the Front face choice from Obscuration Segment Side list. (We want to observe the obscurations caused by exhaust pipe.) Select the Distance option from Zone Bounding list and assign 500 cm Bounding Distance.





Reflection Zones

Reflection Zones tool allows user to create geometry representative of sight for the reflections from objects. You can assign the human eye to an object with direct line of sight and observe the reflections for your design analysis.



Analysis Menu *– Reflection Zones*

Below example demonstrates a reflection sight from a rearview mirror of a car. Depending on your design purpose you can work on several reflection zones to optimize the reflection coverage.

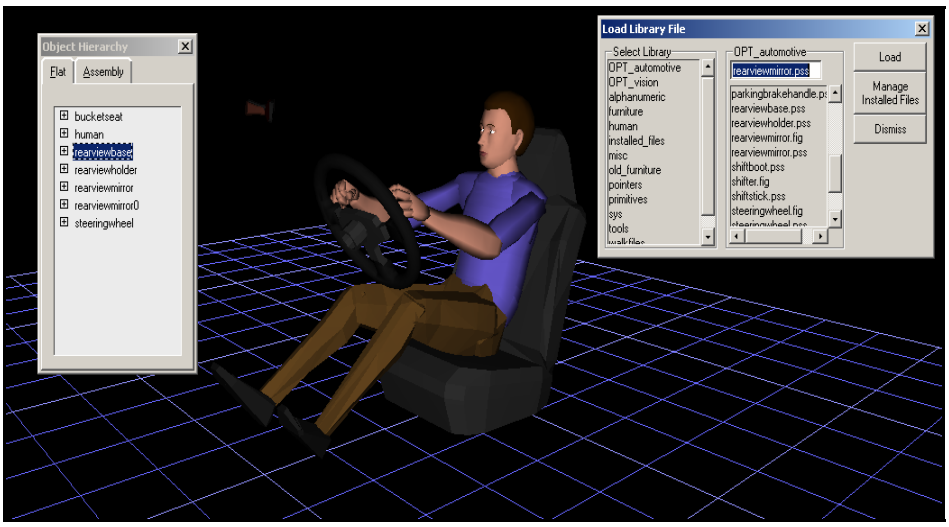
Step 1: Build Human and Object

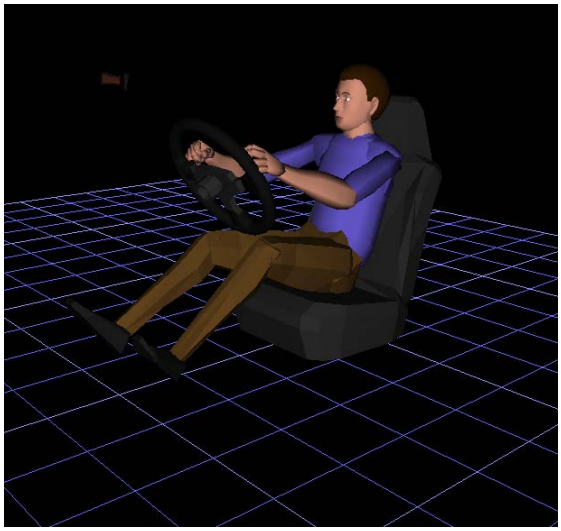
We started the demonstration by creating the basic animation components; digital human model and objects.

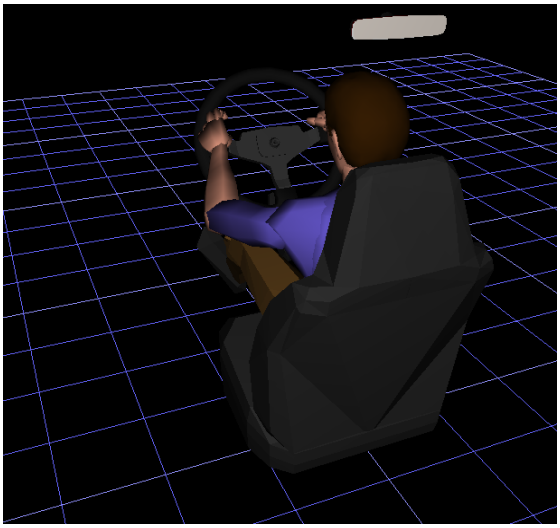
First, you may start creating a human model. Anthropometry Information is not important in this case. After you've inserted the human model, right click on it, go *postures* and choose *driving* posture.

After you created the digital human model, go and insert the crane automobile parts from object library.

Object → Create → Figure from Library, click on OPT_automative library.



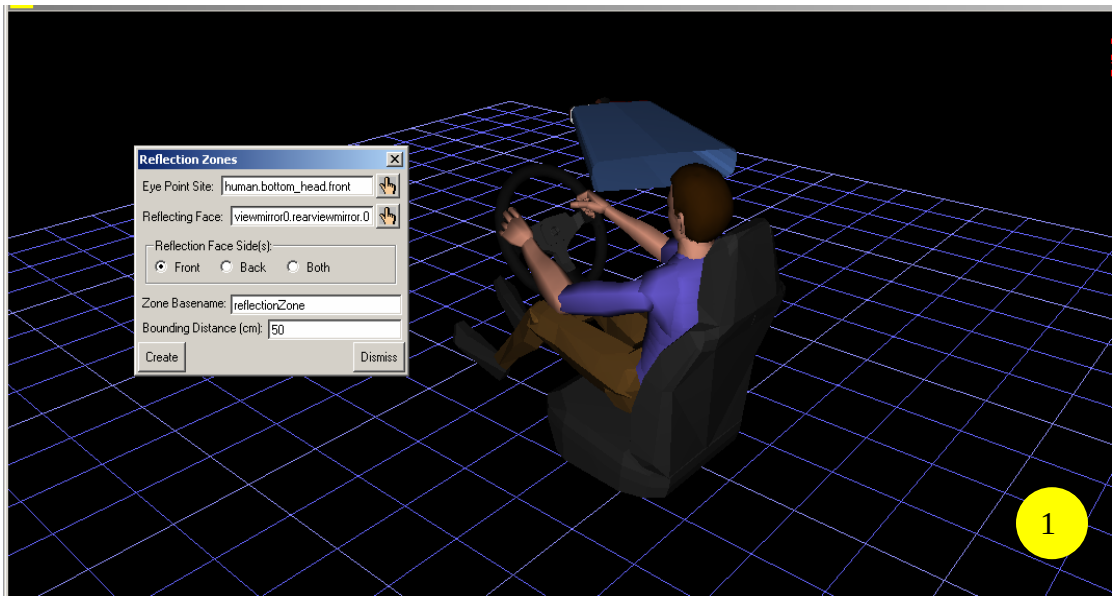


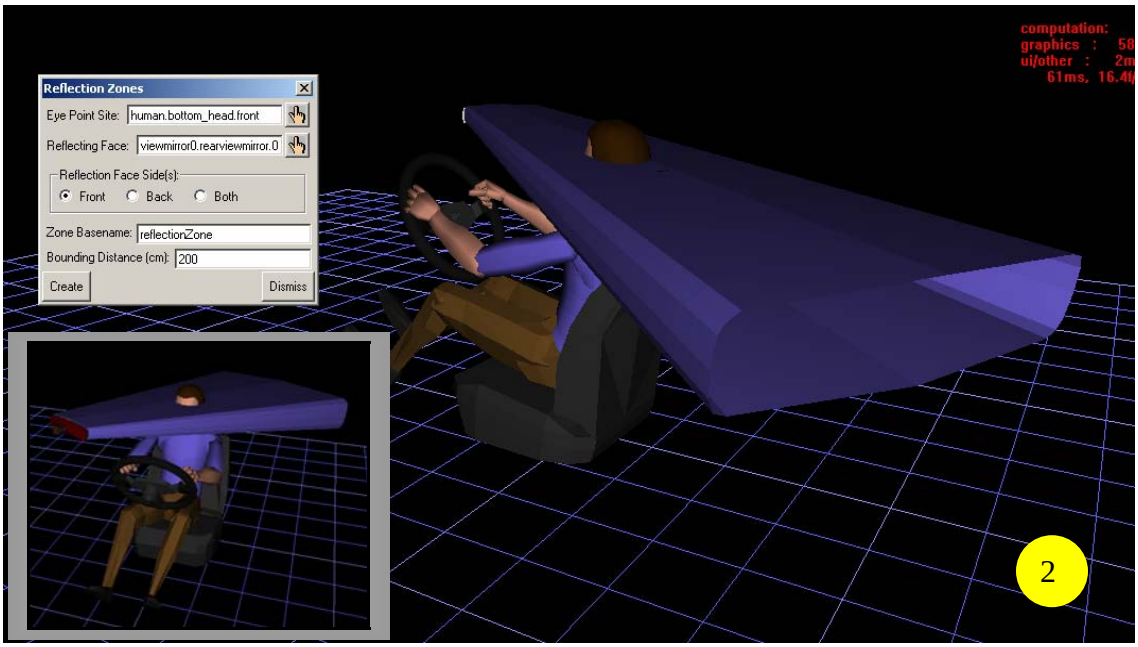


Step 2: Perform Reflection Zones Analysis

After you've setup the environment components, click on the Reflection Zones.
When the menu is activated, select the Eye Point Site and Reflection face by using the hand icon. The reflecting face is the rear view mirror. And the Eye Point site is selected as the front head. After that, choose the Front face choice from Reflection Face Side list. (We want to observe the reflections from mirror.)

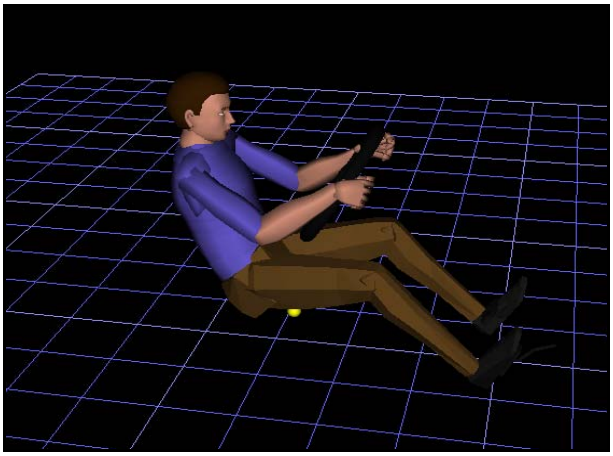
1) Bounding distance of 50 cm was selected to see a closer reflection coverage area.
2) Bounding distance of 200 cm used to see an extended reflection coverage area.





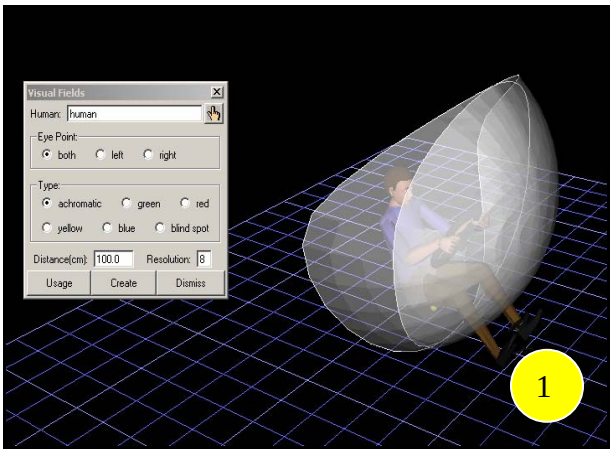
Visual Fields

Fundamental color zone map (Visual field color zone maps for red, yellow, green, and blue are available in Jack Visual Field menu) can be evaluated by the color appearance on the visual field due to the unique hue stimuli presented. Jack's Visual Field tool allows user to create/evaluate a specific visual field. Users can manipulate the distance and resolution to modify the visual field area.

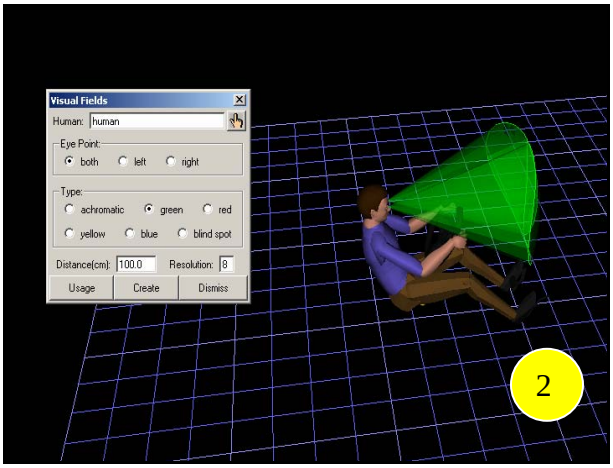


A sample driving posture is applied to a Jack human model by using Posture Prediction.

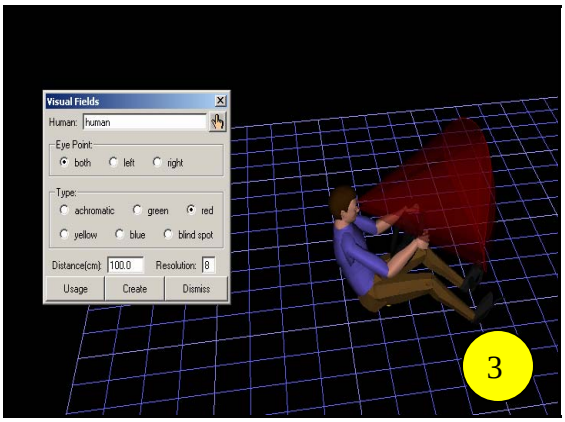
Driving posture on left hand side will be used to observe below Visual Fields.



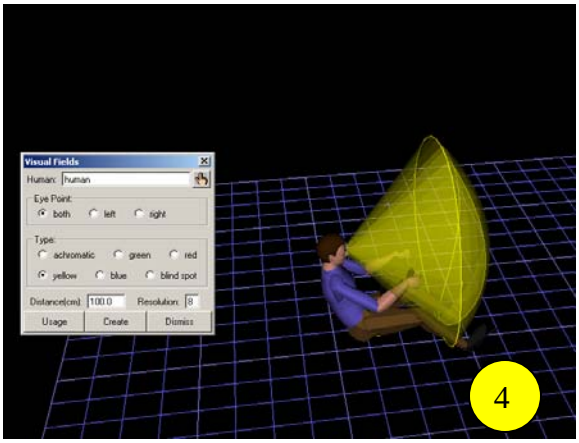
1) Achromatic Visual Field



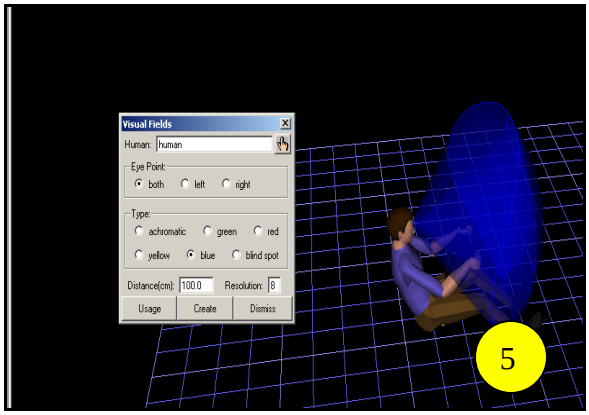
2) Green Visual Field



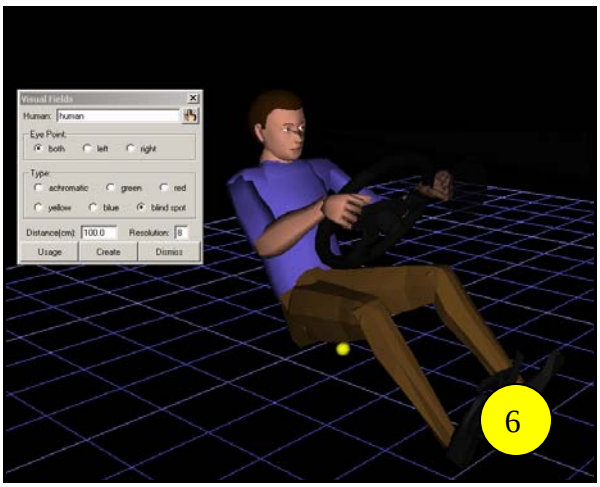
3) Red Visual Field



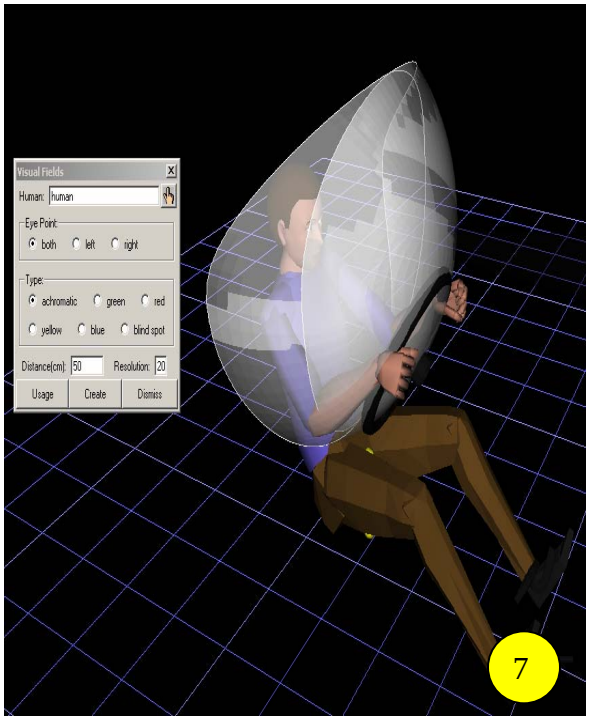
4) Yellow Visual Field

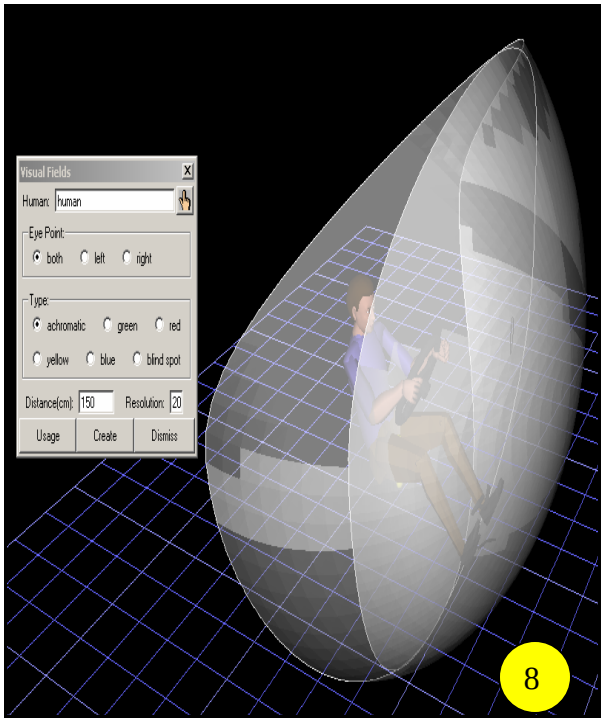


5) Blue Visual Field

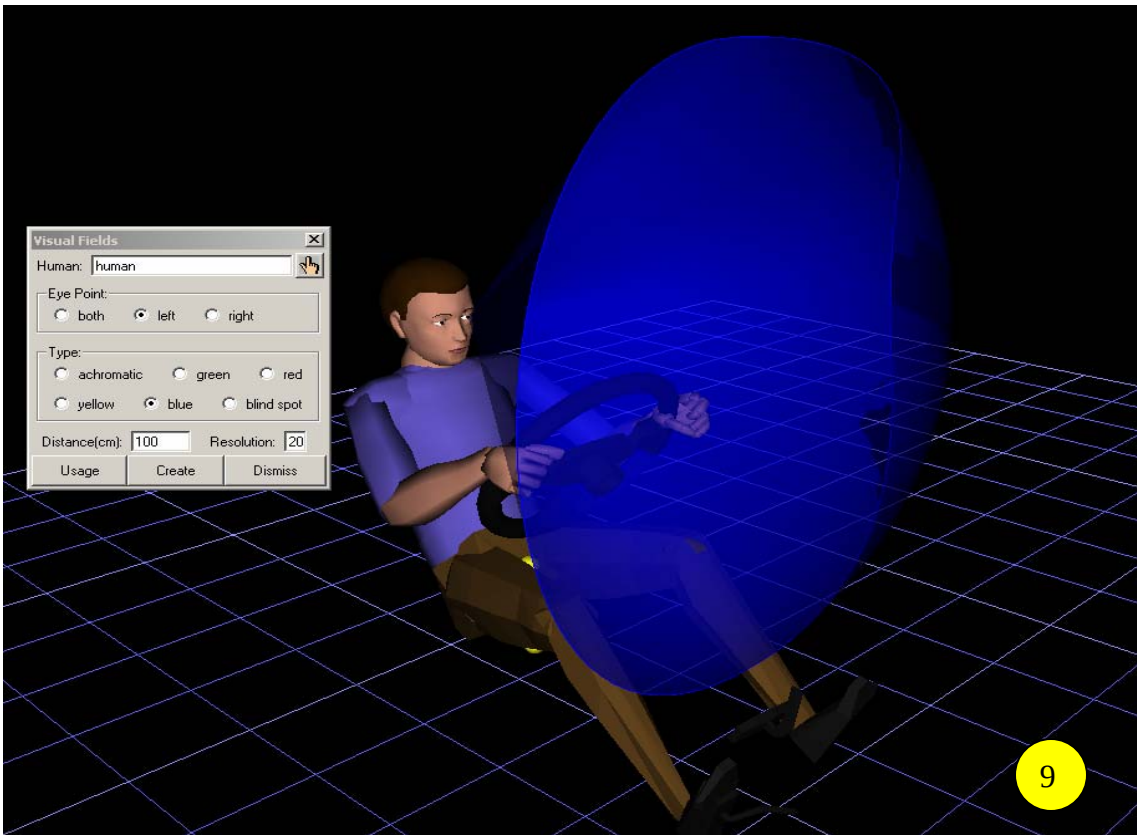


6) Blind Spot





7) Achromatic Visual Field (Distance = 50cm) 8) Achromatic Visual Field (Distance 150cm)

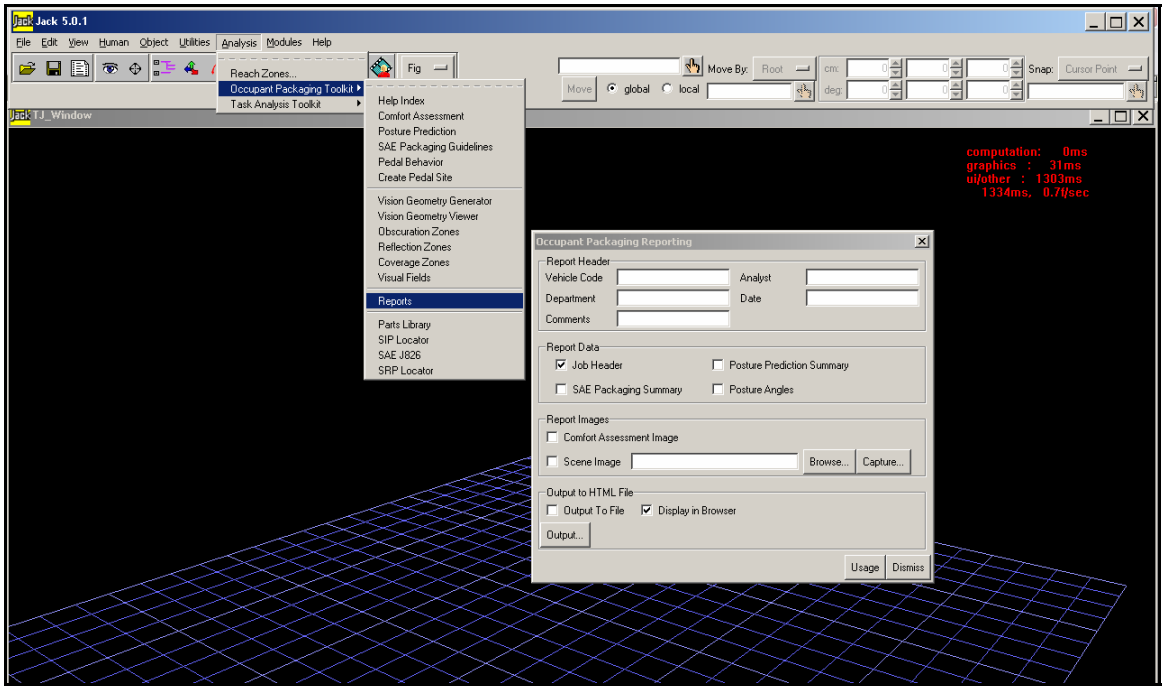


9) Blue Visual Field (Eye Point - Both)

Reports

Jack's Occupant Packaging Toolkit helps you to create an output source where you can store your analysis results as a HTML file. You can find the same report menu under other Occupant Packaging Toolkit tools (Posture Prediction, Comfort Assessment…etc).

In order to form an output file; fill the Report Header information area, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.



Analysis Menu - *Reports*

Example:

Below example demonstrates how one can develop a report output from Comfort Assessment analysis. You can develop report outputs in the same way by using any other Occupant Packaging Toolkit analysis tools.

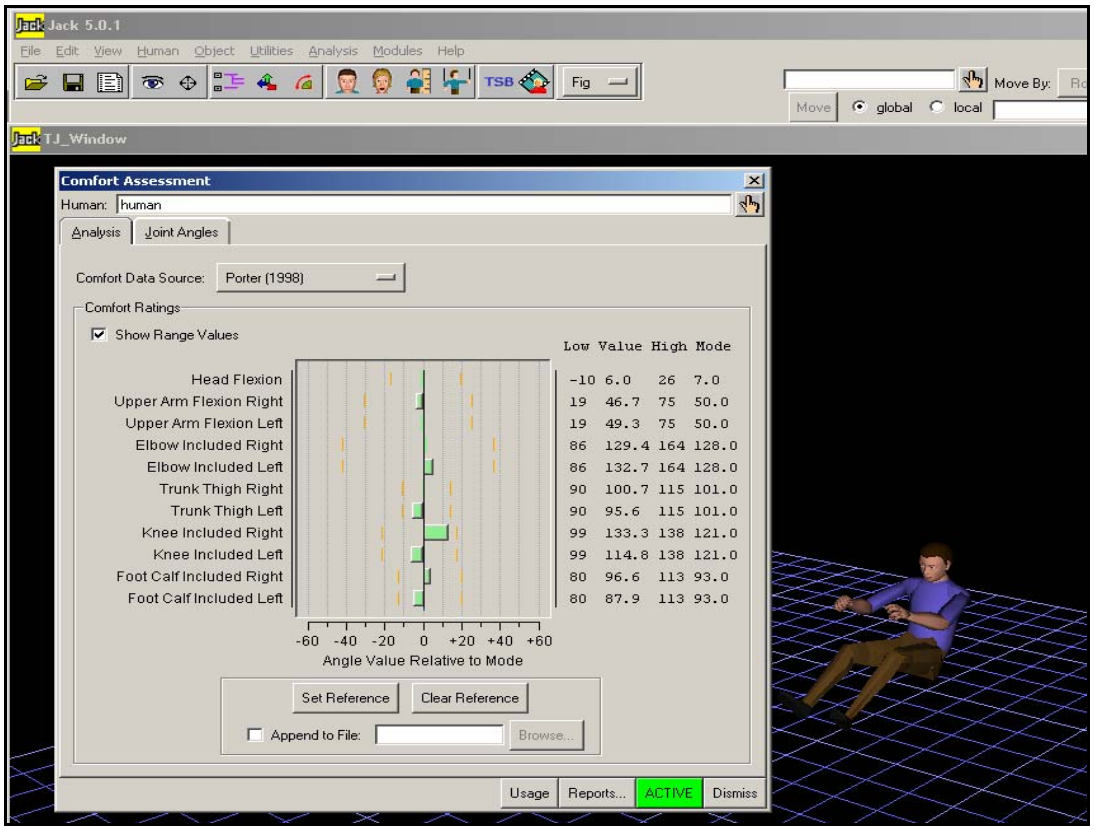


Figure 1 *– Human Posture & Comfort Assessment*

A Jack driving posture was developed and analyzed by using Comfort Assessment tool as seen in ***Figure 1***.

Posture : → Insert a human
→ Right click
→ Select Posture
→ Select Driving

Comfort Assessment: → Analysis
→ Occupant Packaging Toolkit
→ Comfort Assessment
→ Click Activate

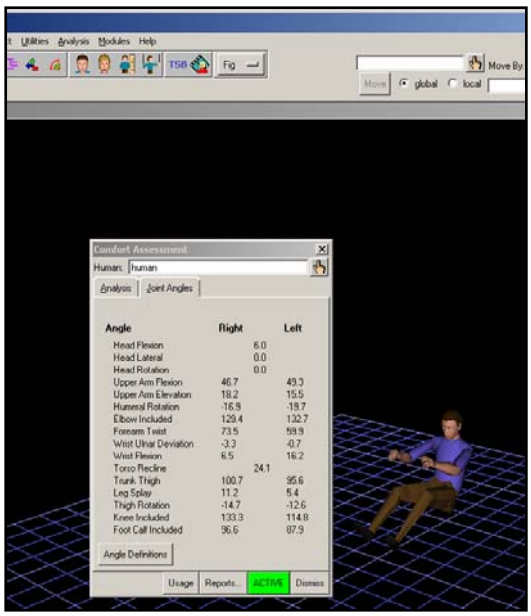


Figure 2 – Joint Angles

After you have activated the comfort assessment, you should be able to see the Joint Angles (***Figure 2***) of the Jack human model in driving position by clicking Joint Angles tab on the main Comfort Assessment window.

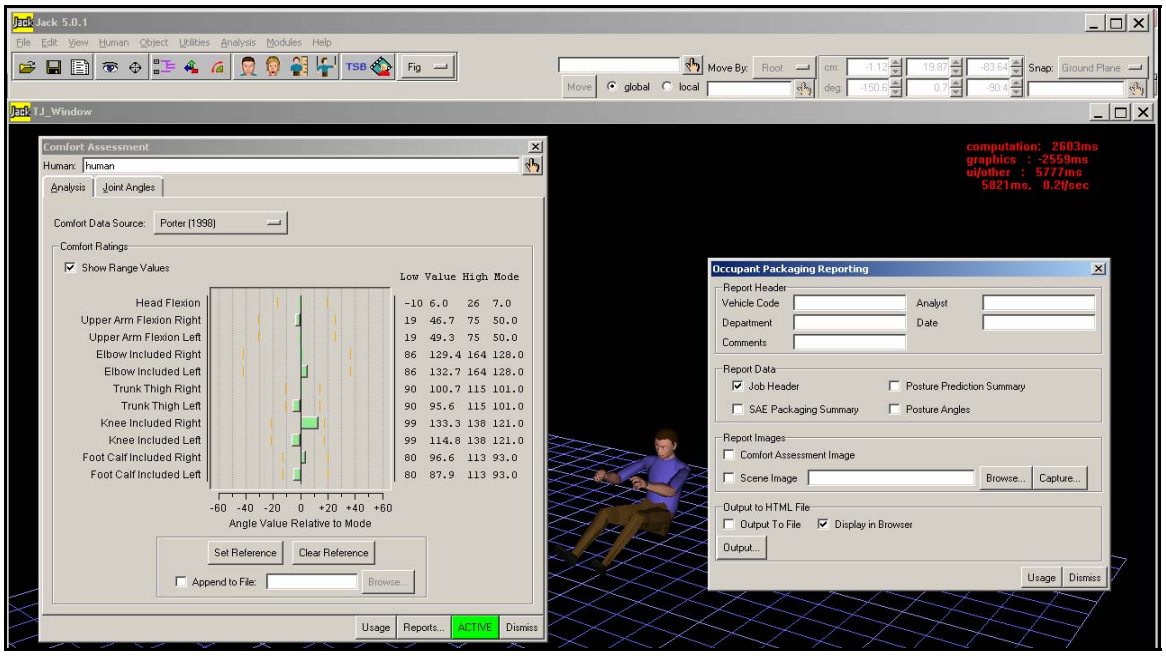


Figure 3 – Report Window

You can develop a report analysis in two ways. In both ways the report windows are identical. (***Figure 3***)

1) Click Reports on the Comfort Assessment (or any other Occupant Packaging Toolkit analysis tools) main windows.

2) → Analysis
   → Occupant Packaging Toolkit
   →Reports

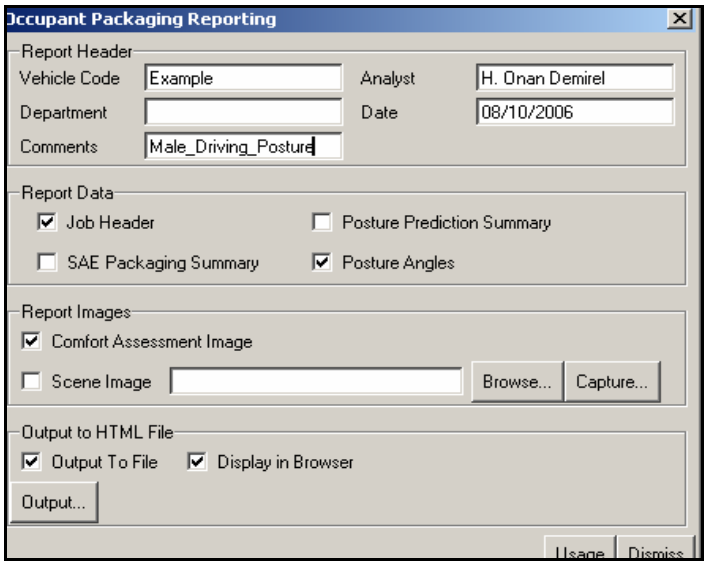
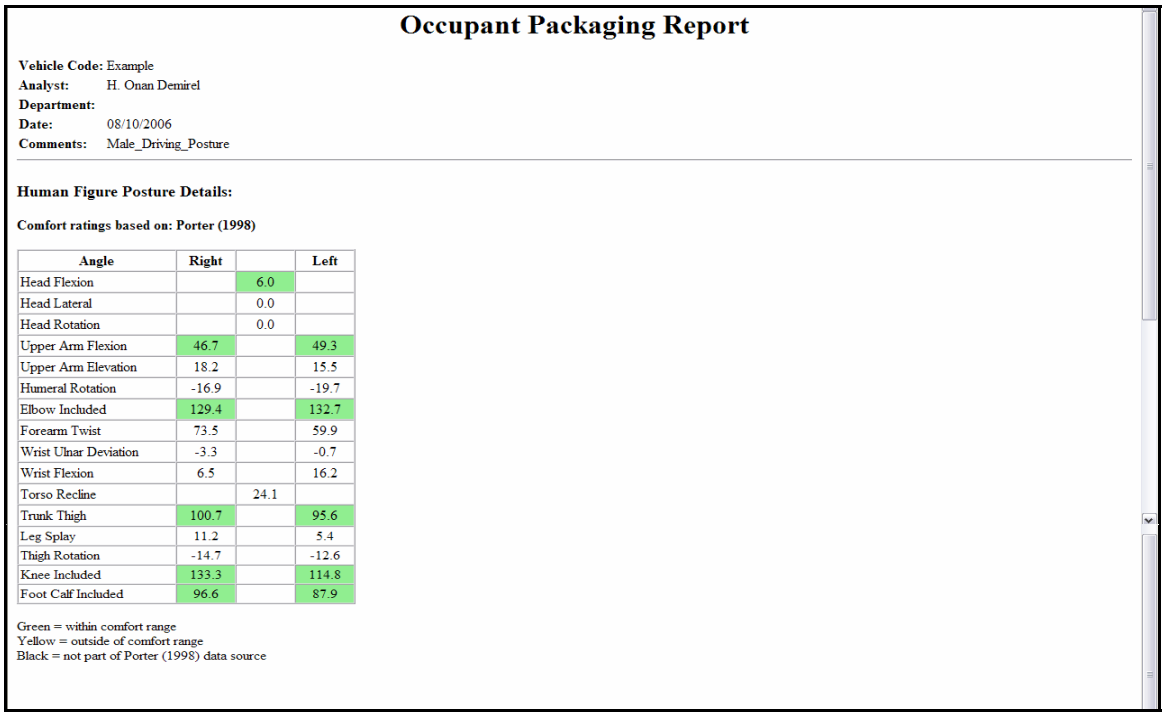


Figure 4 *– Report File Development*

After you click the Report tool, Occupant Packaging Reporting windows (***Figure 4***) should appear. Fill the Report Header information area, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.



Occupant Packaging Report

Vehicle Code: Example
Analyst: H. Onan Demirel
Department:
Date: 08/10/2006
Comments: Male_Driving_Posture

Human Figure Posture Details:

Comfort ratings based on: Porter (1998)

Angle	Right		Left
Head Flexion		6.0	
Head Lateral		0.0	
Head Rotation		0.0	
Upper Arm Flexion	46.7		49.3
Upper Arm Elevation	18.2		15.5
Humeral Rotation	-16.9		-19.7
Elbow Included	129.4		132.7
Forearm Twist	73.5		59.9
Wrist Ulnar Deviation	-3.3		-0.7
Wrist Flexion	6.5		16.2
Torso Recline		24.1	
Trunk Thigh	100.7		95.6
Leg Splay	11.2		5.4
Thigh Rotation	-14.7		-12.6
Knee Included	133.3		114.8
Foot Calf Included	96.6		87.9

Green = within comfort range
Yellow = outside of comfort range
Black = not part of Porter (1998) data source

Figure 5 *– Report Output*

Finally, you can get a report output similar to **Figure 5.** (We selected the Posture Angles choice only since we are only dealing with the Joint Angles in this example. You can have a Posture Prediction Summary if you are working with posture prediction tools.)

Parts Library

The Parts Library provides some useful geometry/objects that users might insert it to an environment to create/evaluate designs. Inside the Parts Library you can find parts from categories of; automotive, furniture, human…etc. (***Figure 1)***

By using this tool, you can access parts like brake pedals, steering wheels, mirrors, gear shifters…etc under automotive category. You can easily insert these parts into the environment you are working in.

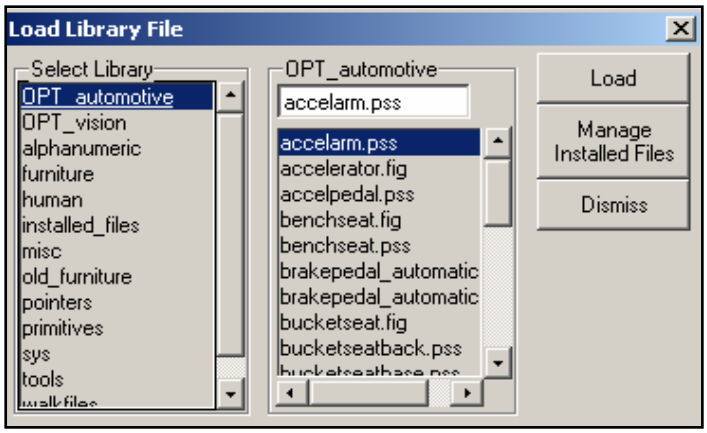


Figure 1 *– Library Tool Menu*

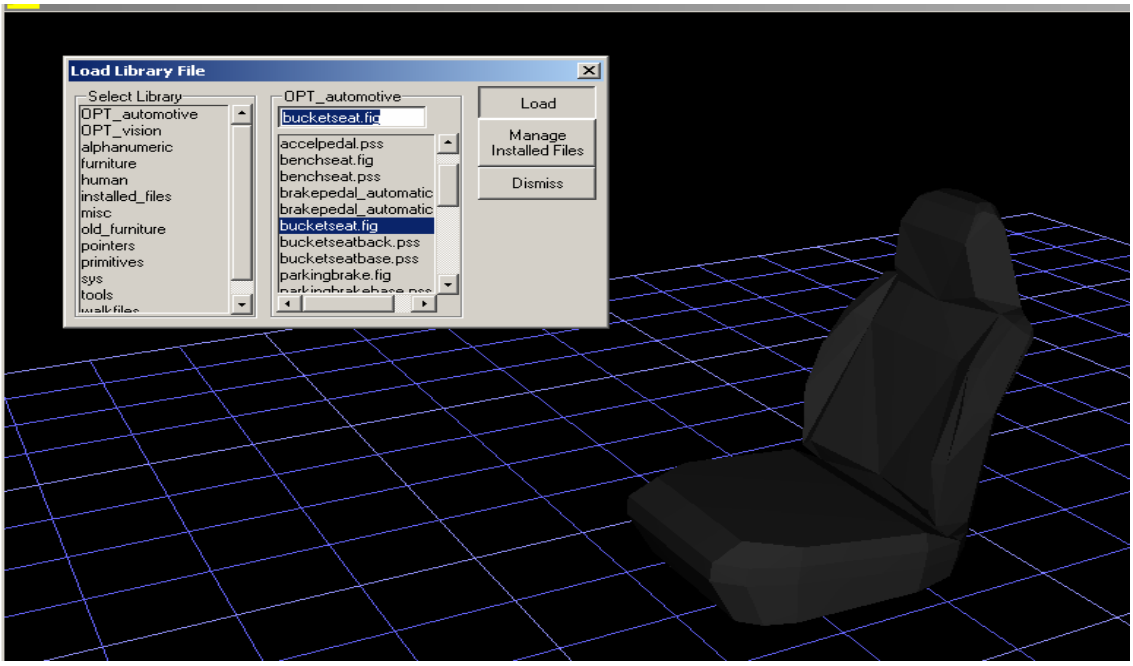
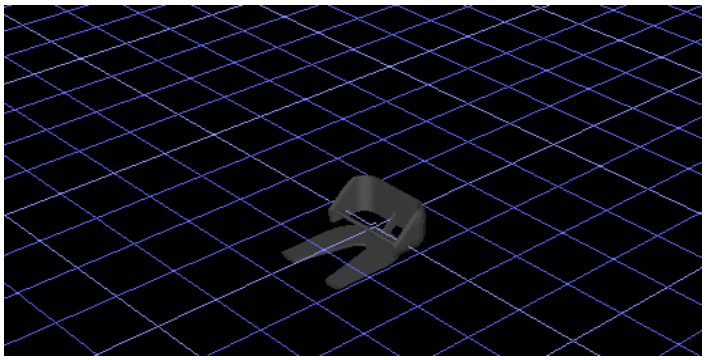


Figure 2 *– Bucket seat loaded*

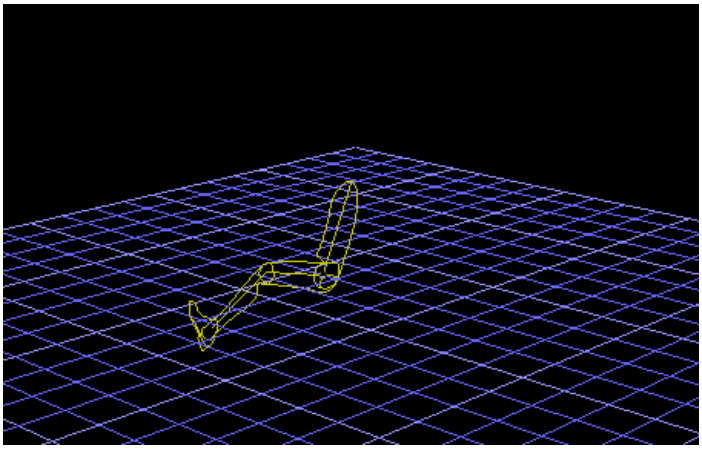
A bucket seat is loaded into the environment from Library Menu. Select the OPT_Automative category. And Click on the bucketseat.fig file. Then click, Load. ***(Figure 2)***

SIP, SAE J826 and SRP

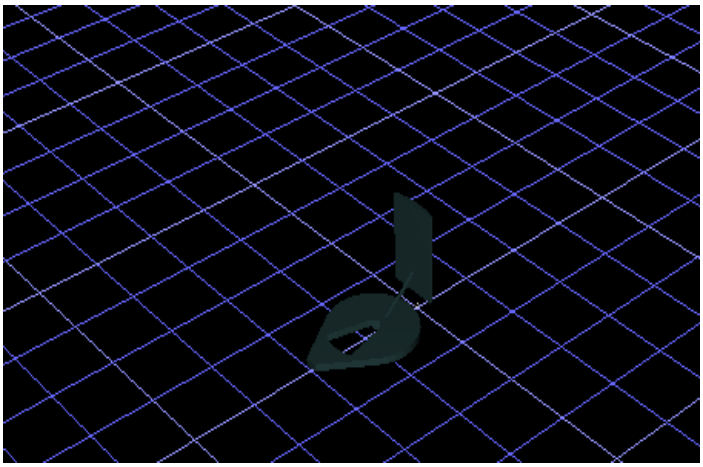
SIP, SAE J826 and SRP are devices for use in defining and measuring vehicle seating accommodations. Users can insert these special tools and modify them depending on desire design specifications. These devices provide seating and driver comfort assessments as well as deformations on the driver and driving compartment during crash tests.



SIP device



SAE J826



SRP device

Chapter

7

UGS TECNOMATIX JACK 5.0

User Manual and Examples

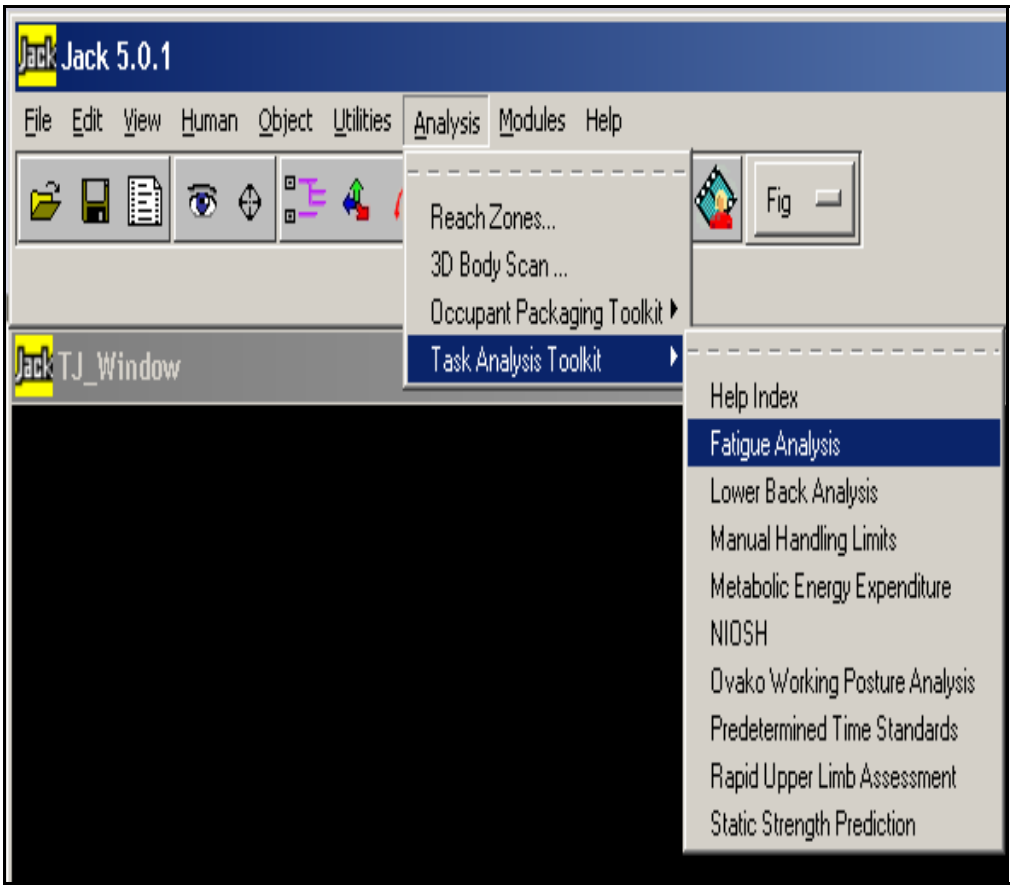
Task Analysis Toolkit

Fatigue Analysis

The Fatigue Analysis tool helps users to evaluate if there is an appropriate recovery time is available for a given job. The recovery time is important to avoid worker fatigue. If there is not enough recovery time is promoted, the workers are assumed to be under risk of fatigue.

With the Fatigue Analysis tool users can;

- Minimize the risk of injury due to excessive fatigue
- Obtain a real-time simulation of the fatigue in static postures
- Improve manual tasks by accommodating necessary recovery time



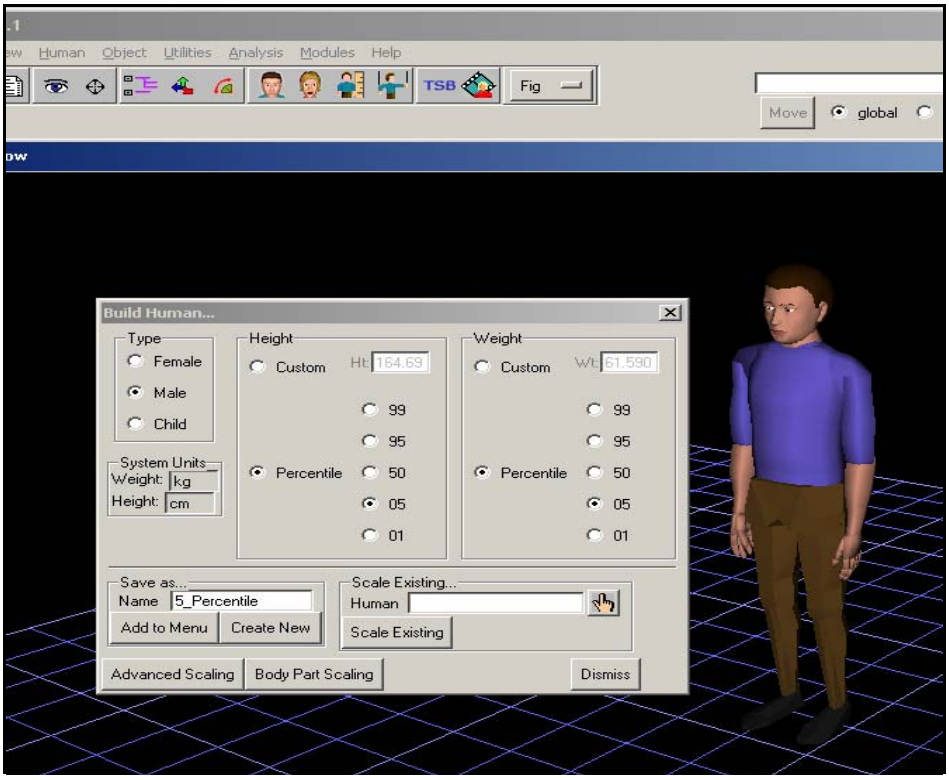
Analysis – *Fatigue Analysis*

The following example is conducted to evaluate the worker's fatigue while lifting a box given posture. The worker starts lifting the box in a squat posture and finalizes the cycle on standing posture.

Step 1: Build Human - ***Anthropometry Information***

We need to know the worker's sex, weight, and height. This information is entered into The **Build Human** dialog box holds the related input variables and helps us to build our digital worker. Our sample digital worker will be a 5% percentile male (164.69 cm tall and 61.590 kg).

1) Go Human → Create →Custom
2) When the diolog box appear choose;
    a. Type = Male
    b. Height → Percentile = 05
    c. Weight → Percentile = 05
3) Save as.. → Name = *give any name you want*, ***ex. 5_Percentile***
4) Create New



Note = In future, you can edit your human figure by using Scale Existing command in above dialog box by changing the anthropometry variables.

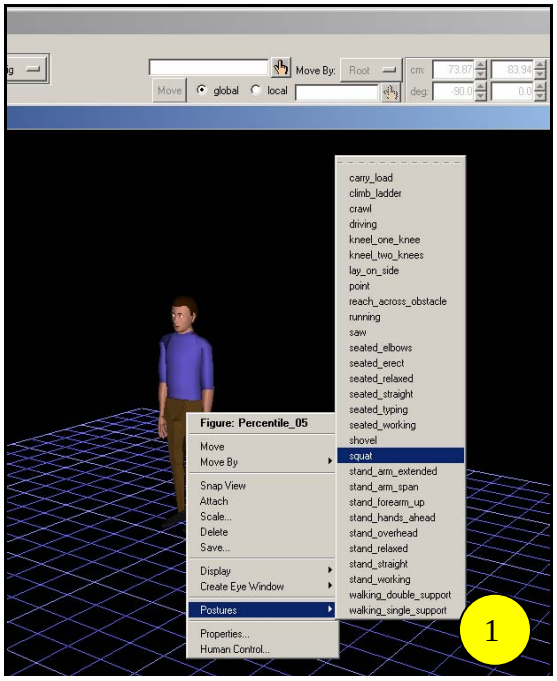
Step 2: Fatigue Analysis - *Setup*

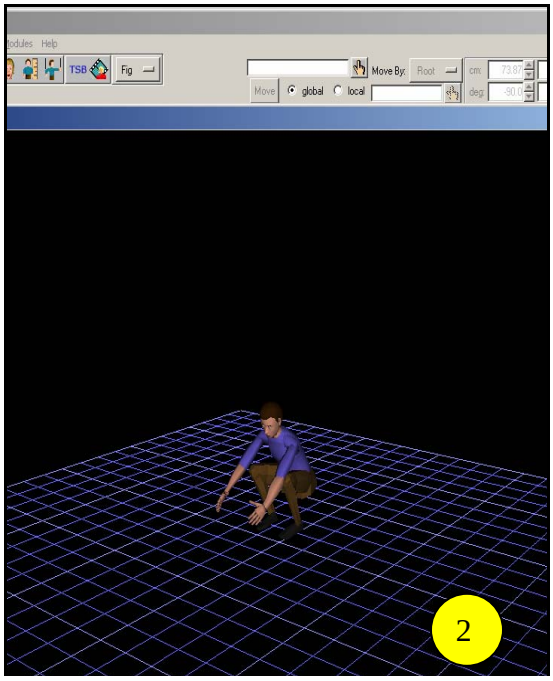
After you build the desired posture go to;

→ Analysis → Task Analysis Toolkit → Fatigue Analysis

A) Initial Posture (squat)

Worker starts the lifting task from squat position. The initial posture is going to be assigned to the Lift Origin.

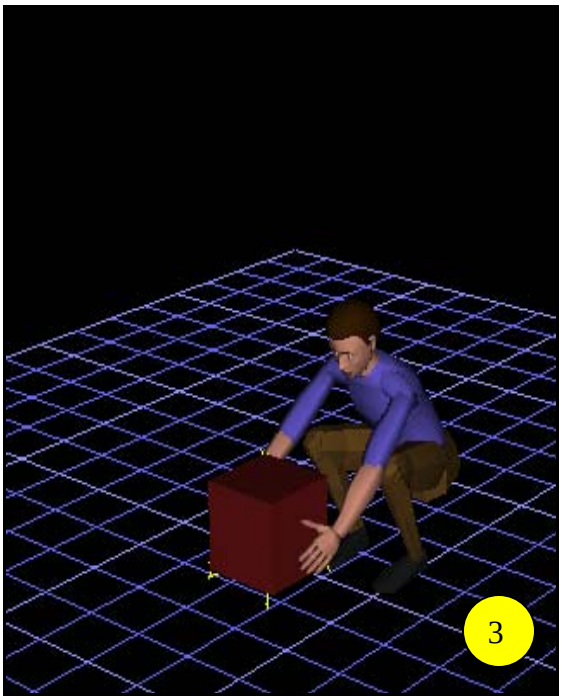




1) Squat Posture
   →Right click on the human model
   →Posture
   →Squat

2) Squat Posture

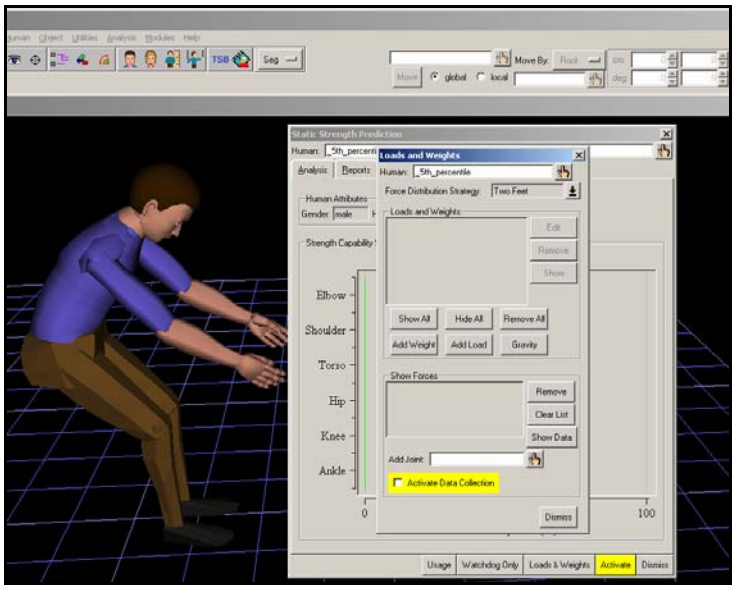
3) Demonstration of initial lifting posture with a box load.



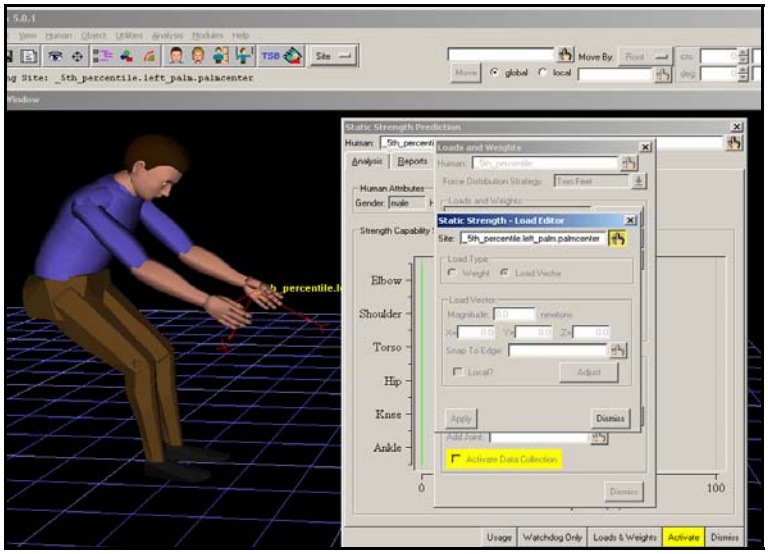
B) Load Assignment (Refer to SSPP Analysis documentation)

Note: *Below Load Assignment is taken from SSPP Analysis documentation. Same procedure is applied in Fatigue Analysis. Do not worry about the differences in the postures, the way you apply the load vectors under any posture is identical.*

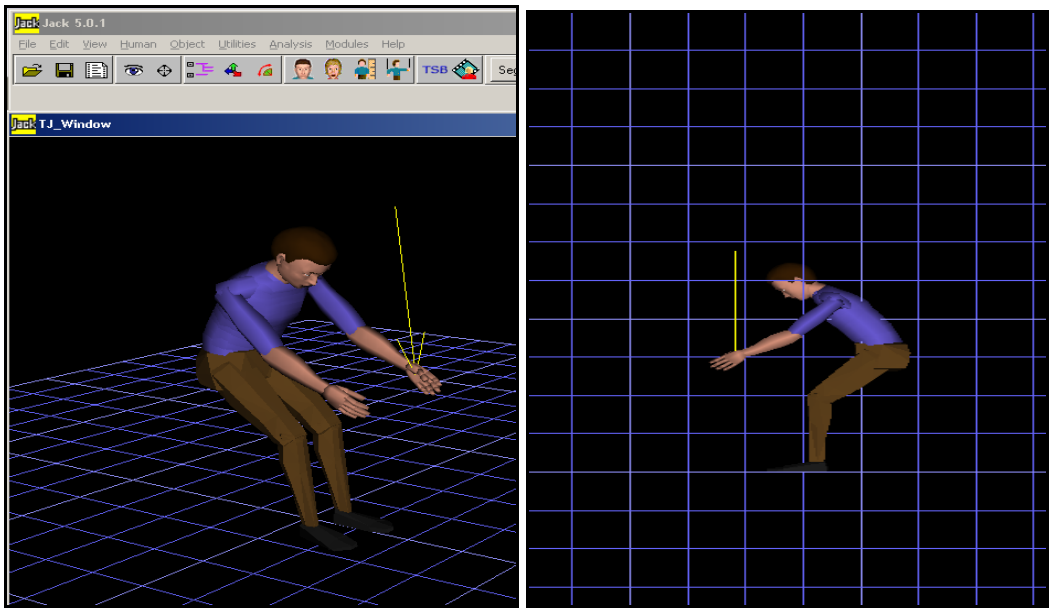
1. Click the Loads & Weights tab on the Static Strength Prediction window. Loads & Weights window will appear as shown below. *Keep the Force Distribution Strategy = Two Feet. This will distribute the loads symmetrically in both feet.*



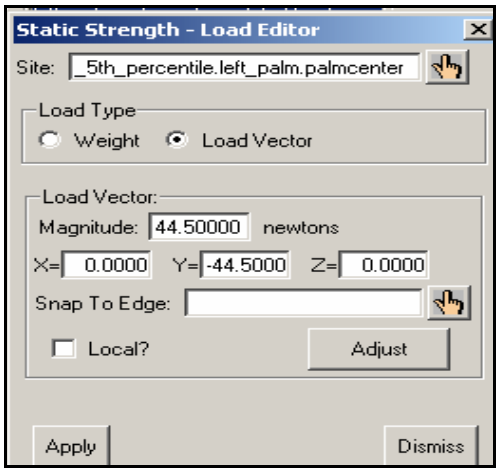
2. Click Add Load, Static Strength – Load Editor box will appear automatically.
3. Select the Hand tool and click on the center of the human hand. (palmcenter). *If you can't select the palmcenter, manually drag & zoom human body.*



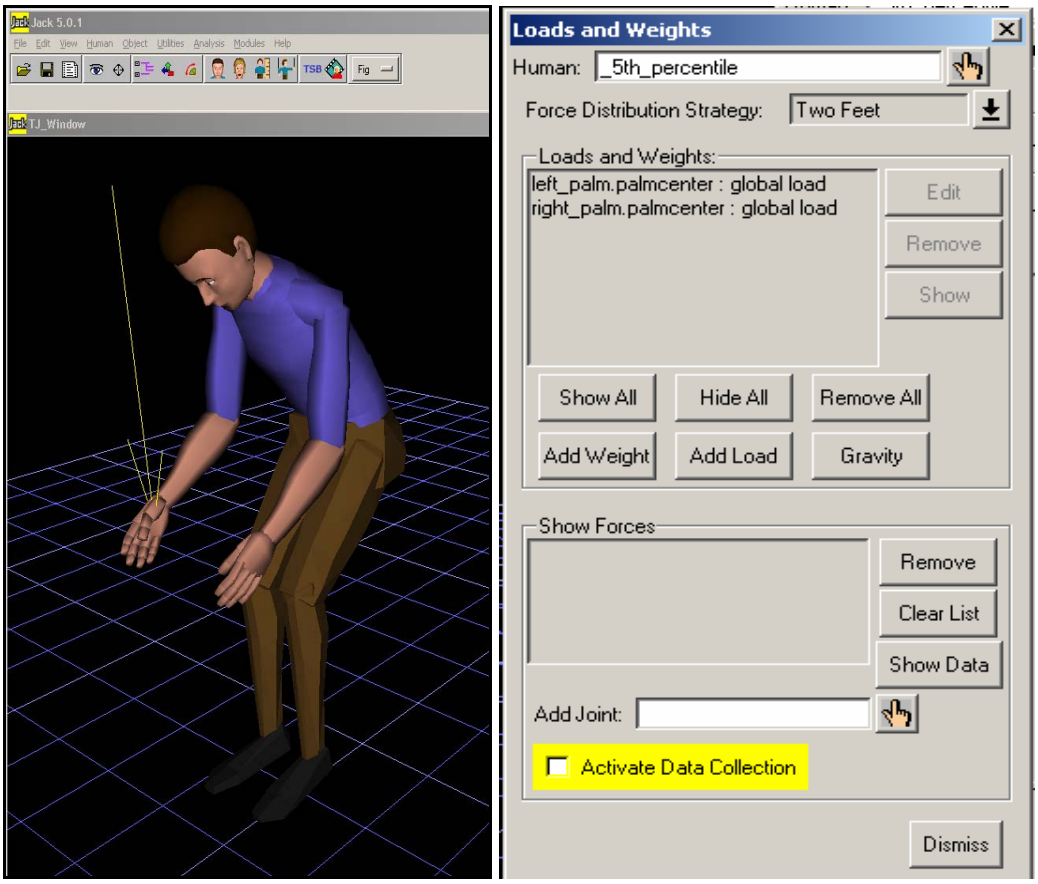
4. When you click on the palmcenter, a 90 degree down force vector will appear to represent the applied load.



5. When you click on the human body, the Static Strength - Load Editor box will let you to enter inputs. Enter 44.5N to the Magnitude box, and click Apply.



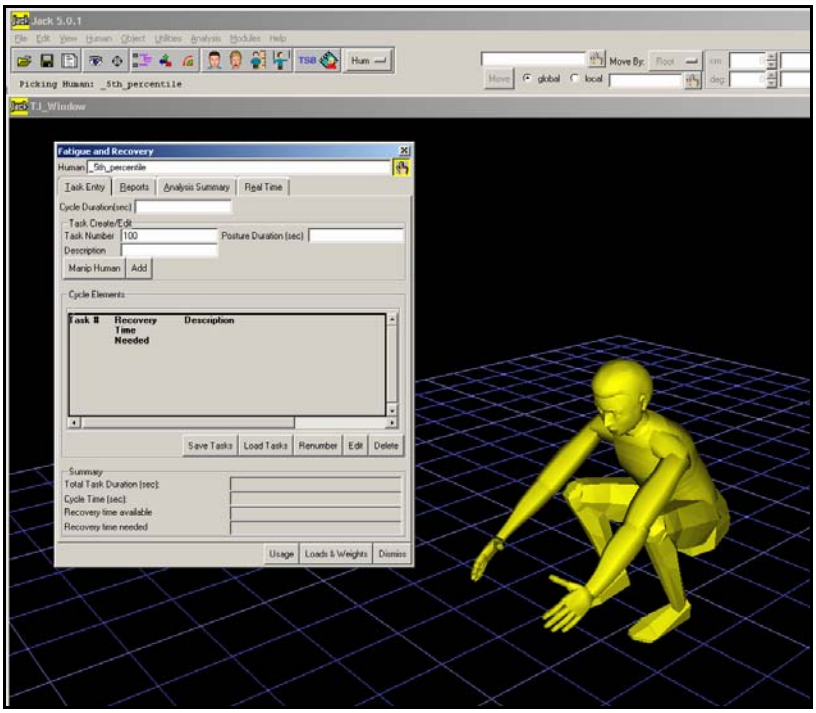
6. Apply the above procedure to enter a symmetrical load (Magnitude = 44.5N) to the other hand. Once you enter all the loads, your Static Strength - Load Editor should include both loads.



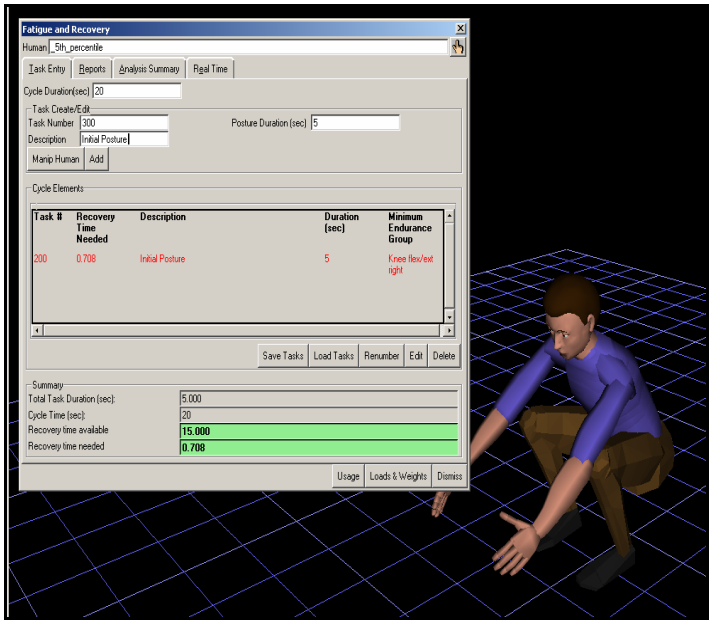
Note = You can add/remove more loads and edit them easily by using the Static Strength - Load Editor window. In addition, you can select different Gravity modes. In this example default gravity mode (980.650 cm/s^2) is used.

C) Task Entry

From Fatigue and Recovery Analysis window click on the hand tool and select your already built human model.



1) Initial Posture Task Entry



Task Entry;

Cycle Duration: 20 sec

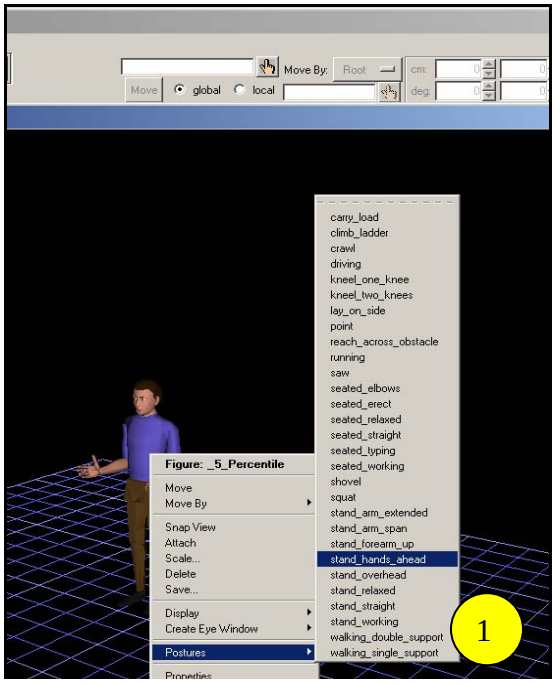
Task Number: 100
Posture Duration: 5 sec

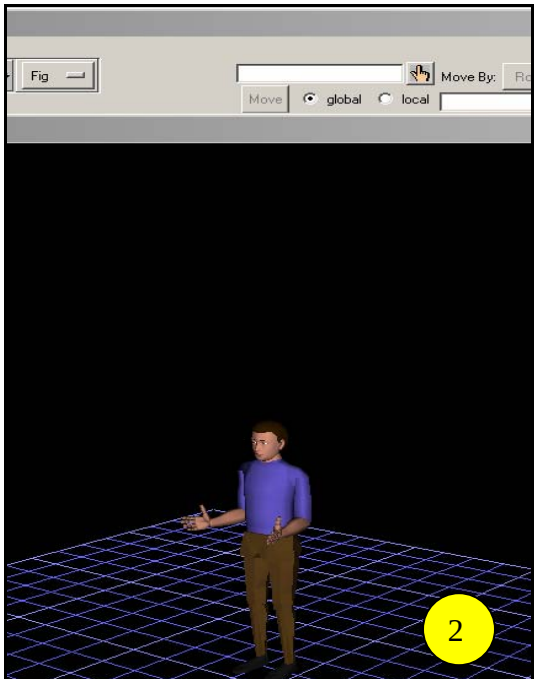
Description: Initial Posture

Click Add after you enter Task Entry values and descriptions.

2) Final Posture *(stand hands ahead)*

Worker finishes the lifting task by standing working position.

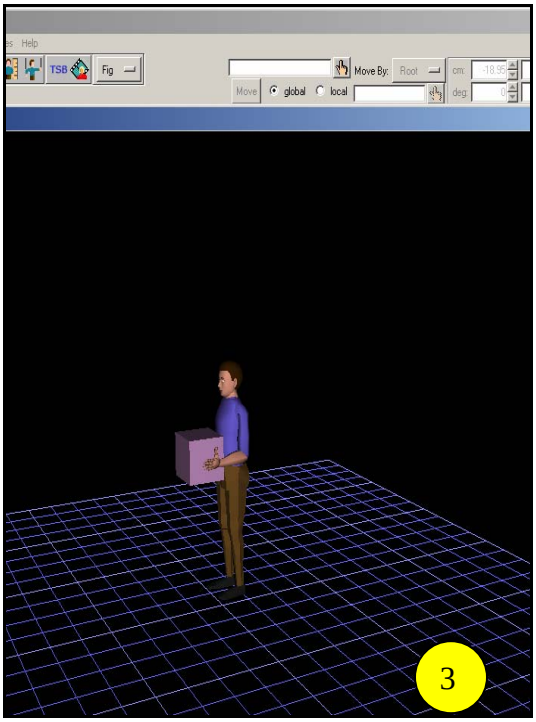




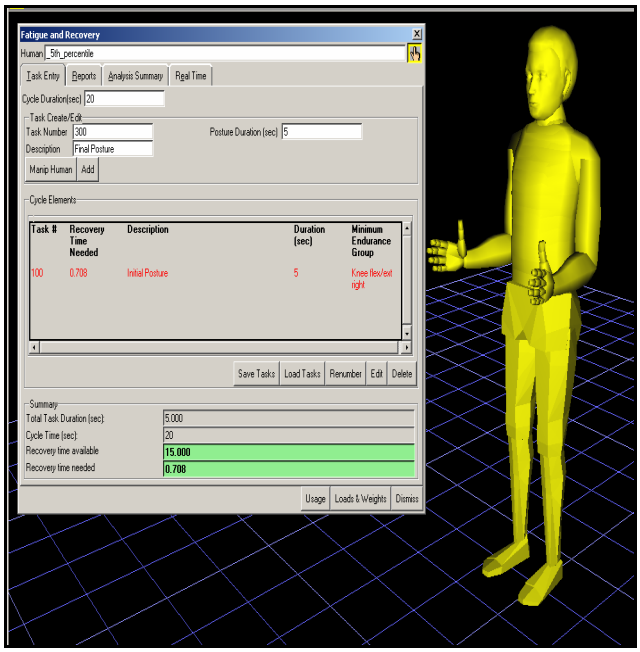
1) Stand Hands Ahead Posture
   →Right click on the human model
   →Posture
   →Stand_hands_ahead

2) Stand_hands_ahead posture

3) Demonstration of final lifting posture with a box load.

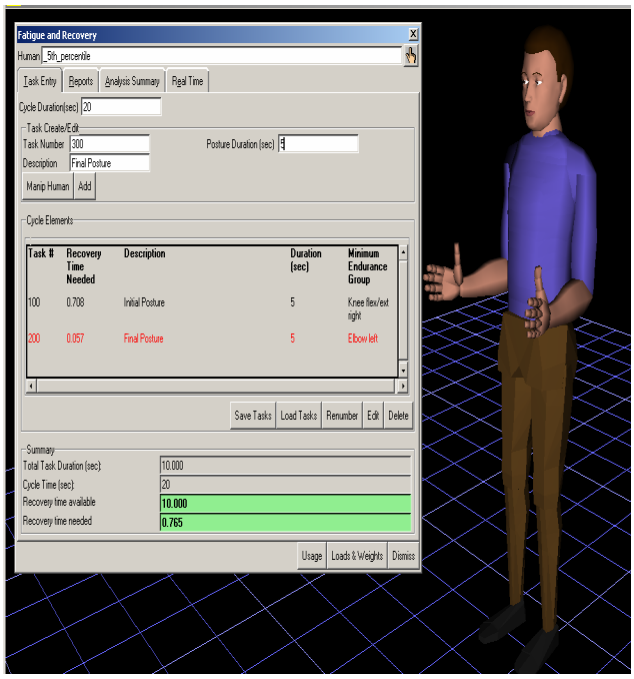


3) Final Posture Task Entry



From Fatigue and Recovery Analysis window click on the hand tool and select your already built human model.

This assigns the new posture as a new cycle element.



Task Entry;

Cycle Duration: 20 sec

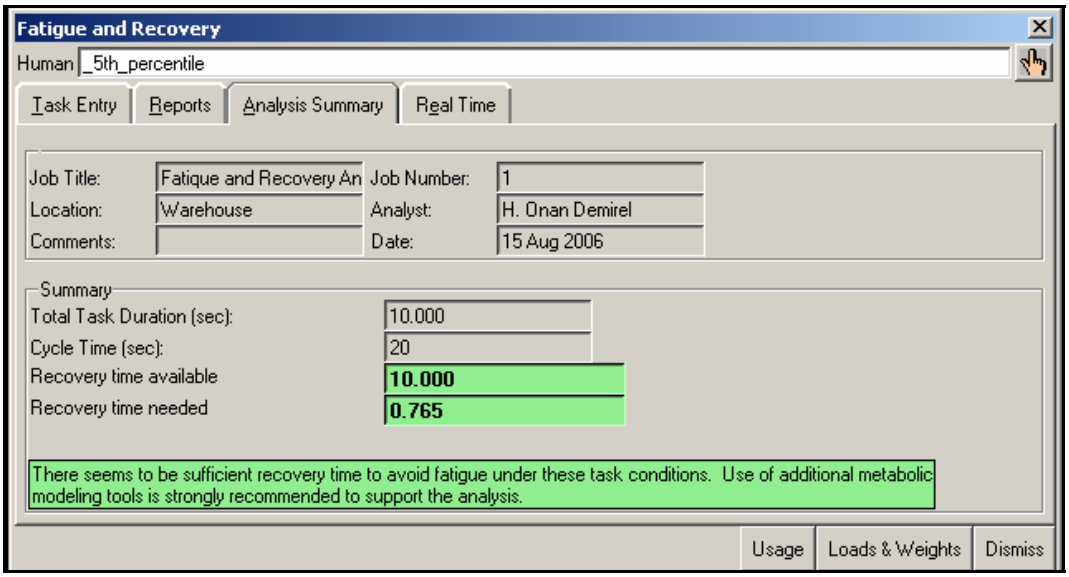
Task Number: 200
Posture Duration: 5 sec

Description: Final Posture

Click Add after you enter Task Entry values and descriptions.

Step 3: Analysis Summary

Jack's Fatigue Analysis tool provides a quick Analysis Summary to evaluate the work design. On Analysis Summary window, users can find information about Total Task Duration, Cycle Time, Recovery time available and Recovery time needed. In addition, a highlighted information bar suggests whether the amount of recovery time.

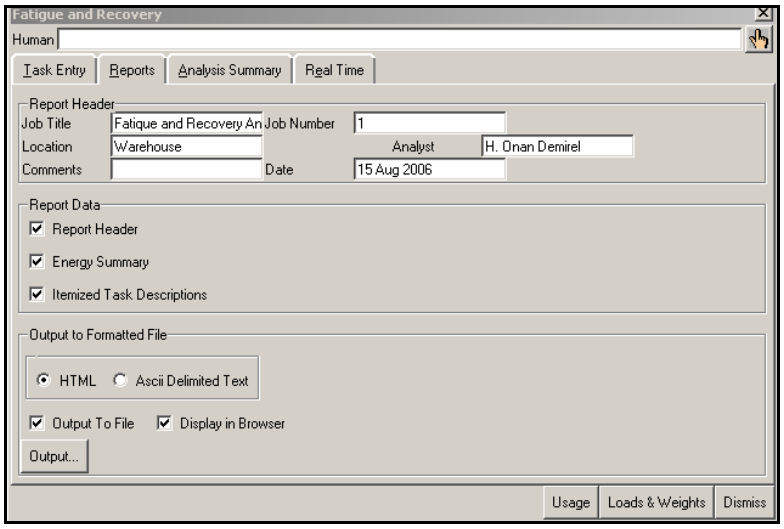


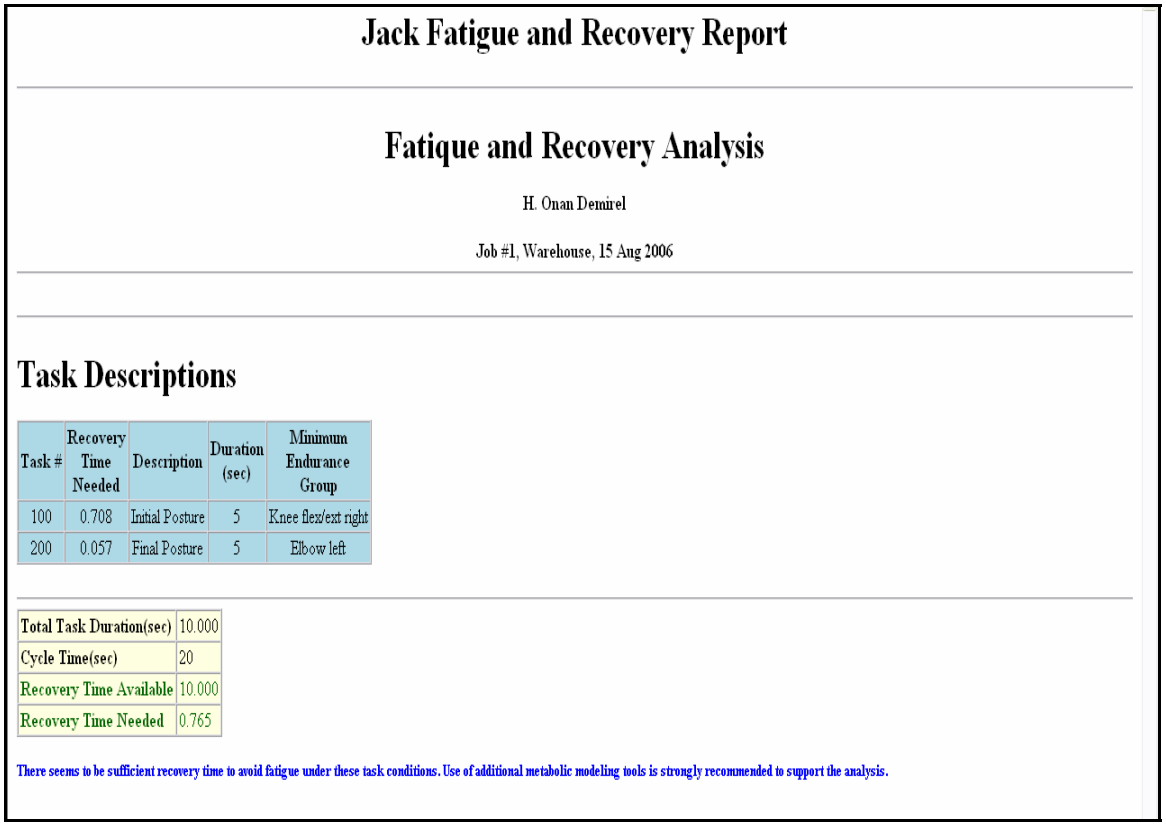
In this example only two postures were used for demonstration purposes. However, more intermediate postures should be used to get a better and a realistic results.

Also, in this experiment there is a well enough time between Cycle Time and Total Task Duration. In many work tasks, there is not enough time and the recovery time is necessary.

Step 4: Output

Jack's Fatigue Analysis module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, fill the Report Header, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Jack Fatigue and Recovery Report

Fatique and Recovery Analysis

H. Onan Demirel

Job #1, Warehouse, 15 Aug 2006

Task Descriptions

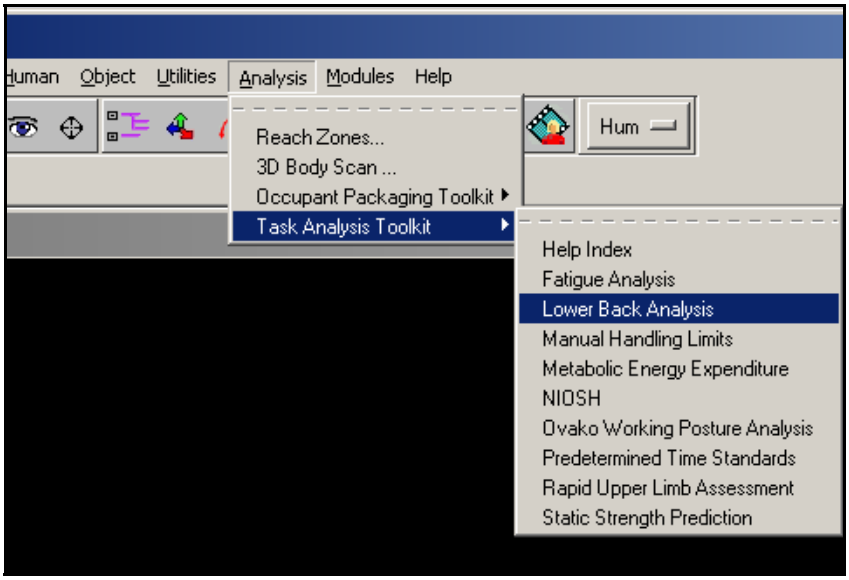
Task #	Recovery Time Needed	Description	Duration (sec)	Minimum Endurance Group
100	0.708	Initial Posture	5	Knee flex/ext right
200	0.057	Final Posture	5	Elbow left

Total Task Duration(sec)	10.000
Cycle Time(sec)	20
Recovery Time Available	10.000
Recovery Time Needed	0.765

There seems to be sufficient recovery time to avoid fatigue under these task conditions. Use of additional metabolic modeling tools is strongly recommended to support the analysis.

Lower Back Analysis

Lower Back Analysis module is capable to predict the compression forces that are applied to the lower back disks. Users can obtain a numeric and a graphical output and then evaluate the design criteria and applied forces.



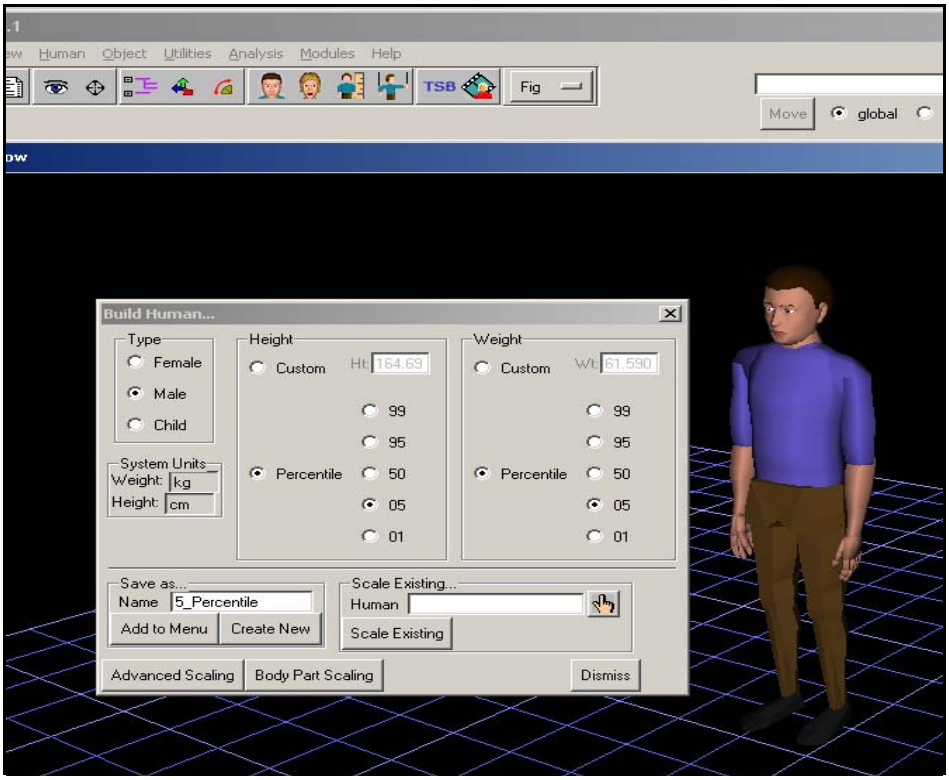
Analysis Menu – *Lower Back Analysis*

Note: Interpretation of the compression results should be done carefully. The NIOSH guidelines are used in calculation algorithms. For detailed analysis, one should check the NIOSH guidelines.

Step 1: Build Human - ***Anthropometry Information***

We need to know the worker's sex, weight, and height. This information is entered into The **Build Human** dialog box holds the related input variables and helps us to build our digital worker. Our sample digital worker will be a 5% percentile male (164.69 cm tall and 61.590 kg).

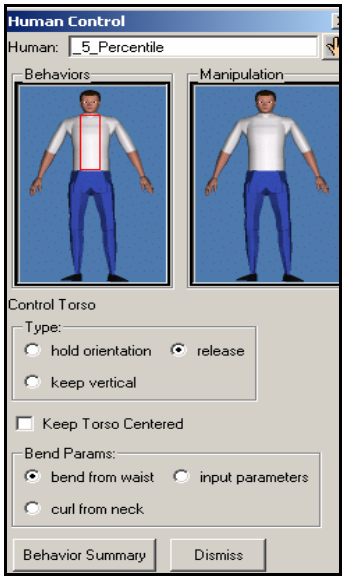
1) Go Human → Create →Custom
2) When the diolog box appear choose;
    a. Type = Male
    b. Height → Percentile = 05
    c. Weight → Percentile = 05
3) Save as.. → Name = *give any name you want*, ***ex. 5_Percentile***
4) Create New

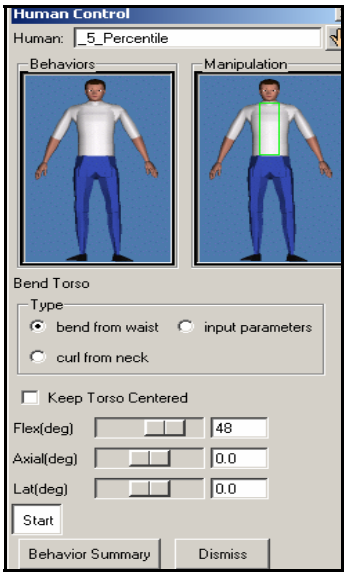


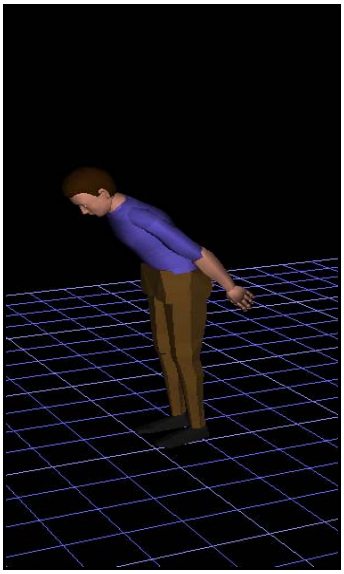
Note = In future, you can edit your human figure by using Scale Existing command in above dialog box by changing the anthropometry variables.

Step 2: Posture – *Joint angles*

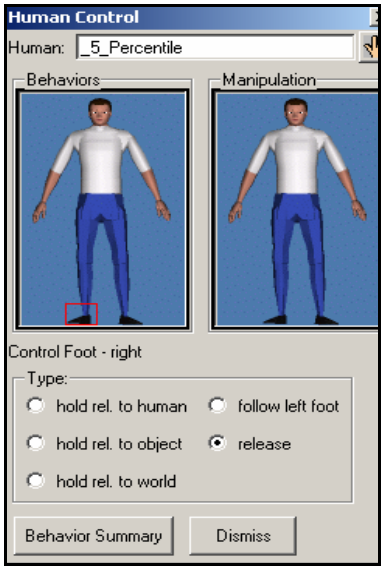
1) Control Torso

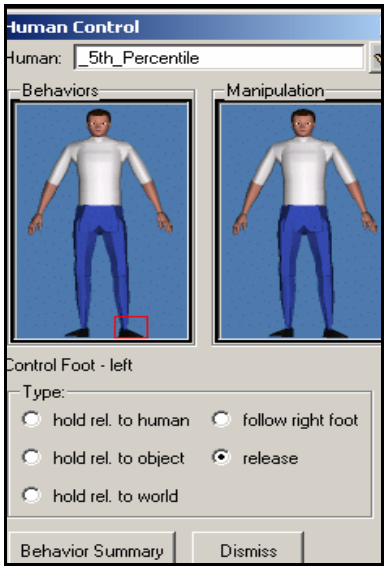




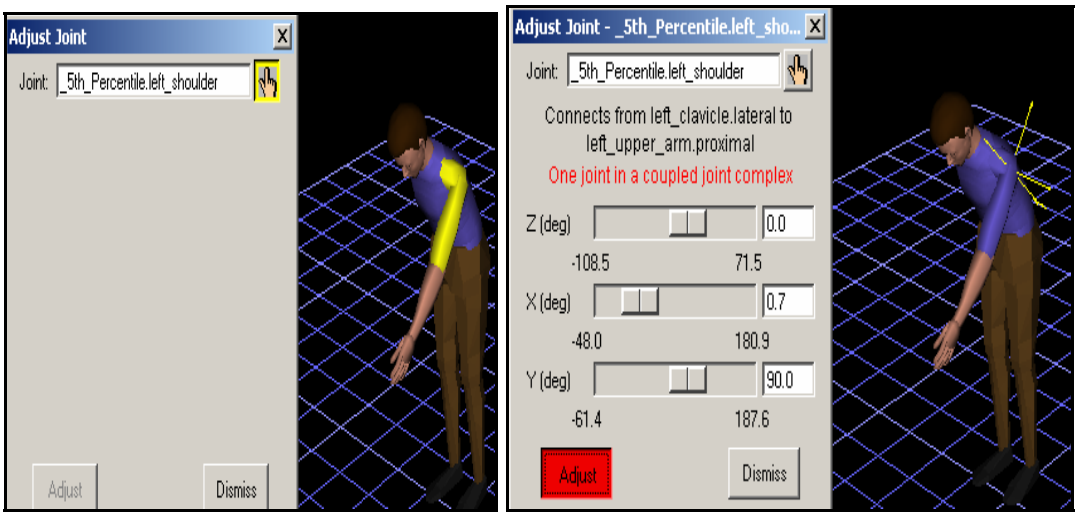


2) Balance Control

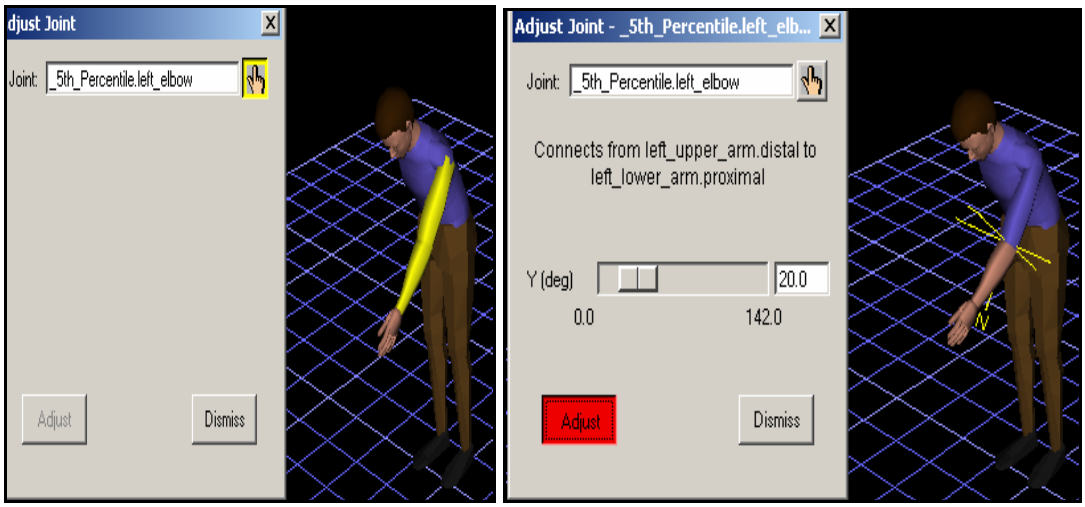




3) Adjust Shoulders

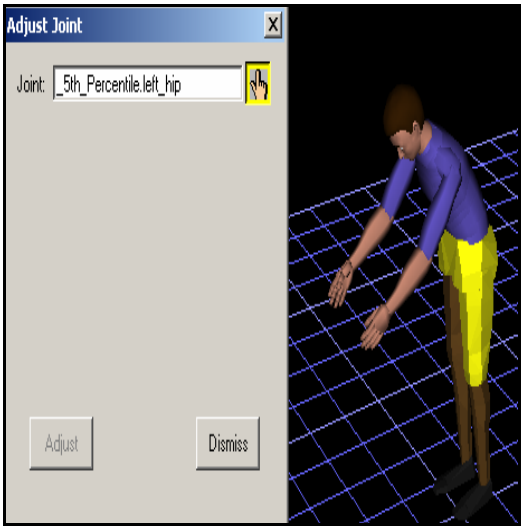


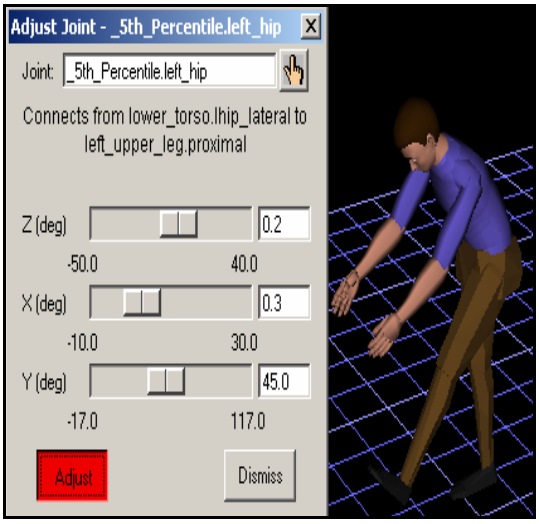
4) Adjust Elbows



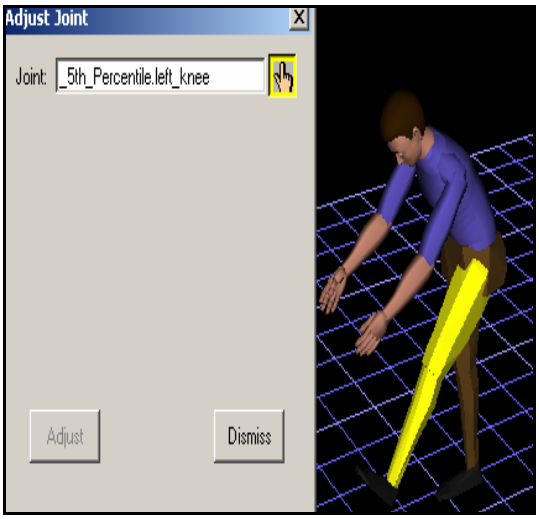
Note = Redo 3rd and 4th step to adjust right shoulder and right elbow. Keep the angles same.

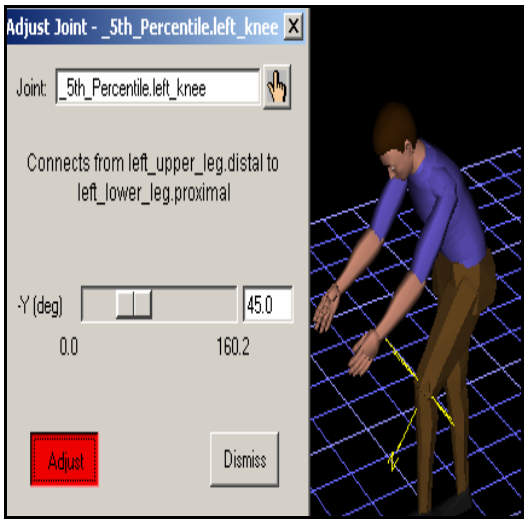
5) Adjust the Left Hip





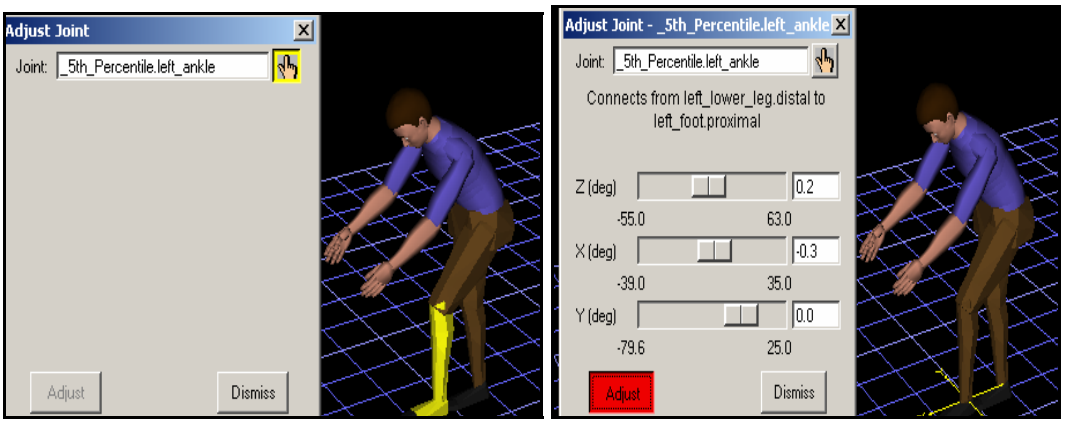
6) Adjust the Left Knee



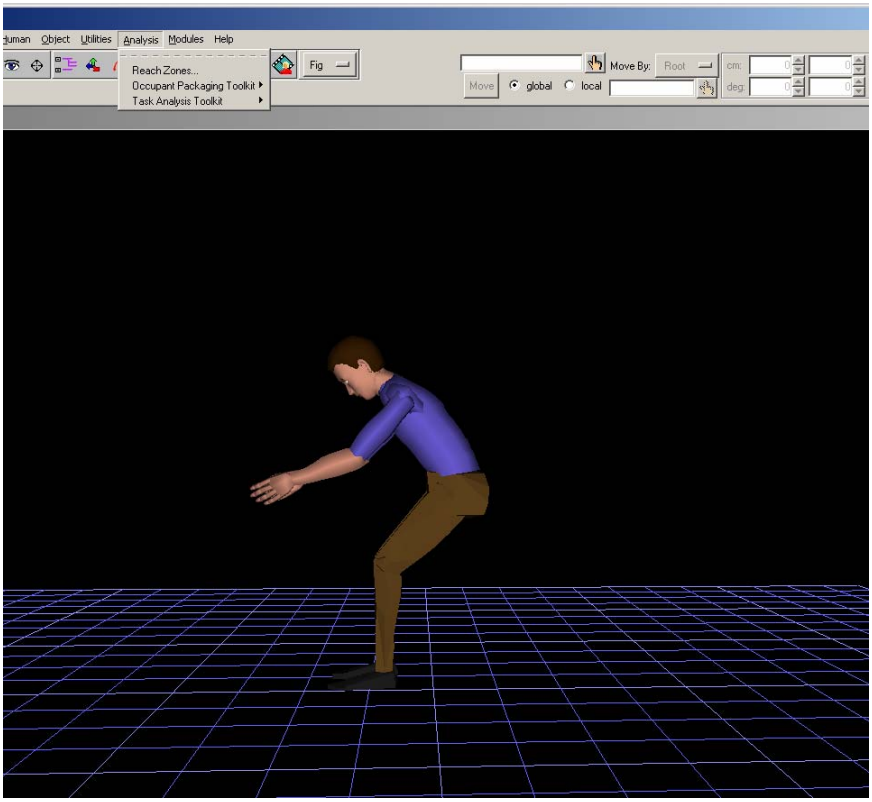


Note = Redo 5th and 6th step to adjust right hip and right knee. Keep the angles same.

7) Adjust the Left Ankle

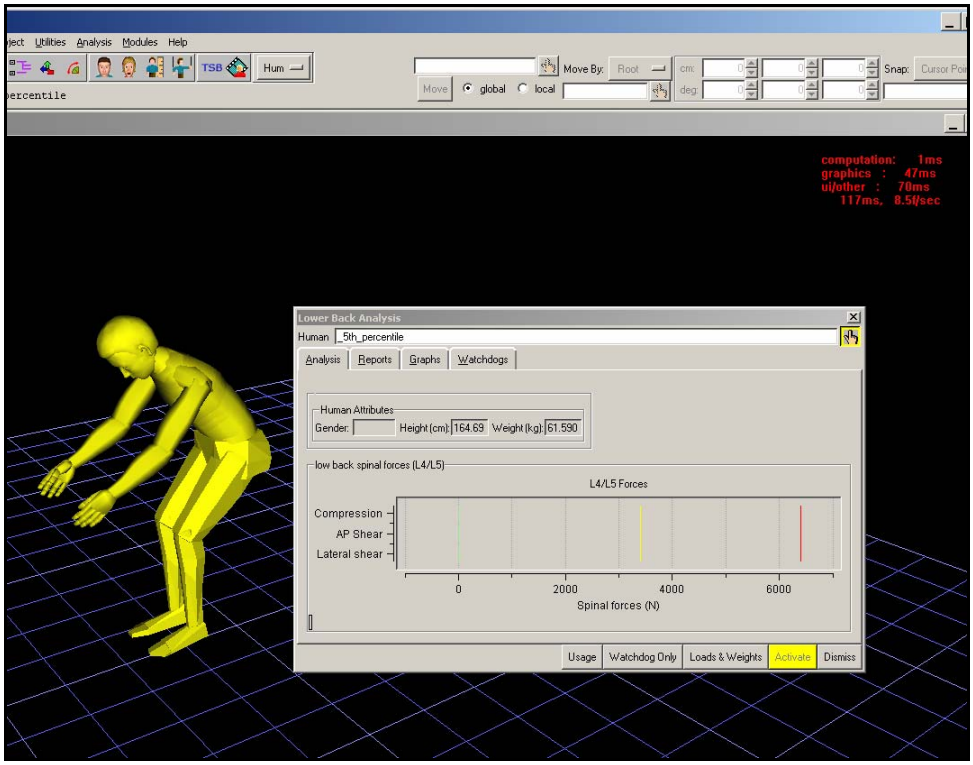


8) Final Posture

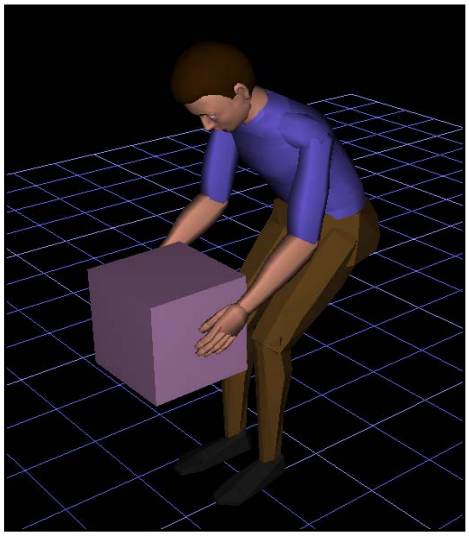


Step 3: Lower Back Analysis Setup – *Loads*

1) After you build the desired posture go to Analysis → Lower Back Analysis. From the Lower Back Analysis window click on the hand tool and select your already built human.



2) OPTIONAL! *Next step is the Load & Weights selection. You don't need to create a solid load or a CAD object. You can assign the loads as vector forces to a specific point on the human body. However, it may be useful to show a box load for presentation purposes, but is optional.*



You can create a box type object in several different ways. One way is;

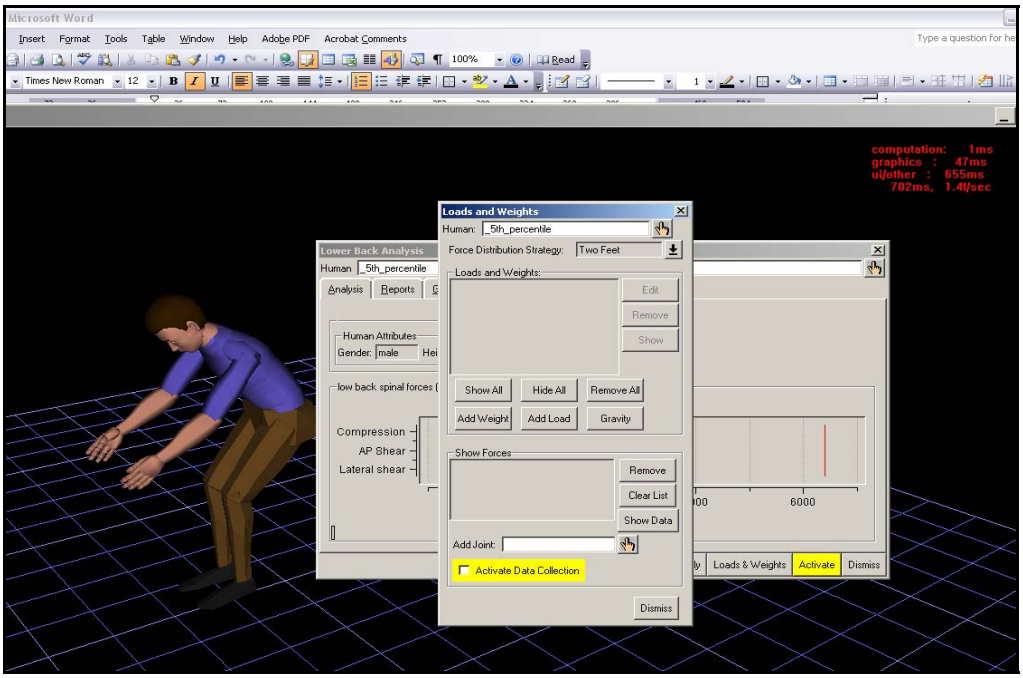
Object → Create → Rectangular Solid

Enter values, height, width and depth.

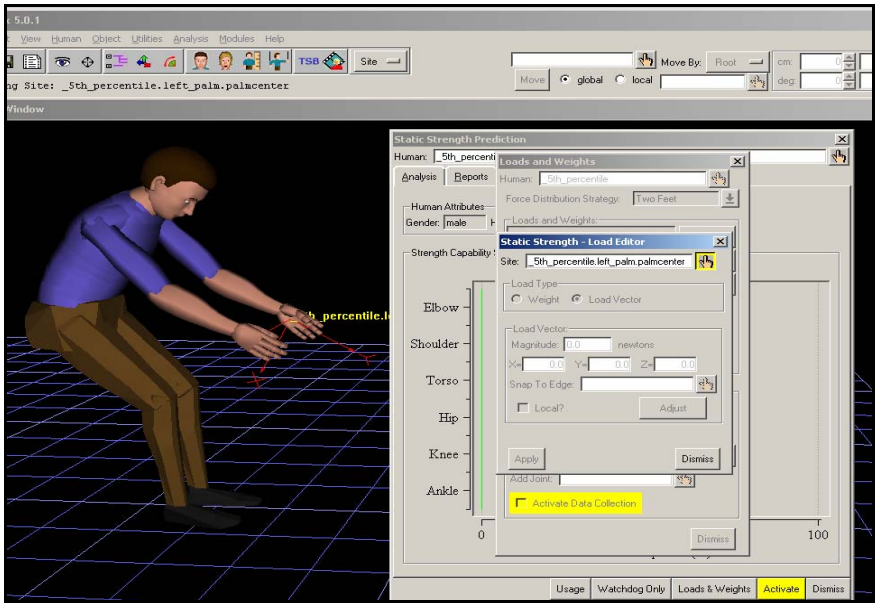
After you create the solid box, manually drag the box to the position respect to the human posture.

3) Now, we will assign the load as a vector force to the human model's hand.

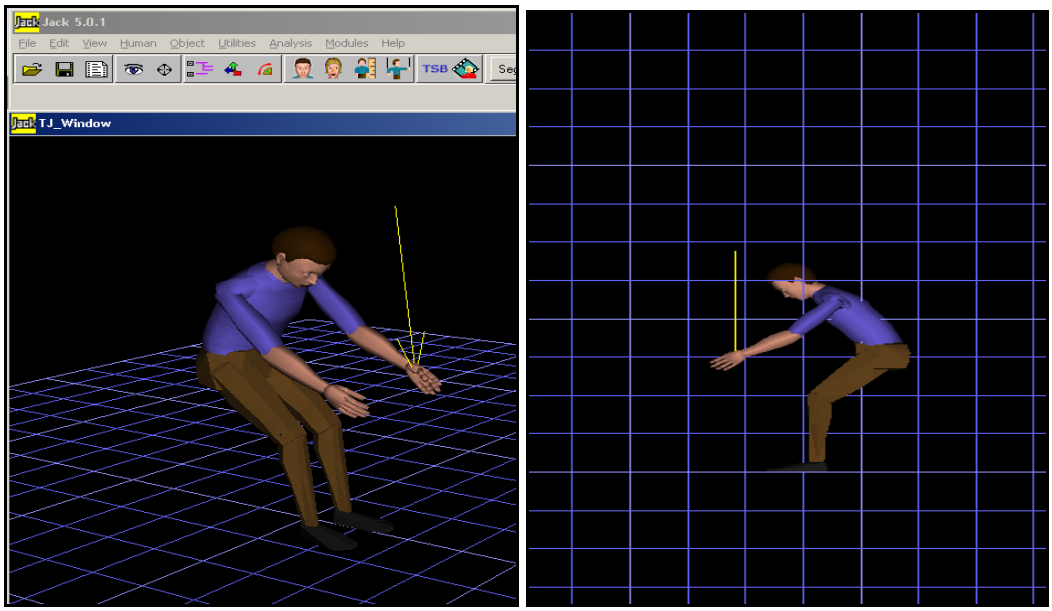
1. Click the Loads & Weights tab on the Lower Back Analysis window. Loads & Weights window will appear as shown below. *Keep the Force Distribution Strategy = Two Feet. This will distribute the loads symmetrically in both feet.*



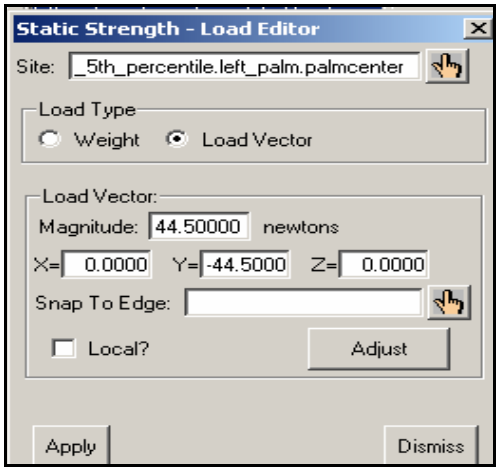
2. Click Add Load, Static Strength – Load Editor box will appear automatically.
3. Select the Hand tool and click on the center of the human hand. (palmcenter). *If you can't select the palmcenter, manually drag & zoom human body.*



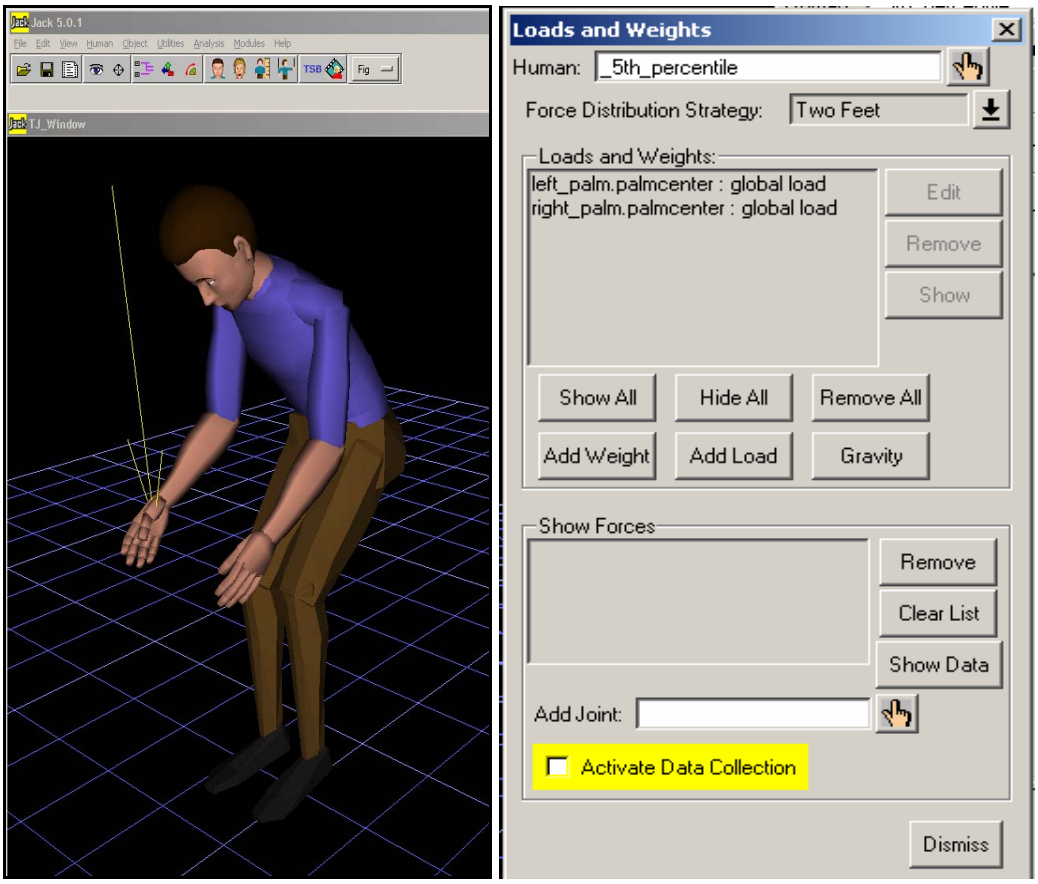
4. When you click on the palmcenter, a 90 degree down force vector will appear to represent the applied load.



5. When you click on the human body, the Static Strength - Load Editor box will let you to enter inputs. Enter 44.5N to the Magnitude box, and click Apply.



6. Apply the above procedure to enter a symmetrical load (Magnitude = 44.5N) to the other hand. Once you enter all the loads, your Static Strength - Load Editor should include both loads.

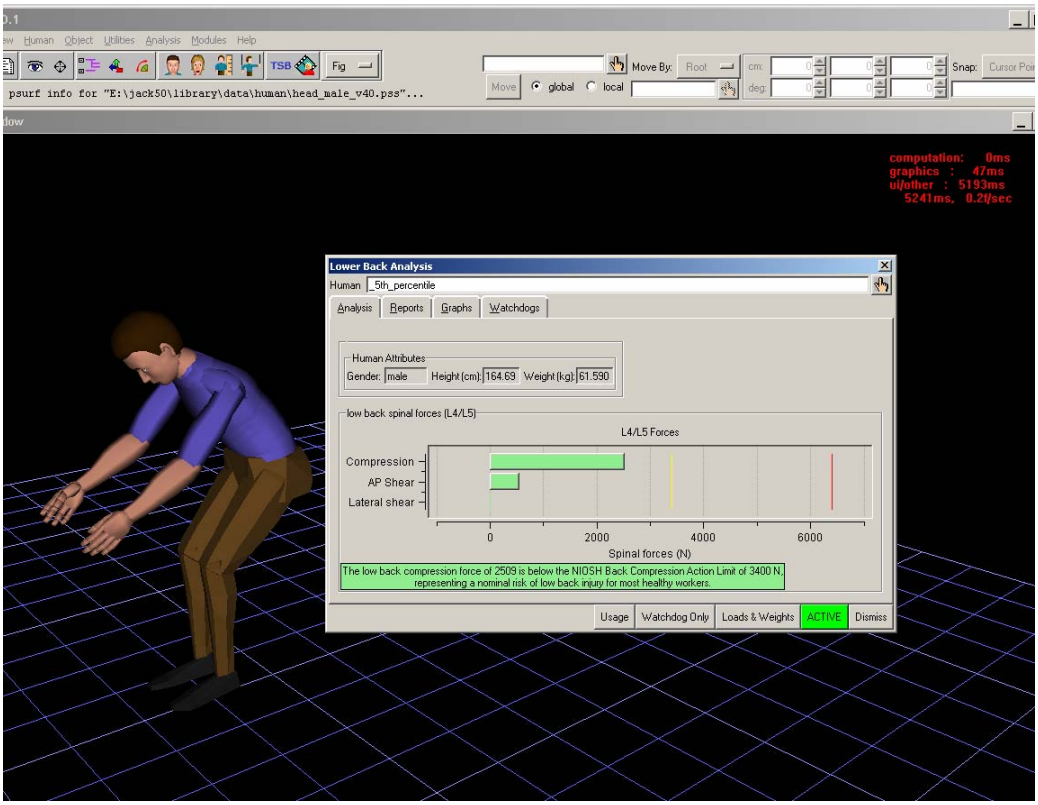


Note = You can add/remove more loads and edit them easily by using the Static Strength - Load Editor window. In addition, you can select different Gravity modes. In this example default gravity mode (980.650 cm/s^2) is used.

Step 4: Activate - *Run the Static Strength Prediction*

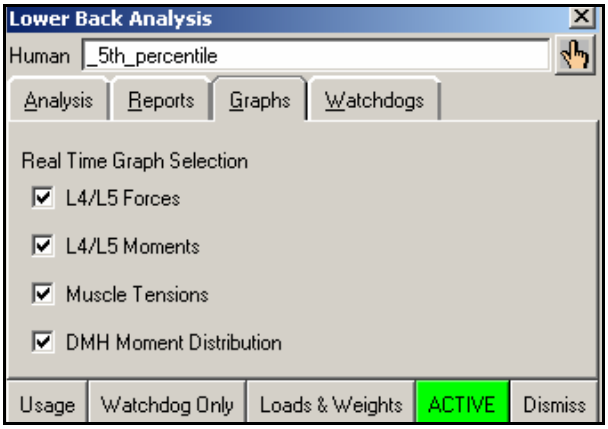
After you finish the Step 3, click the Activate tab on the Lower Back Analysis main window. This will simulate the applied loads and the relative posture by using Lower Back Analysis algorithm.

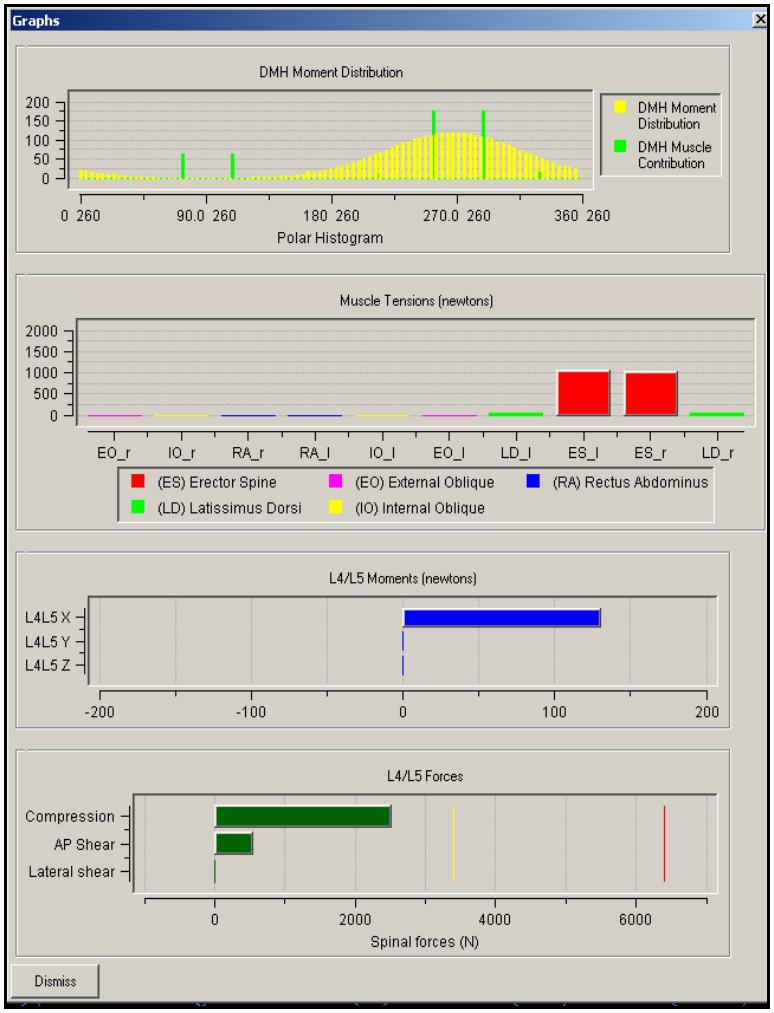
When you click Activate, first thing you should notice is the Low Back Spinal Forces (L4/L5) chart.



Step 5: Analysis – *Graphs*

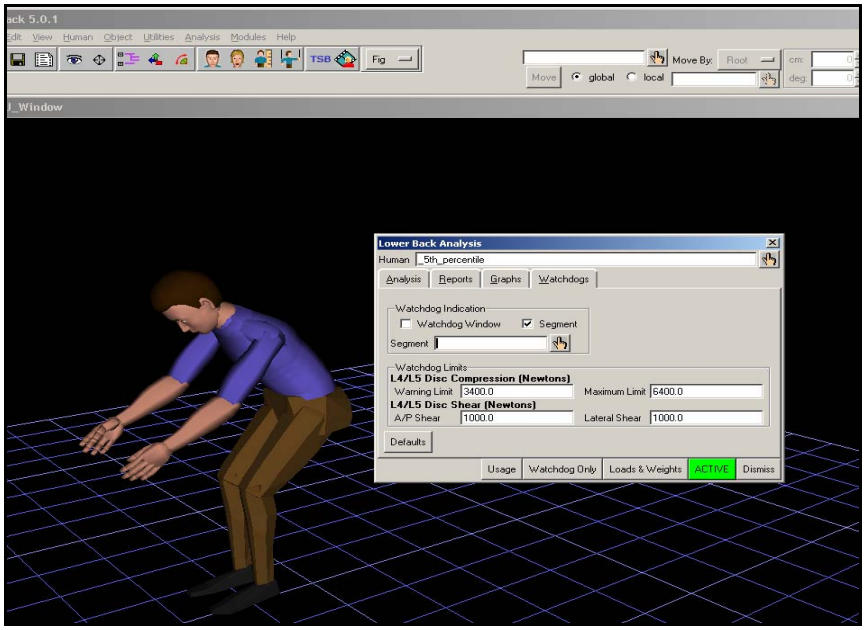
Jack's Lower Back Analysis module will develop DHM Moment Distribution, Muscle Tension, L4/L5 Moments, and L4/L5 Forces graphs for further analysis. In order to view the graphs, click the Graphs tab and select the graph types you want.

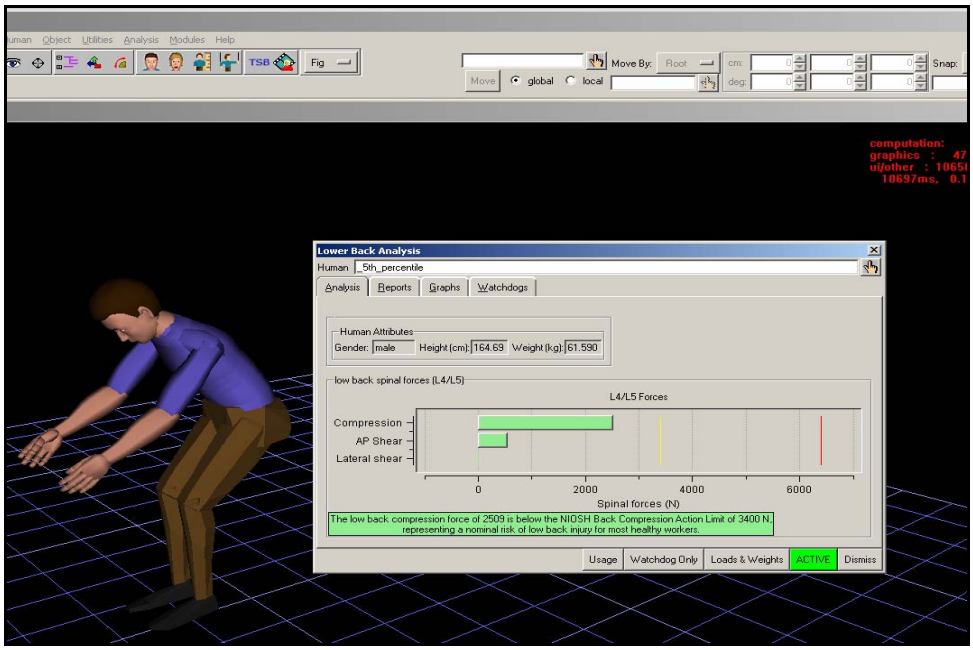




Step 5: Analysis – *Visuals*

You can go to the Watchdogs tab and select the Automated Segment option. When high forces (above guideline limitations) are applied, body segments under tension will be highlighted relative to the L4/L5 forces graph.

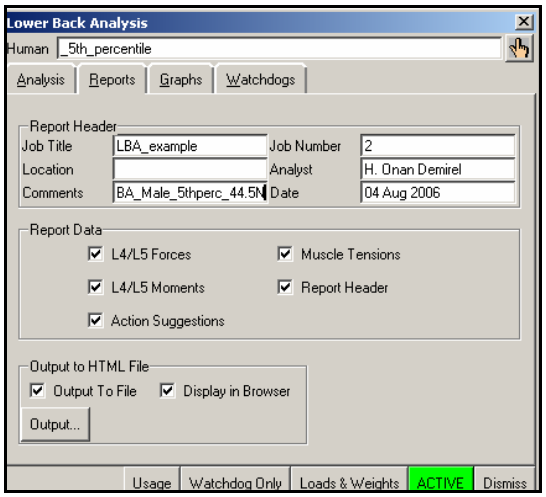


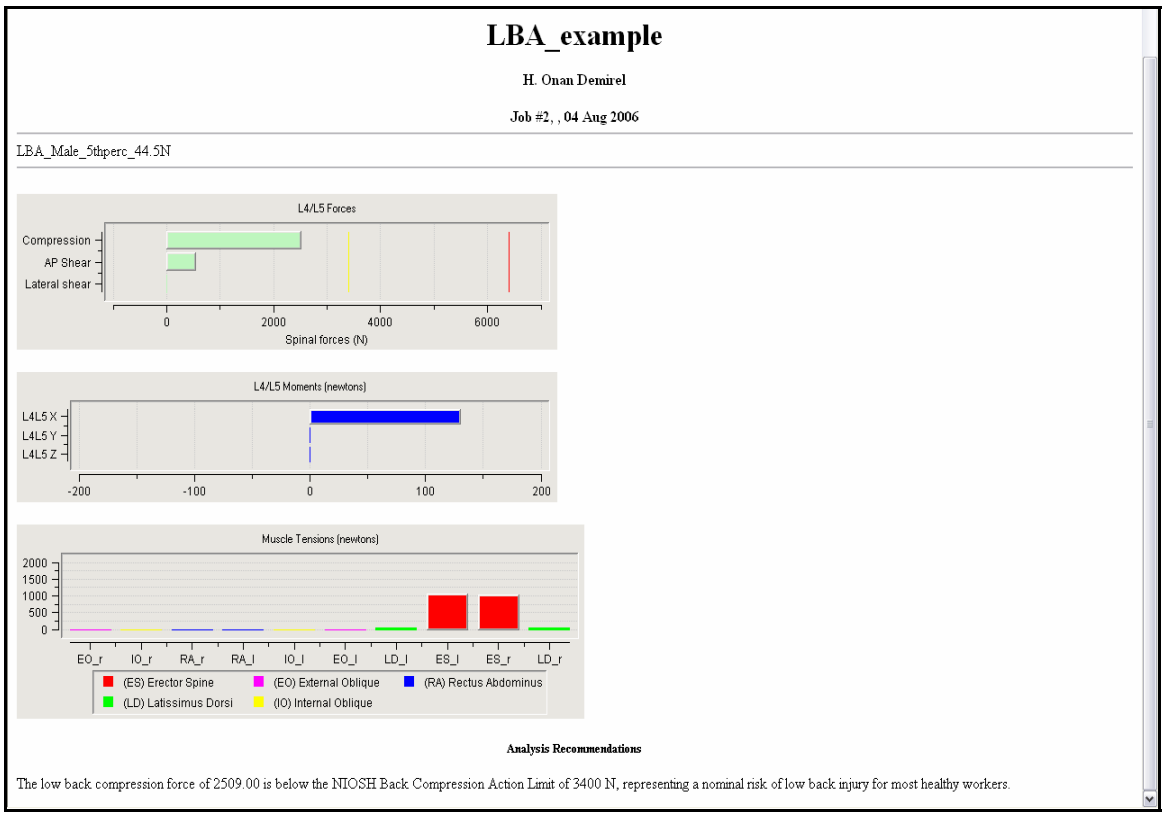


Note: In this example, the force values are in safe zone, there is no body segment is highlighted. (Refer to green highlighted analysis on above figure) When the forces are above the limits, Segment option under Watchdog tab will highlight body segments under extreme forces.

Step 7: Analysis – *Output*

Jack's Lower Back Analysis module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Note: One can see from the Analysis Recommendation option (from above output) points out that calculated compression force is within guideline limits.

Manual Handling Limits

The Manual Handling Limits tool helps users to make sufficient predictions on limitation of manual handling operations to reduce the risk of injury and improve the quality of the work environment. Users can manually enter the dimensions of the load and Jack software calculates a safe boundary respect to the task parameters. **Figure 1** shows the location of the Manual Handling Limits tool under Task Analysis Toolkit package.

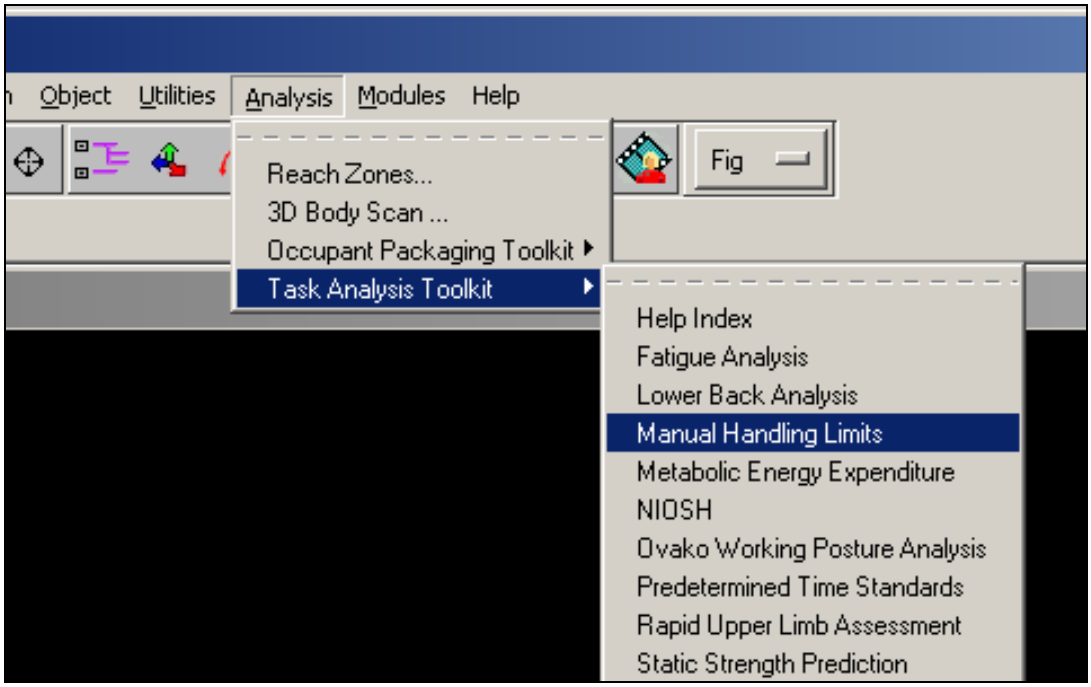


Figure 1 – *Manual Handling Limits*

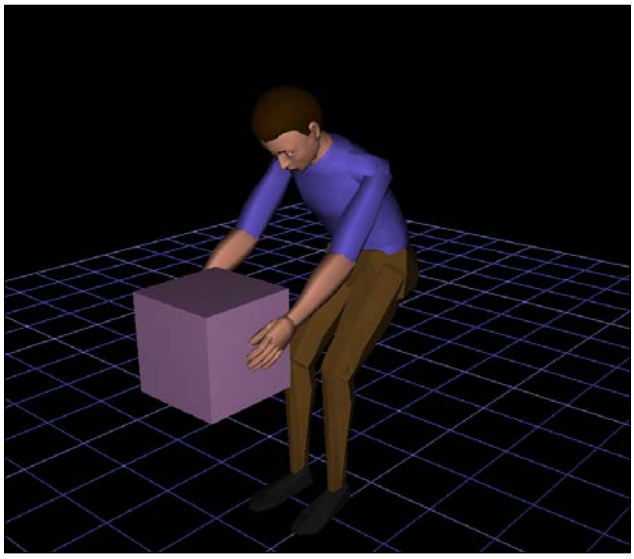


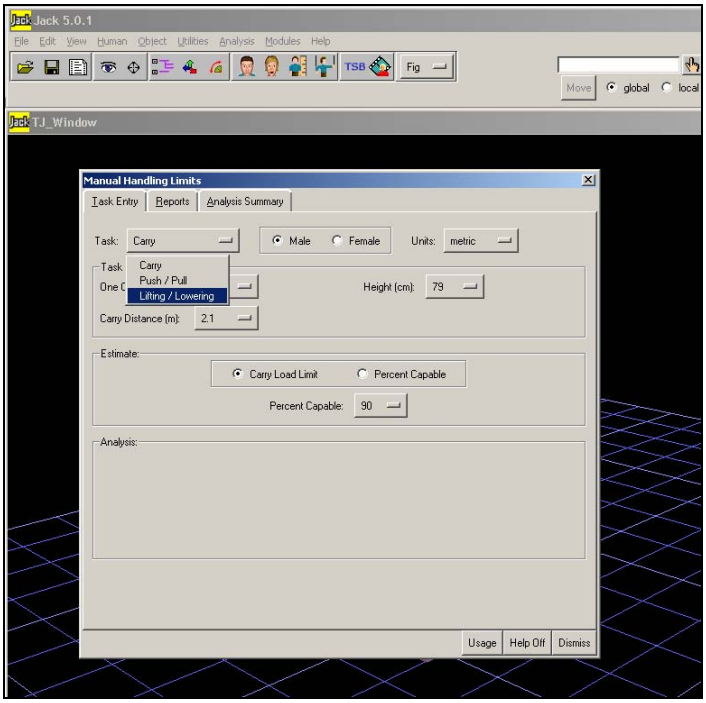
Figure 2 – *Lifting/Lowering Posture*

In this example, we will work on a lifting/lowering task similar to the figure on left.

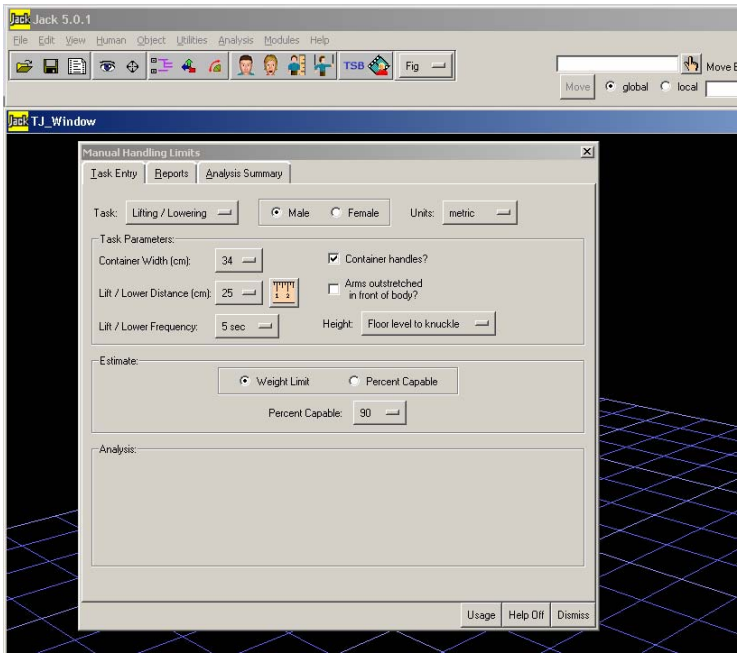
You don't need to create the exact posture **(Figure 2)** in Jack's Manual Handling Limits module. This posture was built for presentation purposes.

Step 1: Manual Material Handling Setup – *Input variables*

1. Go to Analysis → Manual Material Handling
2. From Task option choose Lifting/Lowering,
3. Use Male and metric system

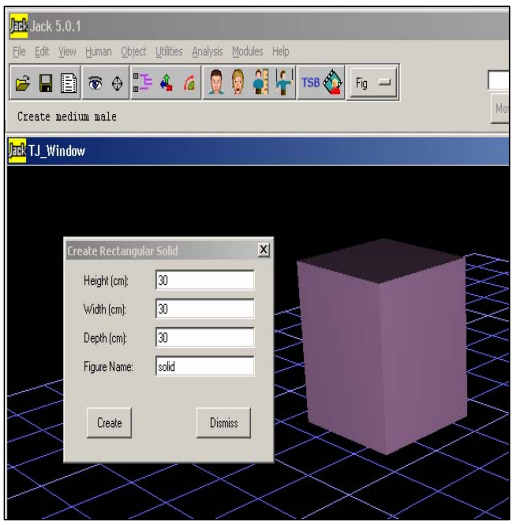


4. Now, you should notice that the Manual Handling Limitation windows has changed. Now, we need to select the task parameters.



5. We will select the Task Parameters according to the already built posture and load. Below figures show the details about the lifting/lowering task and the box load.

   Box Load Dimensions;



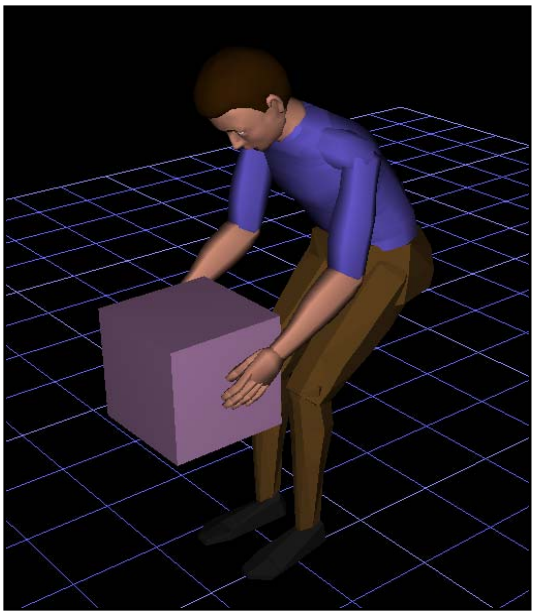
You can create a box type object in several different ways. One way is;

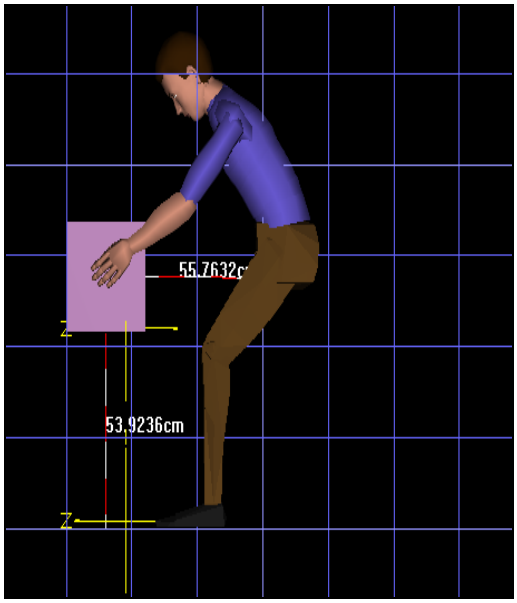
Object → Create → Rectangular Solid

Enter values, height, width and depth.

After you create the solid box, manually drag the box to the position respect to the human posture.

   Lifting/Lowering Task Measurements;





Note: Measurements in above figures are not mandatory; you can use your own measurements depending on the nature of your work analysis.

6. In this step, we will input the Task Parameter.

- **Container Width** , *we choose **34cm**, its relatively close to the width of the box load we have created.*

  Disregard the Container Handles options since we don't have handles in the box load.

- **Lift/Lower Distance,** *you can measure Lifting/Lowering distance by using distance ruler. We will choose **51cm**.*

  Disregard the Arms Outstretched In Front of the Body option.

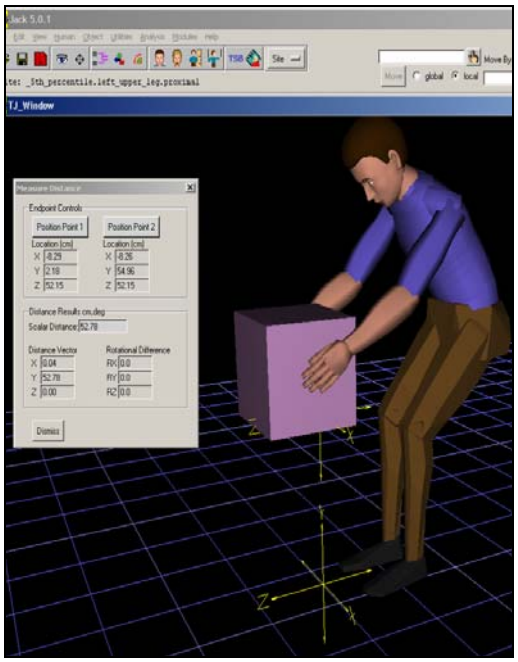


Figure on left hand side demonstrates how one can use the coordinate axis. (Position 1 and Position Point 2) In this way, you can get a scalar distance by two points.

You need to manually drag & position the coordinate axis. In this case Position Point 1 is located on the floor and the Position Point 2 is located on the bottom face of the box. This will give us the lowering/lifting distance.

- **Lift/Lower Frequency,** depending on the nature of the work design You can select a predefined frequency. We will choose **9sec**.

- **Height,** In this case we will choose **Floor Level to knuckle** option.

- **Estimate,** You can either evaluate your design for Weight Limit or Percent Capable. We choose the **Weight Limit** option with **Percent Capability 90**. This will give as an upper & lower limits for load selection whereas Percent Capable option gives the percent capability of the predefined load.

Step 2: Analysis – *Summary*

Jack's Manual Handling Limits module develops a summary report where you can evaluate your analysis results. In order to form an output file click on Reports tab, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.

The Manual Handling Limits summary includes the predefined measurements, weight limits (if you choose Weight Limit option on the Task Entry bar under Estimate option, figure A), Lifting/Lowering Percent Capable (if you choose Percent Capable Option on the Task Entry bar under Estimate option, figure B)

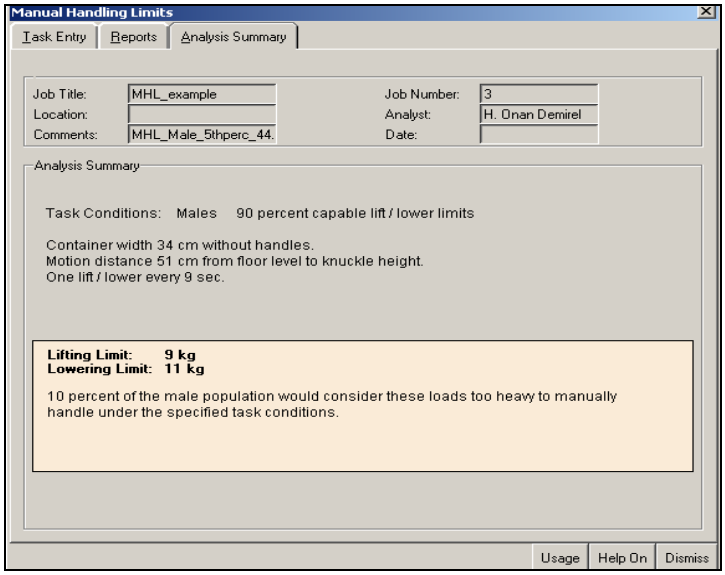


Figure A

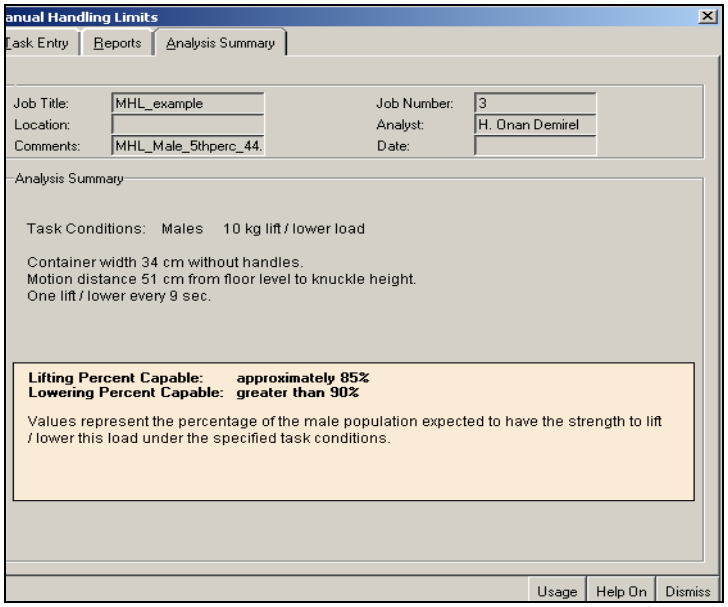
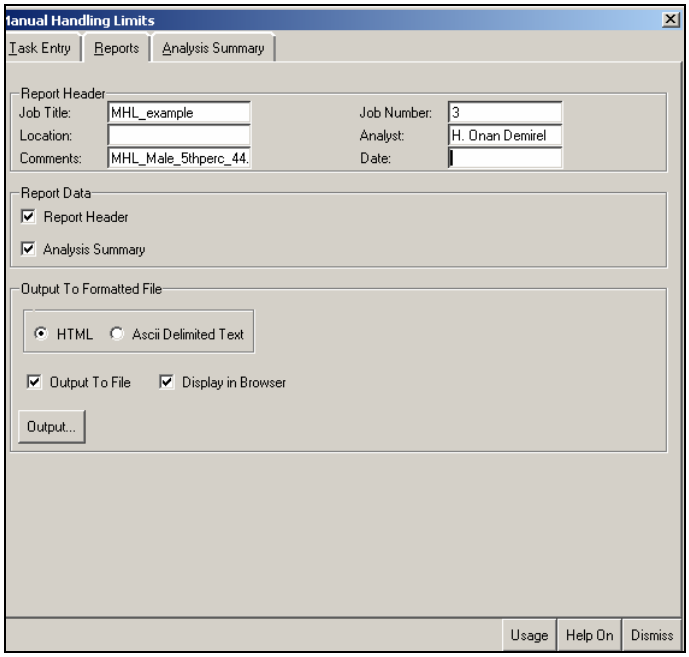
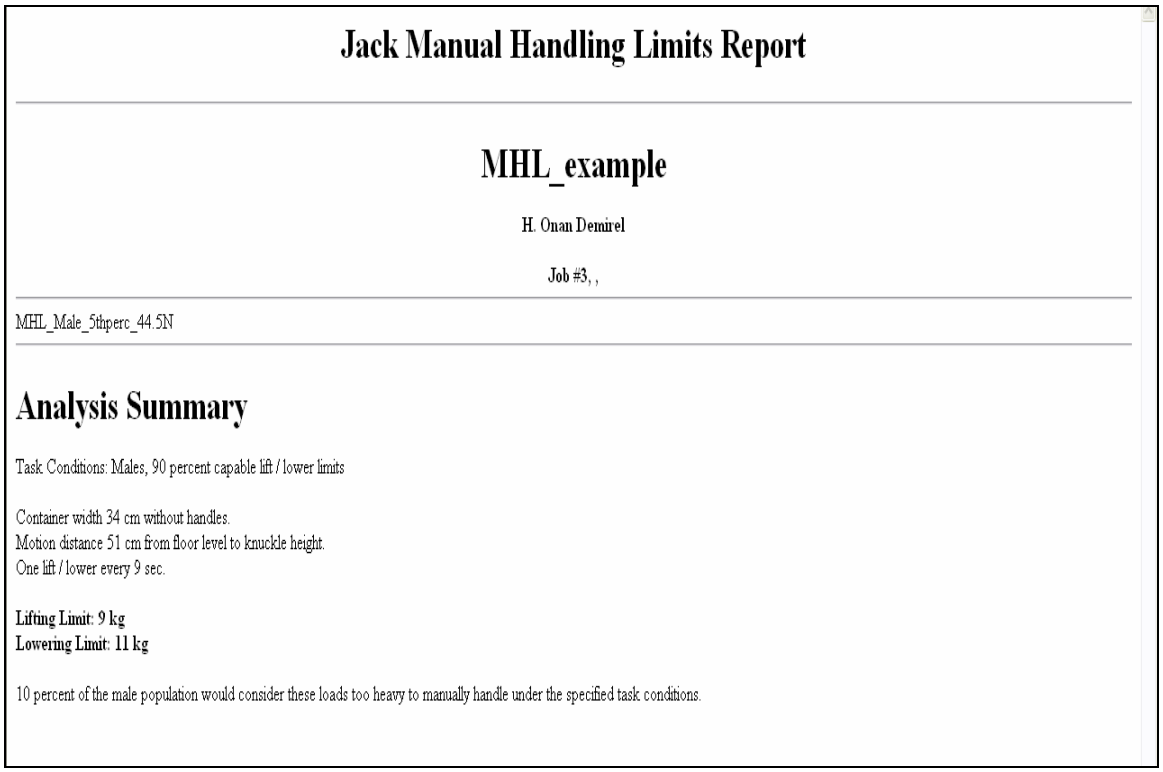


Figure B

Step 3: Analysis – *Output*

Jack's Manual Handling Limits module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Jack Manual Handling Limits Report

MHL_example

H. Onan Demirel

Job #3, ,

MHL_Male_5thperc_44.5N

Analysis Summary

Task Conditions: Males, 90 percent capable lift / lower limits

Container width 34 cm without handles.
Motion distance 51 cm from floor level to knuckle height.
One lift / lower every 9 sec.

Lifting Limit: 9 kg
Lowering Limit: 11 kg

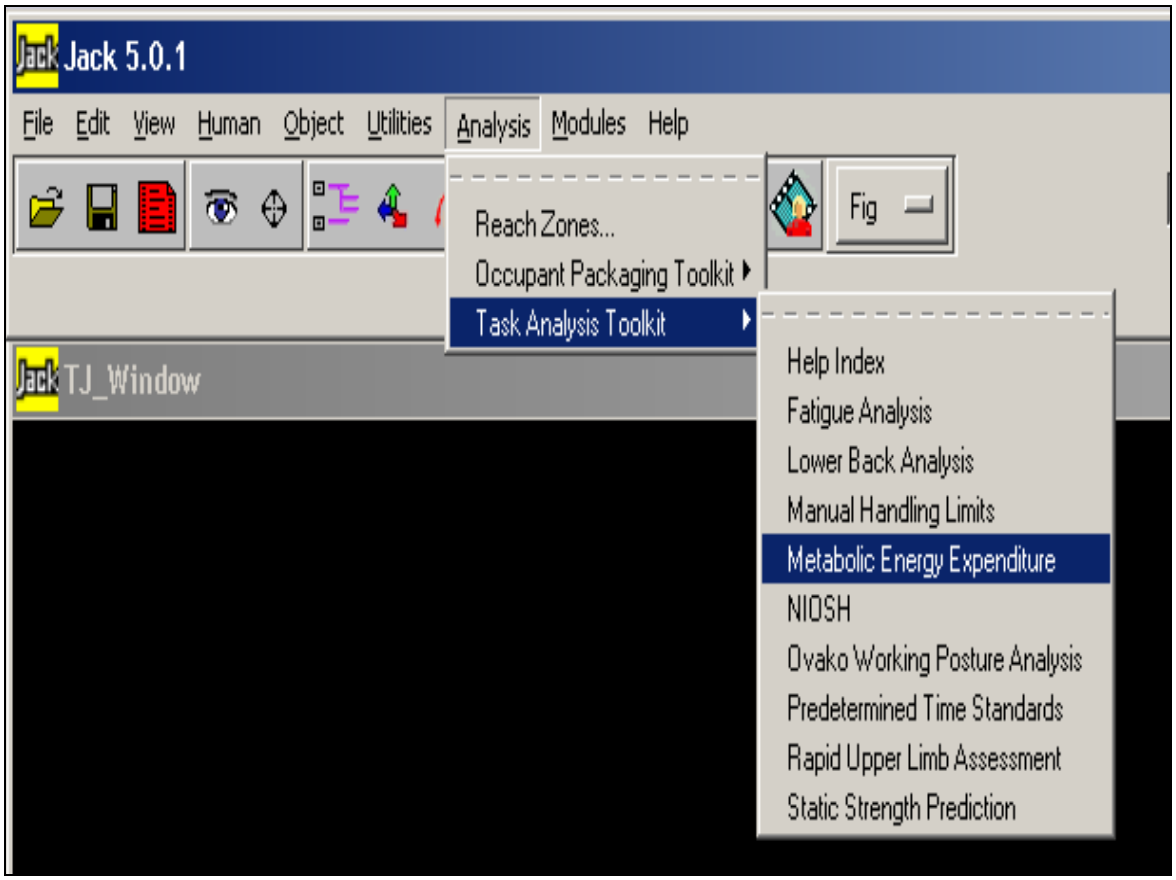
10 percent of the male population would consider these loads too heavy to manually handle under the specified task conditions.

Metabolic Energy Expenditure

The Metabolic Energy Expenditure tool helps users to predict the metabolic energy expenditure requirements and helps them to assure worker safety. The Metabolic Energy Expenditure is based on specific worker characteristics, worker's posture, and duration of the work cycle and the description of the worker's task.

With the help of Metabolic Energy Expenditure tool users can;

- Analyze the existing job's overall energy expenditure and check if it conforms to industry based guidelines for metabolic energy expenditure.
- Evaluate the risk of worker's fatigue and injury caused by excessive energy expenditure.



Analysis – *Metabolic Energy Expenditure*

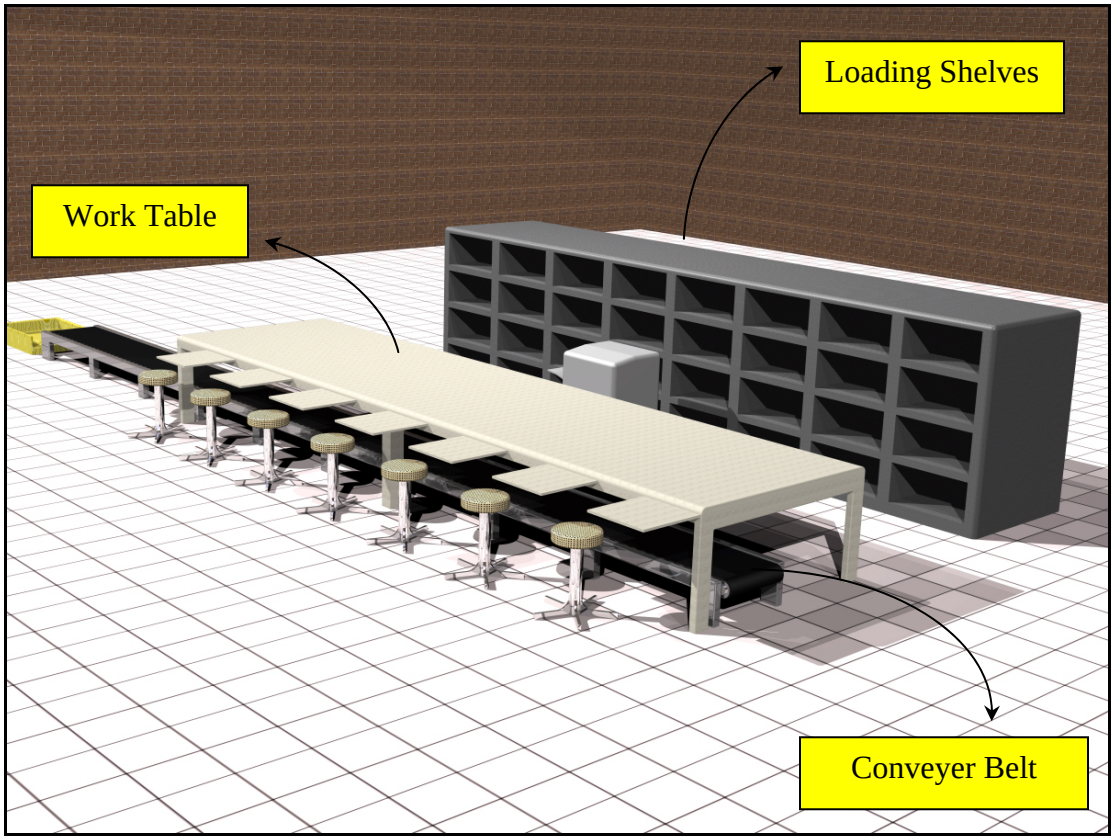
The following example is conducted to evaluate the worker's metabolic energy expenditure on a simple task. The worker starts lifting the box load in a squat posture and finalizes the cycle pushing the box on the work table.

Step 1: Workplace Layout – *Lifting & Carrying Operation*

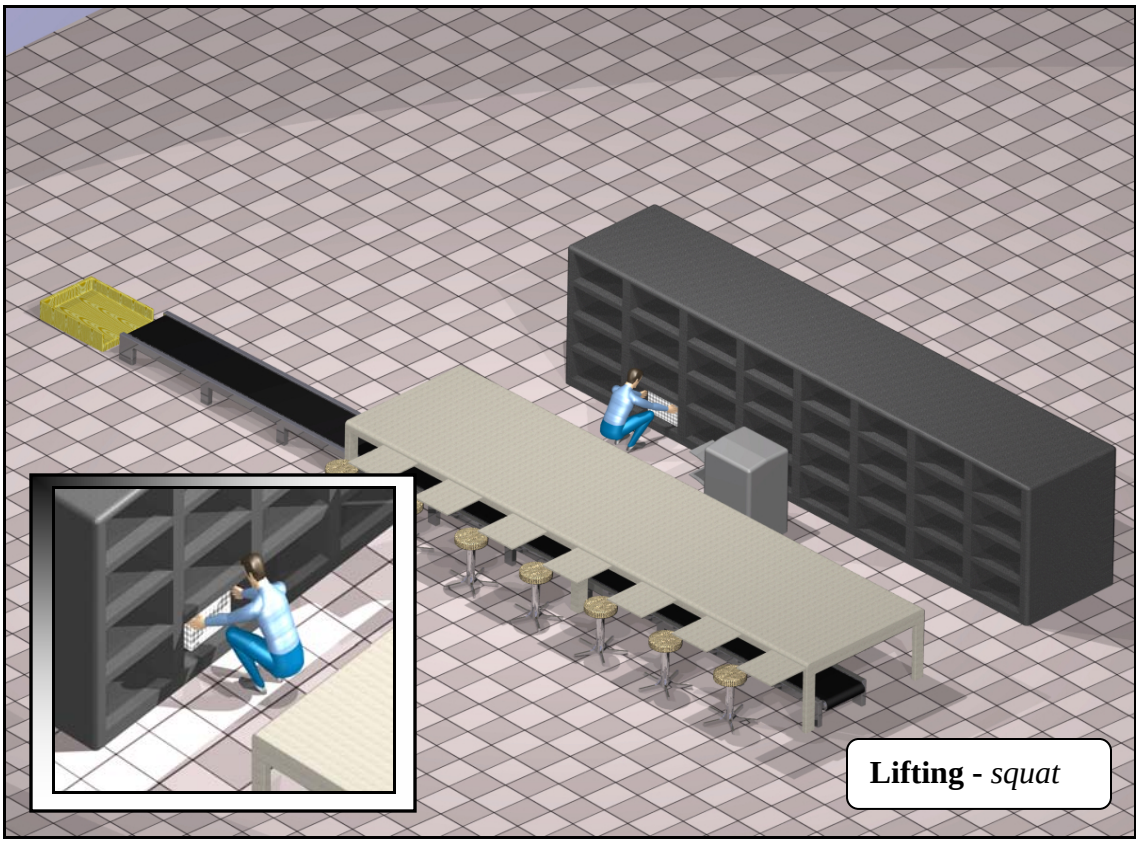
The workplace is a warehouse environment where the worker needs to work on a simple lifting and carrying task. The box loads are located on the loading shelves. Worker must carry the boxes the loading shelves to a work table, and push the box to the other workers where they opened the boxes and placed the defect products on the conveyer belt.

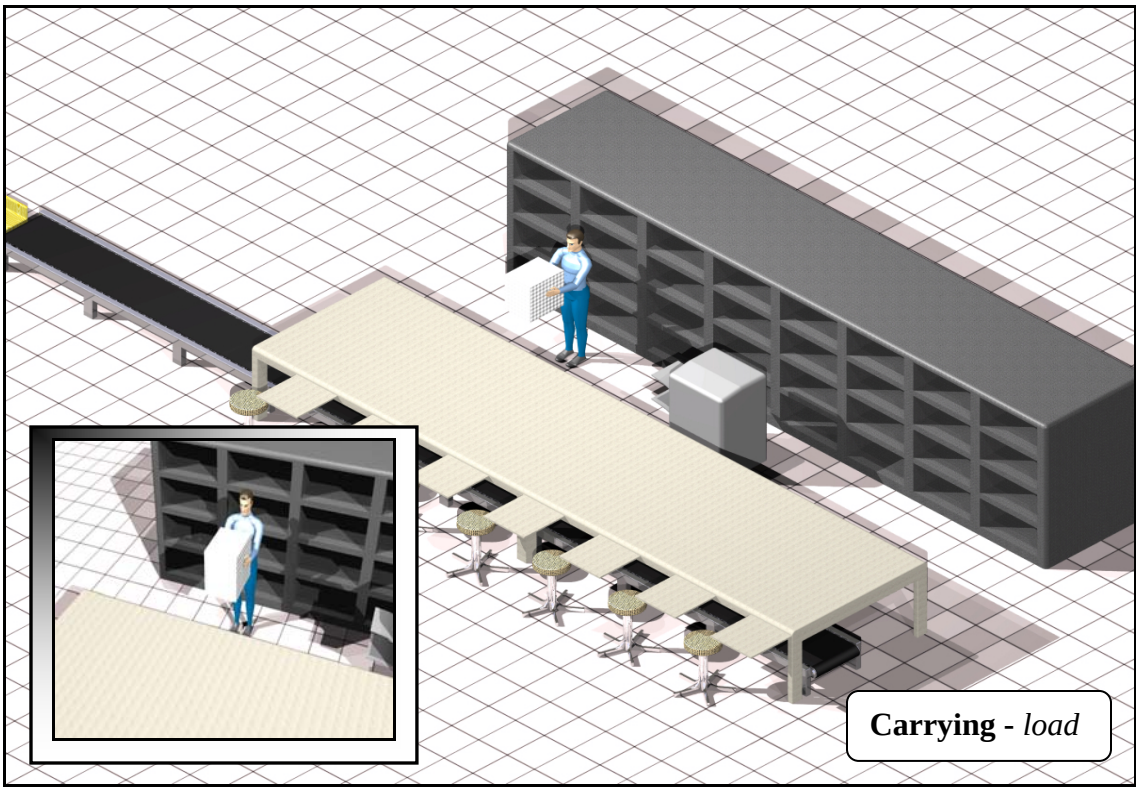
One work cycle is defined as the overall time required placing 20 boxes. Boxes are transferred from loading shelves to workers on the work table, takes 8 minutes. Each box contains approximately 20kg equally balanced solid loads. The height of the box is 0.5m. The worker needs 0.05 minutes to walk 4m between loading shelves and 1m high work tables. It takes worker to exert 20N push force to transfer the box 1m across the table to the other workers. The worker is %50 percentile male, and has a carry height of 0.8m.

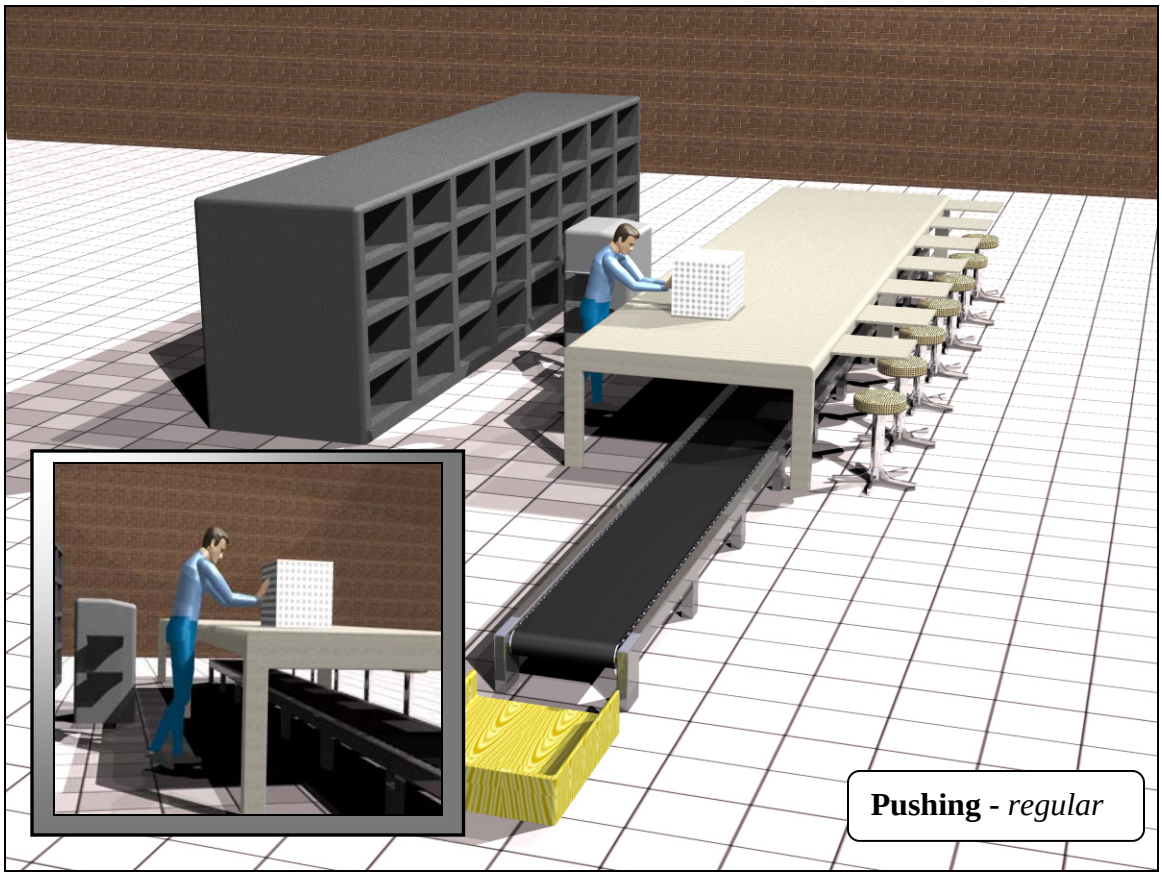
This is a simple sorting task intended to show the user interface and the applications of the Jack's Predetermined Time Standards. One can think about more complex tasks where package carrier companies sort fragile packages by hand and sort them on a conveyer belt based on their priority.



Work environment


Lifting - *squat*


Carrying - *load*



Steps	Movement Type	Position
1	Lift	squat
2	Lift	semi-squat
3	Lift	stoop
4	Carry	loads
5	Lower	arm
6	Push	regular

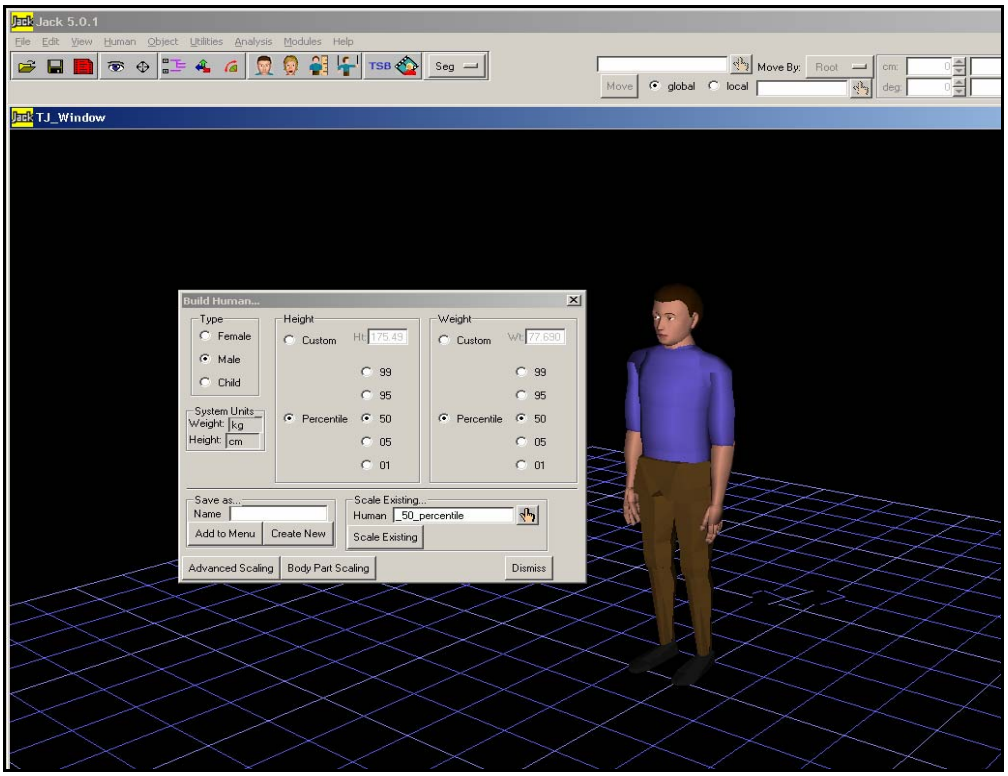
Table 1 – *Task Work Elements*

The overall cycle is divided into 7 work elements. Next, the Metabolic Energy Expenditure analysis will be constructed depending on Table-1.

Step 2: Build Human - ***Anthropometry Information***

We need to know the worker's sex, weight, and height. This information is entered into The **Build Human** dialog box holds the related input variables and helps us to build our digital worker. Our sample digital worker will be a 5% percentile male (175.49 cm tall and 77.690kg).

1) Go Human → Create →Custom
2) When the diolog box appear choose;
    a. Type = Male
    b. Height → Percentile = 50
    c. Weight → Percentile = 50
3) Save as.. → Name = *give any name you want*, ***ex. 50_Percentile***
4) Create New



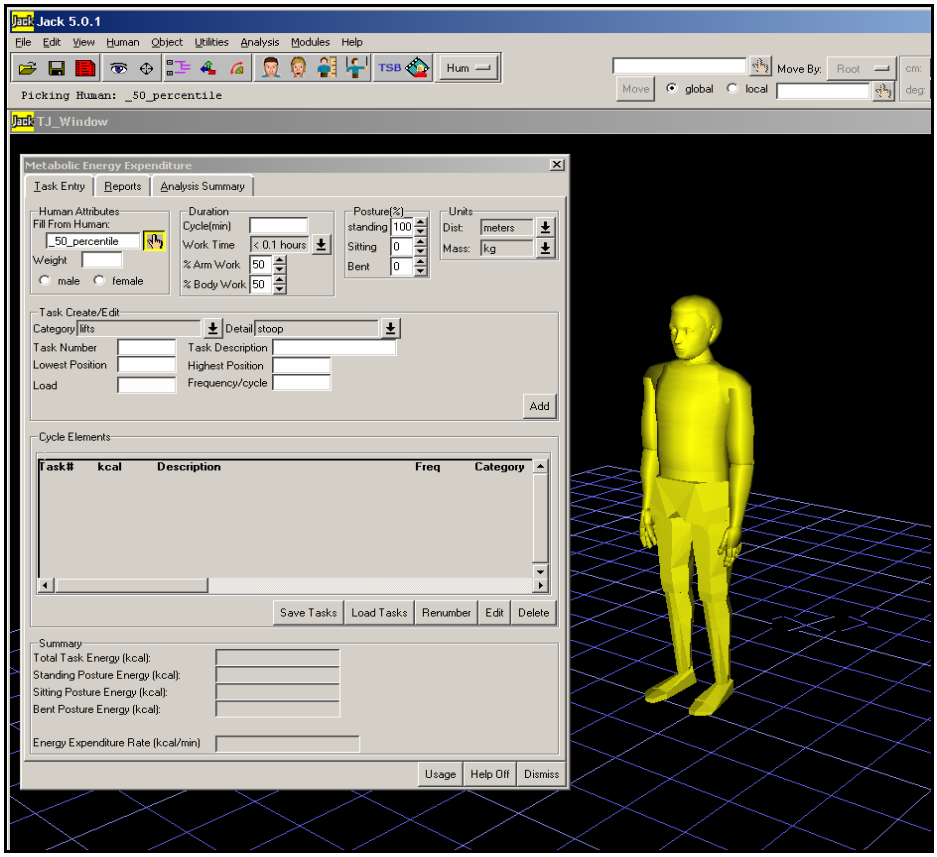
Note = In future, you can edit your human figure by using Scale Existing command in above dialog box by changing the anthropometry variables.

Step 3: **Metabolic Energy Expenditure -** ***Task Entry***

1) After you determine the motion elements, go;

Analysis → Task Analysis Toolkit → The Metabolic Energy Expenditure

From the NIOSH Lifting Analysis window click on the hand tool and select your already built human.



2) Duration;

- Cycle(min) = 8
- Work Time < 0.8 hours

3) Posture & Units

- You may choose %95 standing and %5 bent for posture assignment.
- You may choose either metric or English units.

4) Task entry variable selection;

From the Task Entry window you can start entering information about the work elements. Example Below shows how to assign *Lifting in squat position.*

- You can input any task number; in this case squat lifting is identified as Task Number 1. We use metric units; you can choose either English or metrics units.
- Task Category is Lift in this case, and choose squat from Details pull down menu.
- Lowest Position in this case is 0.2m, approximately the distance between floor and the lowest shelf. And the Highest position is 0.8 m.
- **Figure 1** summarizes the information entered.

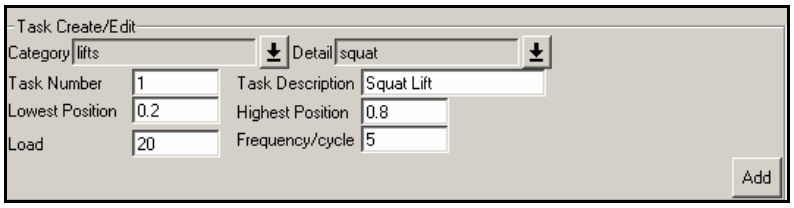
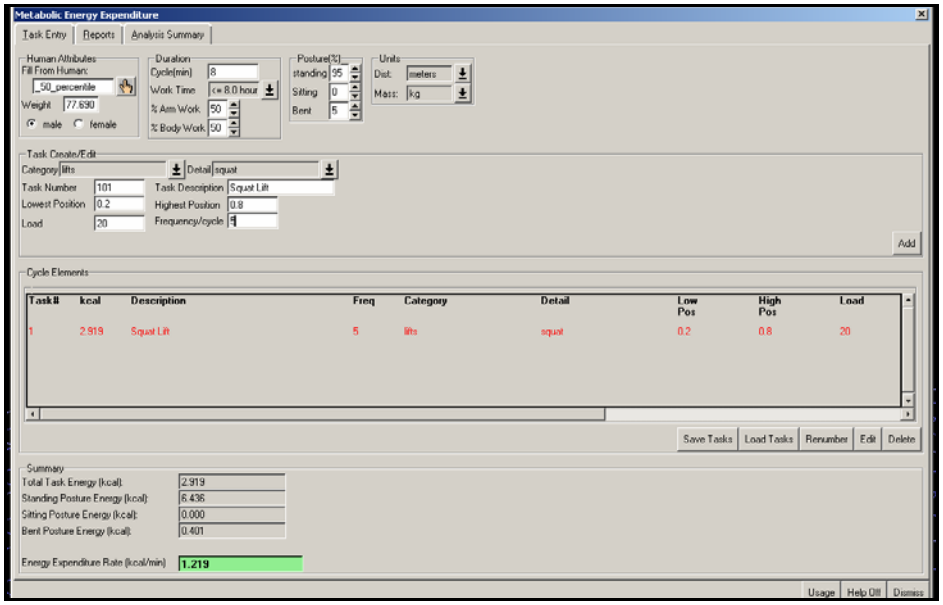


Figure 1 – *Task information*

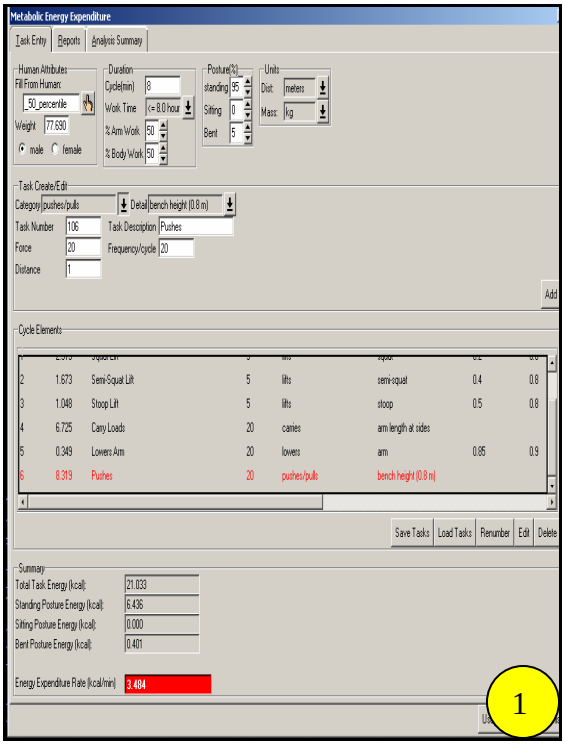
5) Add Task;

After you make your selections, click on Add Task button. This will add your specific work element into the cycle elements list.



You should observe that when you add a work measurement Jack automatically outputs an energy expenditure summary and energy expenditure rate as highlighted on lower left side of the window.

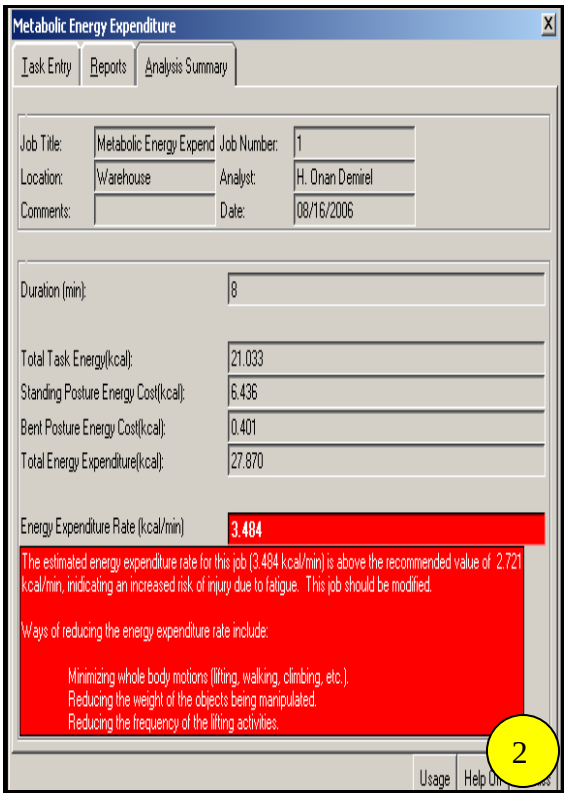
Step 4: Metabolic Energy Expenditure – *Analysis Summary*



1) Edit Task;

After you finish your Task Creation, you should observe that Energy Expenditure of the task is highlighted.

You can change any work elements, by clicking on the desired element at the Task List. When you click one, it turned into red in color and predefined task definitions are appeared. You can make changes by first clicking Edit then Replace to finalize the changes.



2) Analysis Summary;

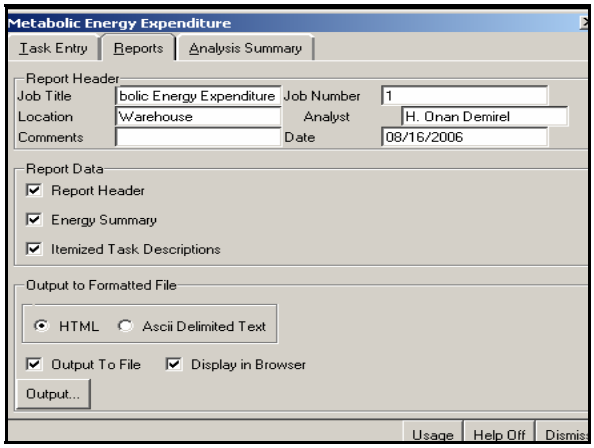
You can find a detailed summary of your work design under Analysis Summary tab.

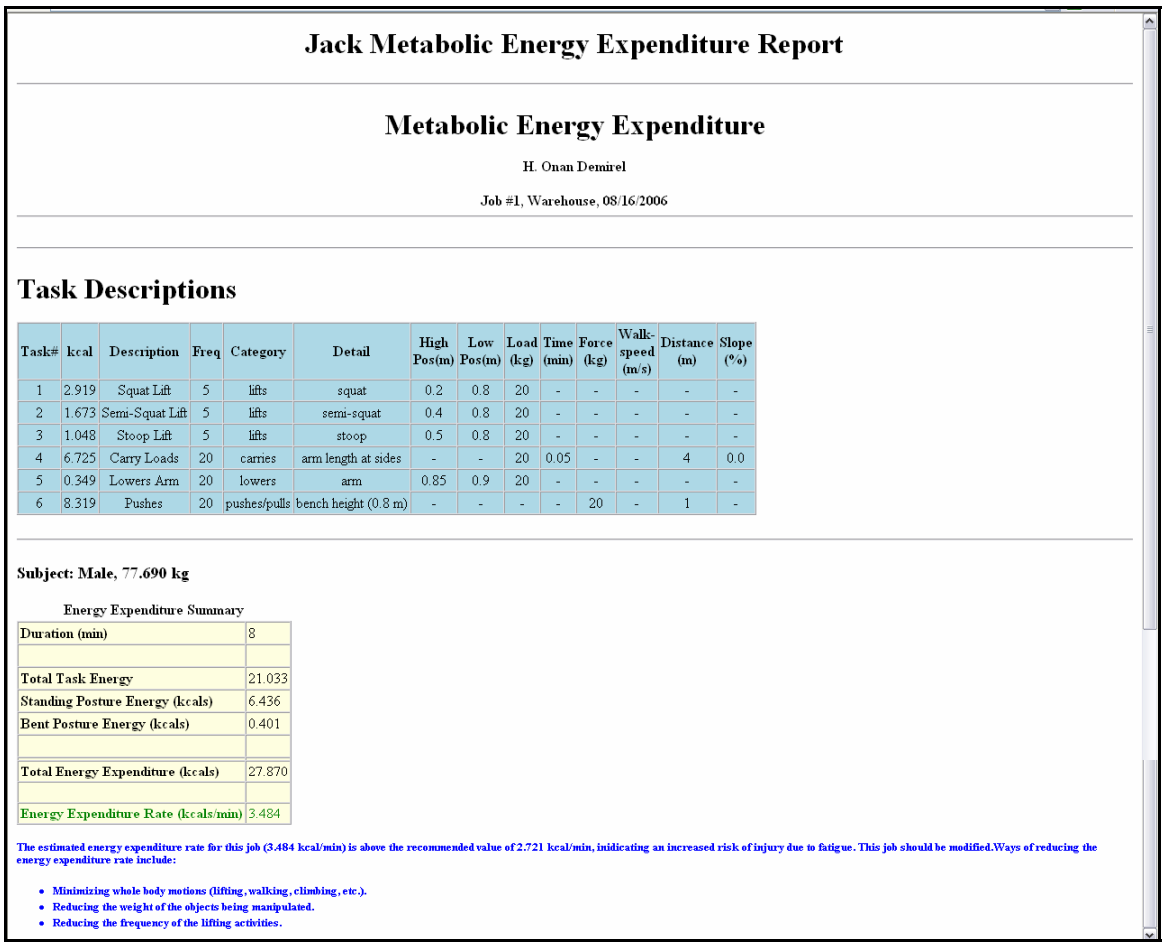
From Analysis Summary windows one can see the Total Task Energy, Posture Energy Costs, Total Energy Expenditure and Energy Expenditure Rate.

In addition, Jack informs the user about the recommended limits and risk of injury. Highlighted information box also suggest future work design improvements.

Step 5: Analysis – *Output*

Jack's The Metabolic Energy Expenditure module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, fill the Report Header, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Jack Metabolic Energy Expenditure Report

Metabolic Energy Expenditure

H. Onan Demirel

Job #1, Warehouse, 08/16/2006

Task Descriptions

Task#	kcal	Description	Freq	Category	Detail	High Pos(m)	Low Pos(m)	Load (kg)	Time (min)	Force (kg)	Walk-speed (m/s)	Distance (m)	Slope (%)
1	2.919	Squat Lift	5	lifts	squat	0.2	0.8	20	-	-	-	-	-
2	1.673	Semi-Squat Lift	5	lifts	semi-squat	0.4	0.8	20	-	-	-	-	-
3	1.048	Stoop Lift	5	lifts	stoop	0.5	0.8	20	-	-	-	-	-
4	6.725	Carry Loads	20	carries	arm length at sides	-	-	20	0.05	-	-	4	0.0
5	0.349	Lowers Arm	20	lowers	arm	0.85	0.9	20	-	-	-	-	-
6	8.319	Pushes	20	pushes/pulls	bench height (0.8 m)	-	-	-	-	20	-	1	-

Subject: Male, 77.690 kg

Energy Expenditure Summary

Duration (min)	8
Total Task Energy	21.033
Standing Posture Energy (kcals)	6.436
Bent Posture Energy (kcals)	0.401
Total Energy Expenditure (kcals)	27.870
Energy Expenditure Rate (kcals/min)	3.484

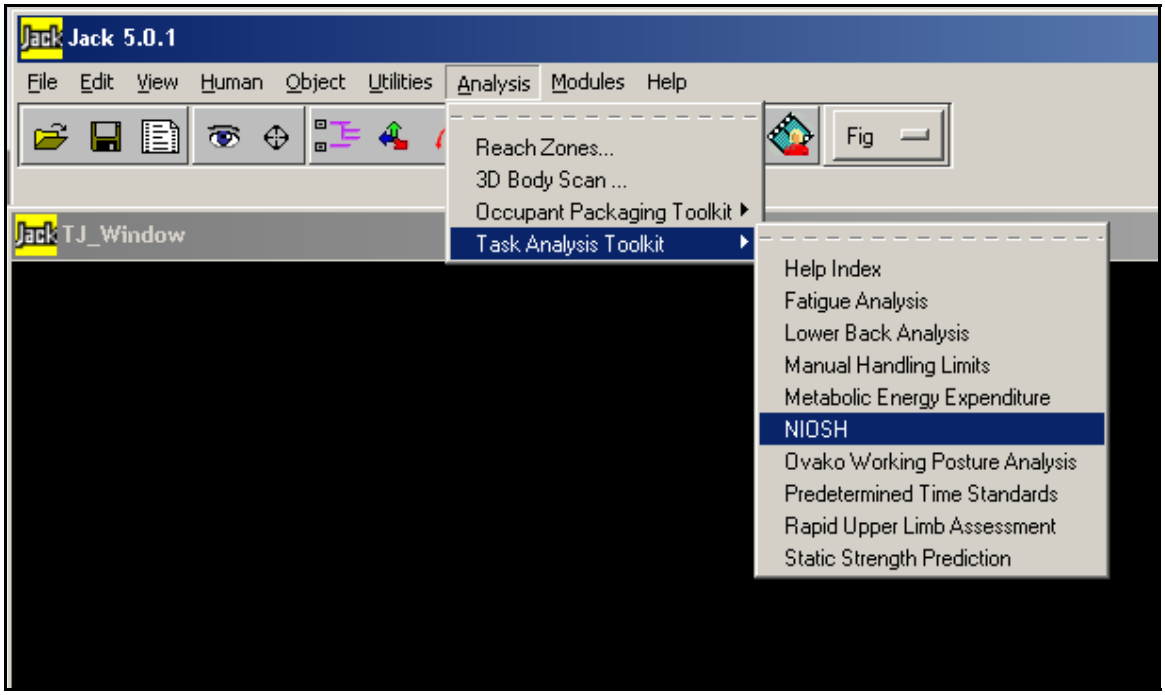
The estimated energy expenditure rate for this job (3.484 kcal/min) is above the recommended value of 2.721 kcal/min, inidicating an increased risk of injury due to fatigue. This job should be modified.Ways of reducing the energy expenditure rate include:

- Minimizing whole body motions (lifting, walking, climbing, etc.).
- Reducing the weight of the objects being manipulated.
- Reducing the frequency of the lifting activities.

NIOSH

The NIOSH Lifting Analysis tool allows user to evaluate lifting tasks based on NIOSH lifting equations developed by a committee of experts. The NIOSH lifting analysis tool considers posture of the worker, frequency of the lift and the couplings between the object and the worker's hands.

By using NIOSH lifting analysis tool users can estimate the expected weight under given posture and lifting frequency that most healthy workers can safely lift. NIOSH analysis tool also suggests some design changes and estimates the level of physical stress associated with lifting task.



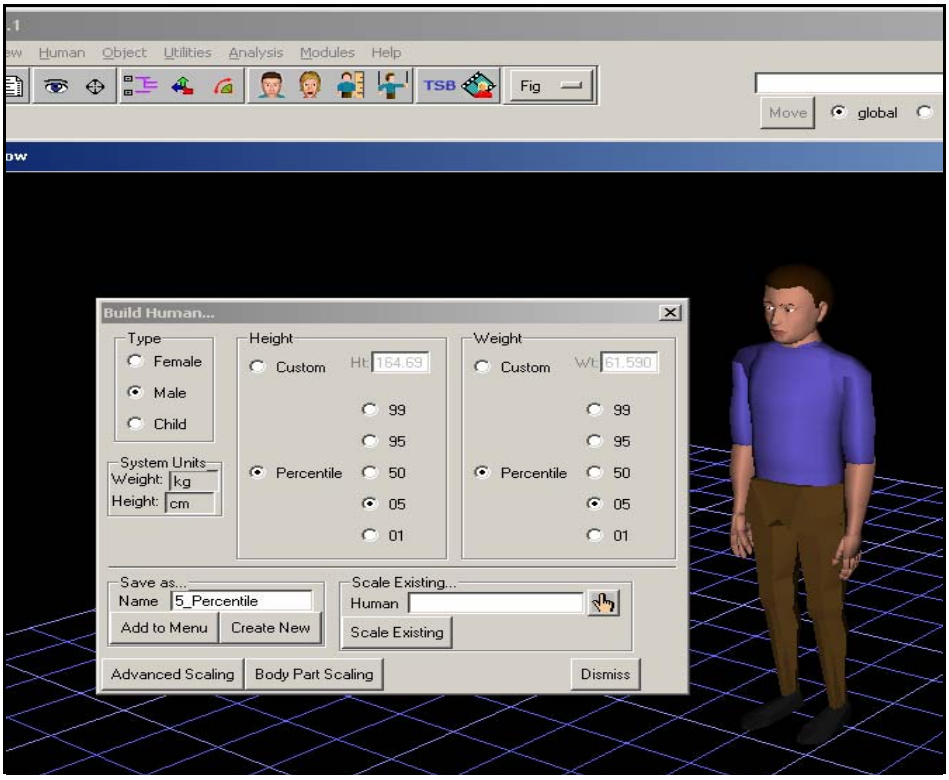
***Analysis Menu** – NIOSH*

This following example is conducted to evaluate the physical job for a worker who is lifting a box on squat position and preparing to place it on a table in a warehouse environment.

Step 1: Build Human - ***Anthropometry Information***

We need to know the worker's sex, weight, and height. This information is entered into The **Build Human** dialog box holds the related input variables and helps us to build our digital worker. Our sample digital worker will be a 5% percentile male (164.69 cm tall and 61.590 kg).

1) Go Human → Create →Custom
2) When the diolog box appear choose;
    a. Type = Male
    b. Height → Percentile = 05
    c. Weight → Percentile = 05
3) Save as.. → Name = *give any name you want*, ***ex. 5_Percentile***
4) Create New



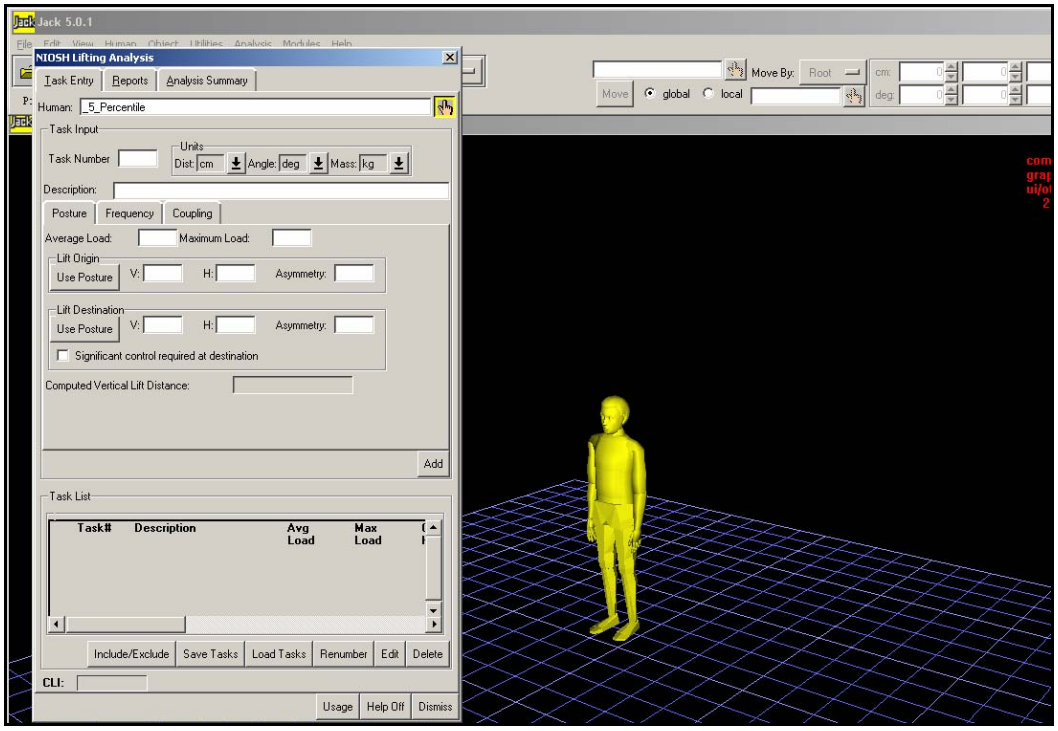
Note = In future, you can edit your human figure by using Scale Existing command in above dialog box by changing the anthropometry variables.

Step 2: NIOSH Analysis - *Setup*

1) After you built the desired posture go to;

→ Analysis → Task Analysis Toolkit → NIOSH

From the NIOSH Lifting Analysis window click on the hand tool and select your already built human.



2) Task Input

- Fill the task number and description options.
- You may also change the units if you are not going to use the metric system.

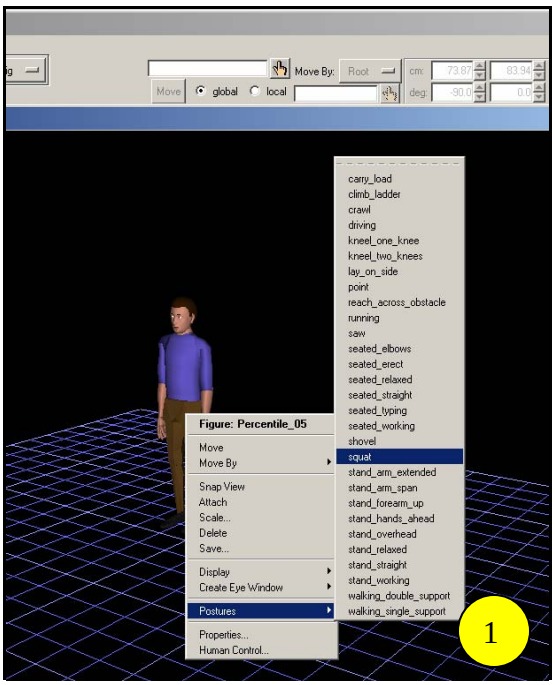
3) Posture

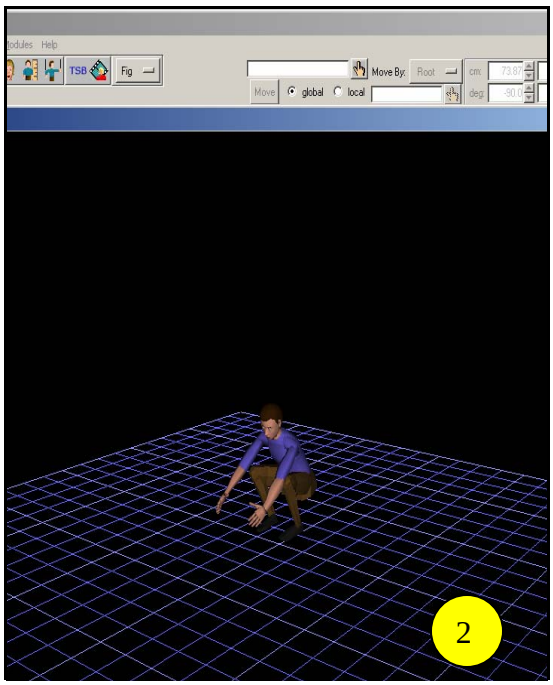
- Average Load = 5 kg
- Max Load = 7 kg

Next step is to develop Initial and Final Posture. After you developed the postures, click on the Use Posture button to assign the postures.

A) Lift Origin – *Initial Posture (squat)*

Worker starts the lifting task from squat position. The initial posture is going to be assigned to the Lift Origin.

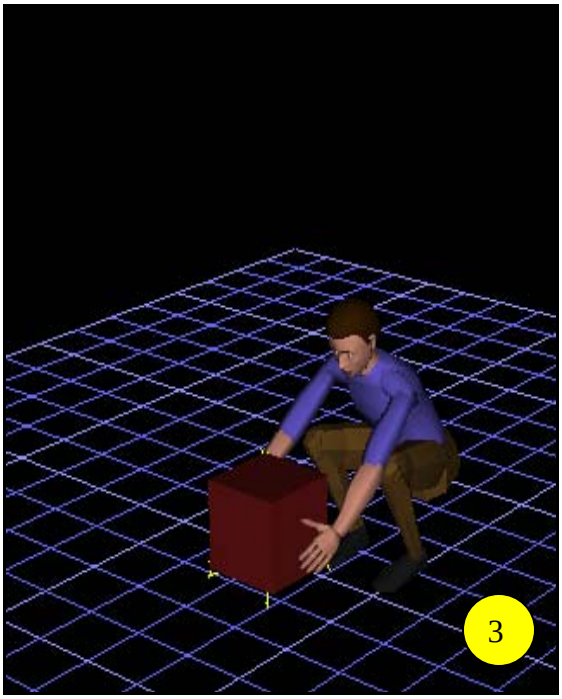




1) Squat Posture
   →Right click on the human model
   →Posture
   →Squat

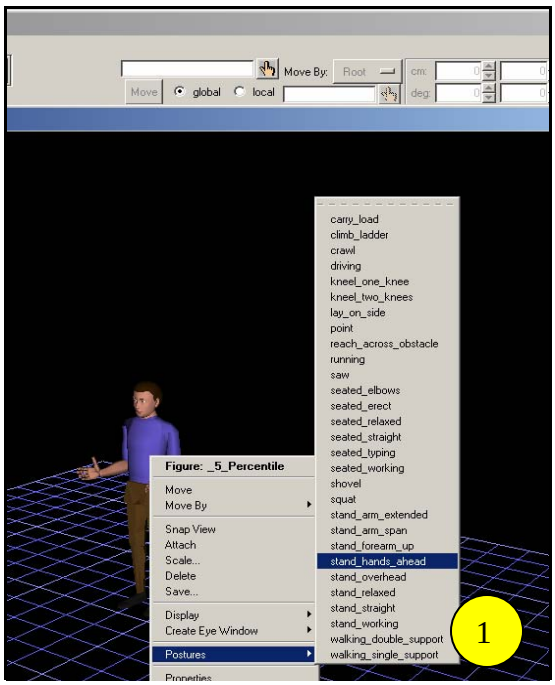
2) Squat Posture

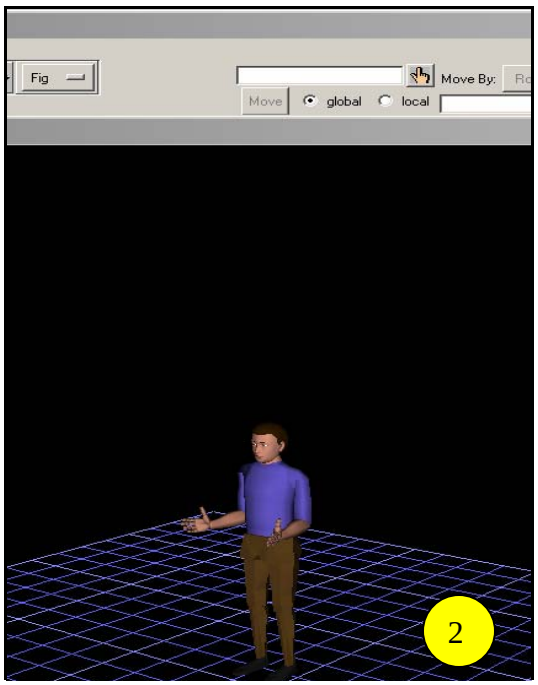
3) Demonstration of initial lifting posture with a box load.



B) Lift Destination – *Final Posture (stand - working)*

Worker finishes the lifting task by standing working position. The final posture is going to be assigned to the Lift Destination.

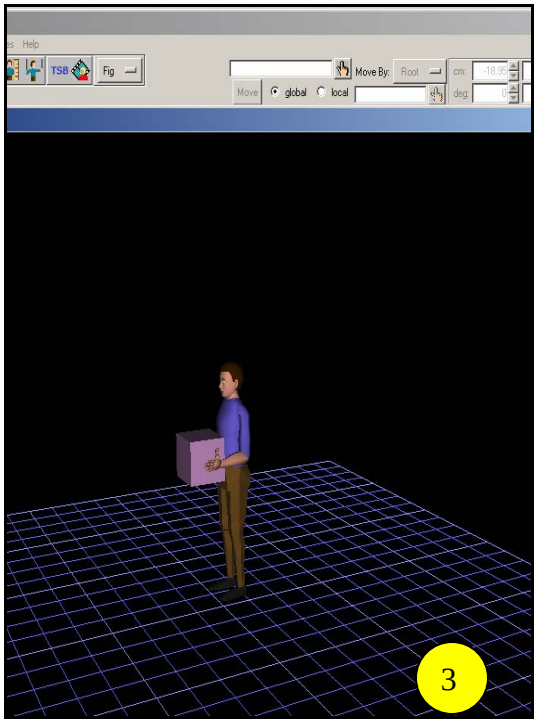




1) Stand Hands Ahead Posture
   →Right click on the human model
   →Posture
   →Stand_hands_ahead

2) Stand_hands_ahead posture

3) Demonstration of final lifting posture with a box load.



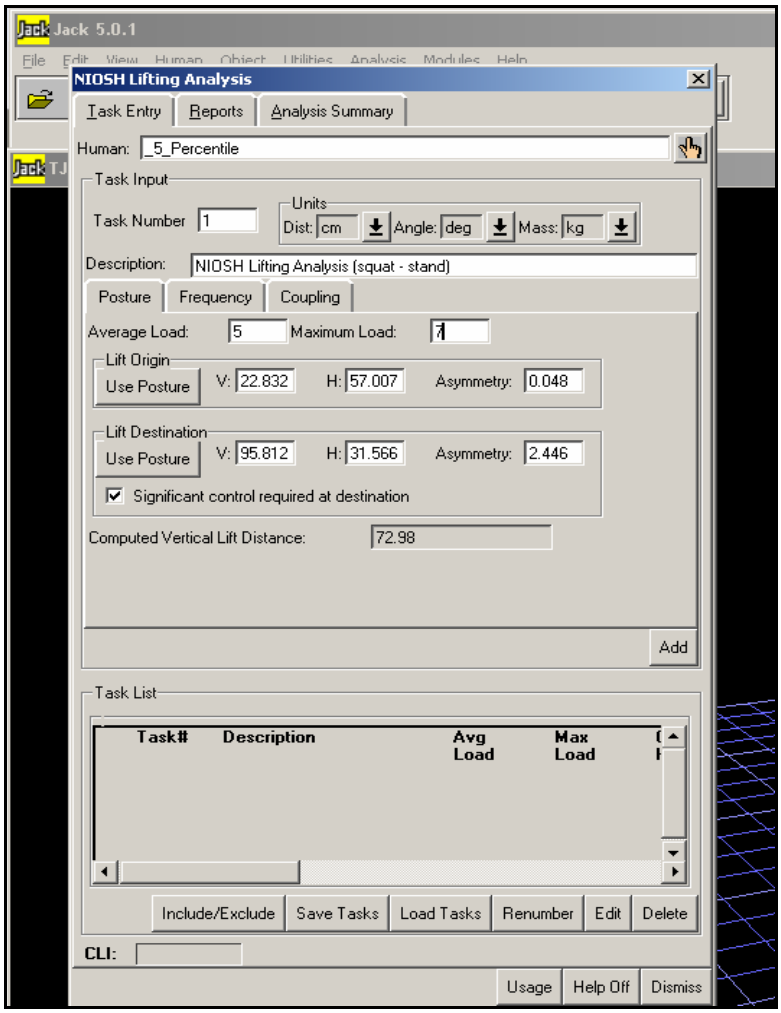


Figure 1 – *NIOSH Lifting Analysis Window*

After you assigned the postures by Use Posture button, now you should observe the changes on the NIOSH Lifting Analysis window (**Figure 1**).

We have finished the Posture tab. Now we need to input other information about lifting task features from Frequency and Coupling tabs.

4) Frequency

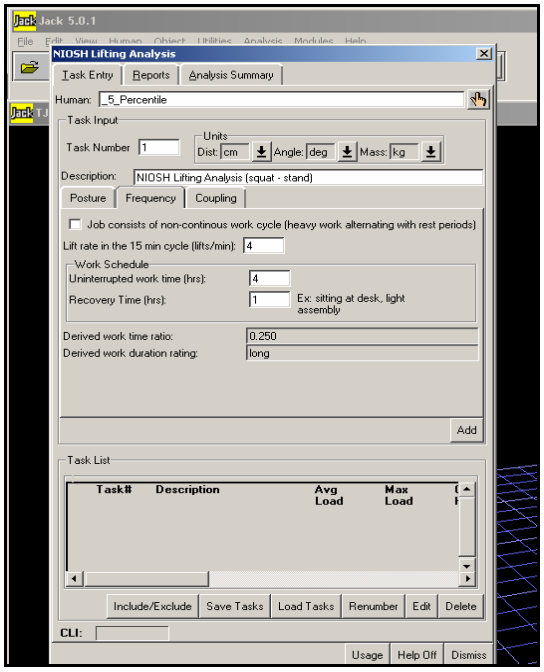


Figure 2

Lift rate in the 15 min cycle (lifts/min): 4

Work Schedule

Uninterrupted work time (hrs): 4

Recovery Time (hrs): 1

Figure 2- *Frequency*

5) Coupling

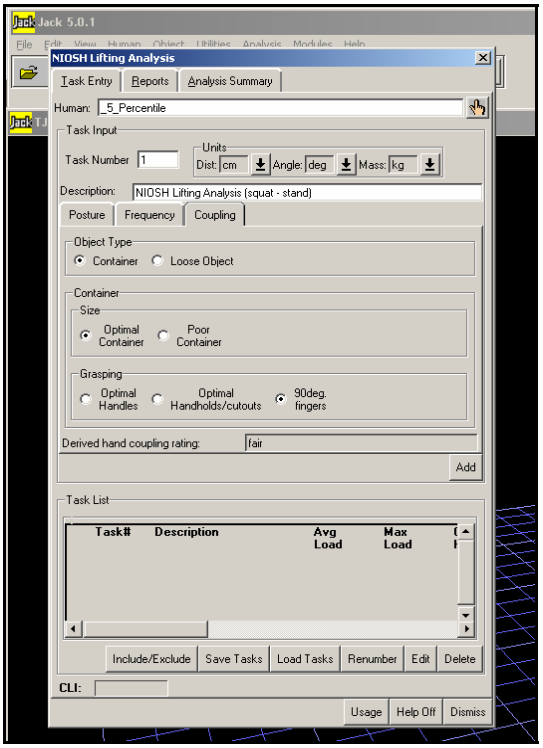


Figure 3

Object Type: Container

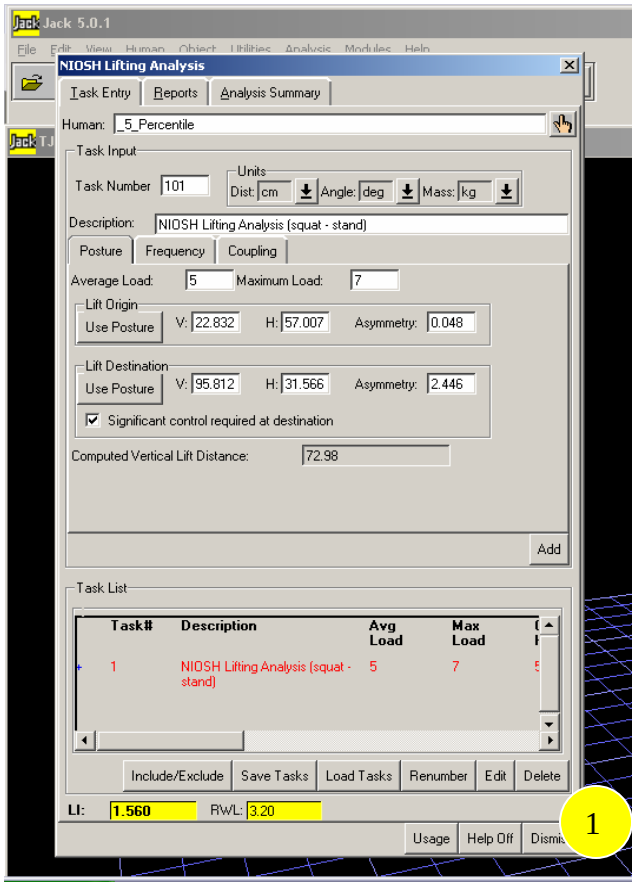
Container

Size: Optimal Container

Grasping: 90deg fingers

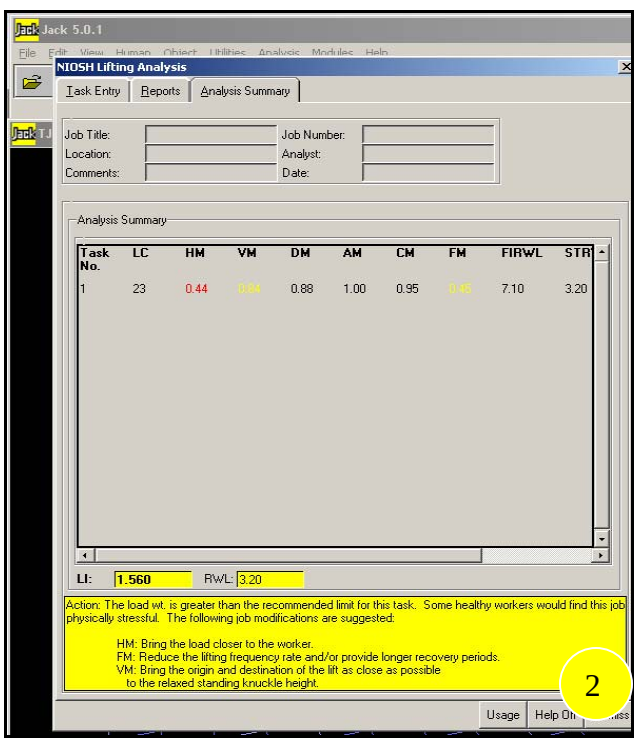
Figure 3- *Coupling*

Step 3: NIOSH Analysis – *Analysis*



1) Add Task

- After you have filled the necessary information in Posture, Frequency and Coupling tabs, return to the Posture tab under Task Entry tab and click Add.
    - ➢ You should observe that Task List window is activated after you click Add button.
- After you click Add, click on the Include/Exclude button to activate the current lifting task.
    - ➢ You should observe that LI and RWL variables are highlighted.

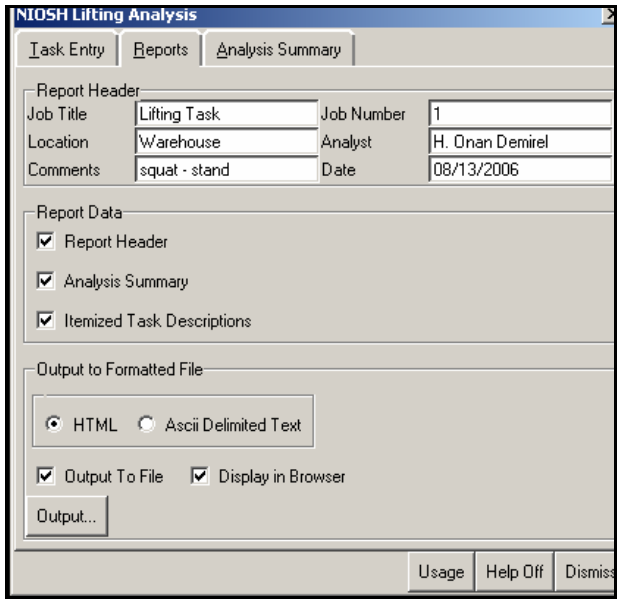


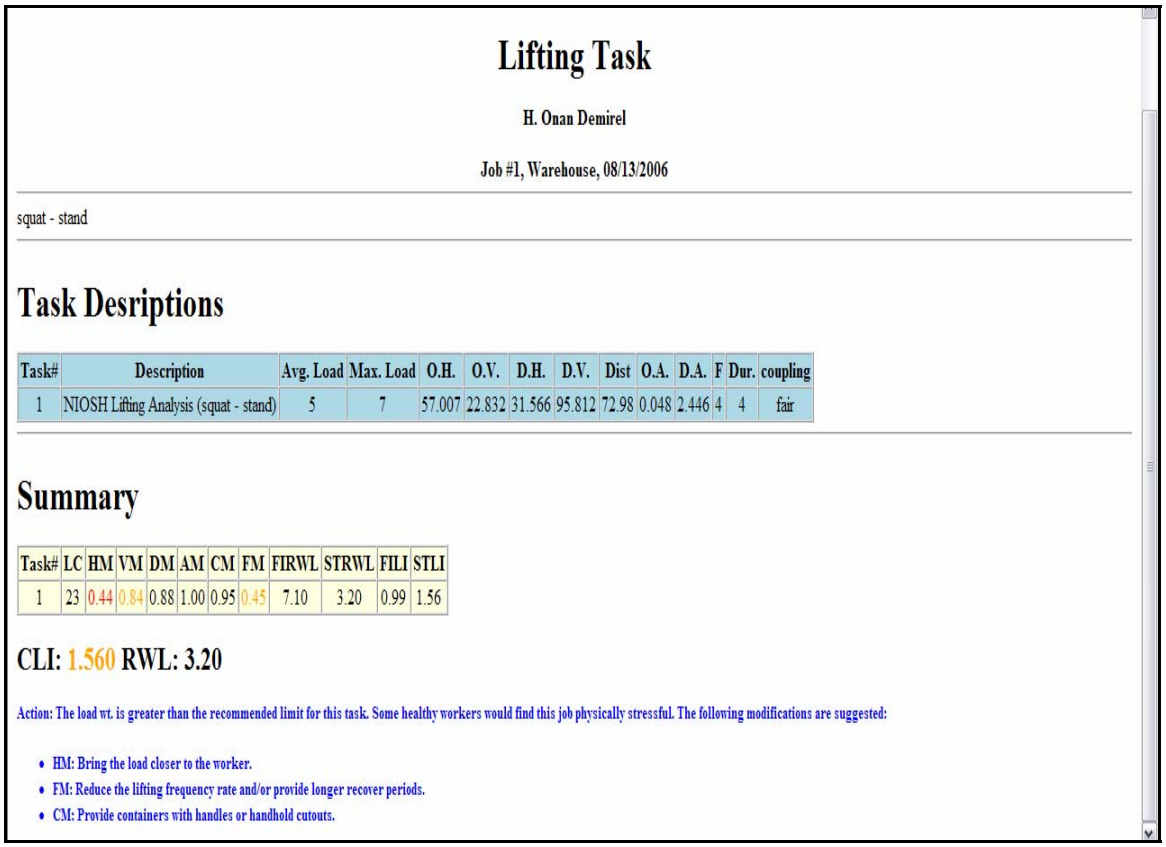
2) Analysis Summary

- Analysis summary window shows each design variables with corresponding values.
- Also, the highlighted box shows the information about the stress information and future design improvements.

Step 4: Analysis – *Output*

Jack's NIOSH Analysis module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, fill the Report Header, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Lifting Task

H. Onan Demirel

Job #1, Warehouse, 08/13/2006

squat - stand

Task Desriptions

Task#	Description	Avg. Load	Max. Load	O.H.	O.V.	D.H.	D.V.	Dist	O.A.	D.A.	F	Dur.	coupling
1	NIOSH Lifting Analysis (squat - stand)	5	7	57.007	22.832	31.566	95.812	72.98	0.048	2.446	4	4	fair

Summary

Task#	LC	HM	VM	DM	AM	CM	FM	FIRWL	STRWL	FILI	STLI
1	23	0.44	0.84	0.88	1.00	0.95	0.45	7.10	3.20	0.99	1.56

CLI: 1.560 RWL: 3.20

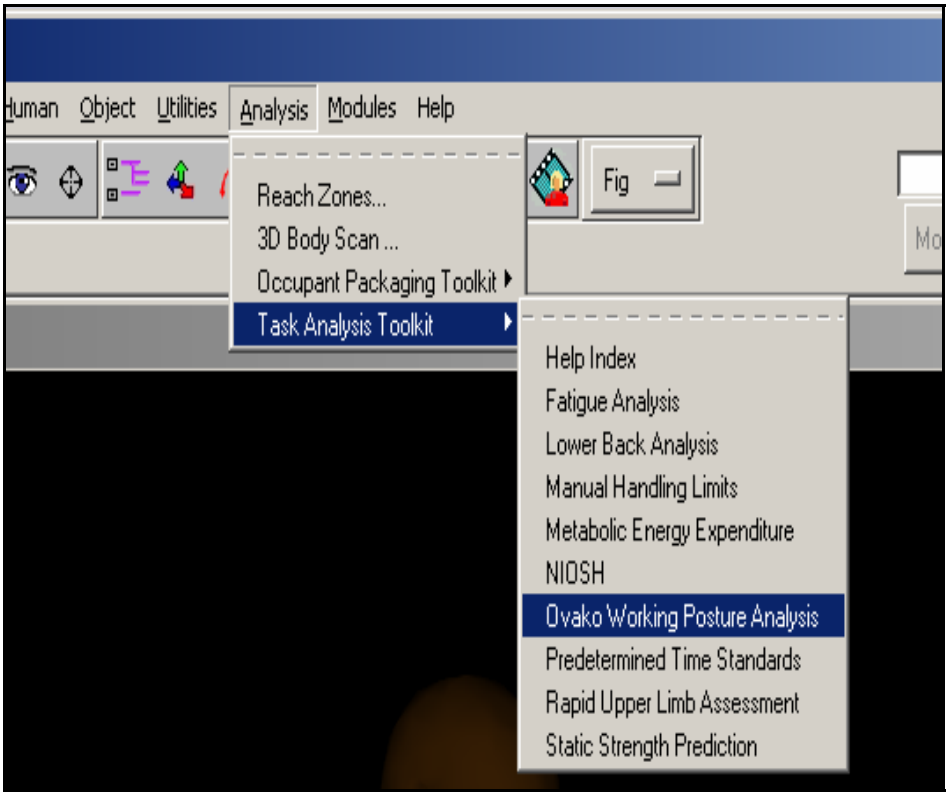
Action: The load wt. is greater than the recommended limit for this task. Some healthy workers would find this job physically stressful. The following modifications are suggested:

- HM: Bring the load closer to the worker.
- FM: Reduce the lifting frequency rate and/or provide longer recover periods.
- CM: Provide containers with handles or handhold cutouts.

Ovako Working Posture Analysis

The Ovako Working Posture Analysis module is a comfort evaluating tool which is based on Ovako Working Posture Analysis System (OWAS). Users can check the comfort of working postures and evaluate their design by calculated posture score.

The Ovako Working Posture Analysis module develops a quick report which includes comfort/discomfort evaluation based on positioning of the arms, legs, trunk, back and the assigned loads.

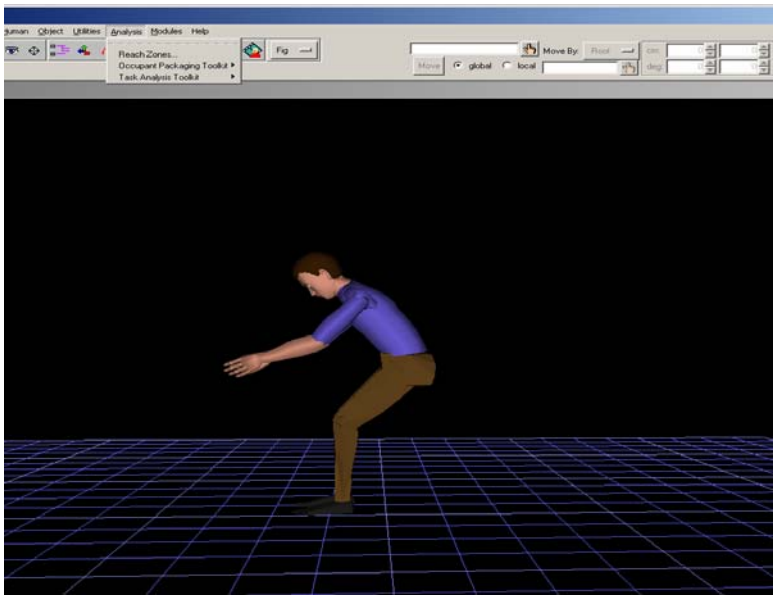


Analysis Menu – *Ovako Working Posture Analysis*

Note: Results and scoring methodology is based on Ovako Working Posture Analysis System (OWAS). Check the OWAS guidelines for further analyses.

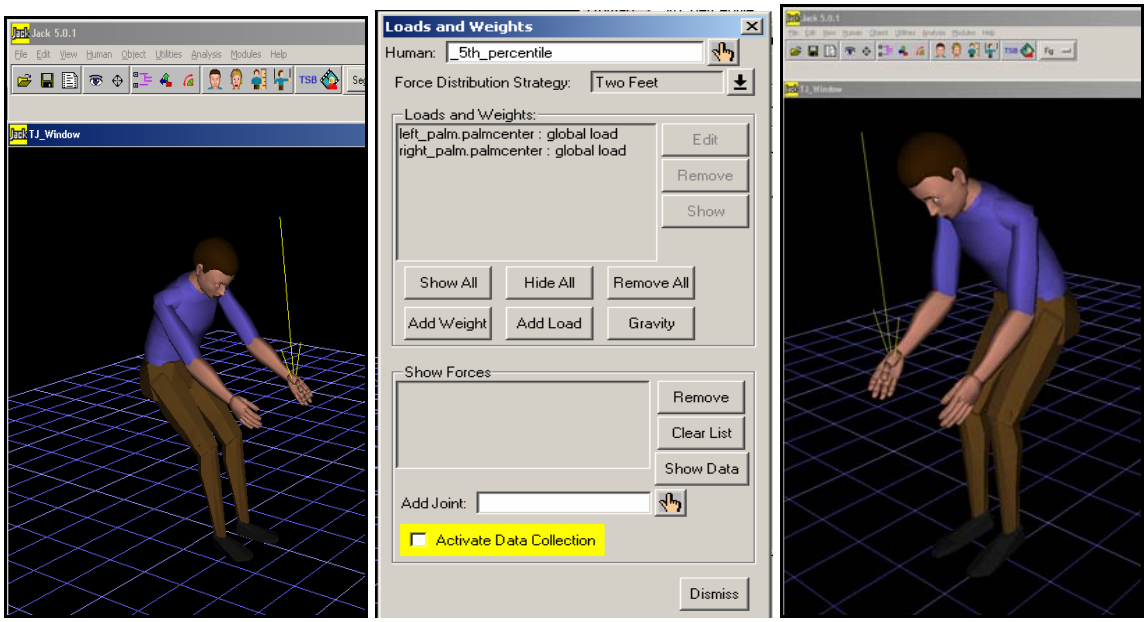
Step 1: Build Human – *Posture*

Please check the Static Strength Prediction and Lower Back Analysis help documentation for the development of the human posture. The exact same human model is used in this example.



Step 2: Ovako Working Posture Analysis Setup – *Loads*

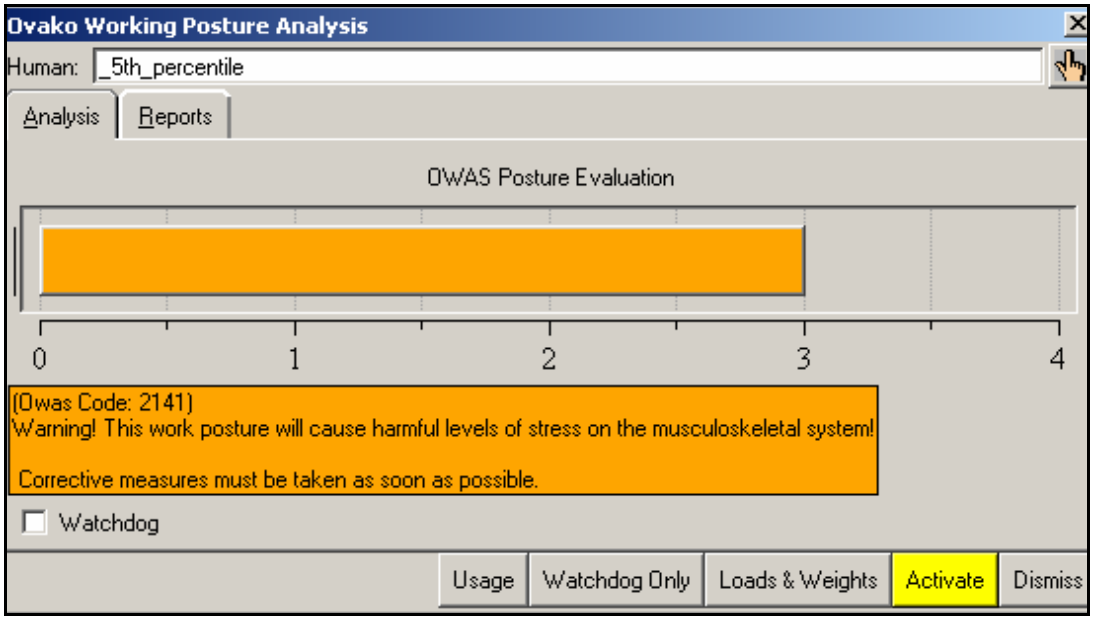
Please check the Static Strength Prediction and Lower Back Analysis help documentation for the load assignment. The exact same loads are used in this example.



Step 3: Activate - *Run the Ovako Working Posture Analysis*

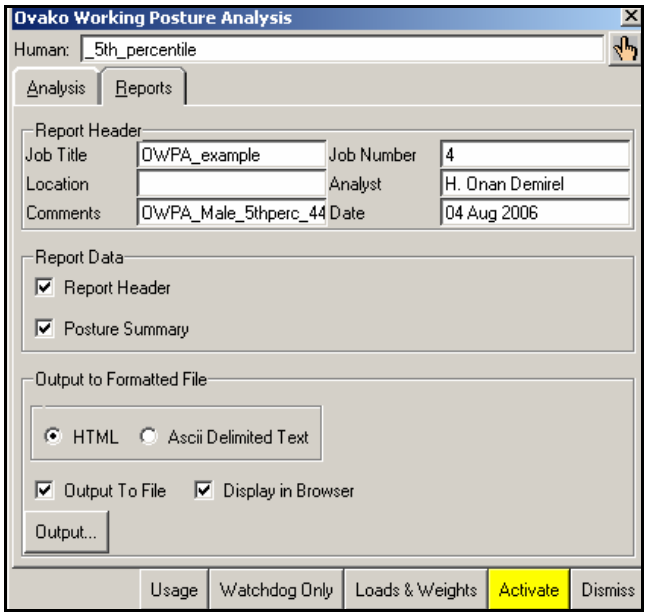
After you finish the Step 1 & 2, click the Activate tab on the Ovako Working Posture Analysis main window. This will simulate the applied loads and the relative posture by using OWAS guidelines.

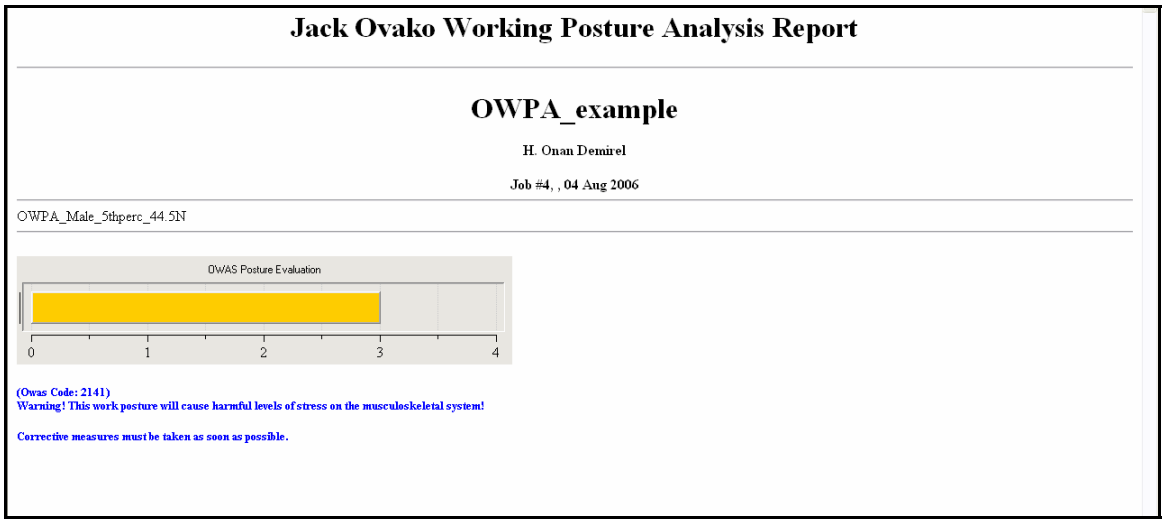
When you click Activate, first thing you should notice is the OWAS Posture Evaluation chart and the highlighted information box.



Step 4: Analysis – *Output*

Jack's Ovako Working Posture Analysis module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.



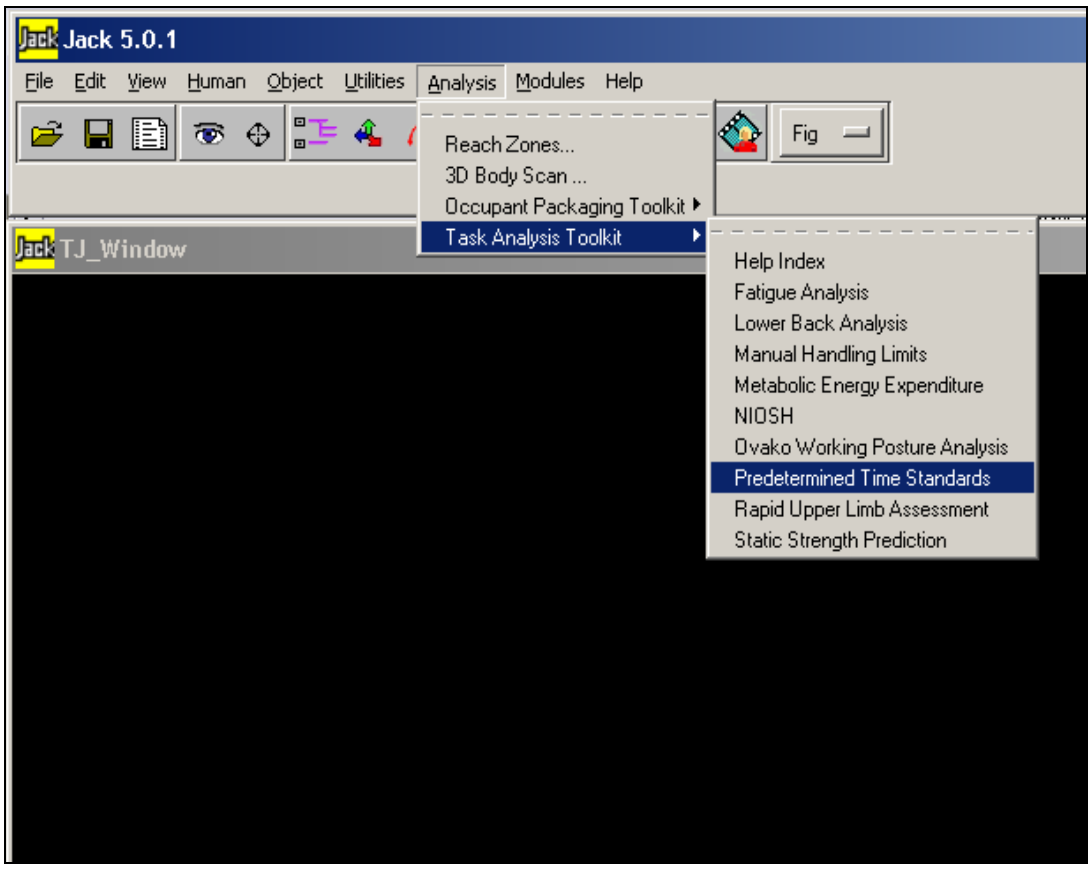


Predetermined Time Standards

The Predetermined Time Standards tool allows users to predict the required time to perform a task. Users can divide the task into set of motions and assign times based on MTM-1 (Methods-Time Measurement)

By using the Predetermined Time Standards tool users can;

- improve the cycle times
- evaluate alternate work methods
- design workbenches
- decrease the excess time to perform a task.



Analysis – *Predetermined Time Standards*

This following example is conducted to demonstrate how Jack's Predetermined Time Standards can be used to evaluate a simple sorting task.

Step 1: Workplace Layout – *Parts Movement Operation*

The workplace is a warehouse environment where the worker needs to work on a simple sorting task. There are four circular objects on the top row of a work board and four circular holding places. The worker has to take the objects on the top row and place it to assigned location on the bottom area of the work board. At the end of each assigned task, worker needs to press down the buttons. **(Figure 2)**

This is a simple sorting task intended to show the user interface and the applications of the Jack's Predetermined Time Standards. One can think about more complex sorting task where workers on the automotive assembly line pick fasteners and place them into the right location.

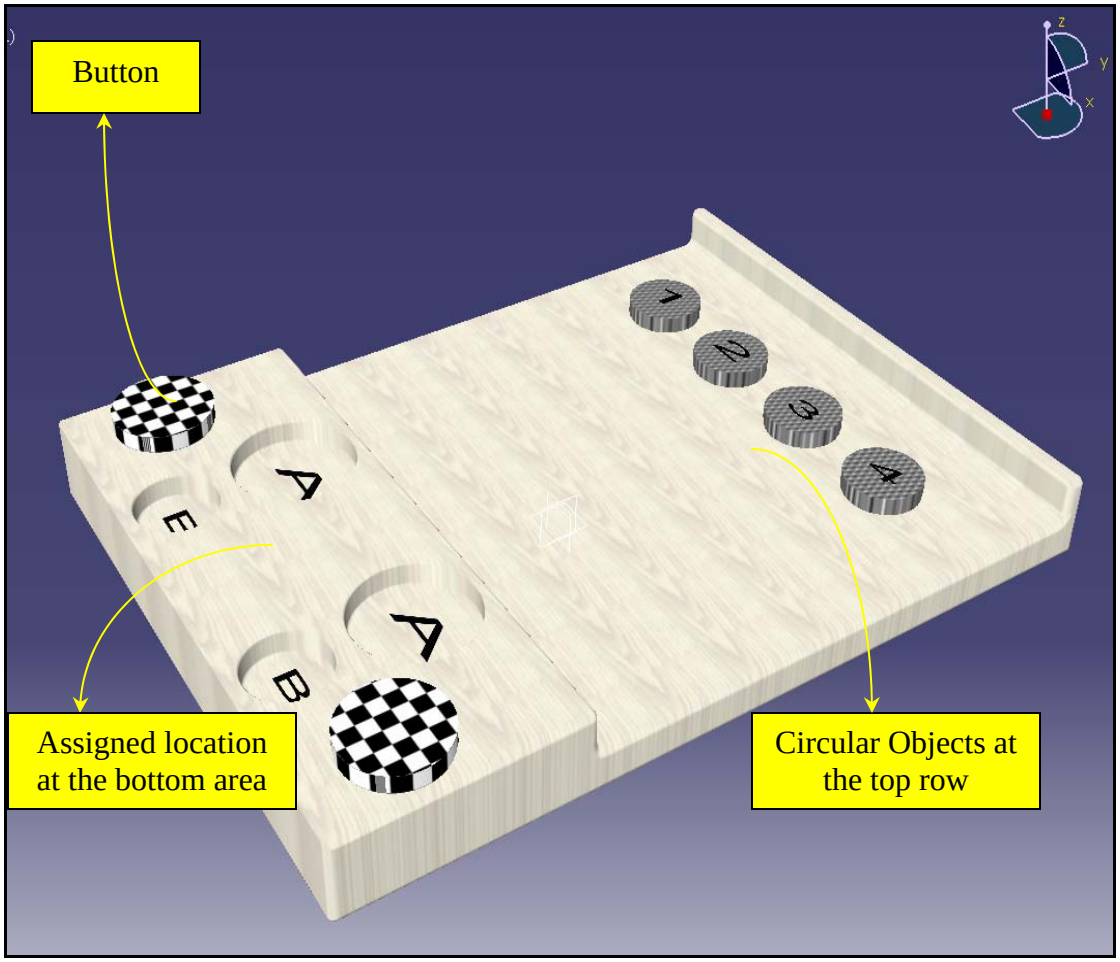


Figure 2 – *Work board*

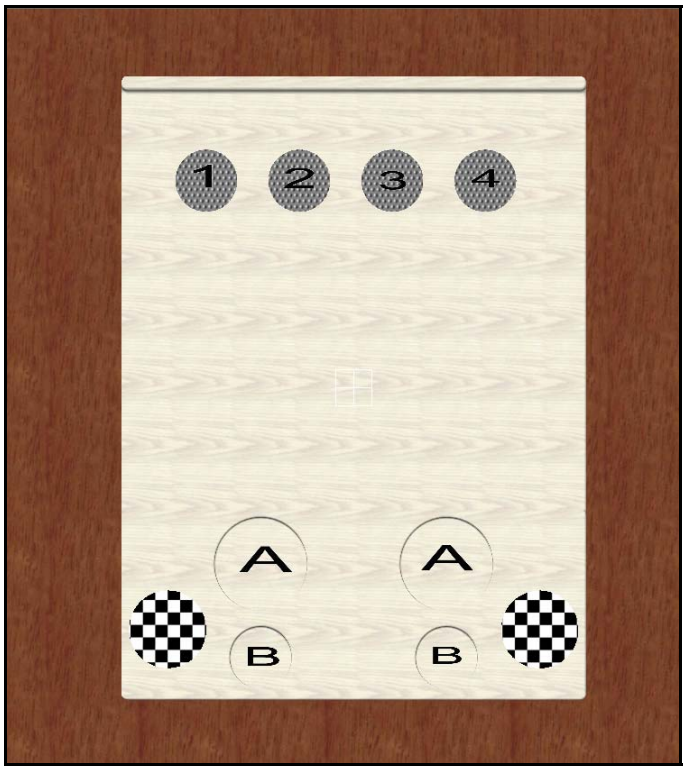


Figure 3 – *Motion Assignment Layout*

MTM Analysis For: Parts Movement Operation **Element 1:** *Pick up parts from top row and move to bottom area.*		
Left Hand		Right Hand
Motion Description		Motion Description
Break Contact		Break Contact
Reach for Object 1		Reach for Object 4
		Grasp Object 4
Grasp Object 1		
Move Object 1 to A		Move Part 4 to A
Release		Release
Reach for Object 2		Reach for Object 3
		Grasp Object 3
Grasph Object 2		
Move Object 2 Close to B		Move Part 3 to B
Move to Exact Location		Release
Position		
Release		
Reach to Button		Reach to Button
Press Down		Press down

Step 2: **Setup Predetermined Time Standards - *Task Entry***

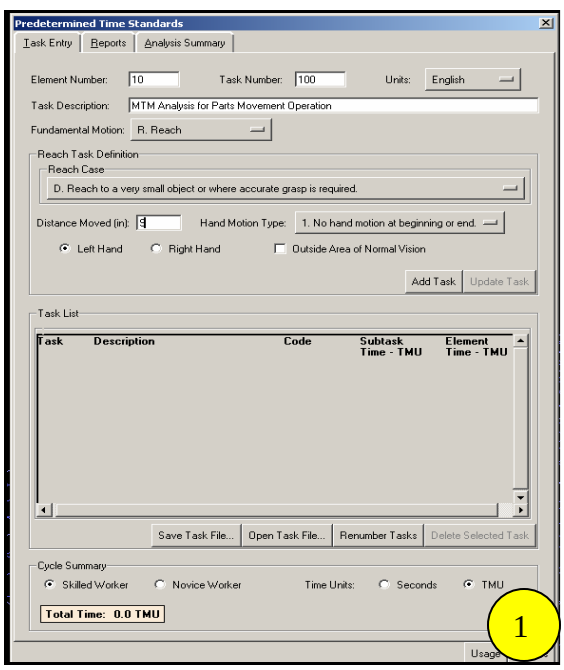
After you decide the motion assignments, go;

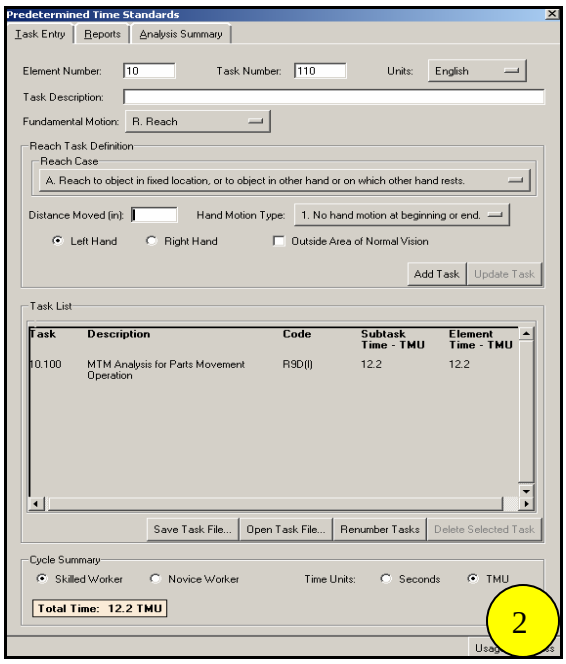
Analysis → Task Analysis Toolkit → Predetermined Time Standards

From the Task Entry window you can start entering your motions and task definitions. Example Below shows how to assign *Reach for Object 1 (R9D).*

1) Task entry variable selection;

- You can input different Element Number and Task Number. We use the default setting in this case.
- We use English units; you can choose either English or metrics units.
- Fundamental Motion is Reach in this case. You can choose any other motions from the Fundamental Motion pull down menu.
- Reach Case is option D. Again, choose any other option from the Reach Case pull down menu.
- You can choose any other options depending on the motion preferences depending on the selected Fundamental Motion. In this case, we specify the Distance Motion, Hand Motion Type and selected hand.

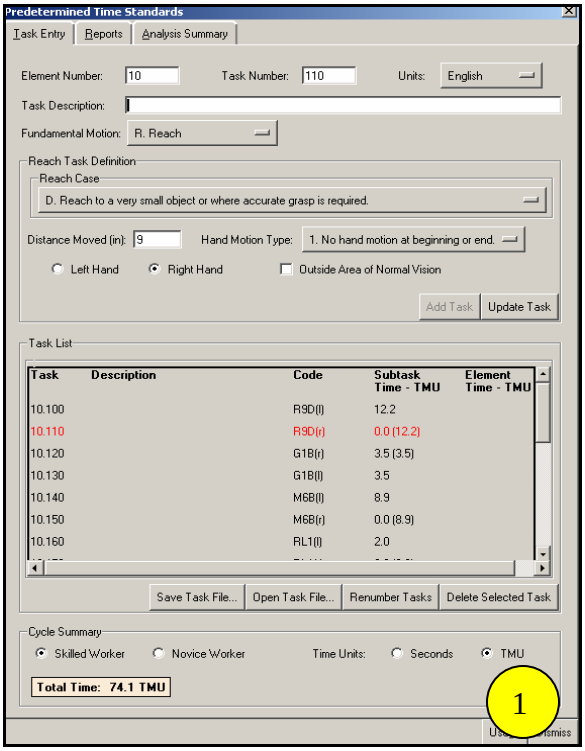




2) Add Task;

- After you make you selections, click on Add Task button. This will add your specific task with time measurements. You can use either TMU or seconds as time units.
- Also you can select between Skilled Worker and Novice Worker depending on your work design.

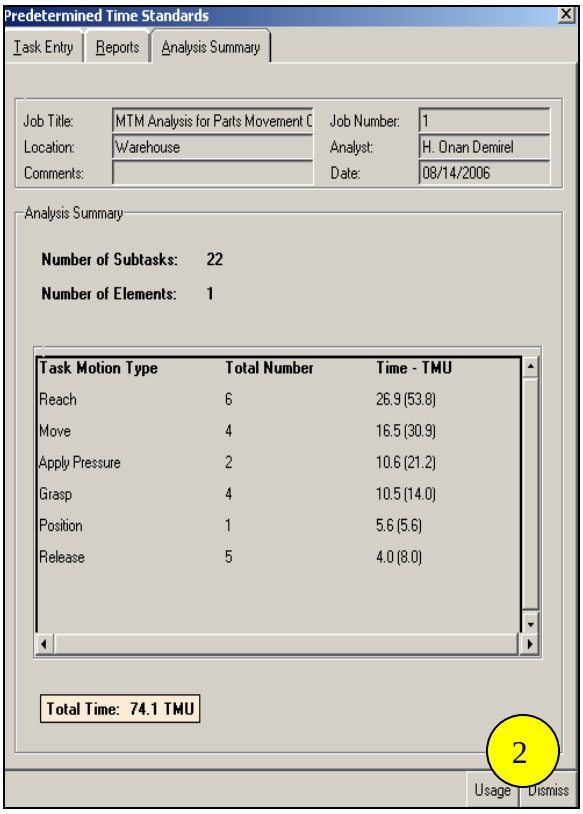
Step 3: Predetermined Time Standards Analysis – *Analysis Summary*



1) Update Task;

After you finish your Task Entry, you should observe that Total Time is highlighted.

You can change any motion, by clicking on the desired motion at the Task List. When you click one, it turned into red in color and predefined task definitions are appeared. You can make changes and click Update Task to finalize any change.



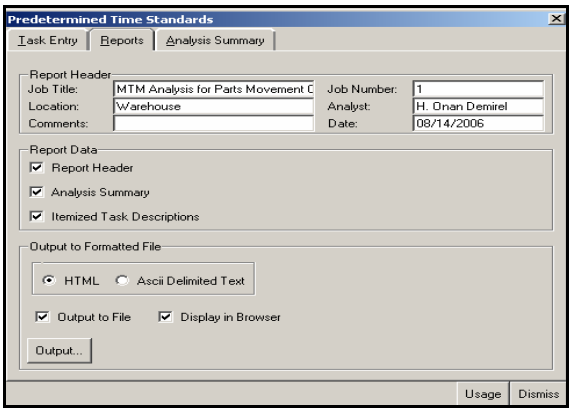
2) Analysis Summary;

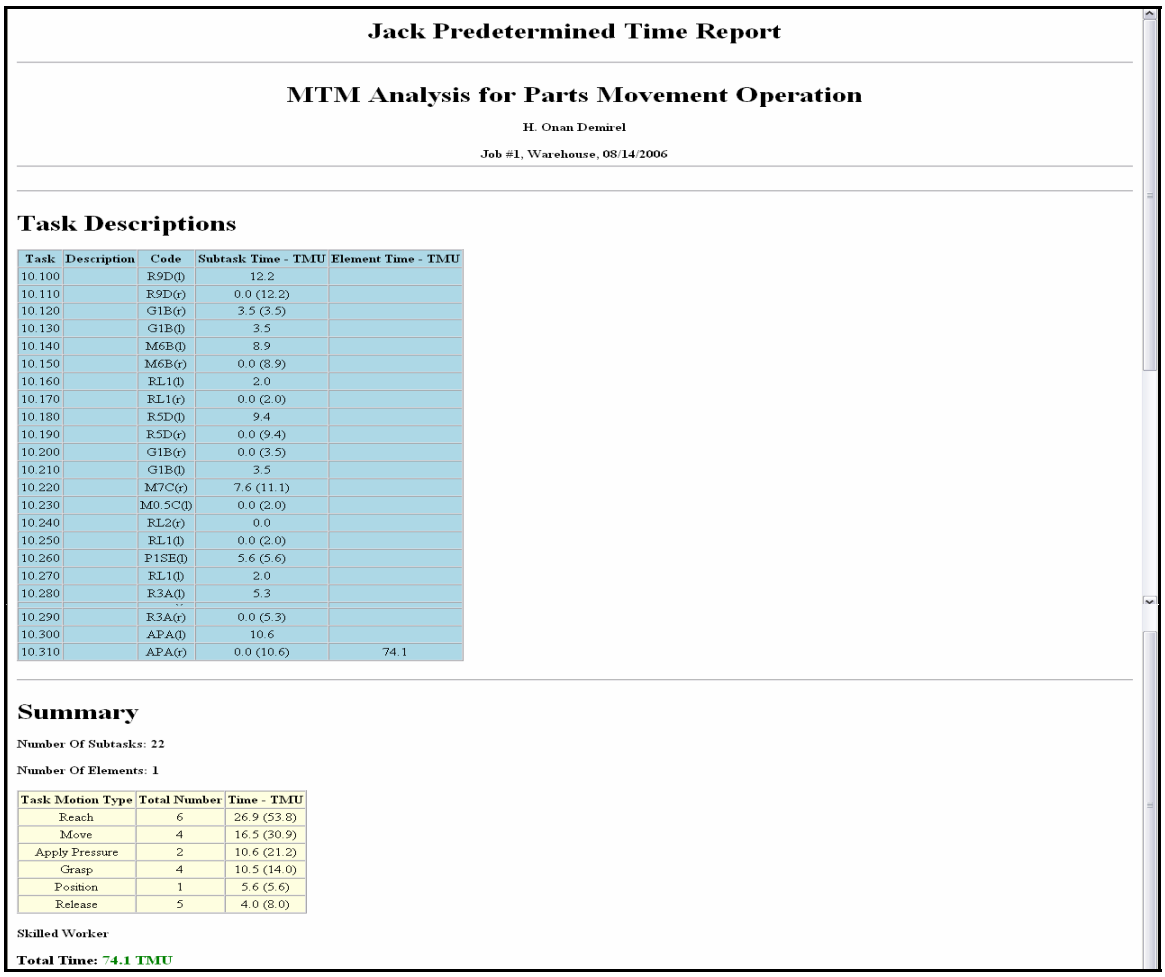
You can find detailed summary of your work assignment with task motions under Analysis Summary tab.

One can see the defined task motions, total number of motions and the time length of each motion type.

Step 4: Analysis – *Output*

Jack's Predetermined Time Standards module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, fill the Report Header, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Jack Predetermined Time Report

MTM Analysis for Parts Movement Operation

H. Onan Demirel

Job #1, Warehouse, 08/14/2006

Task Descriptions

Task	Description	Code	Subtask Time - TMU	Element Time - TMU
10.100		R9D(l)	12.2	
10.110		R9D(r)	0.0 (12.2)	
10.120		G1B(r)	3.5 (3.5)	
10.130		G1B(l)	3.5	
10.140		M6B(l)	8.9	
10.150		M6B(r)	0.0 (8.9)	
10.160		RL1(l)	2.0	
10.170		RL1(r)	0.0 (2.0)	
10.180		R5D(l)	9.4	
10.190		R5D(r)	0.0 (9.4)	
10.200		G1B(r)	0.0 (3.5)	
10.210		G1B(l)	3.5	
10.220		M7C(r)	7.6 (11.1)	
10.230		M0.5C(l)	0.0 (2.0)	
10.240		RL2(r)	0.0	
10.250		RL1(l)	0.0 (2.0)	
10.260		P1SE(l)	5.6 (5.6)	
10.270		RL1(l)	2.0	
10.280		R3A(l)	5.3	
10.290		R3A(r)	0.0 (5.3)	
10.300		APA(l)	10.6	
10.310		APA(r)	0.0 (10.6)	74.1

Summary

Number Of Subtasks: 22

Number Of Elements: 1

Task Motion Type	Total Number	Time - TMU
Reach	6	26.9 (53.8)
Move	4	16.5 (30.9)
Apply Pressure	2	10.6 (21.2)
Grasp	4	10.5 (14.0)
Position	1	5.6 (5.6)
Release	5	4.0 (8.0)

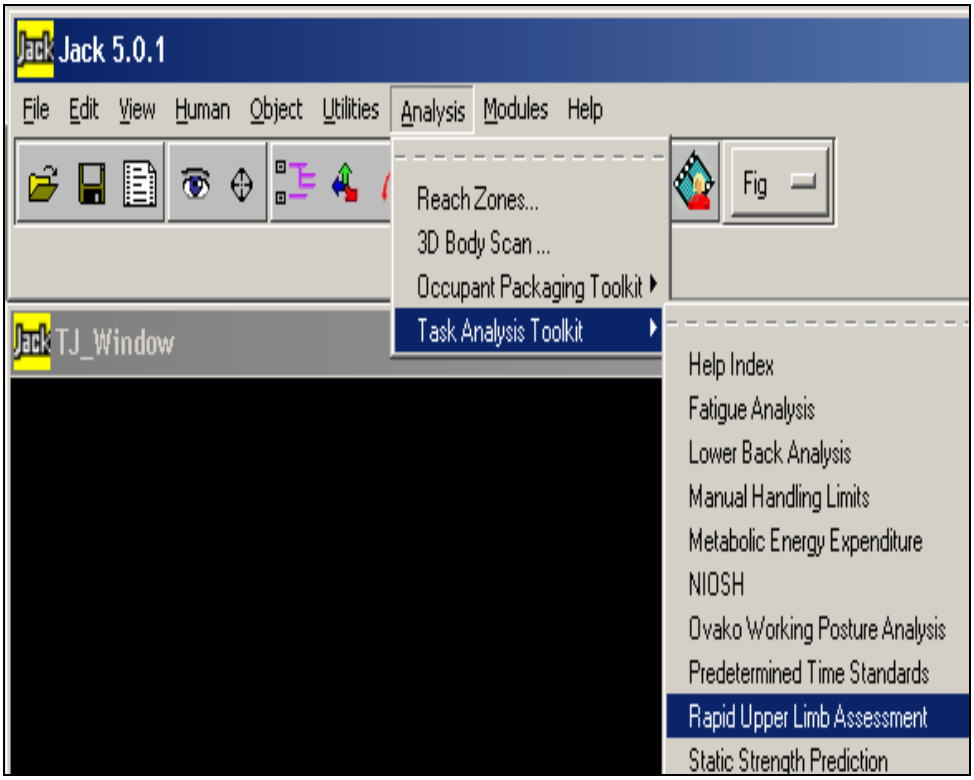
Skilled Worker

Total Time: 74.1 TMU

Rapid Upper Limb Assessment

The Rapid Upper Limb Assessment module is an evaluation aid for workers who under upper limb disorder risks. This module is based on Rapid Upper Limb Assessment (RULA). Users can select the working conditions from Task Entry tab and then evaluate their design aspects.

The Rapid Upper Limb Assessment module forms a quick report that includes posture rating, muscle use, weight of loads, frequency and task duration.

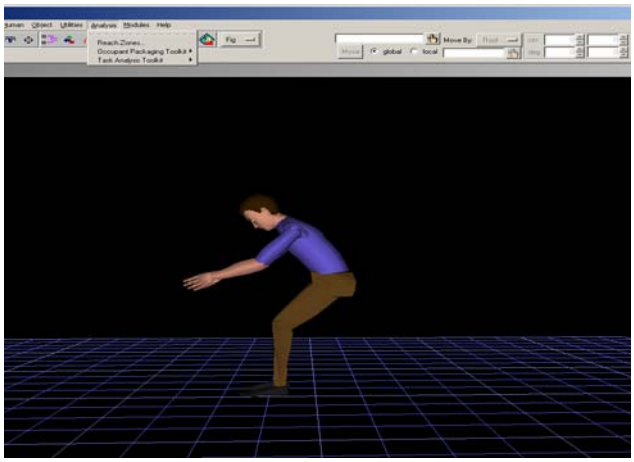


Analysis Menu – *Rapid Upper Limb Assessment*

Note: Results and scoring methodology is based on Rapid Upper Limb Assessment (RULA). Check the RULA guidelines for further analyses.

Step 1: Build Human – *Posture*

Please check the Static Strength Prediction and Lower Back Analysis help documentation for the development of the human posture. The exact same human model is used in this example.

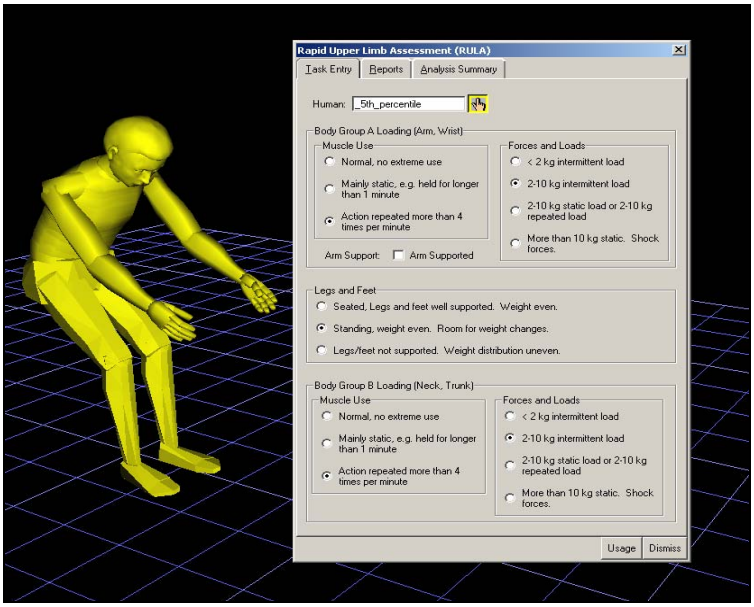


Note: You don't need to assign loads in this analysis module. However, you need to form a posture.

Step 2: Task Entry - *Setup Rapid Upper Limb Assessment (RULA)*

- After Step 1, go to Rapid Upper Limb Assessment module and use the hand tool to select the already built human body.

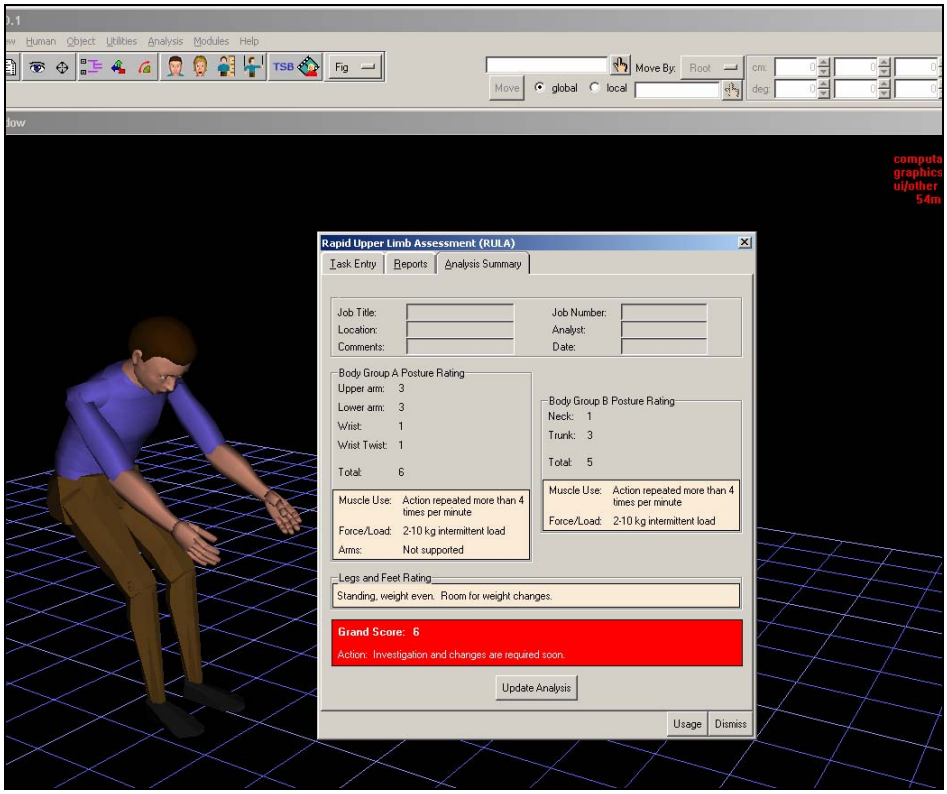
- Select the corresponding pre-defined choices (depending on the nature of your work design) from Task Entry form as shown below. In this example Task Entry choices follows the below figure.



Step 3: Analysis Summary – *Grand score*

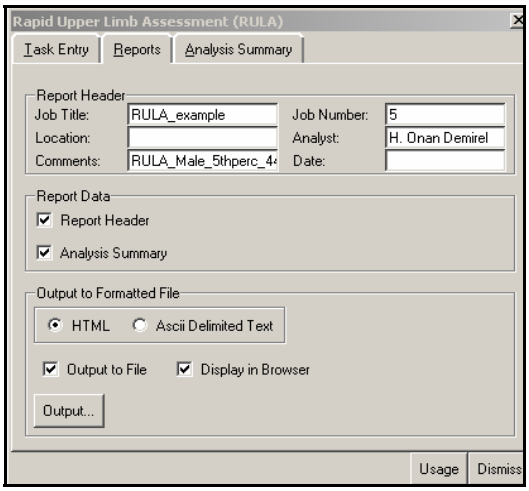
After you made your choices in the Task Entry tab, click on the Analysis tab to activate the Rapid Upper Limb Assessment (RULA) analysis. This will simulate your Task Entry choices relative to the posture.

When you click Analysis Summary tab, posture ratings, muscle use and Force/Load analysis is developed for Body Group A (Arm, Wrist), Body Group B (Neck, Trunk), Legs and Feet. In addition, Grand Score is calculated as seen in figure below. In this example, Grand Score calculation suggests a design change.



Step 4: Analysis – *Output*

Jack's Rapid Upper Limb Assessment (RULA) module develops an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.



Jack Rapid Upper Limb Assessment Report

RULA_example

H. Onan Demirel

Job #5, ,

RULA_Male_5thperc_44.5

Analysis Summary

Body Group A Posture Rating

Upper arm: 3
Lower arm: 3
Wrist: 1
Wrist Twist: 1
Total: 6

Muscle Use: Action repeated more than 4 times per minute
Force/Load: 2-10 kg intermittent load
Arms: Not supported

Body Group B Posture Rating

Neck: 1
Trunk: 3
Total: 5

Muscle Use: Action repeated more than 4 times per minute
Force/Load: 2-10 kg intermittent load

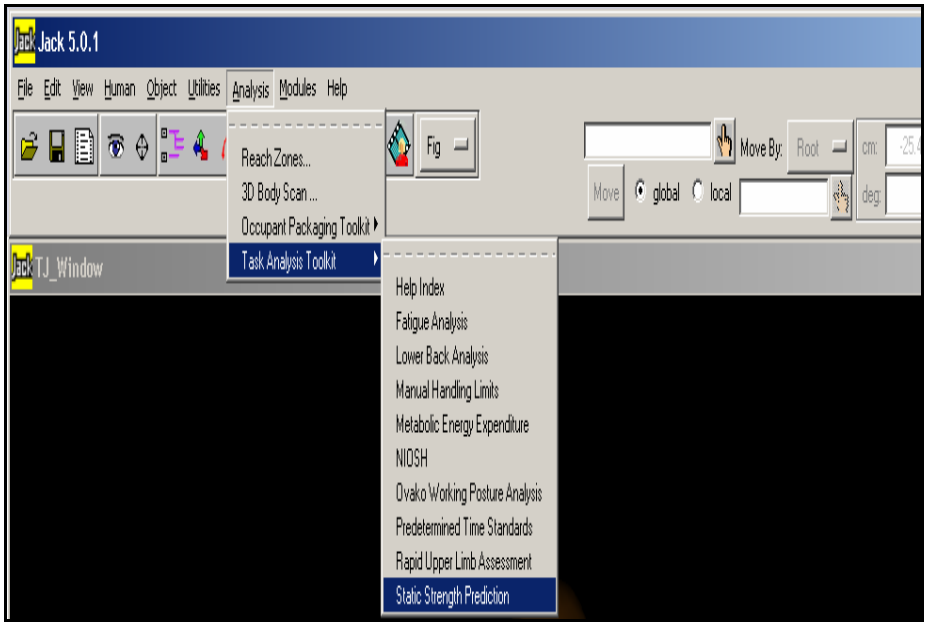
Legs and Feet Rating

Standing, weight even. Room for weight changes.

Grand Score: 6

Action: Investigation and changes are required soon.

Static Strength Prediction



Analysis Menu - *Static Strength Prediction*

The Static Strength Prediction tool provides an approximate strength prediction for many job simulations. Static Strength Prediction tool can be applied in the evaluation of the physical job and workplace design.

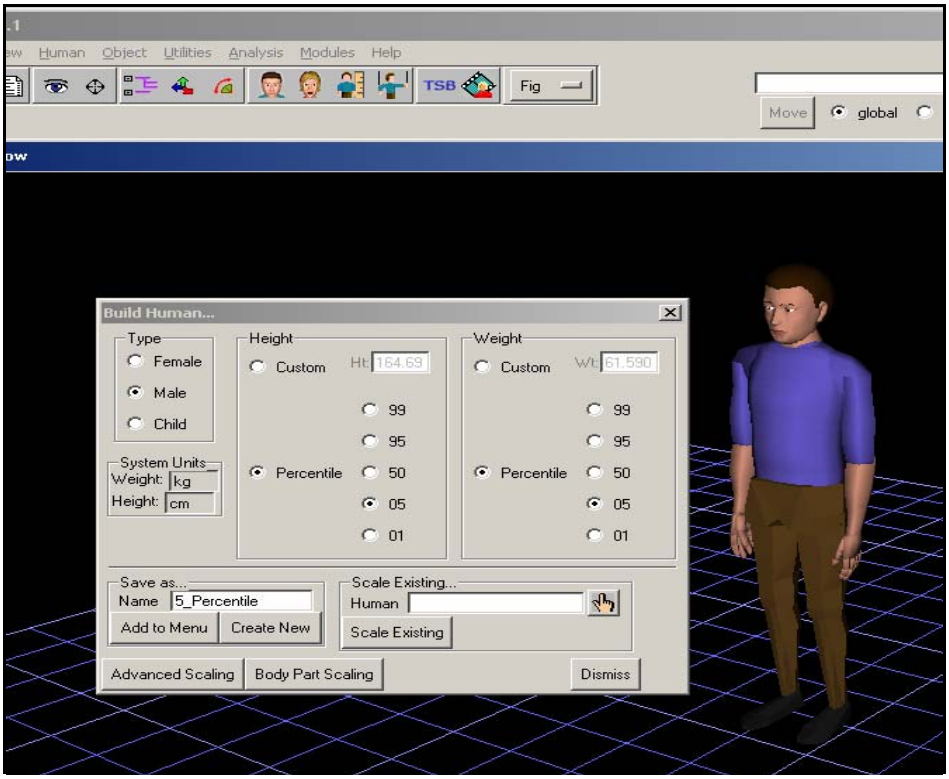
The user can form real human postures and assigns loads to the manikin depending on the needs of the work environment. This job simulation application enables users to analyze the posture parameters, male/female anthropometry, forces and moments exerted on the manikin. In addition, the output report includes strength performance percentages of the men/women, capability chart, calculated joint angles, and highlighted body segments.

This following example will be conducted to evaluate the physical job for a worker who is lifting a heavy box and preparing to place it on a dolly in a warehouse environment. In order to make a realistic posture and joint angles estimation, a snap-shot form a real working environment will be used. After that anthropometrical variables will be selected and desired loads will be applied. At the end, complete analysis and a final report will be developed for evaluation.

Step 1: Build Human - ***Anthropometry Information***

We need to know the worker's sex, weight, and height. This information is entered into The **Build Human** dialog box holds the related input variables and helps us to build our digital worker. Our sample digital worker will be a 5% percentile male (164.69 cm tall and 61.590 kg).

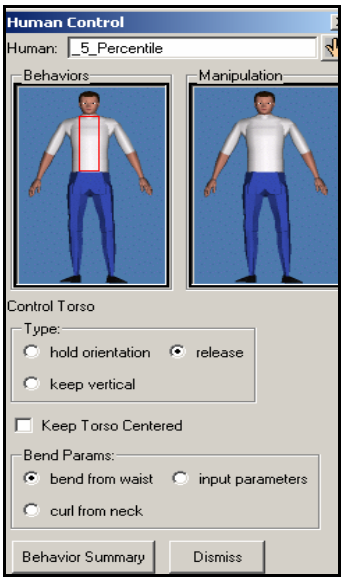
1) Go Human → Create →Custom
2) When the dialog box appear choose;
    a. Type = Male
    b. Height → Percentile = 05
    c. Weight → Percentile = 05
3) Save as.. → Name = *give any name you want*, ***ex. 5_Percentile***
4) Create New

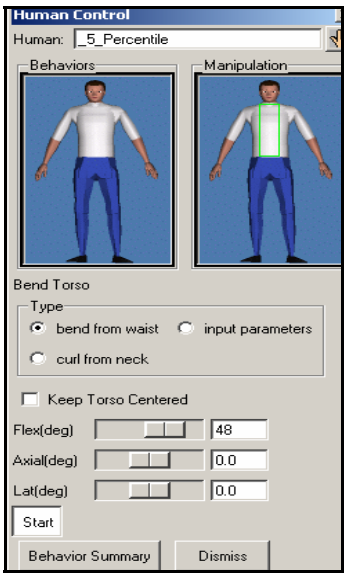


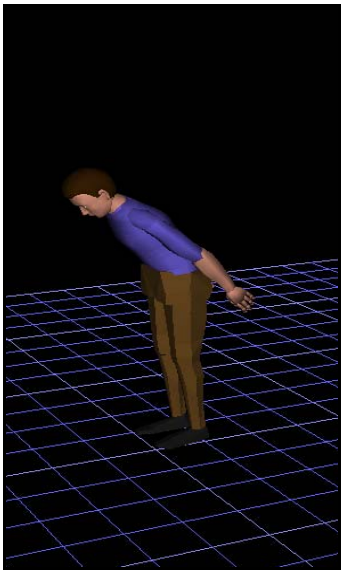
Note = In future, you can edit your human figure by using Scale Existing command in above dialog box by changing the anthropometry variables.

Step 2: Posture – *Joint angles*

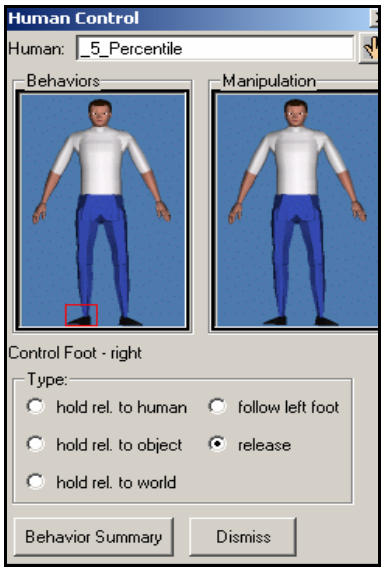
1) Control Torso

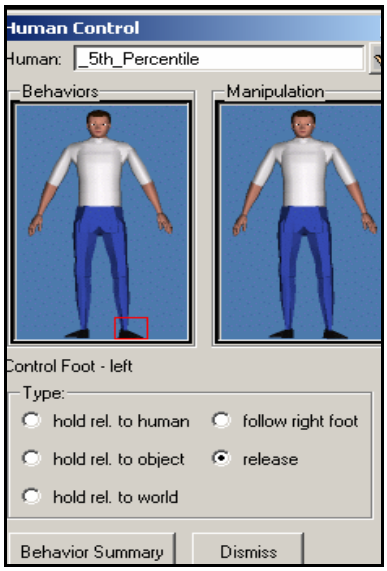




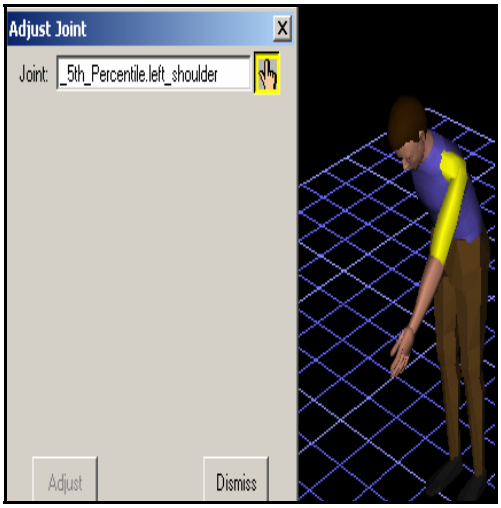


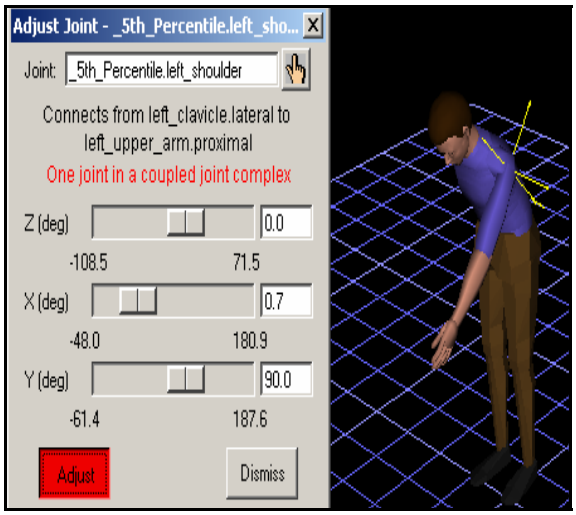
2) Balance Control



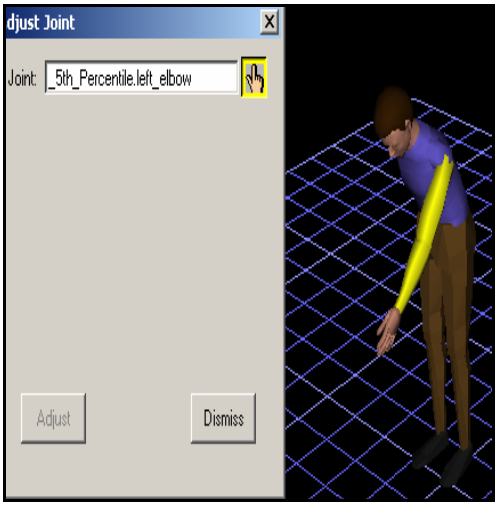


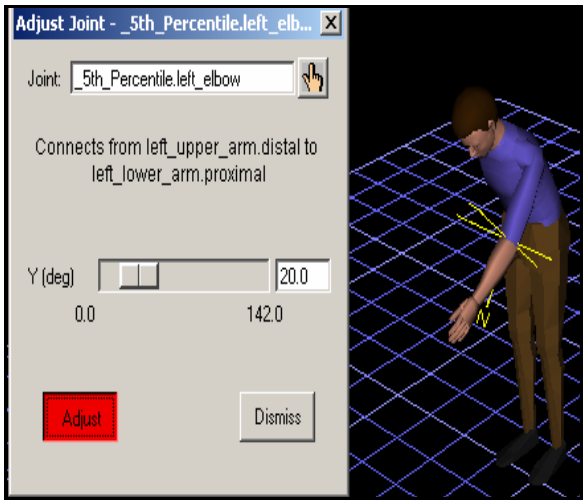
3) Adjust Shoulders





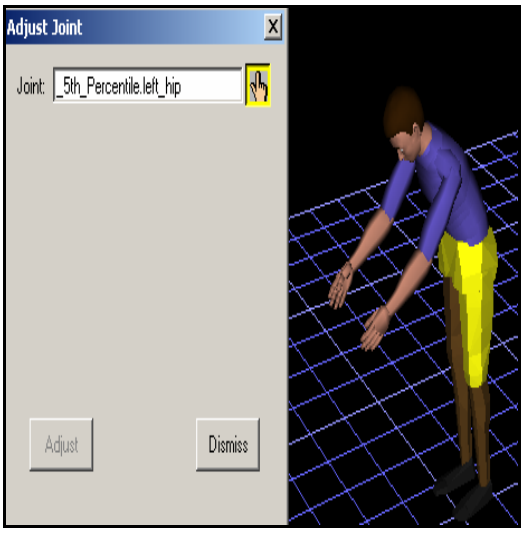
4) Adjust Elbows

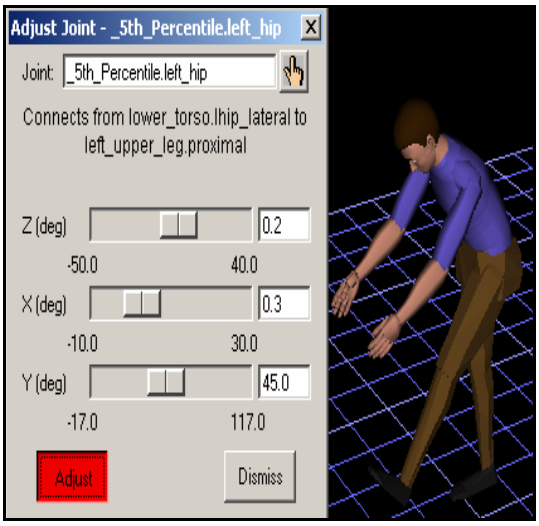




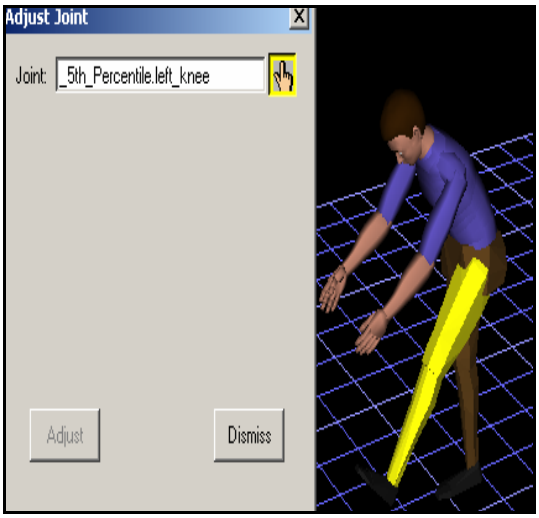
Note = Redo 3rd and 4th step to adjust right shoulder and right elbow. Keep the angles same.

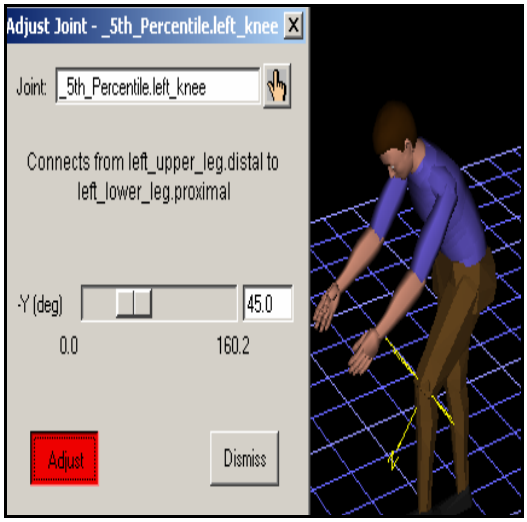
5) Adjust the Left Hip





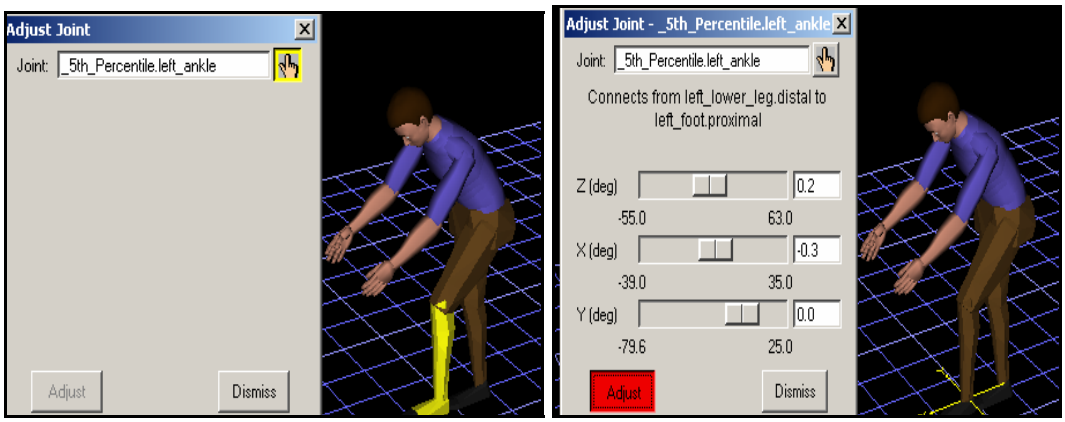
6) Adjust the Left Knee



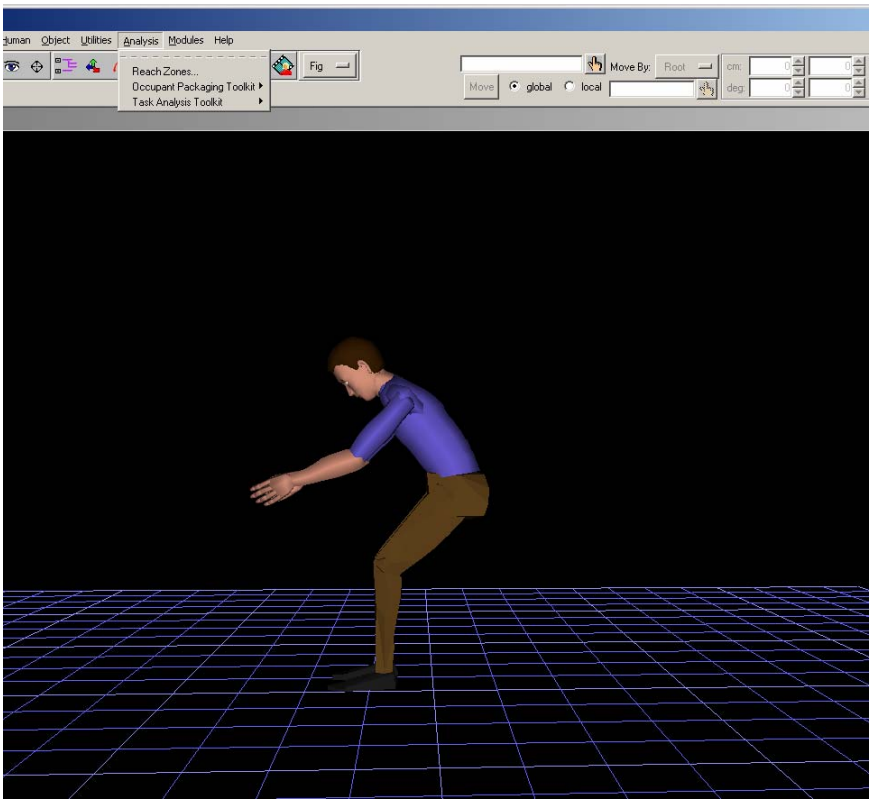


Note = Redo 5th and 6th step to adjust right hip and right knee. Keep the angles same.

7) Adjust the Left Ankle

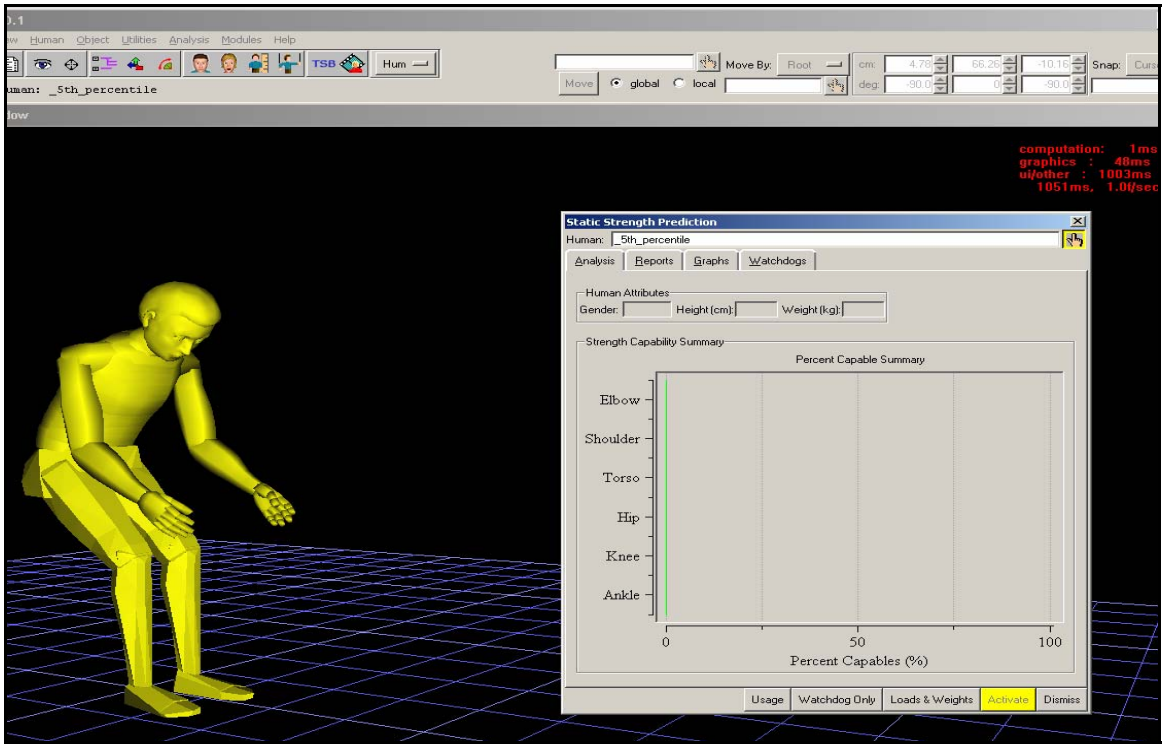


8) Final Posture

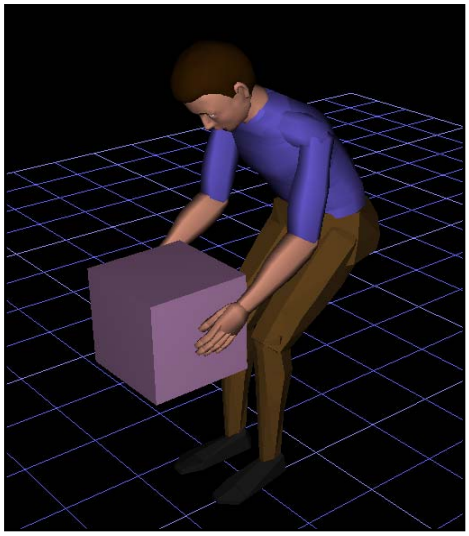


Step 3: Static Strength Prediction Setup – *Loads*

1) After you build the desired posture go to Analysis → Static Strength Prediction. From the Static Strength Prediction window click on the hand tool and select your already built human.



2) OPTIONAL! *Next step is the Load & Weights selection. You don't need to create a solid load or a CAD object. You can assign the loads as vector forces to a specific point on the human body. However, it may be useful to show a box load for presentation purposes, but is optional.*



You can create a box type object in several different ways. The easiest one is;

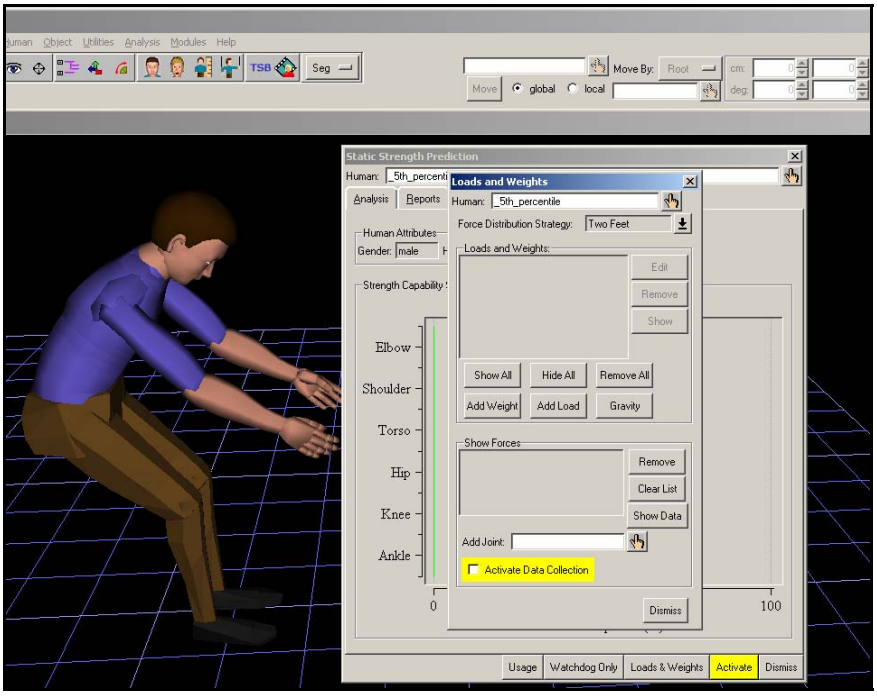
Object → Create → Rectangular Solid

Enter values, height, width and depth.

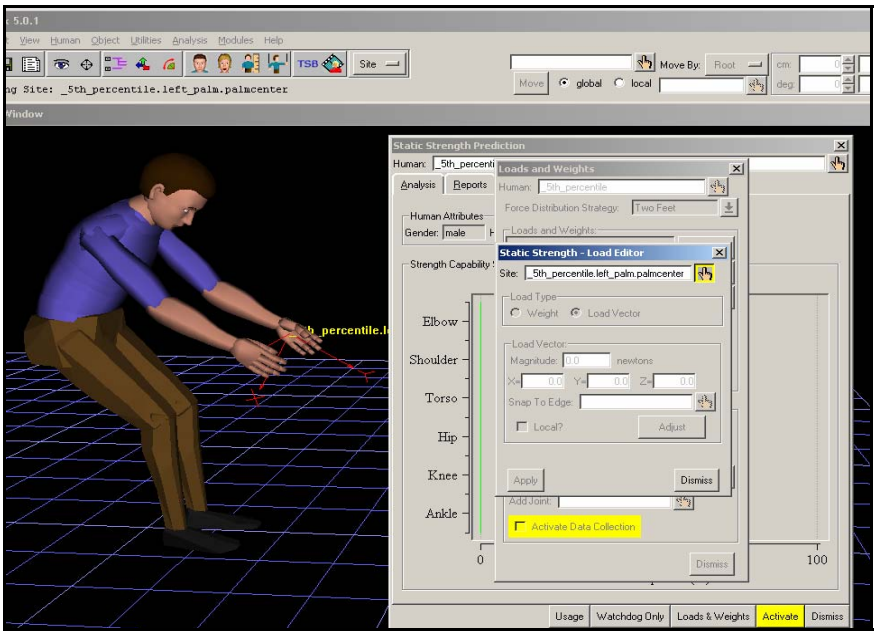
After you create the solid box, manually drag the box to the position respect to the human posture.

3) Now, we will assign the load as a vector force to the human model's hand.

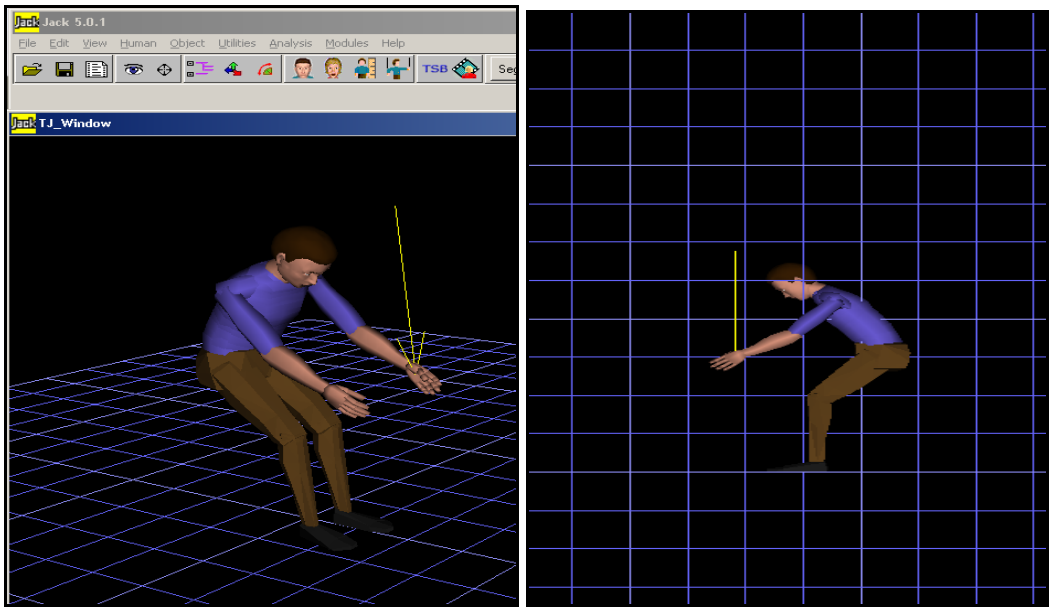
1. Click the Loads & Weights tab on the Static Strength Prediction window. Loads & Weights window will appear as shown below. *Keep the Force Distribution Strategy = Two Feet. This will distribute the loads symmetrically in both feet.*



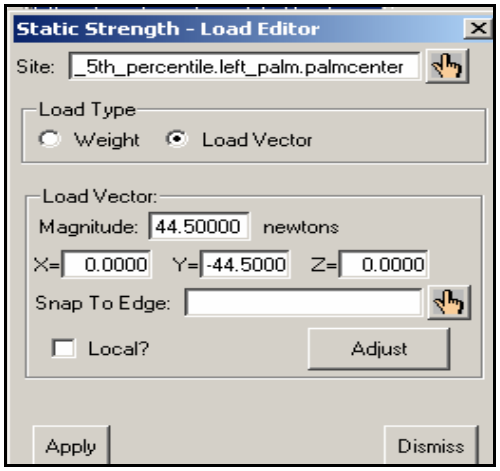
2. Click Add Load, Static Strength – Load Editor box will appear automatically.
3. Select the Hand tool and click on the center of the human hand. (palmcenter). *If you can't select the palmcenter, manually drag & zoom human body.*



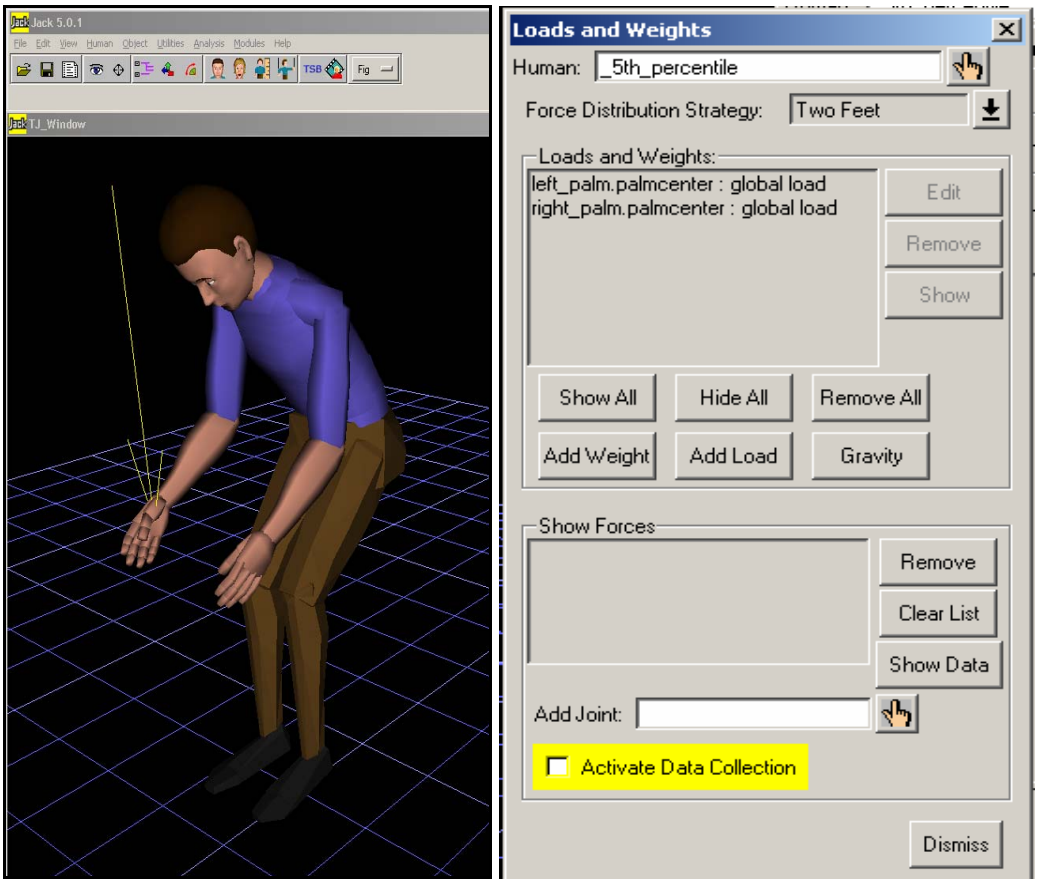
4. When you click on the palmcenter, a 90 degree down force vector will appear to represent the applied load.



5. When you click on the human body, the Static Strength - Load Editor box will let you to enter inputs. Enter 44.5N to the Magnitude box, and click Apply.



6. Apply the above procedure to enter a symmetrical load (Magnitude = 44.5N) to the other hand. Once you enter all the loads, your Static Strength - Load Editor should include both loads.

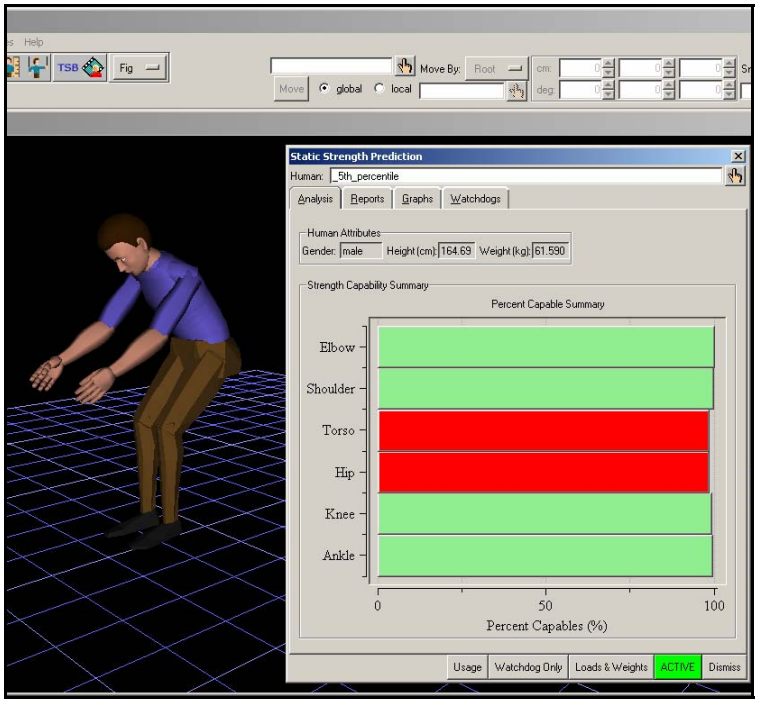


Note = You can add/remove more loads and edit them easily by using the Static Strength - Load Editor window. In addition, you can select different Gravity modes. In this example default gravity mode (980.650 cm/s^2) is used.

Step 4: Activate - *Run the Static Strength Prediction*

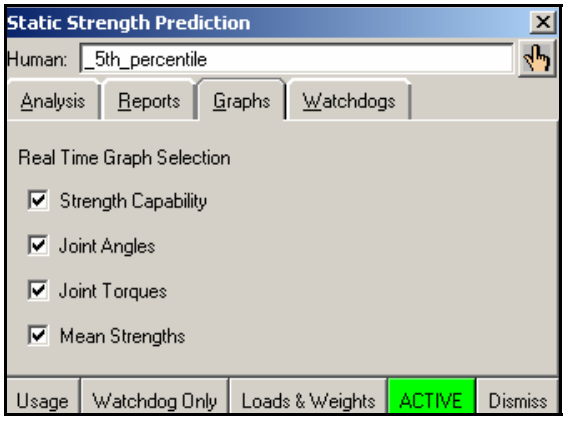
After you finish the Step 3, Click on the Activate tab on the Static Strength Prediction main window. This will simulate the applied loads and the relative posture by using Static Strength Algorithm. (http://www.engin.umich.edu/dept/ioe/3DSSPP/)

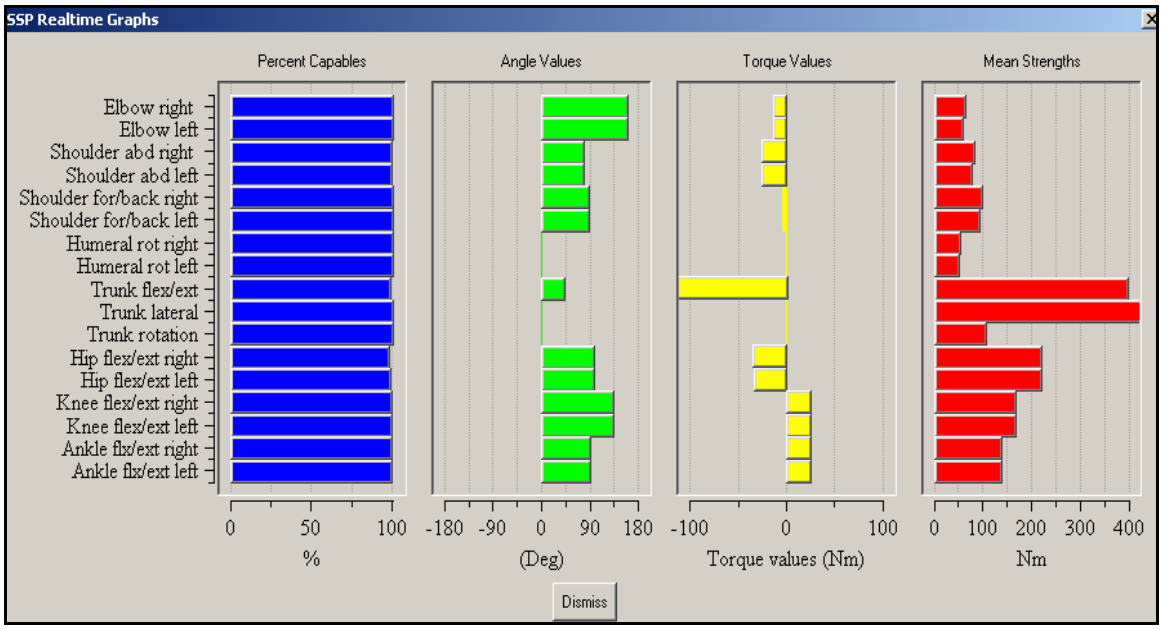
When you click Activate, first thing you will notice is the Percentage Capable chart for each body segment.



Step 5: Analysis – *Graphs*

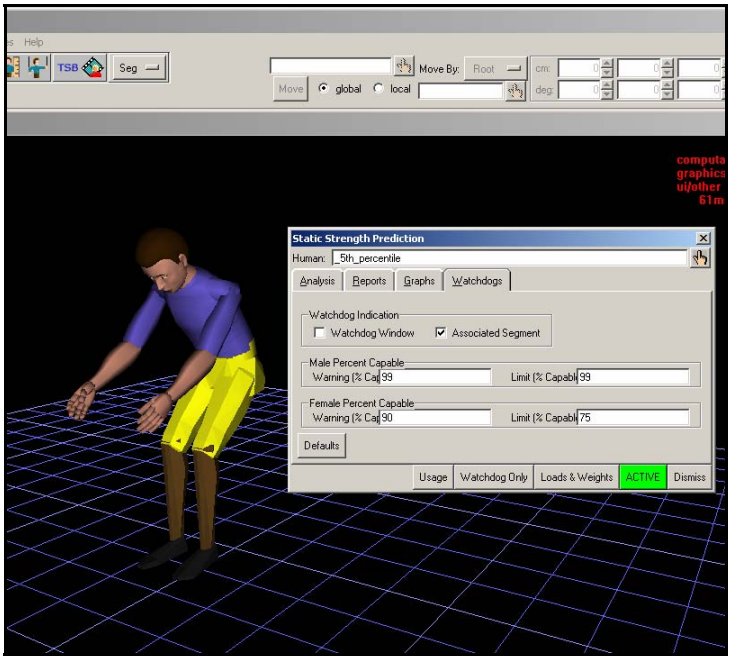
Jack's Static Strength Prediction module will develop Strength Capability, Joint Angles, Joint Toques and Mean Strength graphs for further analysis. In order to view the graphs, click the Graphs tab and select the graph types you want.

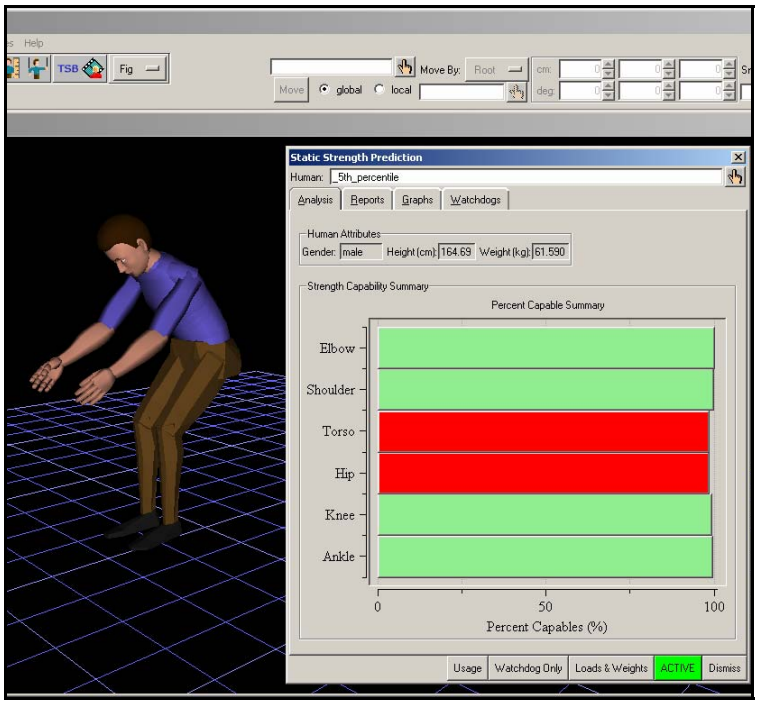




Step 5: Analysis – *Visuals*

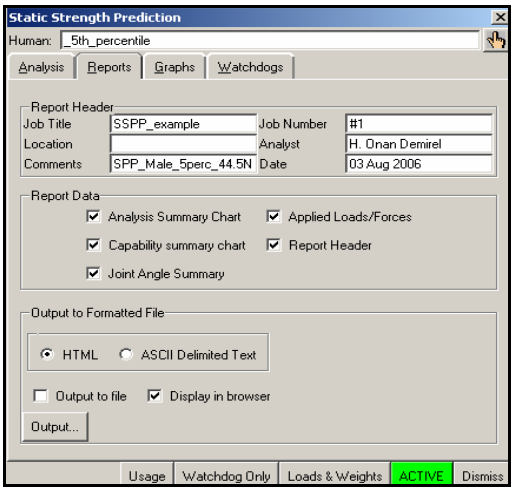
You can see the segments under the Static Strength. You can go to the Watchdogs tab and select the Automated Segment option. In this example Torso & Hip is highlighted as shown below relative to the Percent Capable Summary graph.

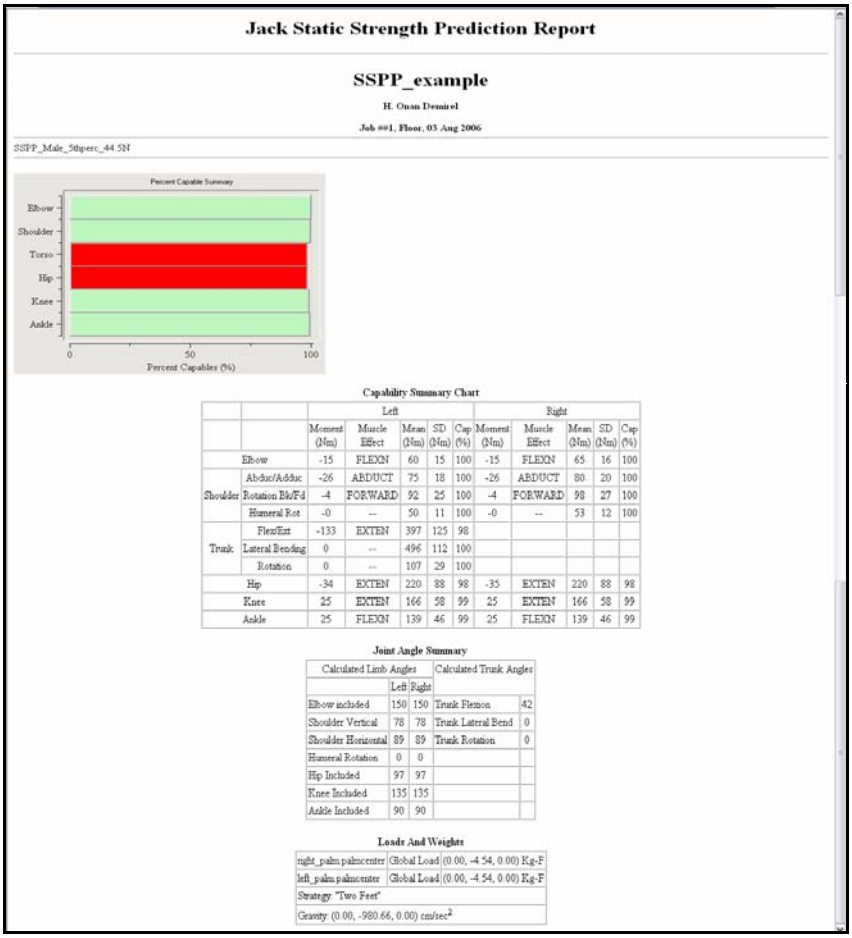




Step 7: Analysis – *Output*

Jack's Static Strength Prediction module will develop an output source where you can store your analysis results as a HTML or ASCII Delimited Text. In order to form an output file click on Reports tab, choose the Report Data you want, select the Output to file and click Output button. Then, Save your file.





Jack Static Strength Prediction Report

SSPP_example

H. Onan Demirel

Job #1, Floor, 03 Aug 2006

SSPP_Male_5thperc_44.5N

Capability Summary Chart

		Left					Right				
		Moment (lNm)	Muscle Effect	Mean (lNm)	SD (lNm)	Cap (%)	Moment (lNm)	Muscle Effect	Mean (lNm)	SD (lNm)	Cap (%)
Elbow		-15	FLEXN	60	15	100	-15	FLEXN	65	16	100
Shoulder	Abduc/Adduc	-26	ABDUCT	75	18	100	-26	ABDUCT	80	20	100
	Rotation Bk/Fwd	-4	FORWARD	92	25	100	-4	FORWARD	98	27	100
	Humeral Rot	-0	--	50	11	100	-0	--	53	12	100
Trunk	Flex/Ext	-133	EXTEN	397	125	98					
	Lateral Bending	0	--	496	112	100					
	Rotation	0	--	107	29	100					
Hip		-34	EXTEN	220	88	98	-35	EXTEN	220	88	98
Knee		25	EXTEN	166	58	99	25	EXTEN	166	58	99
Ankle		25	FLEXN	139	46	99	25	FLEXN	139	46	99

Joint Angle Summary

Calculated Limb Angles			Calculated Trunk Angles	
	Left	Right		
Elbow included	150	150	Trunk Flexion	42
Shoulder Vertical	78	78	Trunk Lateral Bend	0
Shoulder Horizontal	89	89	Trunk Rotation	0
Humeral Rotation	0	0		
Hip Included	97	97		
Knee Included	135	135		
Ankle Included	90	90		

Loads And Weights

right_palm.palmcenter	Global Load	(0.00, -4.54, 0.00) Kg-F
left_palm.palmcenter	Global Load	(0.00, -4.54, 0.00) Kg-F
Strategy "Two Feet"		
Gravity (0.00, -980.66, 0.00) cm/sec^2		

Chapter

8

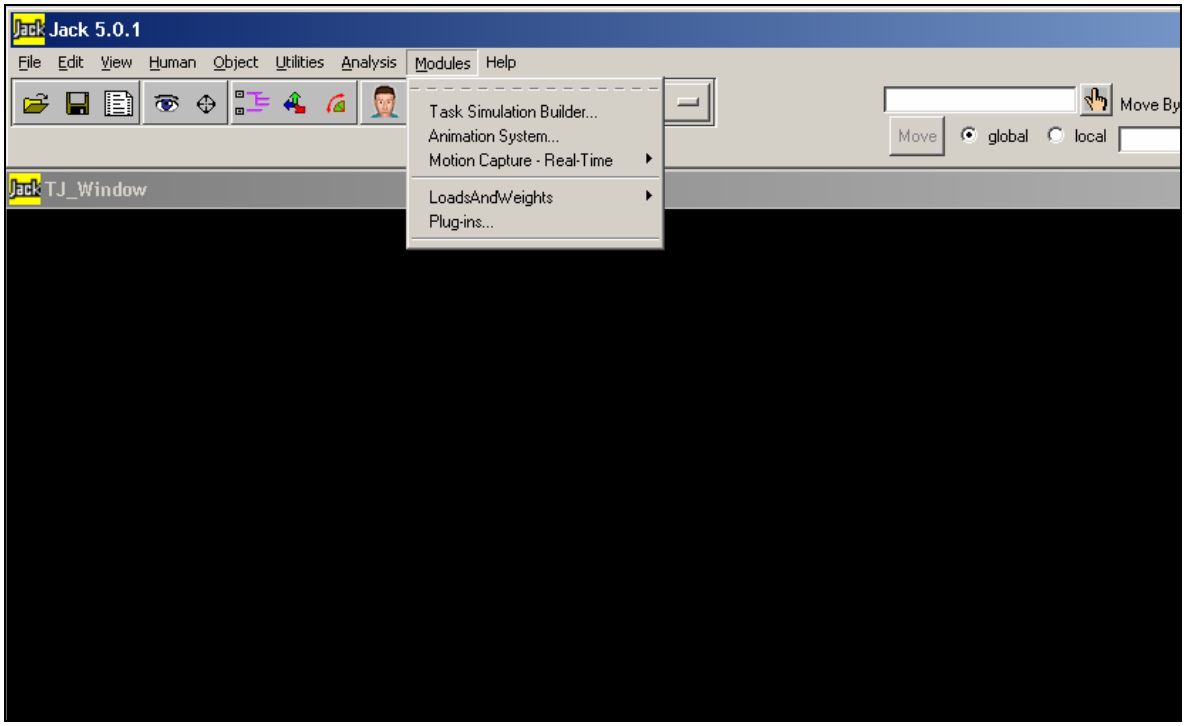
UGS TECNOMATIX JACK 5.0

User Manual and Examples

MODULES menu

Modules

Modules menu contains the animation tools where you can build and analyze 3D realistic motions. Animation System tool helps users to build up and playback motions in Jack. Motion Capture – Real Time tool helps engineers to interact with the virtual environments in real time and optimize the design features. In addition, users can assign Loads and Weights, and use the Plug-in tools to enhance their animations.



Modules Menu

For more information please check;

UGS Tecnomatix Jack
http://www.ugs.com/products/tecnomatix/human_performance/jack/

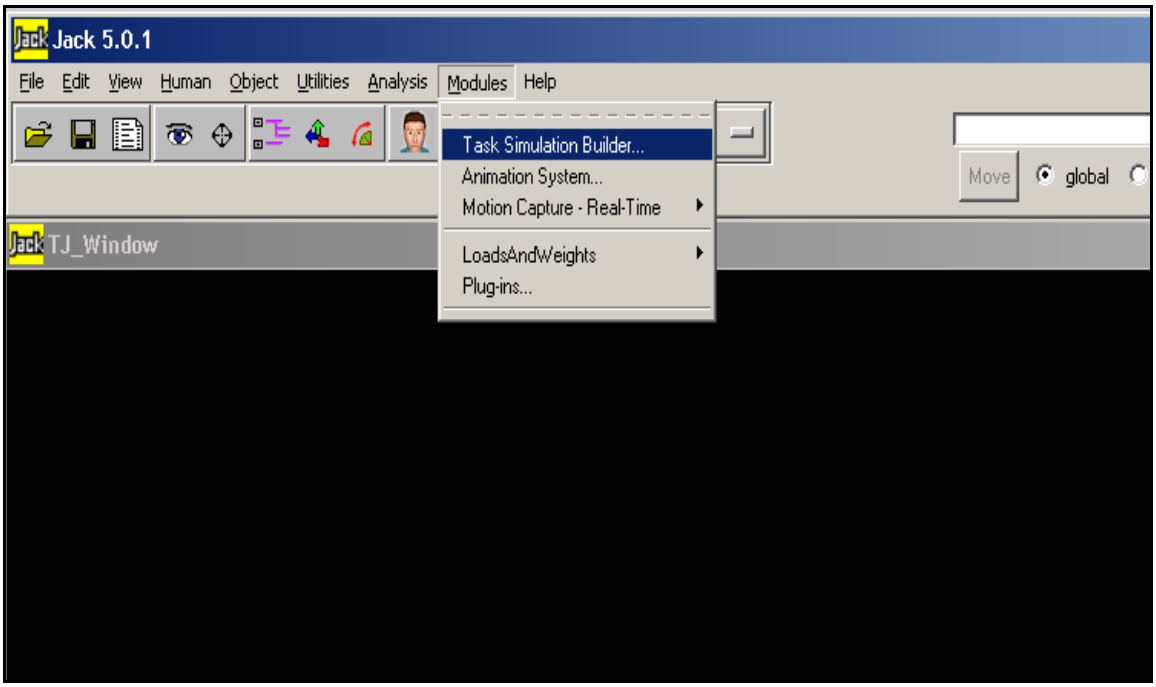
Purdue University, School of Industrial Engineering
IE 656 – Digital Human Modeling for Design
http://web.ics.purdue.edu/~duffy/index656

Purdue University, School of Industrial Engineering
IE 590 – Applied Ergonomics
http://web.ics.purdue.edu/~duffy/index590D

Task Simulation Builder

Task Simulation Builder tool helps users to quickly build animations and analyze them. You can define actors (digital human models), objects and assign locations and postures to them. You don't need to manually create each motion. Jack uses shortcuts tools to build up desired motions.

By using Task Simulation Builder tool, users can assign working tasks such as Go, Get, Put, Move and quickly develop animations. You can switch back and forth between Authoring and Analysis modes to observe changes in the animation environment. Also, you can export the already built tasks to Animation System to manually create joint motions if a custom motion is needed.



Modules Menu – *Task Simulation Builder*

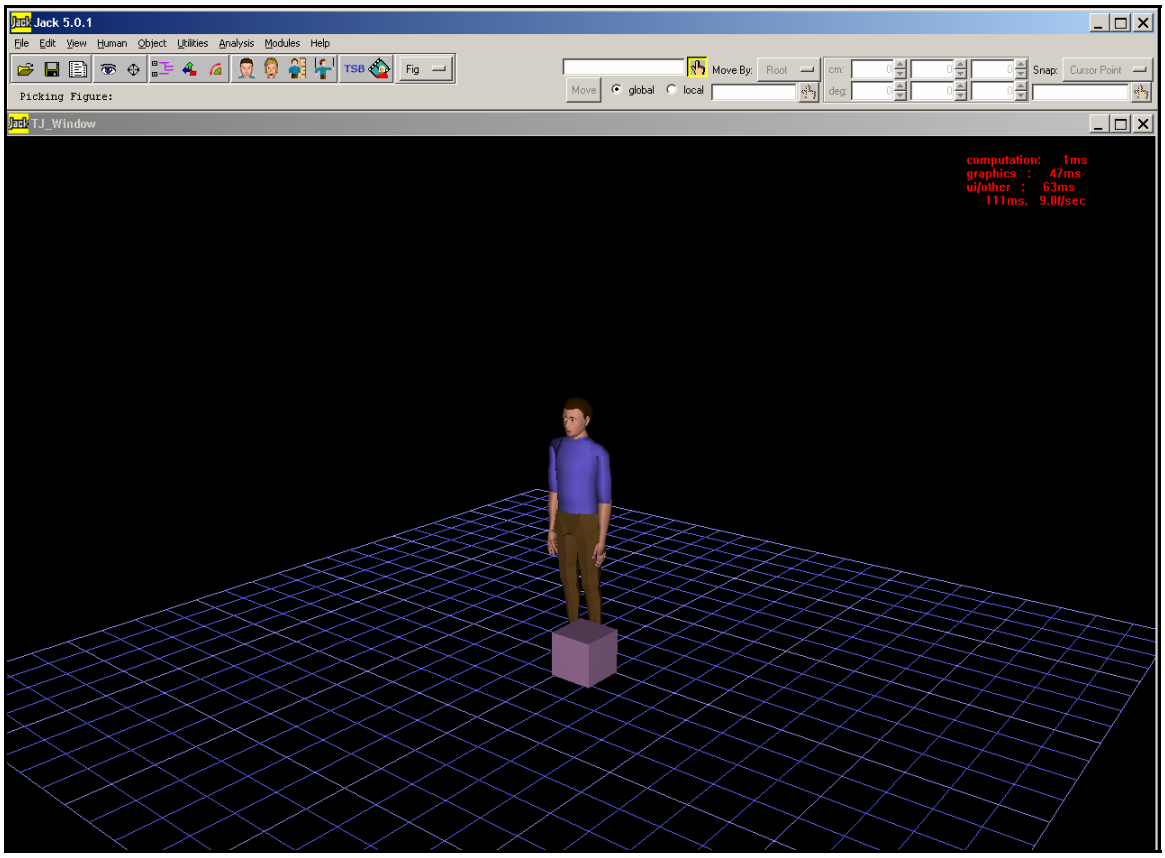
Following example will be conducted to demonstrate a simple Go and Move task for a worker who is picking up a box in a selected location and moving it to a predefined location.

Step 1: Build Human and Object

We started the animation by creating the basic animation components; digital human model and objects.

First, you may start with creating a human model. Anthropometry Information is not important in this case since the purpose of this example is demonstration the animation characteristics of Jack.

After you created the digital human model, go and create a CAD or solid object. In this example, we use a simple solid cube with 30 cm length.



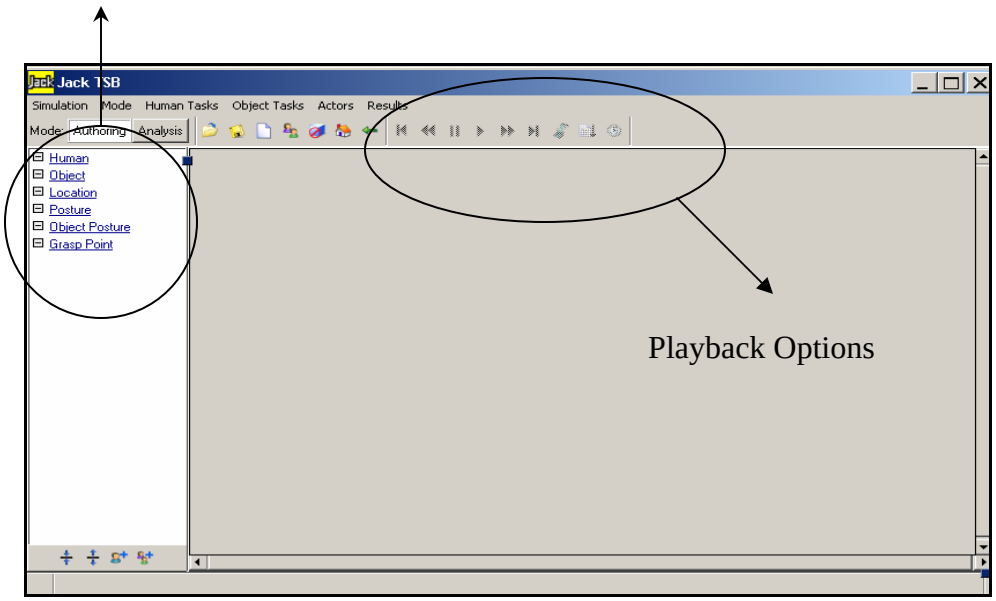
Step 2: Task Simulation Builder Window (TSB) - *Setup*

1) After you create the human model go to Task Simulation Builder module.

→ Modules → Task Simulation Builder

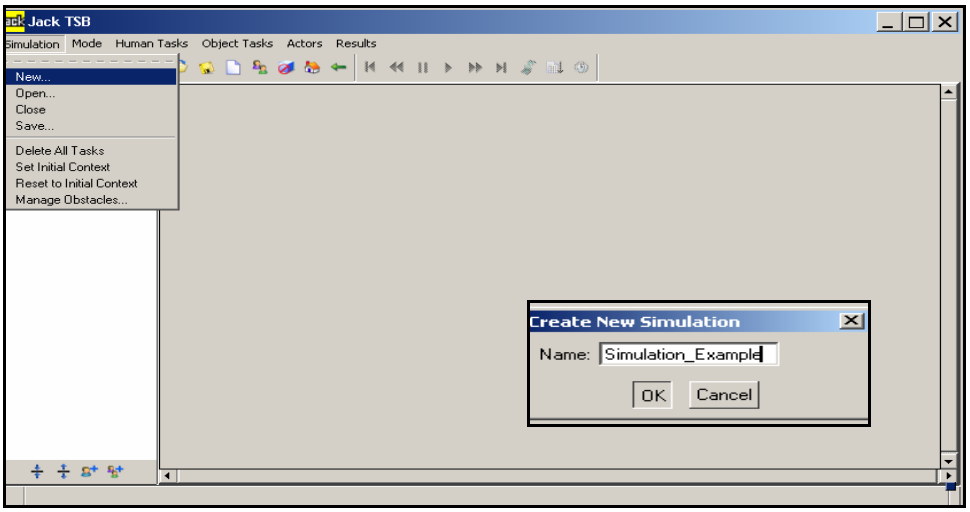
The Task Simulation Builder window contains all the necessary components and tools for the user to create simple task simulations, playback, analyze and manipulate them.

The tree structure on the left hand side lets user to dynamically observe the human, object, location and posture creations. You can assign any of these components to your simulation or edit them by using the tree structure.



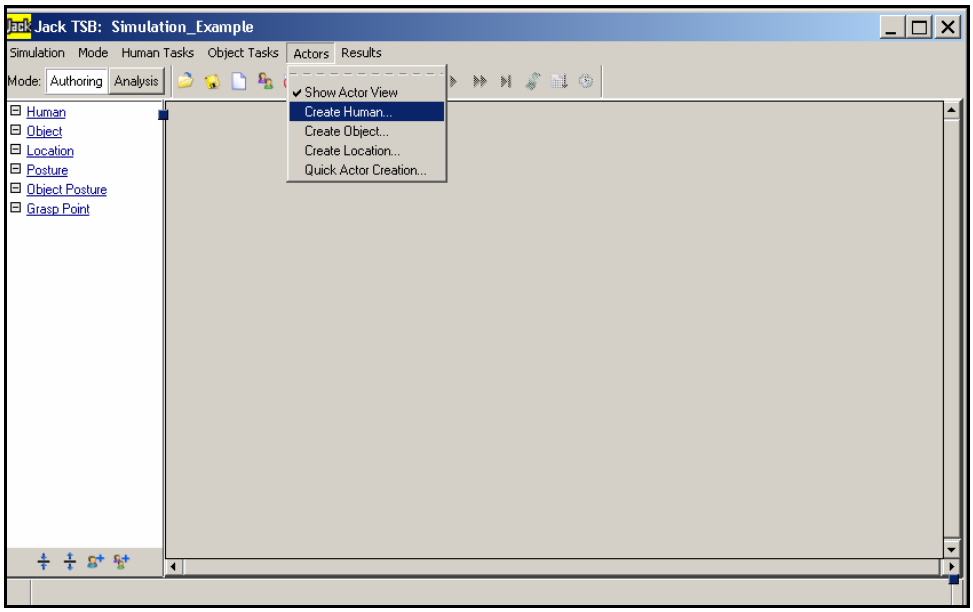
2) Create a new simulation and name your simulation. (***ex.*** *Simulation_Example*)

→ Simulation → New



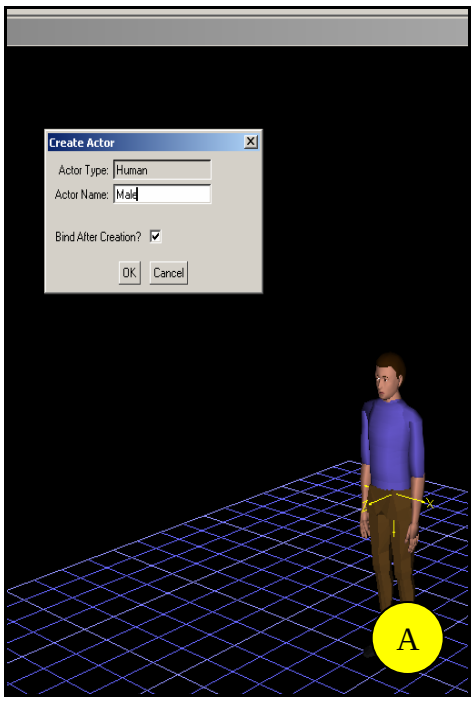
3) Create Actors, Human

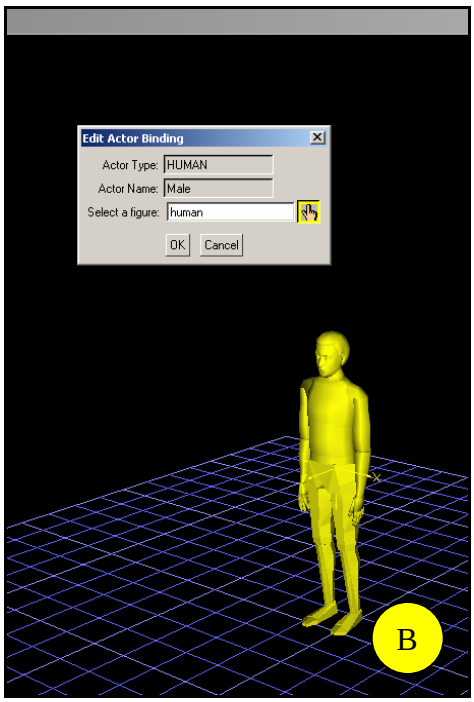
→ Create Actors → Create Human



A. When the Create Actor (Actor Type: Human) window appears, give a name to your human model and click OK.

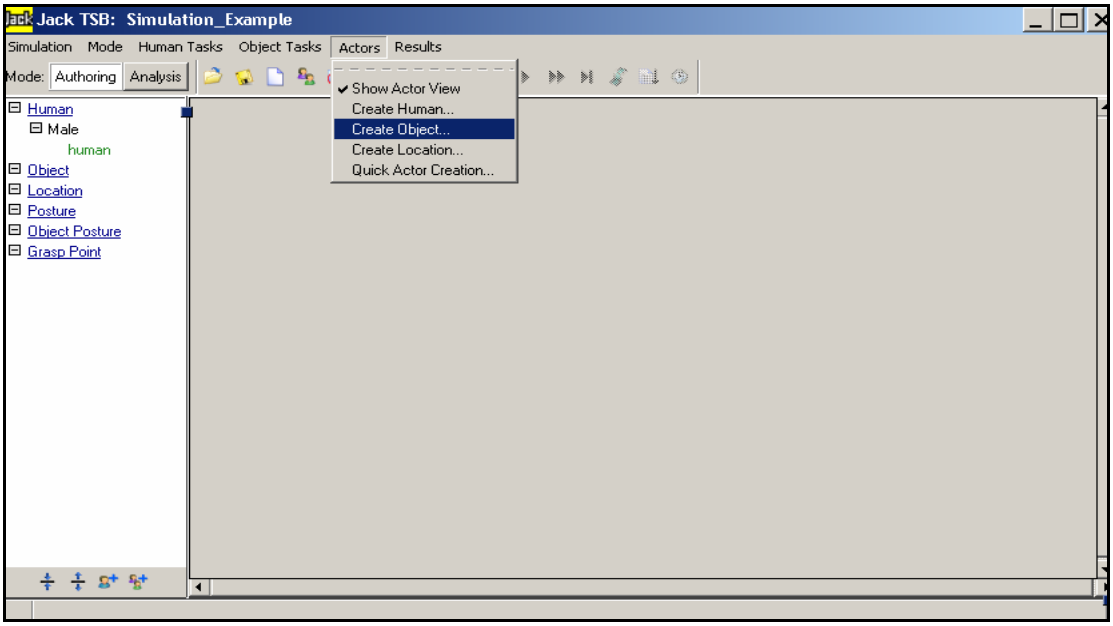
B. After that, select your human model by using hand icon when the Edit Actor Binding Window appears.





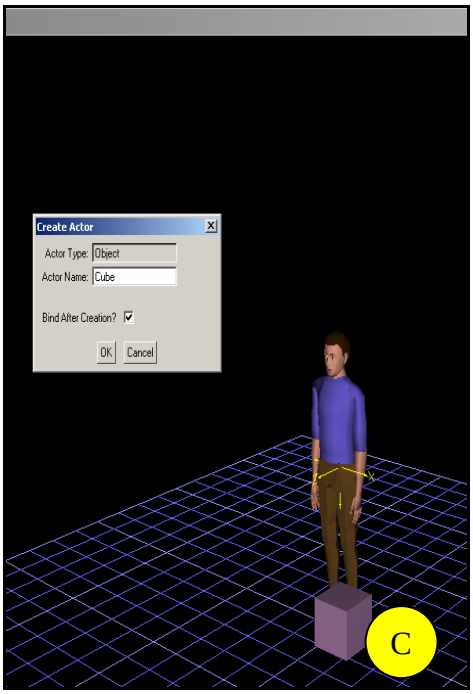
4) Create Actors, Object

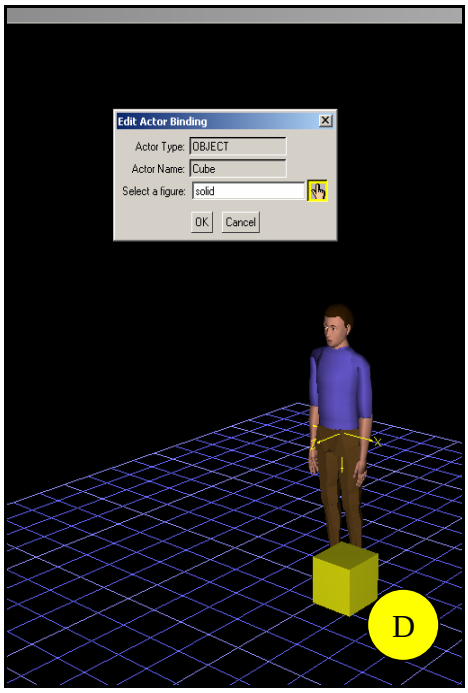
→ Create Actors → Create Object



C. When the Create Actor (Actor Type: Object) window appears, give a name to your object and click OK.

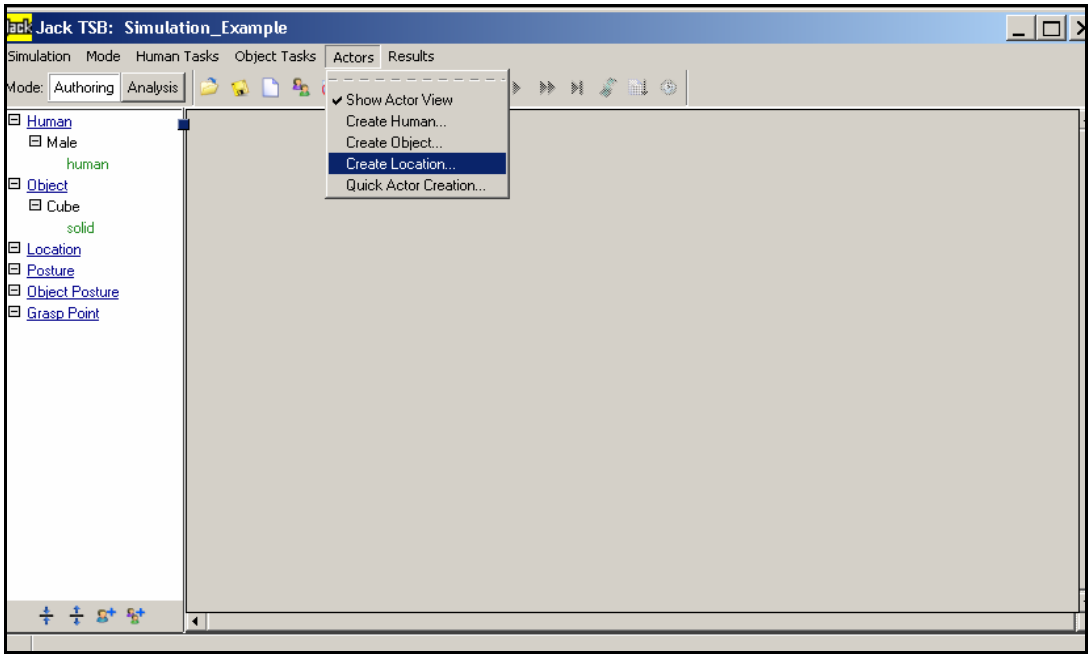
D. After that, select your object by using hand icon when the Edit Actor Binding Window appears.





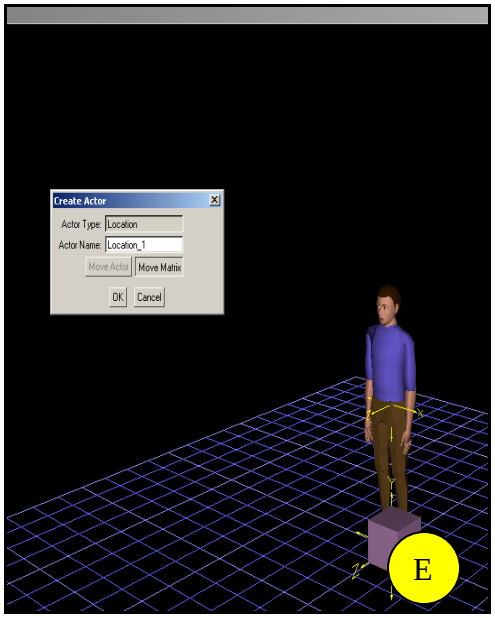
5) Create Actors, Location

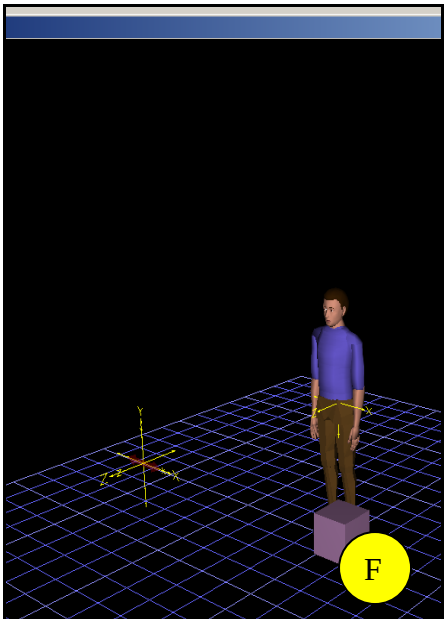
→ Create Actors → Create Location



E. When the Create Actor (Actor Type: Location) window appears, give a name to your location and click OK.

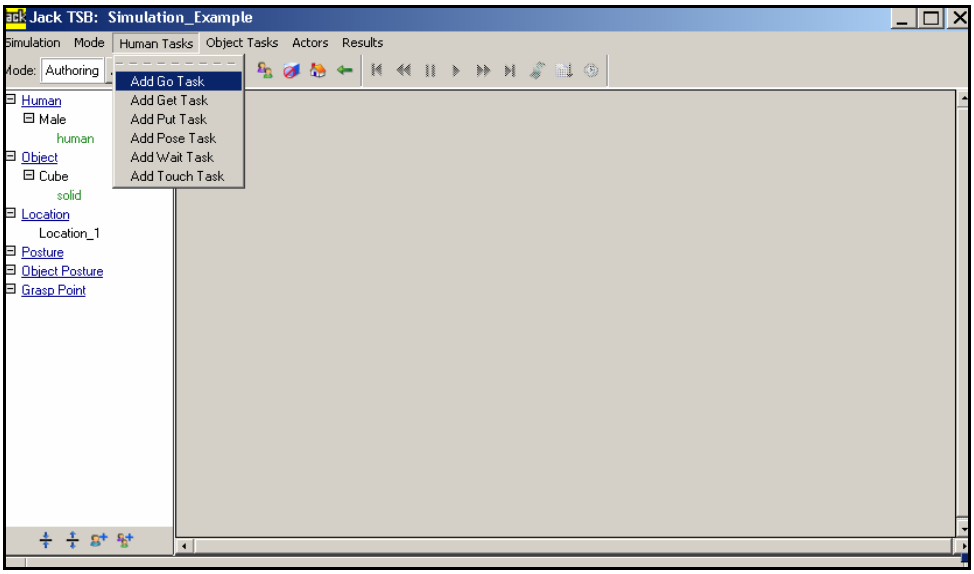
F. After that, select Moving Matrix option and move the coordinate icon to a desired location. Click on Esc to exit from Move Matrix mode and click OK.





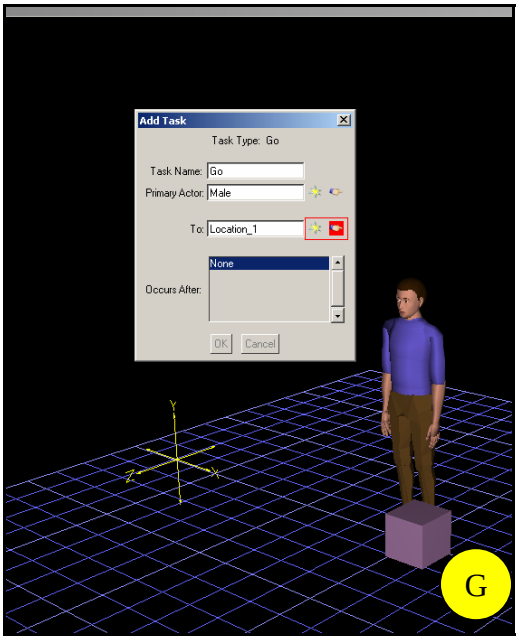
Step 3: Task Creation, *Go and Get Tasks*

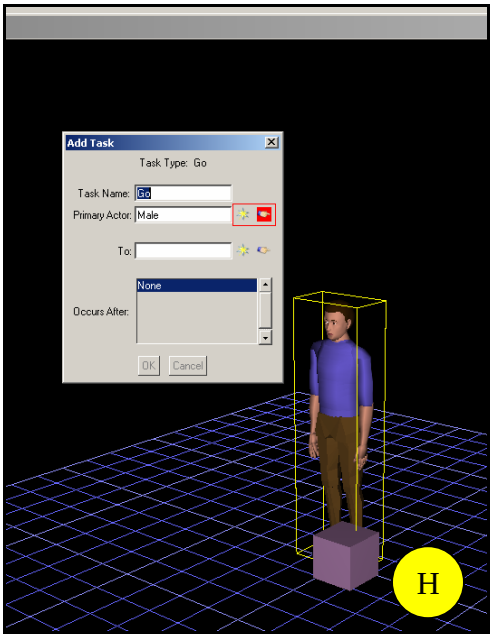
1) Go Task



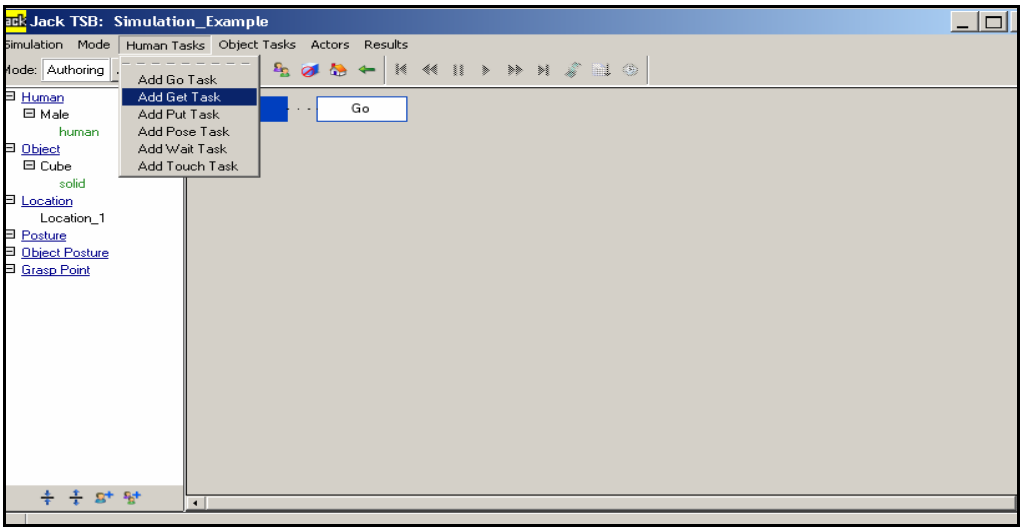
G. When Add Task (Task Name: Go) window appears choose the Primary Actor as the human model you've created. Use the hand icon to make your selection. Star icon works for new human model creation.

H. After that, select the Location_1 for To destination.





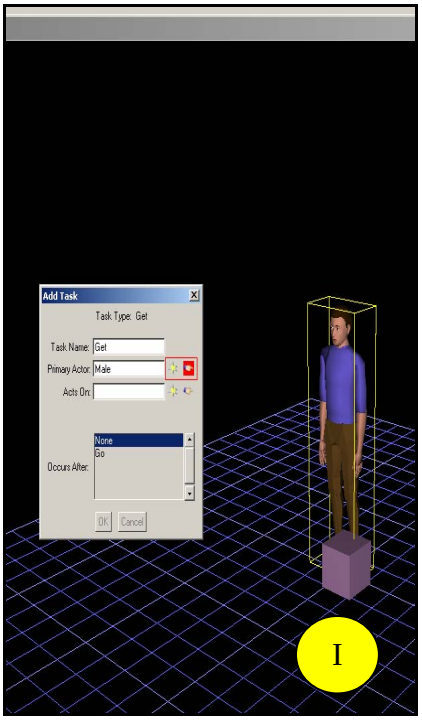
2) Get Task

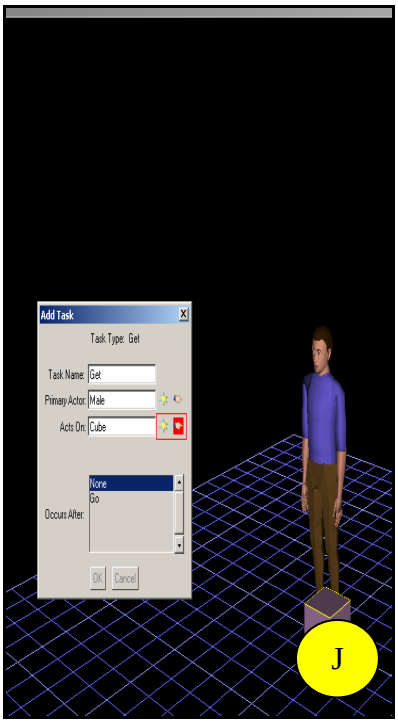


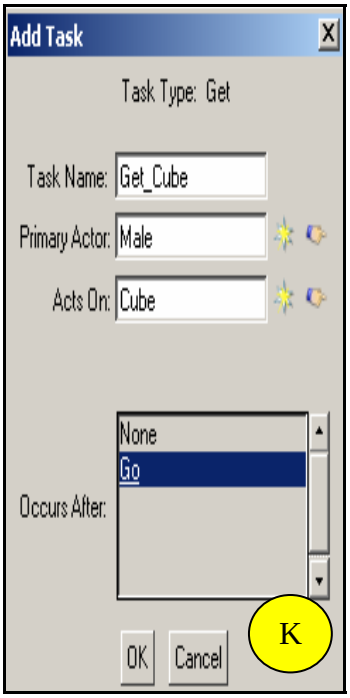
I. When Add Task (Task Name: Get) window appears choose the Primary Actor as the human model you've created. Use the hand icon to make your selection.

J. After that, select the Cube object as Act On choice.

K. Click Go in Occurs after option. This will assign the Get task after Go task.

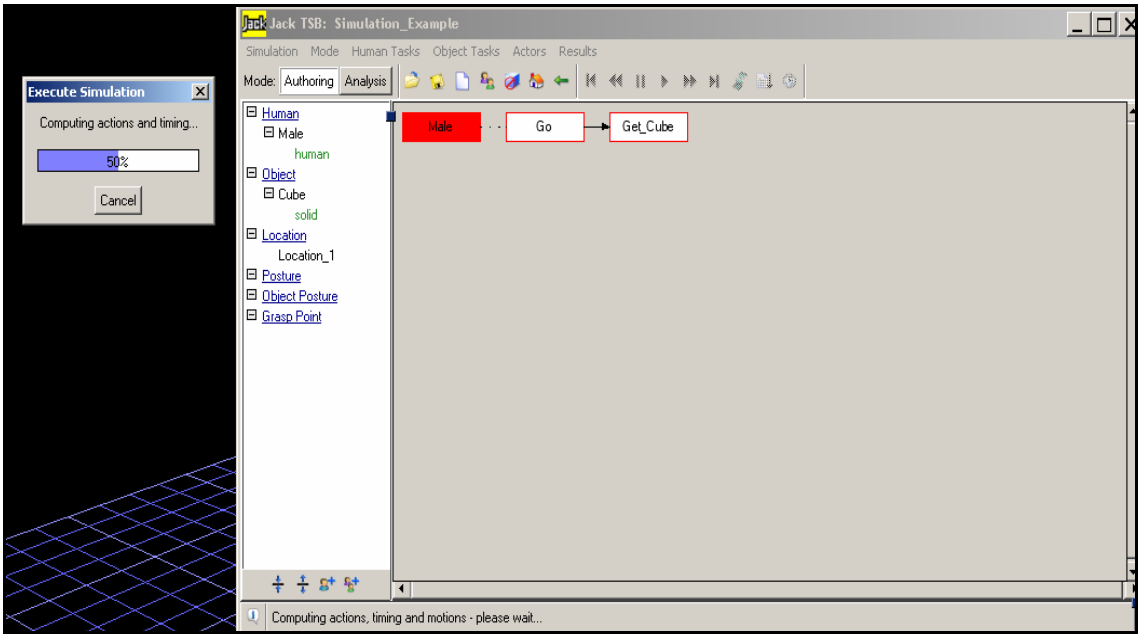




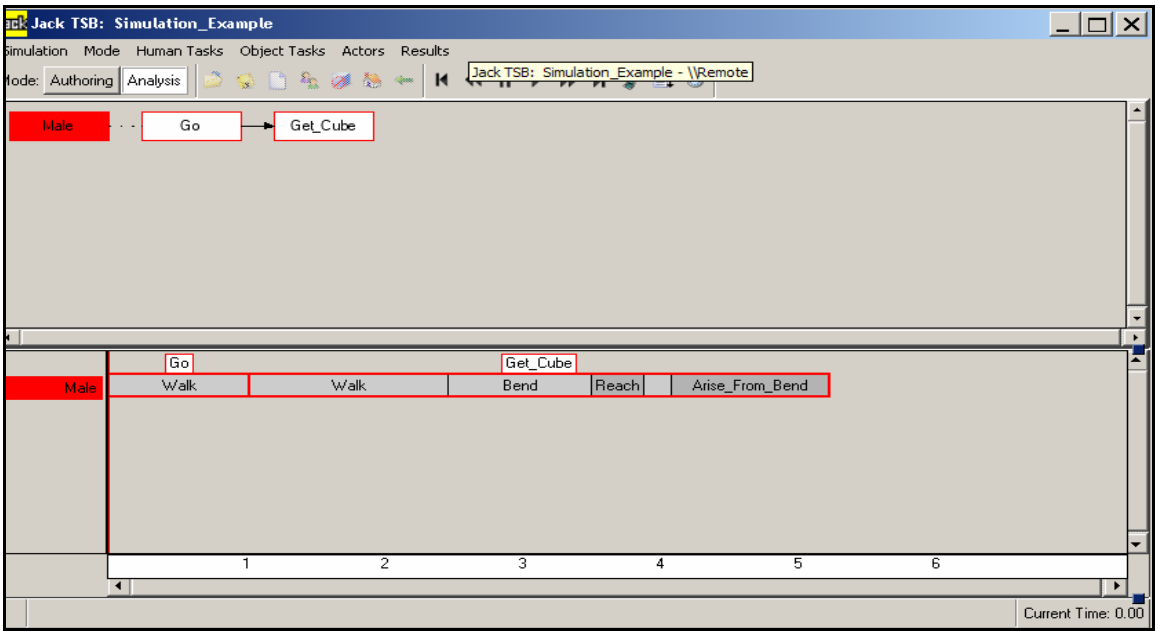


Step 3: Task Analysis, *Animation*

After you've completed the Go and Get Task, you should observe that human actor and assigned tasks are appeared on the Task Simulation Window as rectangular boxes.



Click on the Analysis mode (upper left corner) and activate the animation. An execution window will appear. Wait until playback bar is activated.



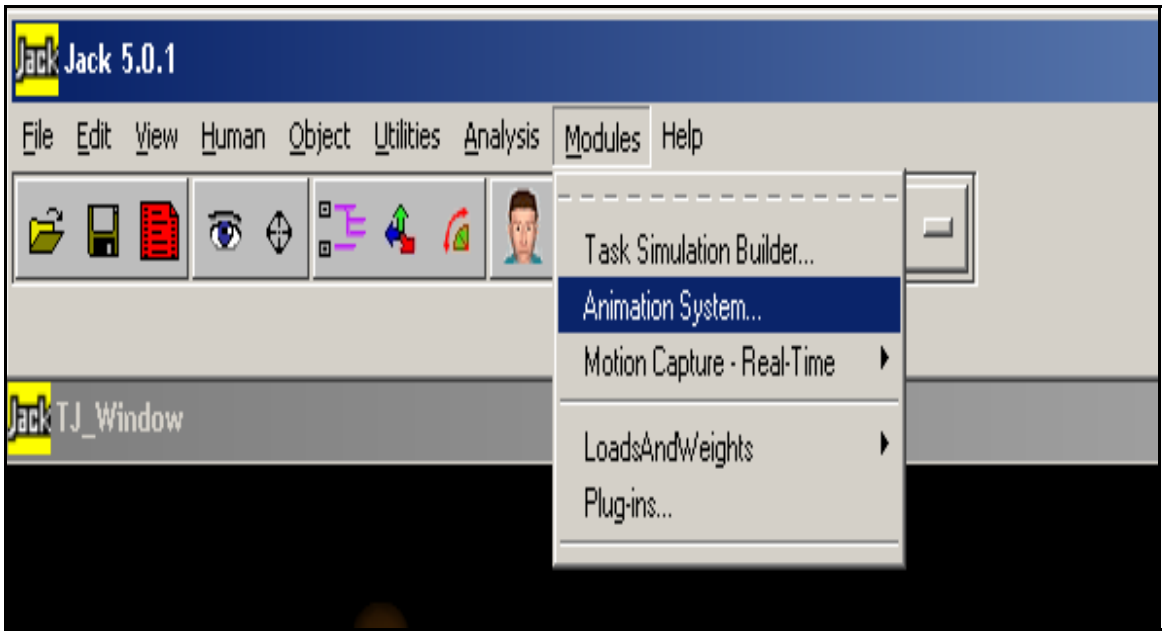
After you activate the Task Simulation Builder, a complete task sequence and playback menu is ready to animate the given task.

Animation System

Animation System allow user to build custom animations. Animation Systems works similar to the Task Simulation Builder but its customized animation menu gives more flexibility for complex object-human related animations.

In Animation System module, one can define joint motions, complete figure motions, human and object motions. You can easily assign time frames for each motion and edit them by click and drag manner. Once you set up the animation components, you can easily generate an animation and control it by using the playback options.

Animation System module allows users to save their animation channelset files. In addition, you can export your animation as Movie (mpeg) file. You can also use Animation System and Task Simulation Builder module interchangeably.



Modules Menu – *Animation System*

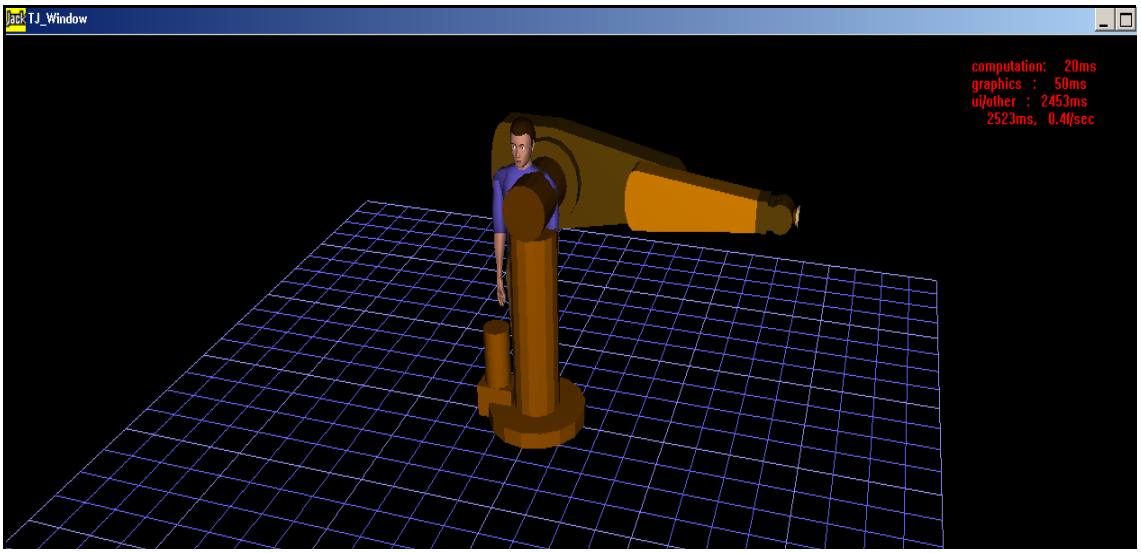
The following example will be conducted to demonstrate a simple human-object interaction for a worker who is controlling a small crane.

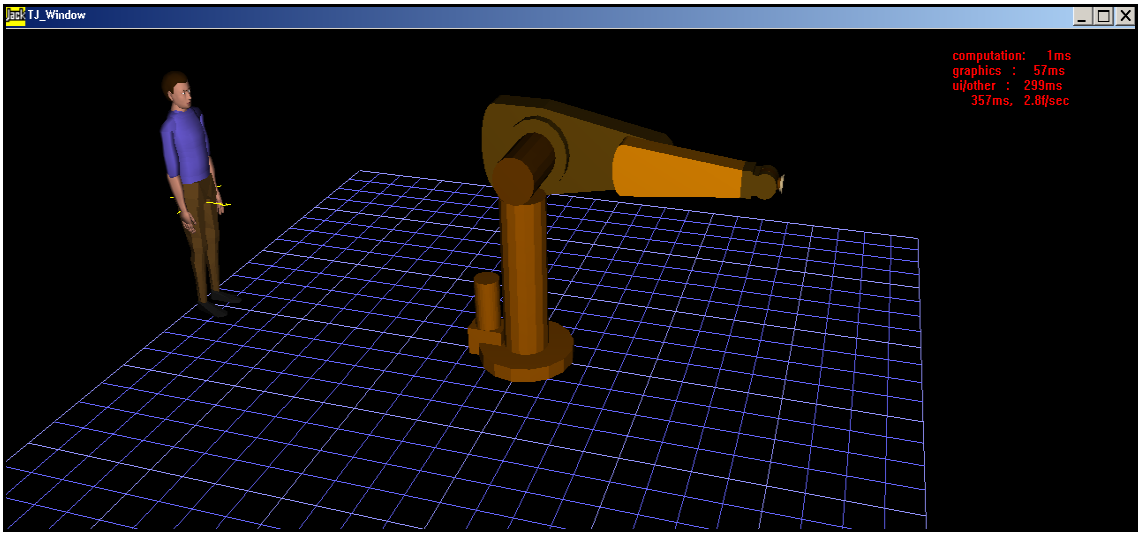
Step 1: Build Human and Object

We started the animation by creating the basic animation components; digital human model and objects. First, you may start creating a human model. Anthropometry Information is not important in this case since the purpose of this example is demonstration the animation characteristics of Jack.

After you created the digital human model, go and insert the crane model Puma560 from object library.

Object → Create → Figure from Library,
Click *misc*. library, select *puma560.fig* and click load.





After you insert the human body and the crane object, they overlap each other. Move the human body in a similar position shown below.

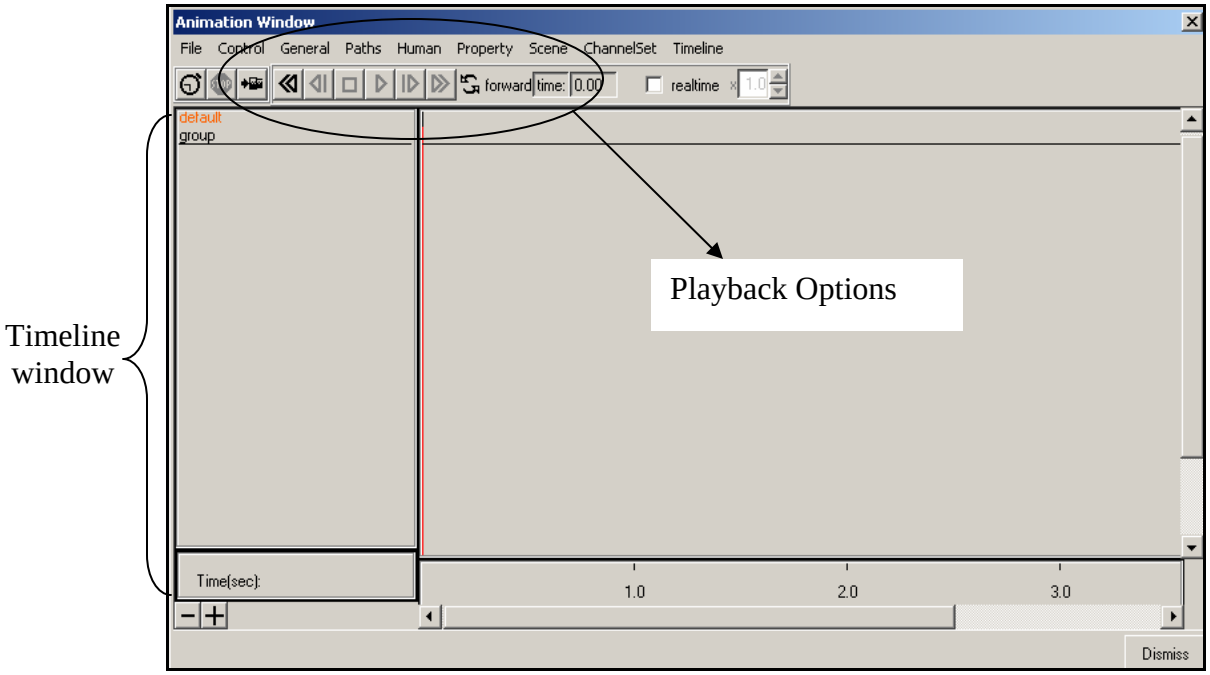
Step 2: Animation System Window - *Setup*

1) After you create the human model and insert the object, go to Animation System module.

→ Modules → Animation System

The Animation System window contains all the necessary components and tools for the user to create custom simulations.

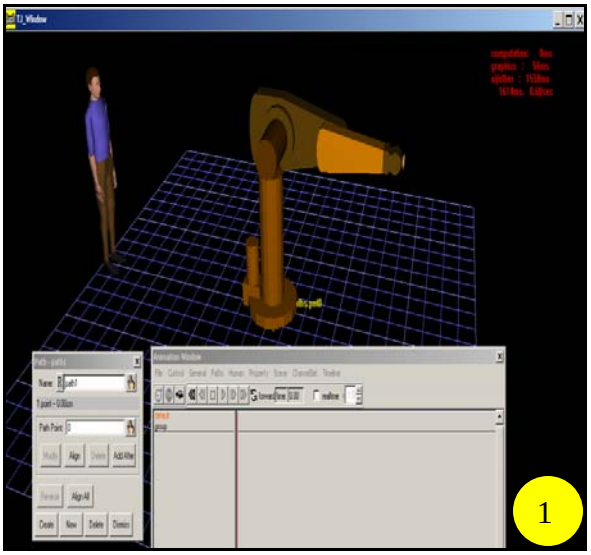
The timeline window holds the inputs, parameters, relations and the animation characteristics. You can edit the timeline window in drag and drop fashion.

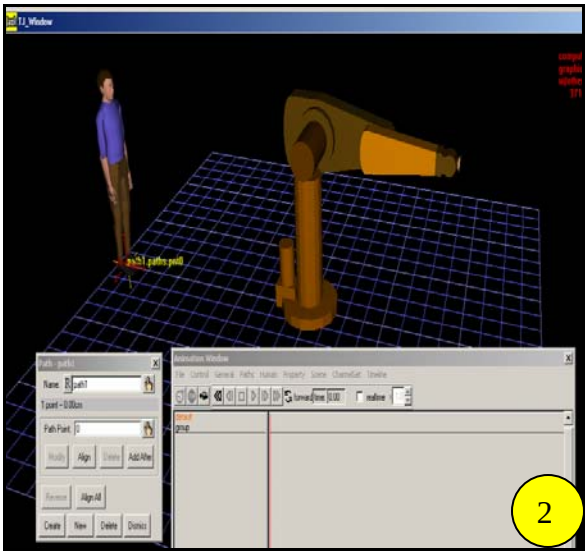


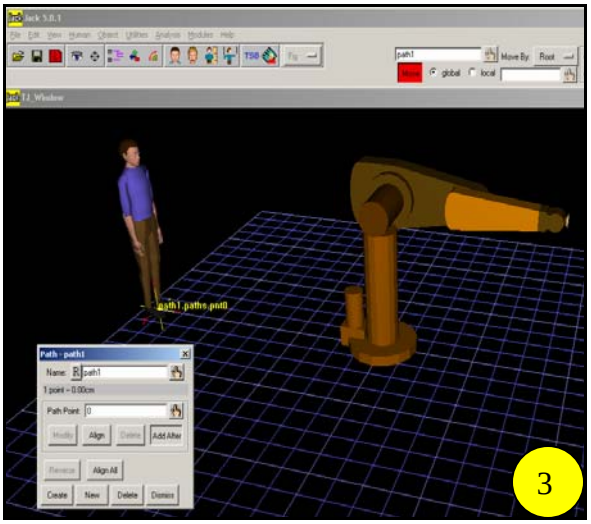
2) Create a Path

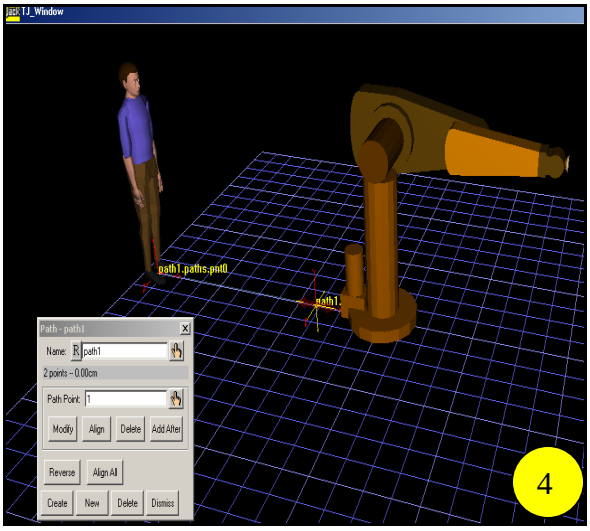
The worker's first motion is walk. (From his original position to the crane.) We need to create a walk simulation to animate this task. Before we initialize the walk task we need to create a walking path. We will use *create path* command under *paths* menu.

Paths → Create Path







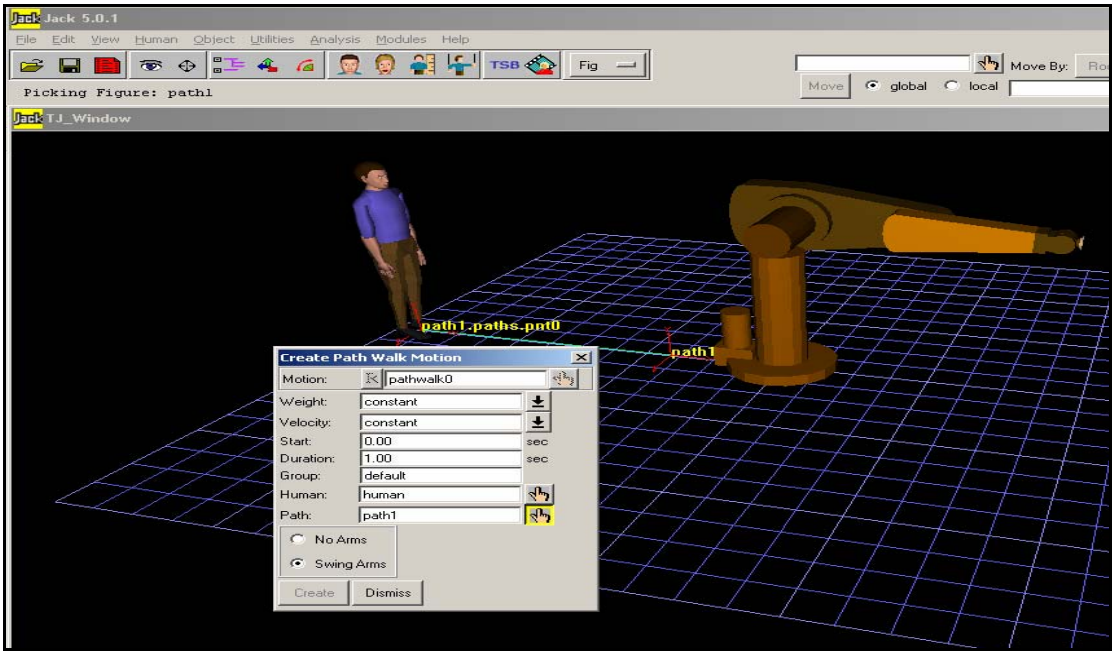


1) When you click on the create path command, the initial coordinate path appears in the middle of the screen. We want the initial point starts from the human model.
2) Click and drag the coordinate system to a location close to the human model.
3) After that click on the Add After button on the Path window, this will add the second path coordinate to form a straight line. The second coordinate system appears on where you left the initial coordinate system.
4) Drag and move the second coordinate system to a location close to the crane. After that, click on the Create button.

3) Create a Walk

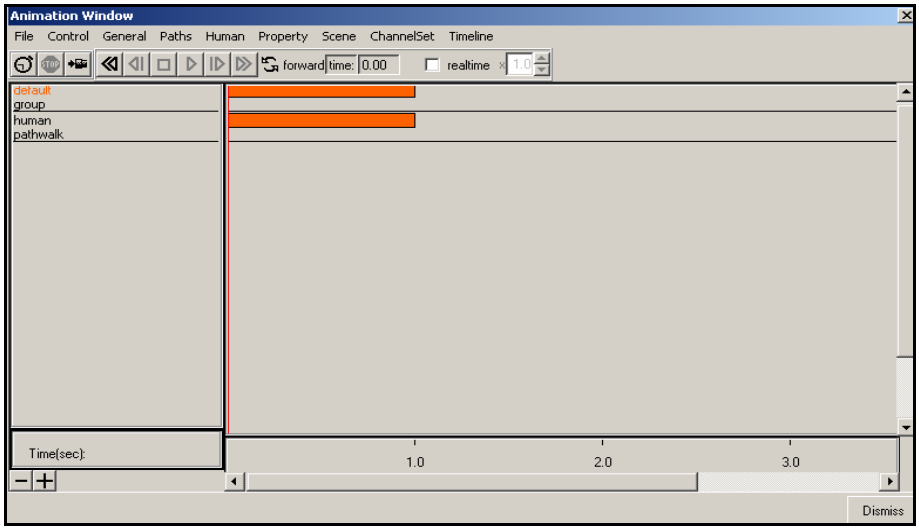
Now we can assign the walk task to the worker. Go and select the Path Walk option under the Human menu. Human menu contains all necessary predefined body motions where you can assign them with desired time lengths.

Human → Path Walk



When the Create Path windows activated, go and select the path that was created before by using the hand icon. The motion starts from time 0.00 and the duration time in 1 sec. You may choose between No Arms and Swing Arms options depending on your task characteristics. After you've chosen the path1, click create to set your task on time line.

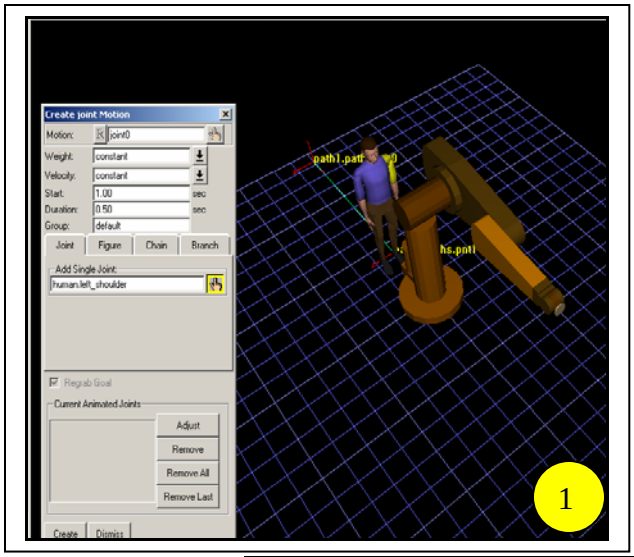
You should observe that there is a human path walk task is assigned on the timeline window that starts from 0.0 sec and finishes at 1.0 sec.

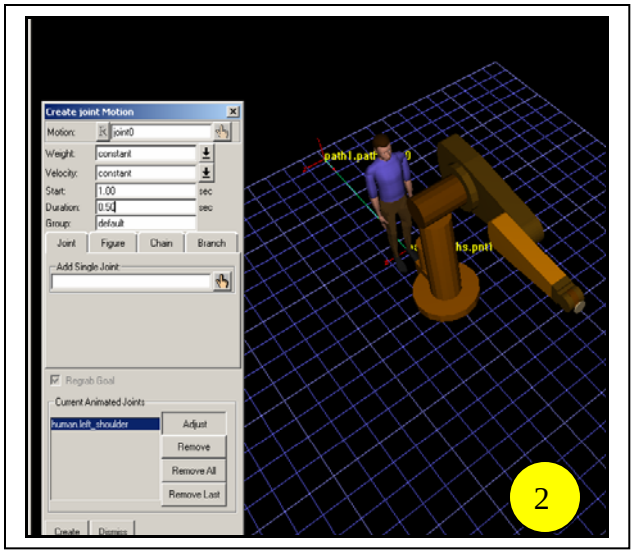


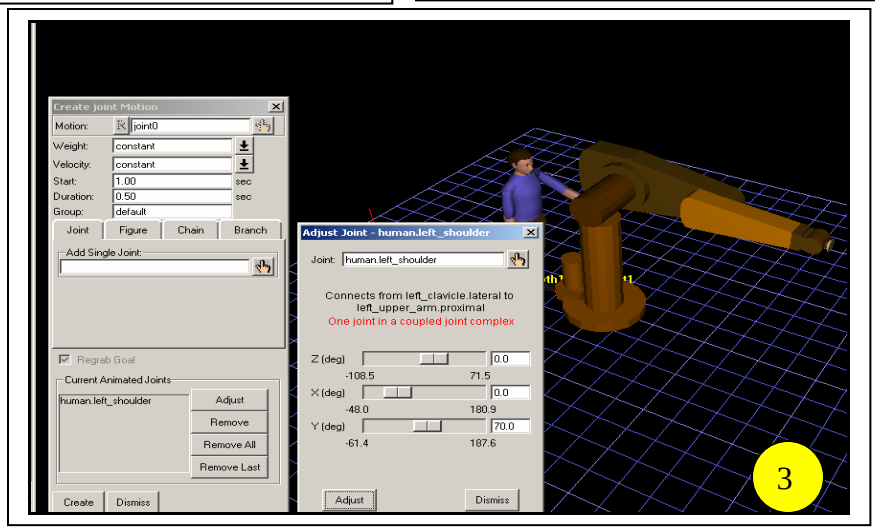
4) Create a Joint movement – *Human*

This time we will set up a simple human joint movement. We assume that the worker is going to activate the crane by touching the operator pad. To simulate this task, we need to assign a custom joint task to the human model. We are going to use the Joint command under Figure menu.

General → Joint





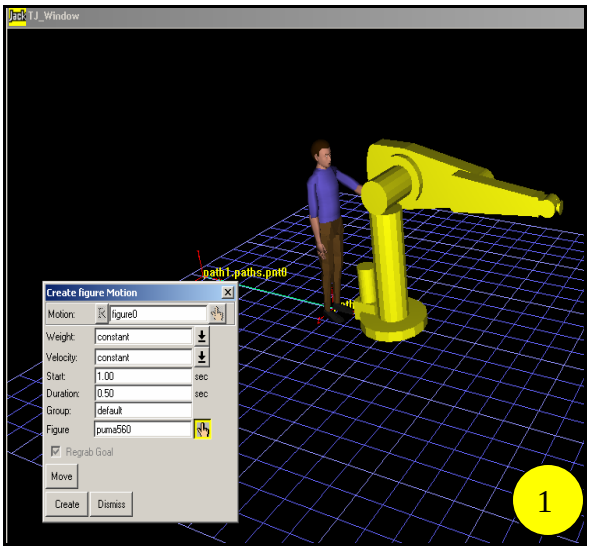


1) Click on the shoulder joint of the human model by using the hand icon. Set the starting time 1.00 seconds and the duration is 0.50 seconds.
2) After that select on the Adjust button. We are going to create a custom shoulder movement by using selected shoulder joint.
3) Adjust the shoulder joint on Y (deg) approximately 70.0 degrees. This will raise the shoulder to a desired location close to the crane. Click Create button to assign the shoulder movement.

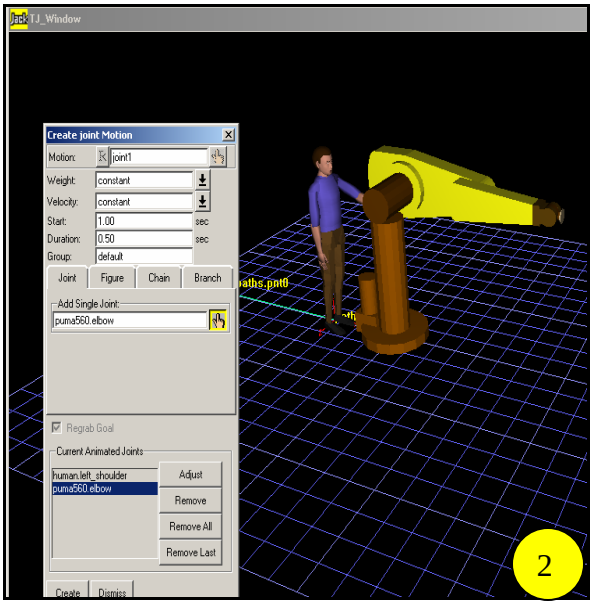
5) Create a Joint movement – *Crane*

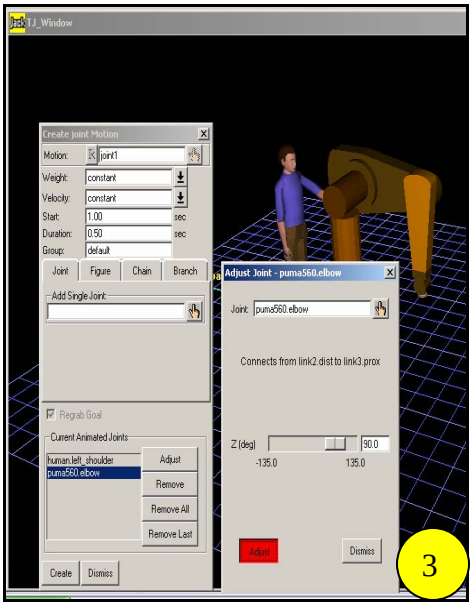
This time we will set up a simple joint movement for crane. We assume that after worker activated the crane pad, the crane front joint is going to level down. To simulate this task, we need to assign a custom joint task to the crane model. We are going to use the Joint command under Figure menu. But before doing that, we need to select the working object, crane.

General → Figure
General → Joint



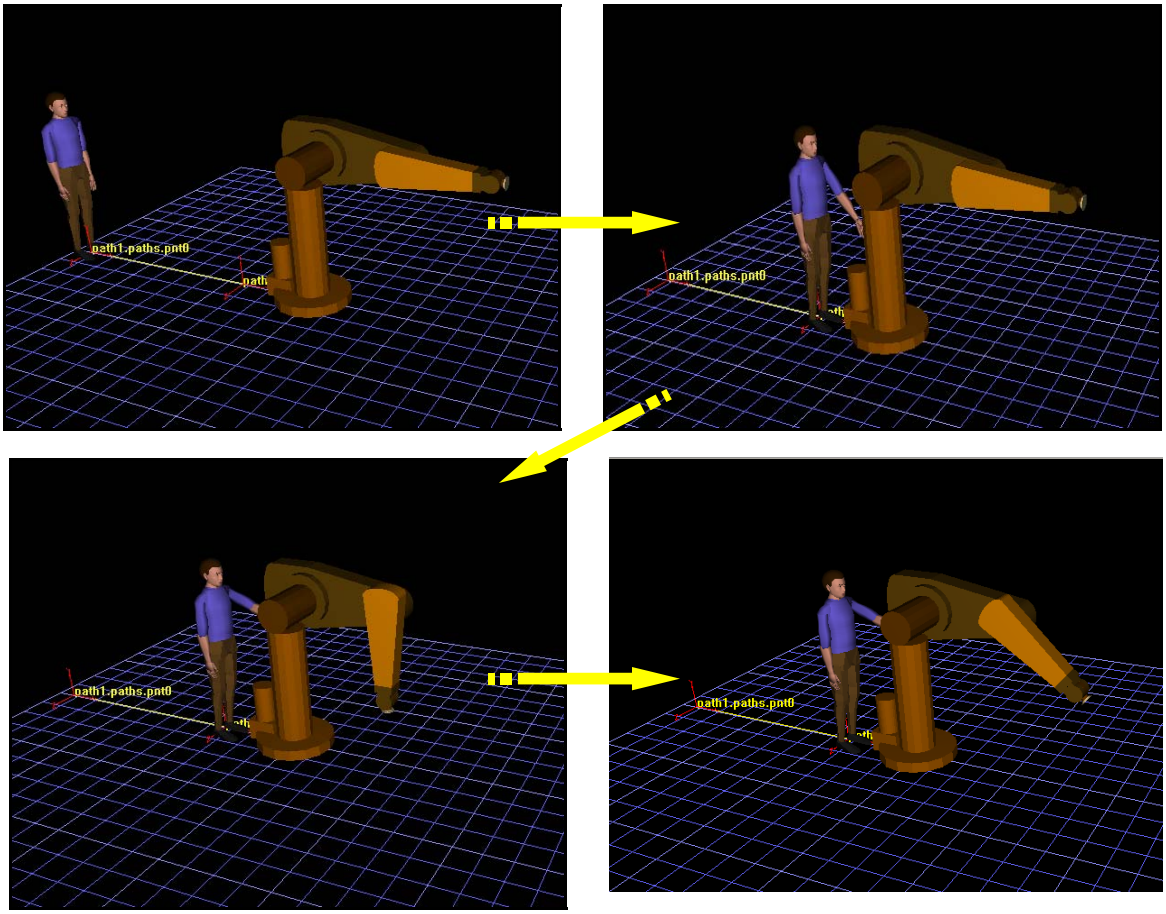
1) Go General → Figure, select the crane by hand tool.
2) Go General → Joint, Select the front end joint of the crane.
3) Click Adjust, and level Down the crane joint approximately 90 deg.

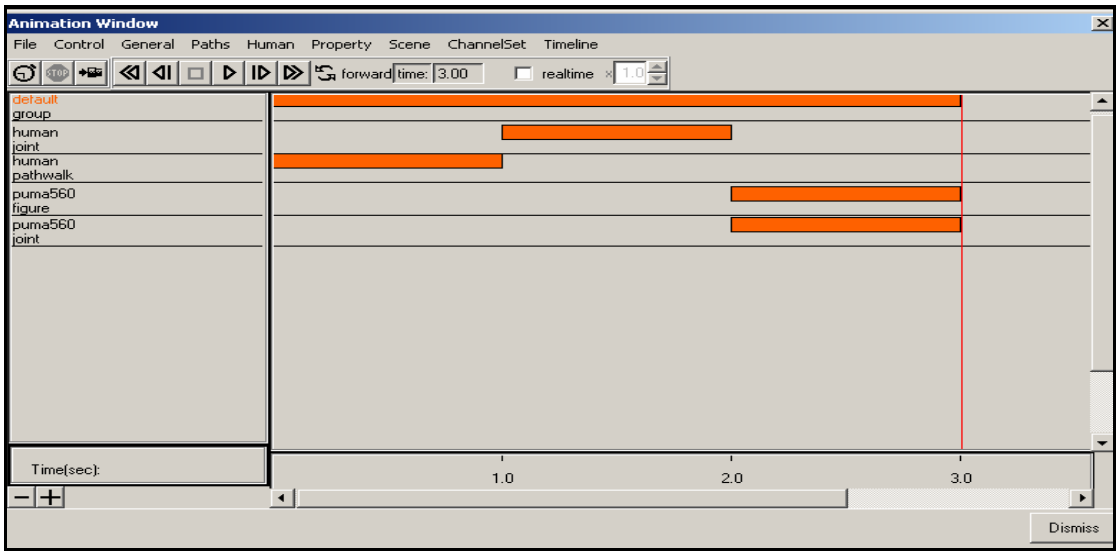




Step 3: Animation Overview

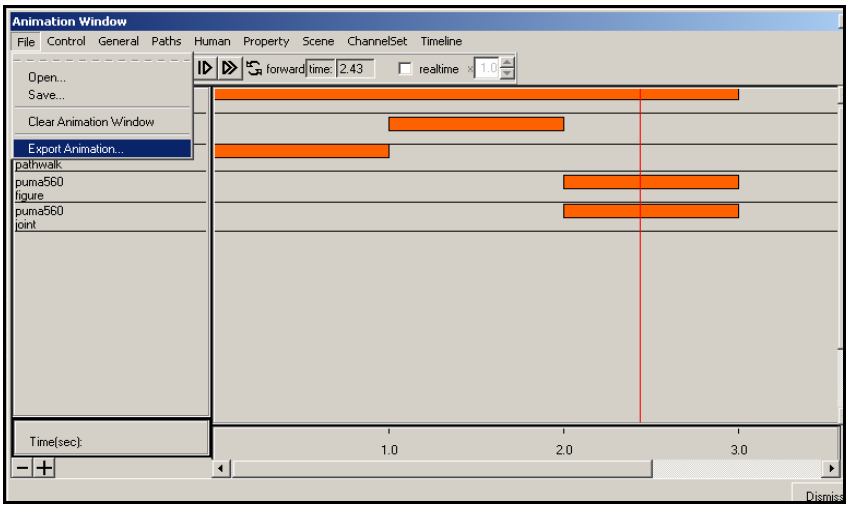
Below snapshots shows selected steps of the animation. You can watch the complete simulation by clicking on the *generate* button. You can use playback tools to navigate through the animation.

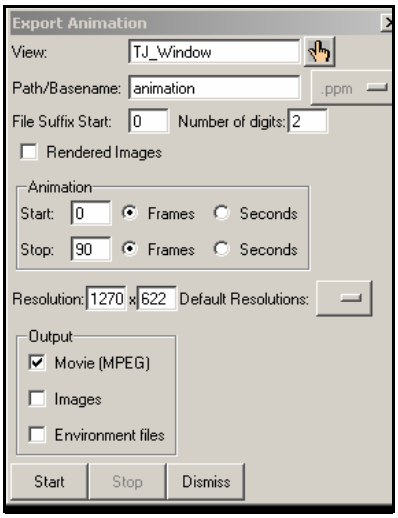




Step 4: Export Animation

After you have completed your animation you can export them in MPEG format by using Export Animation tool under File menu.





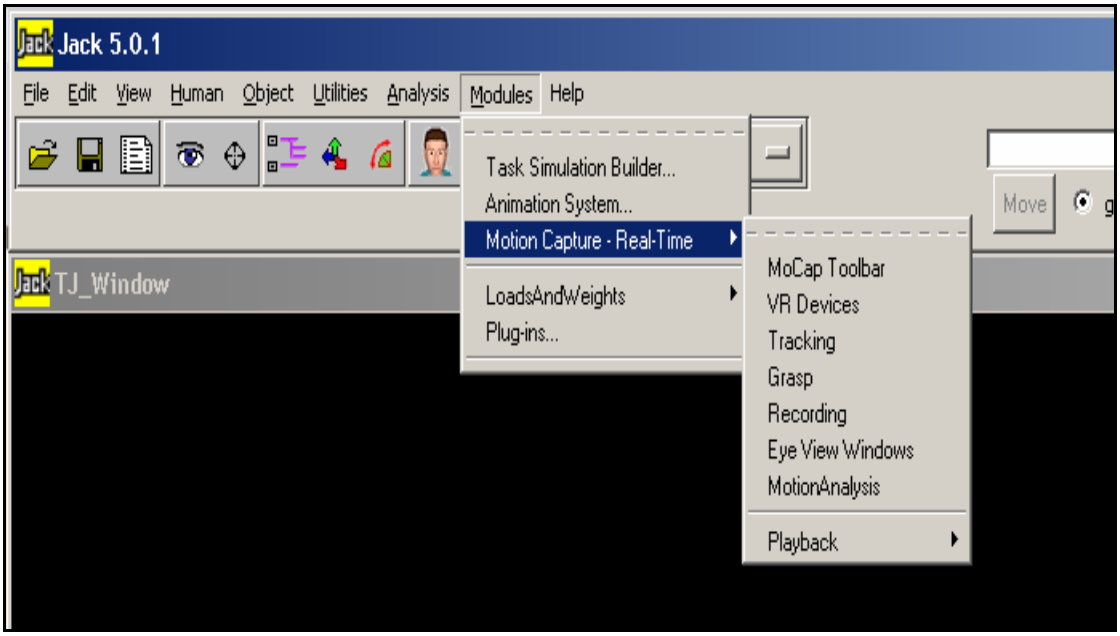
Motion Capture - Real Time

Motion Capture – Real Time tools helps user to access virtual reality devices.

You can track the motions of objects or humans with a special hardware to develop human posture. The collected data is used to develop a human posture in Jack environment in real-time.

By using MoCap tool users can interact with the virtual design where ergonomics and human factors issues of a new design can be evaluated.

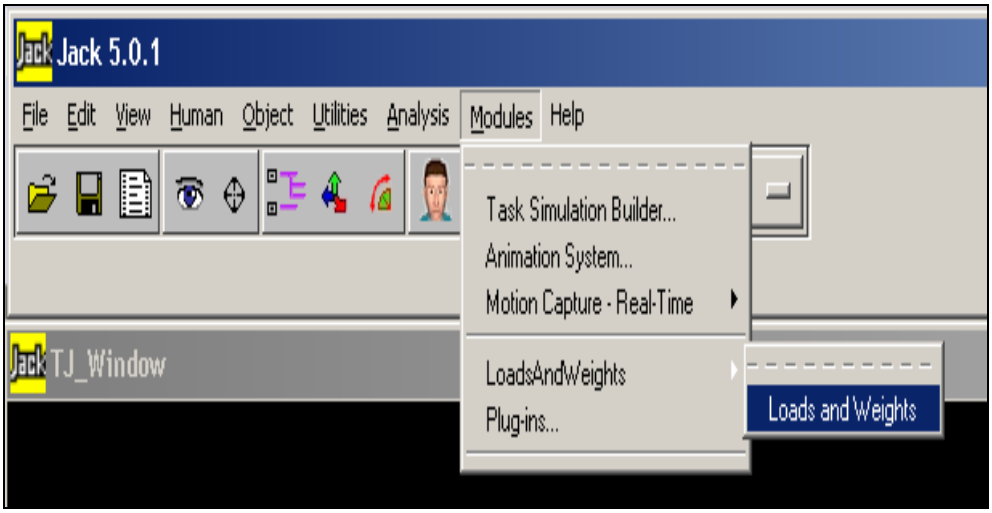
With the help of special motion tracking hardware individual finger motions can be captured. In the same way, head mounted displays help users to eye movements.



Motion Capture Tools

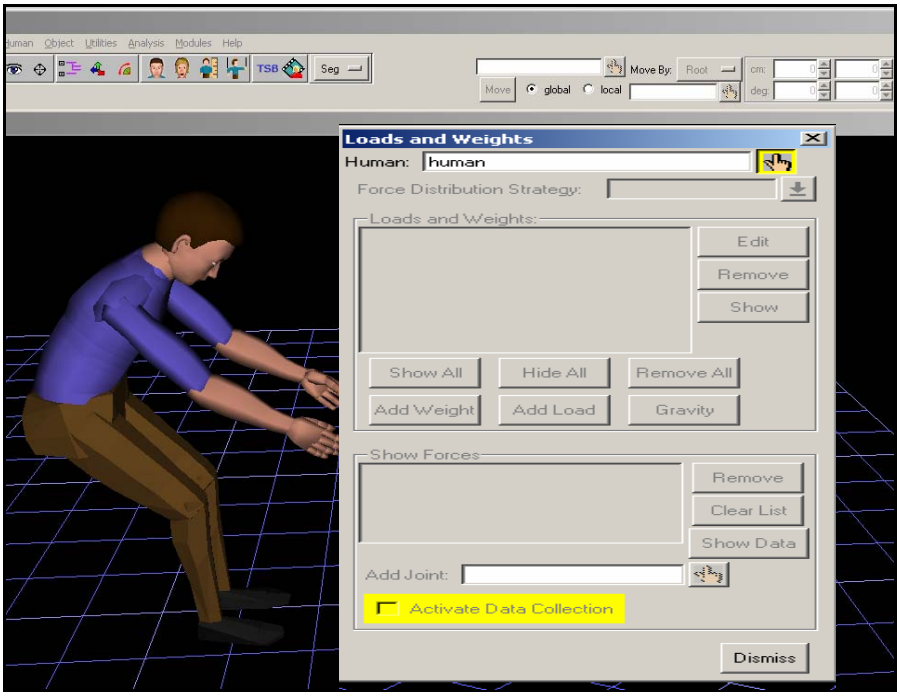
Load & Weights

Jack's Load & Weights tool allow users to assign loads into their human models. This application adds realistic load & weight assignment on a digital human model and enhances the analysis.

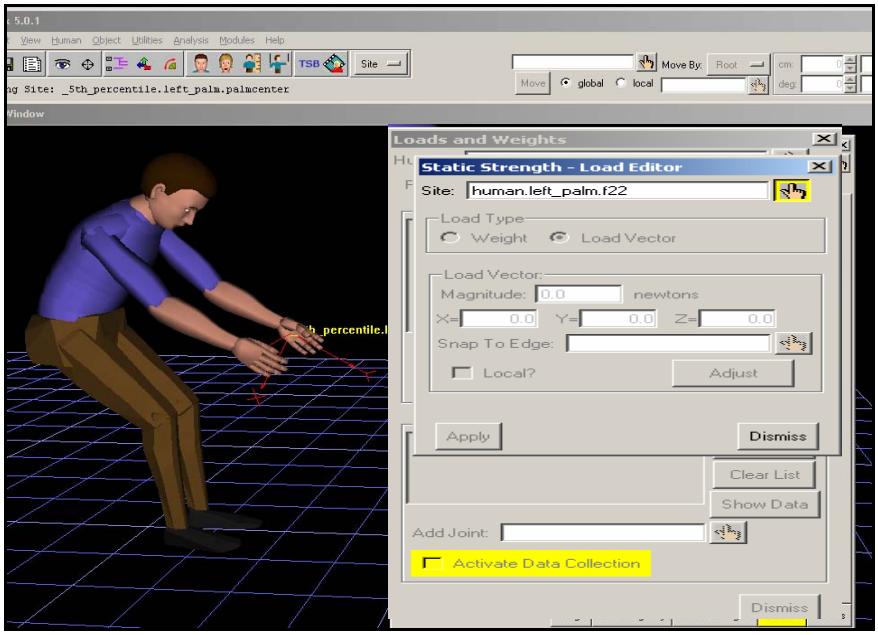


Below example shows how one can apply loads to a human model. We will assign the load as a vector force to the human model's hand.

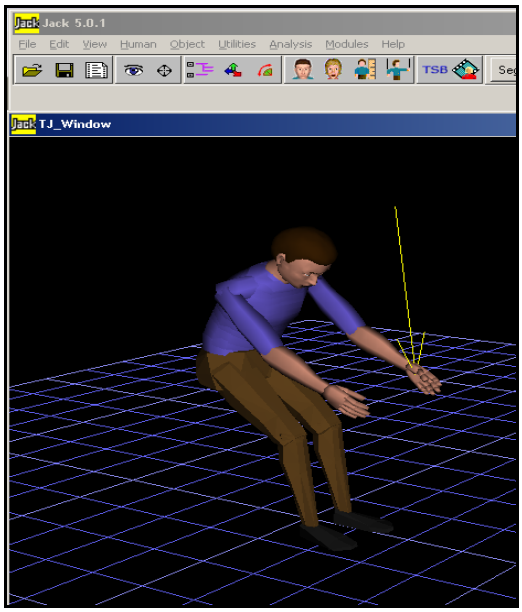
1. Click the Loads & Weights tool. Loads & Weights window will appear as shown below. *Keep the Force Distribution Strategy = Two Feet. This will distribute the loads symmetrically in both feet.*

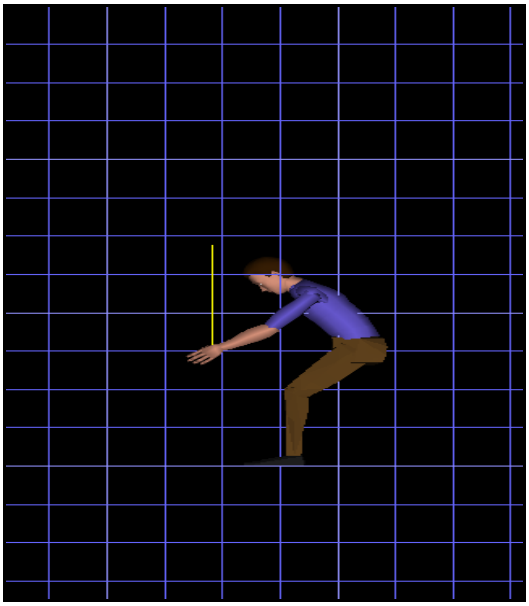


2. Click Add Load, Static Strength – Load Editor box will appear automatically.
3. Select the Hand tool and click on the center of the human hand. (palmcenter).
   If you can't select the palmcenter, manually drag & zoom human body.

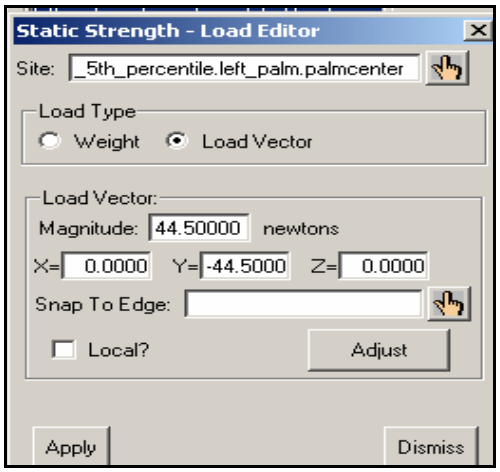


4. When you click on the palmcenter, a 90 degree down force vector will appear to represent the applied load.

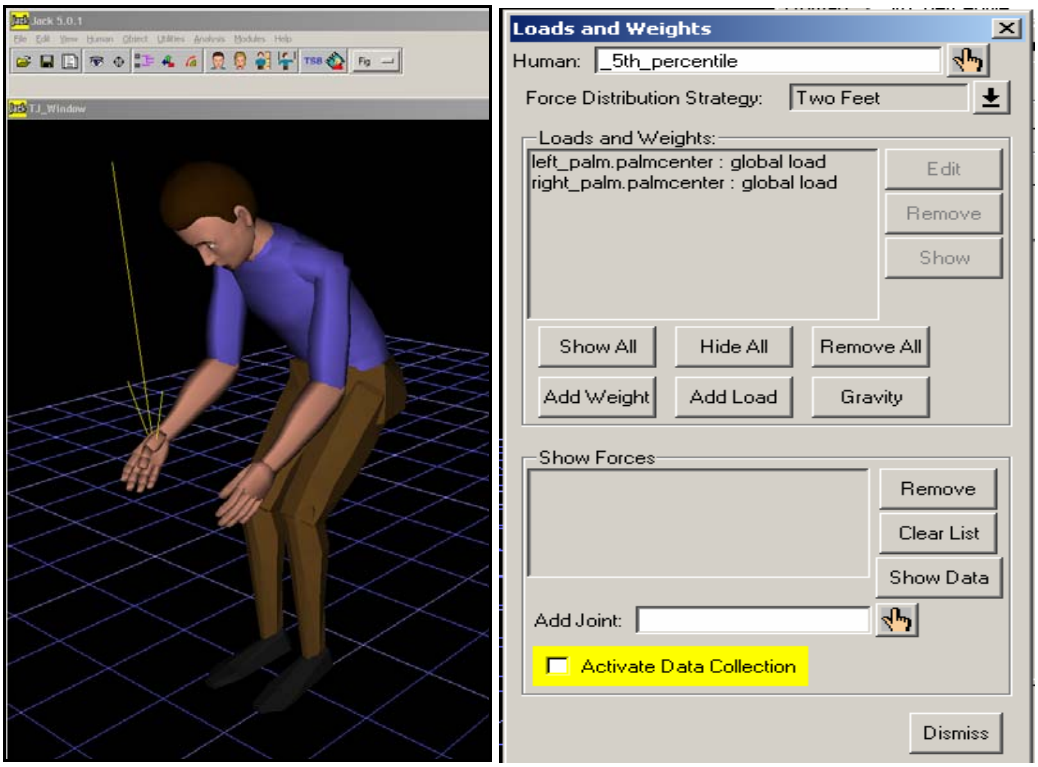




5. When you click on the human body, the Static Strength - Load Editor box will let you to enter inputs. Enter 44.5N to the Magnitude box, and click Apply.



6. Apply the above procedure to enter a symmetrical load (Magnitude = 44.5N) to the other hand. Once you enter all the loads, your Static Strength - Load Editor should include both loads.



Note = You can add/remove more loads and edit them easily by using the Static Strength - Load Editor window. In addition, you can select different Gravity modes. In this example default gravity mode (980.650 cm/s^2) is used.

Appendix

A

UGS TECNOMATIX JACK 5.0

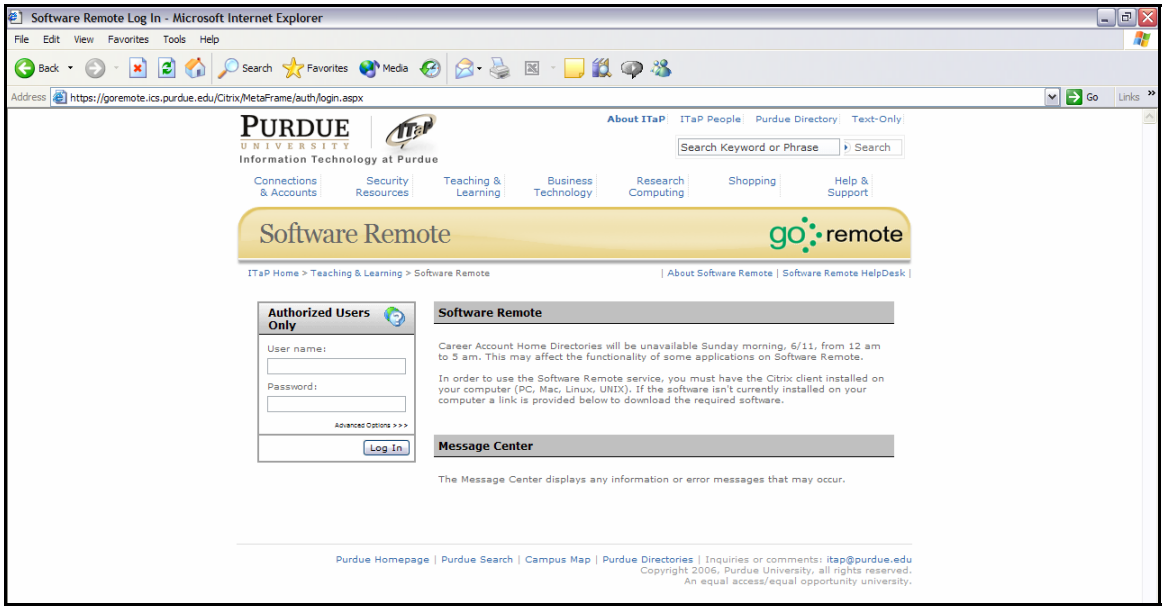
User Manual and Examples

Appendix A

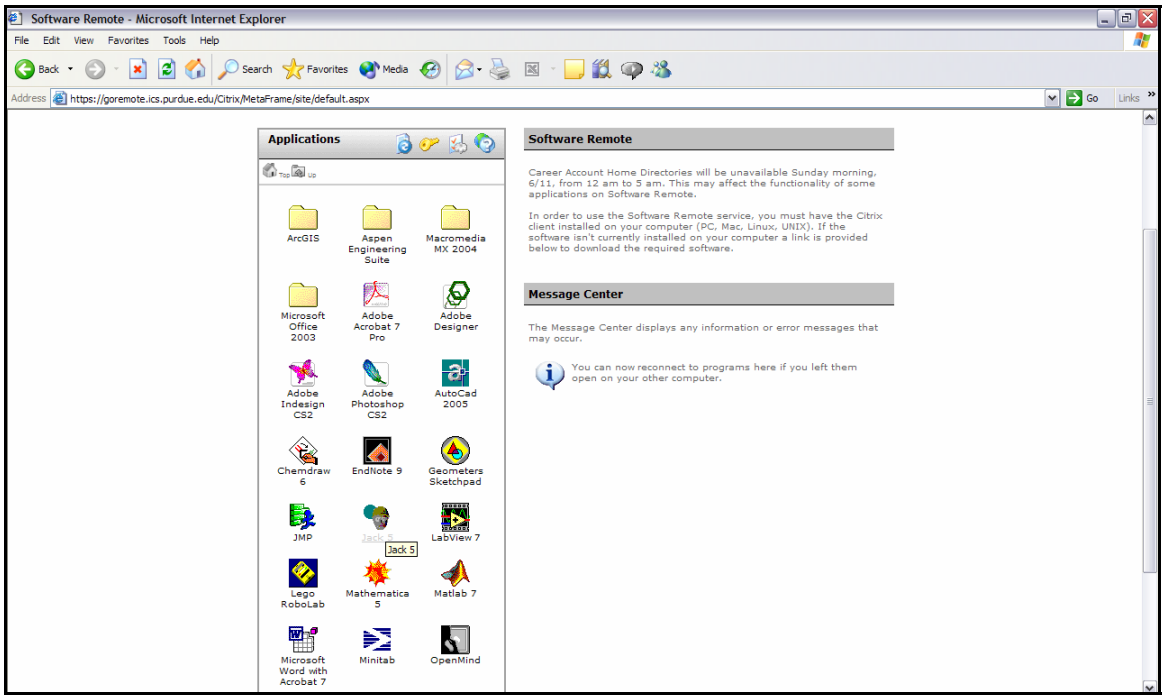
How to access Jack 5 in ITAP computers

1. Go to ITAP software remote access page via https://goremote.ics.purdue.edu

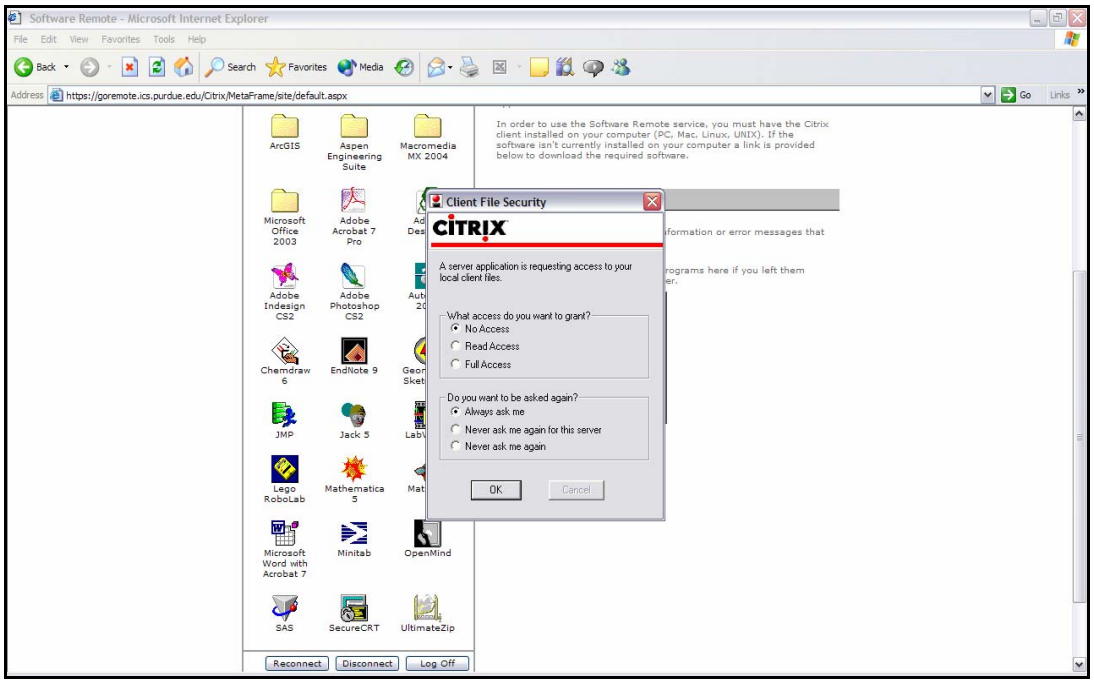
2. Enter your user name and password, click *Login*.



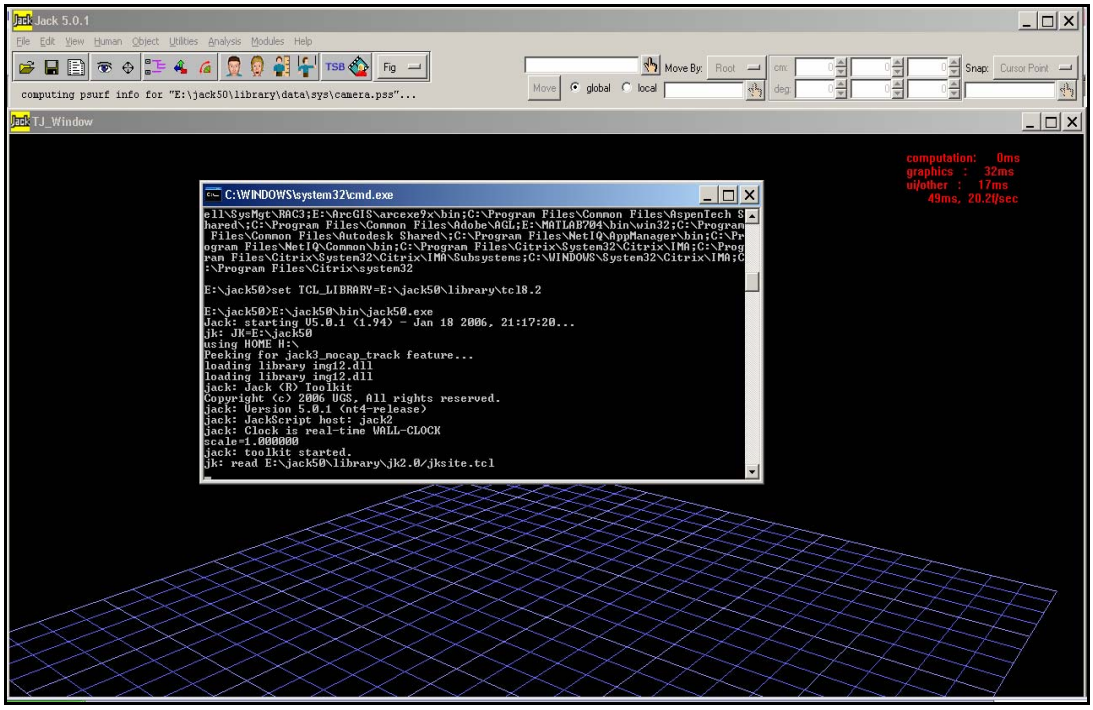
3. After successfully login to the remote access page, double click the Jack 5 icon to initiate the software.



4. Click *OK* when the *"Client File Security"* pop-up window appears.



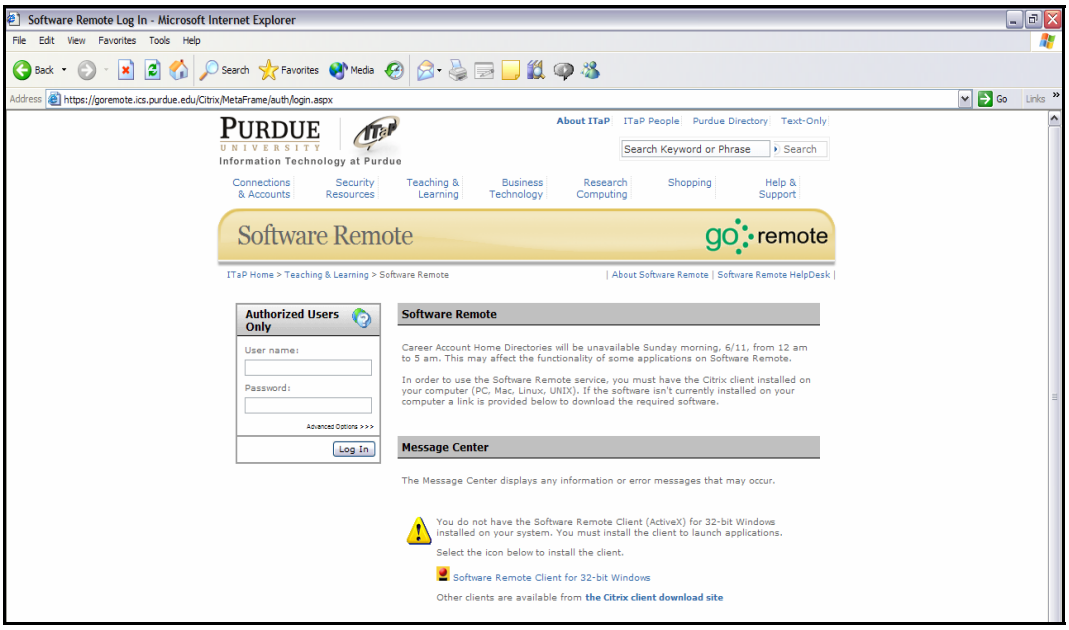
5. The Jack 5 software should be running and a command box should be initiated. Do not close the command box, just minimize it!



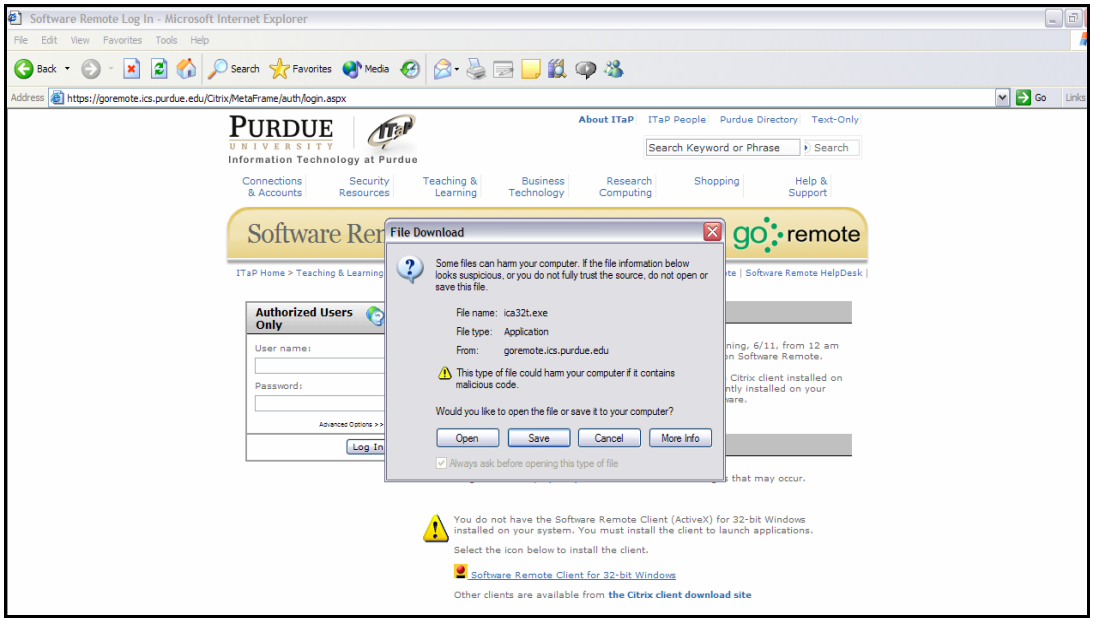
How to access Jack 5 from off-campus computers

1. Go to ITAP software remote access page via https://goremote.ics.purdue.edu

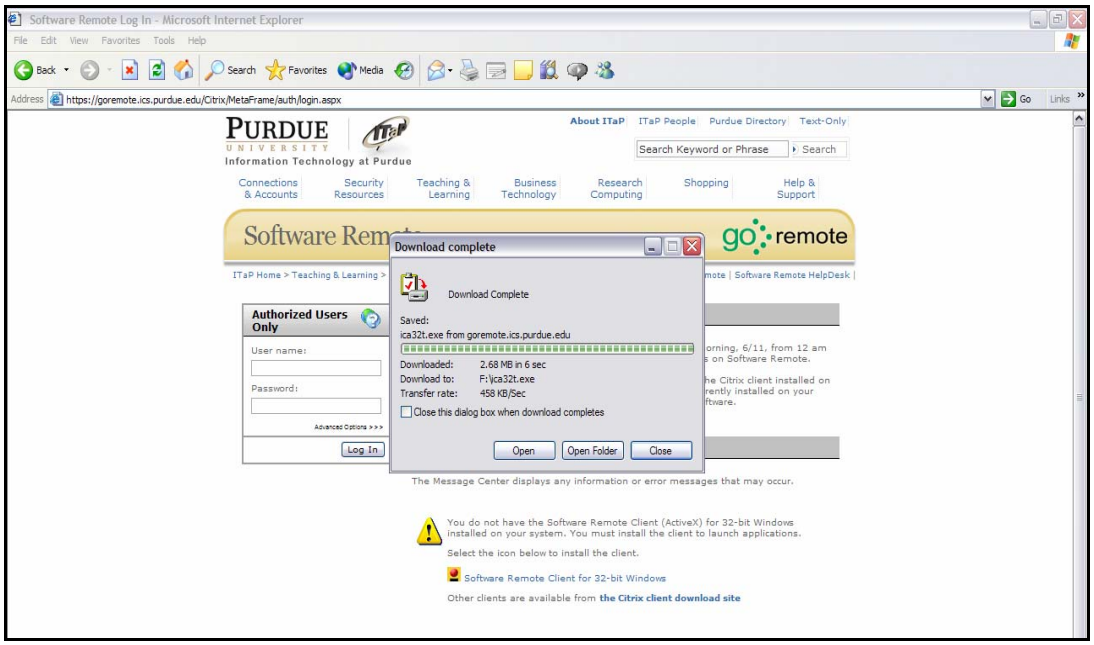
2. A warning massage will appear when you first enter to the page.
   Click the *"Software Remote Client for 32 bit Windows"* link to install Software Remote client (Active X)



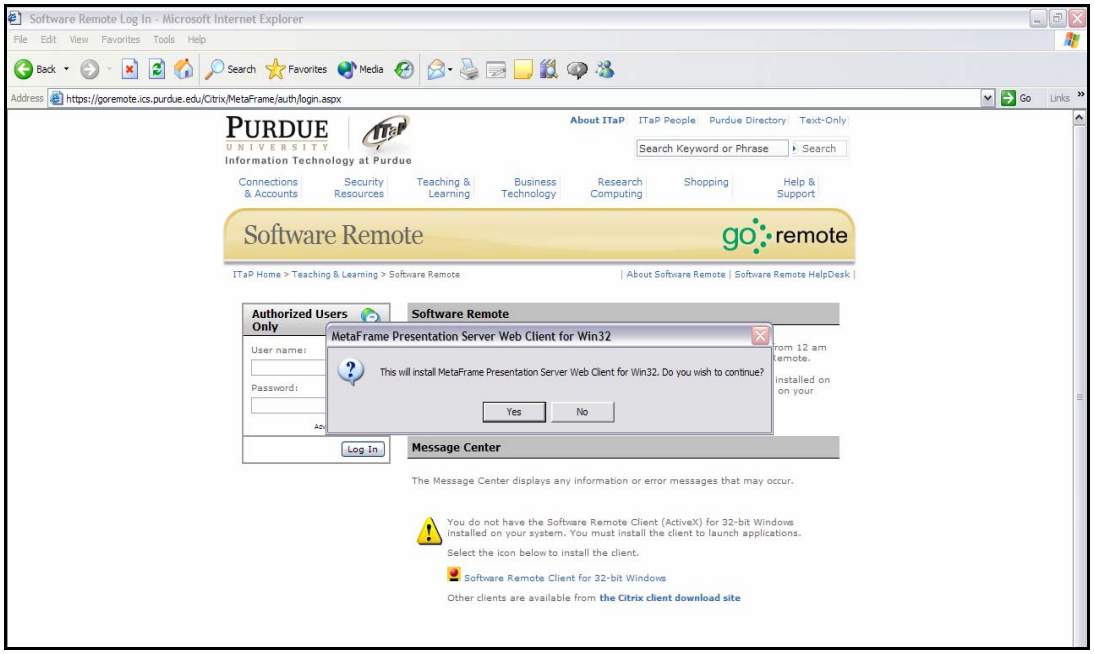
3. Click *Save* when the installation pop-up window appears.
   Select the desired location in your computer to install the files.
   This will automatically download the necessary files.



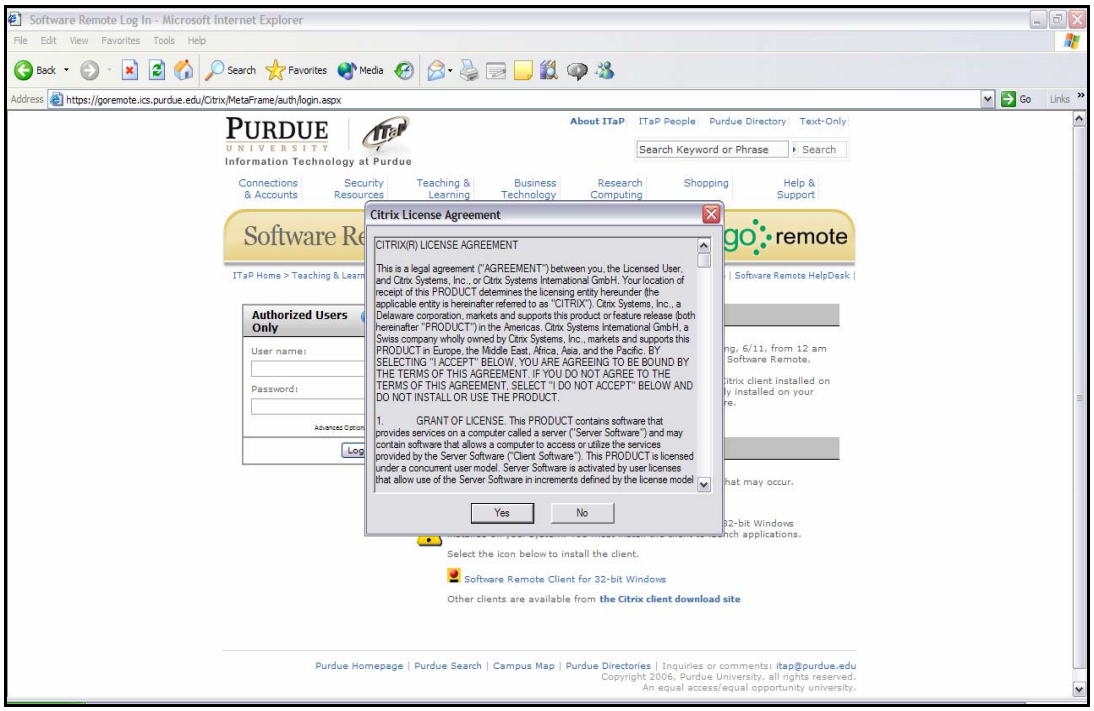
4. Click *Open* when the downloading process finishes.



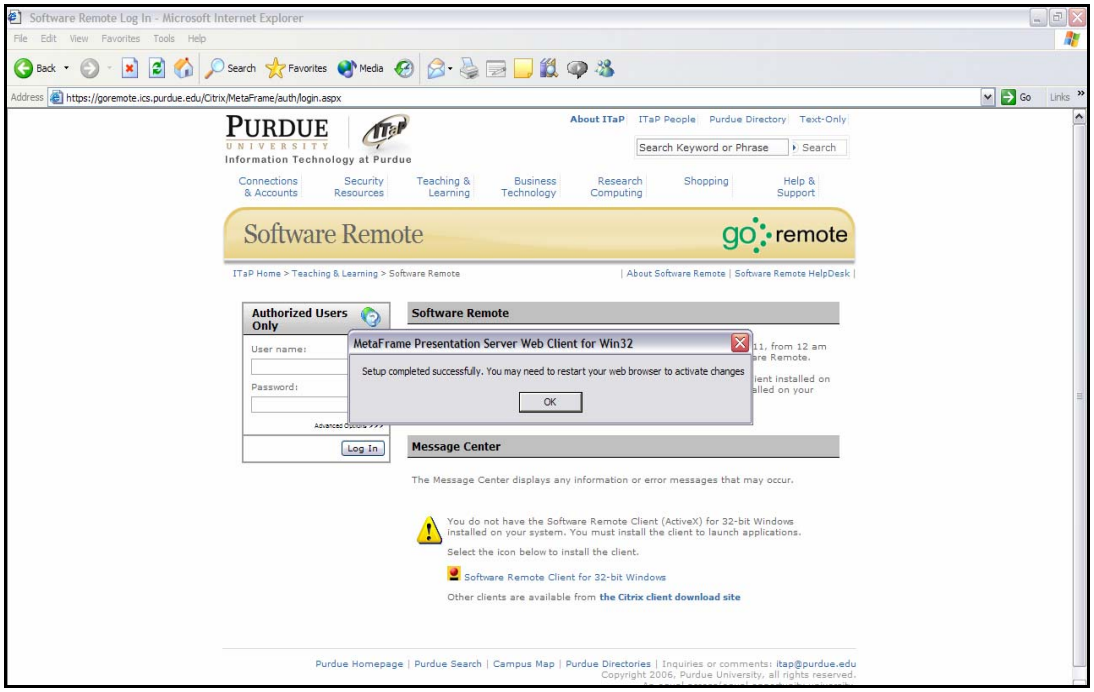
5. Click *Yes* when you see "*This will install MetaFrame Presentation Server Web Client for Win32. Do you wish to continue?*" pop-up window.



6. Click *Yes* when "*Citrix License Agreement*" window appears.
   This automatically copy installation files.

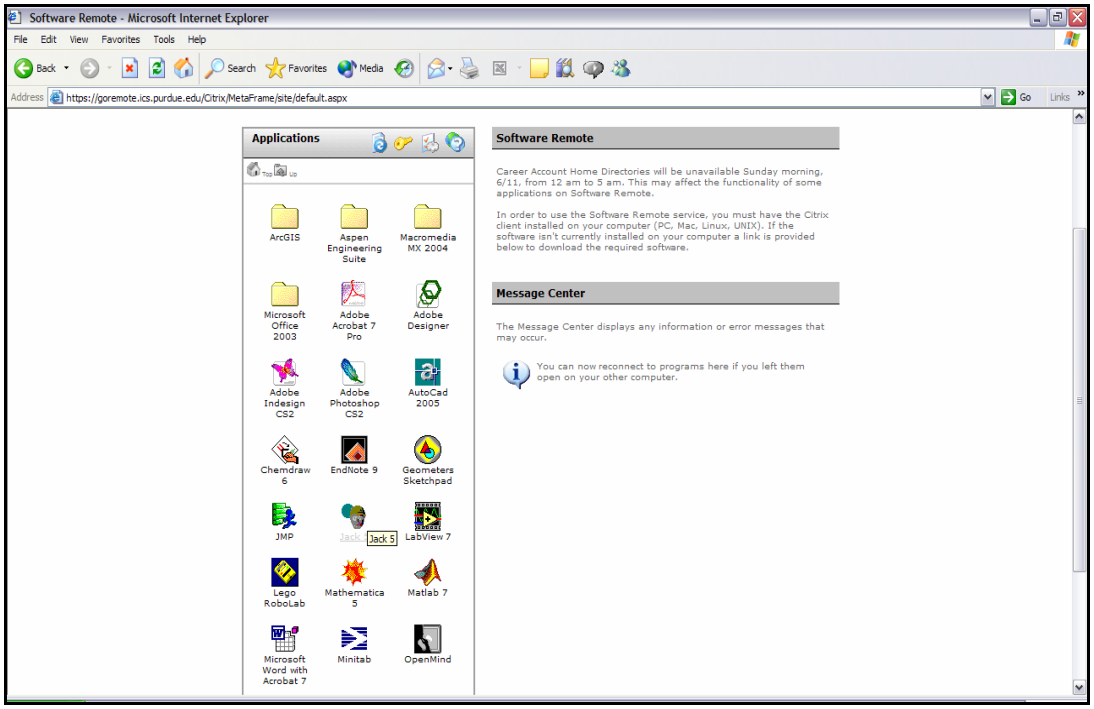


7. Click *OK* when the setup is completed.
   Close and open your browser to activate the changes.
   Go https://goremote.ics.purdue.edu

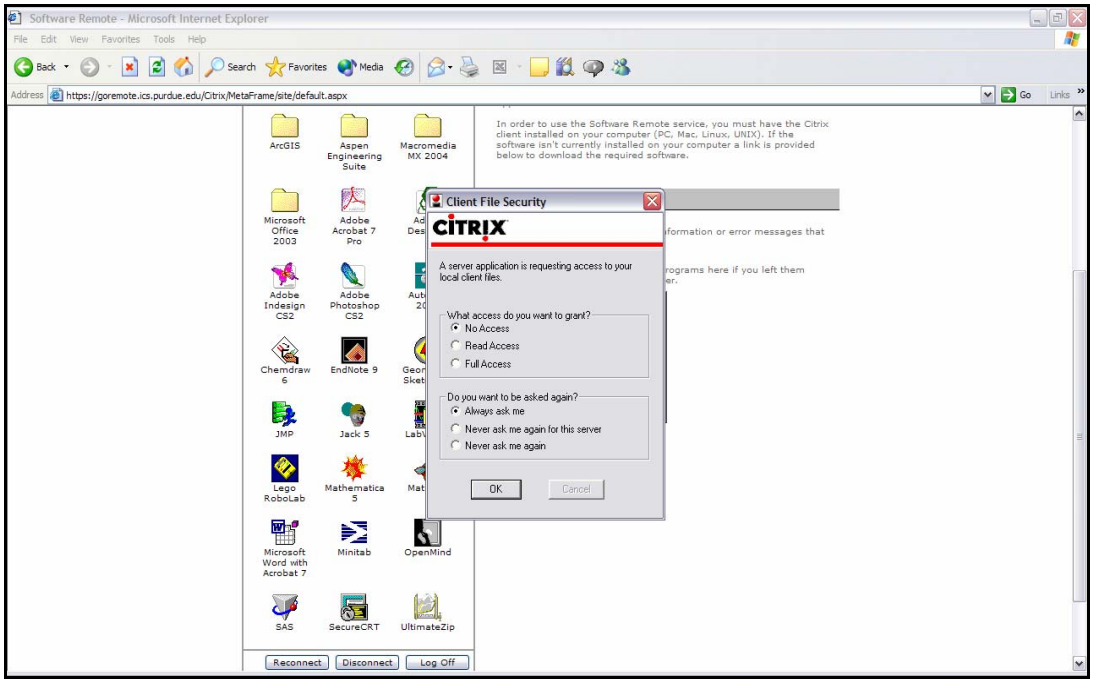


8. After you restarted your browser, remote access page should be updated automatically. Enter your user name and password, click *Login*.

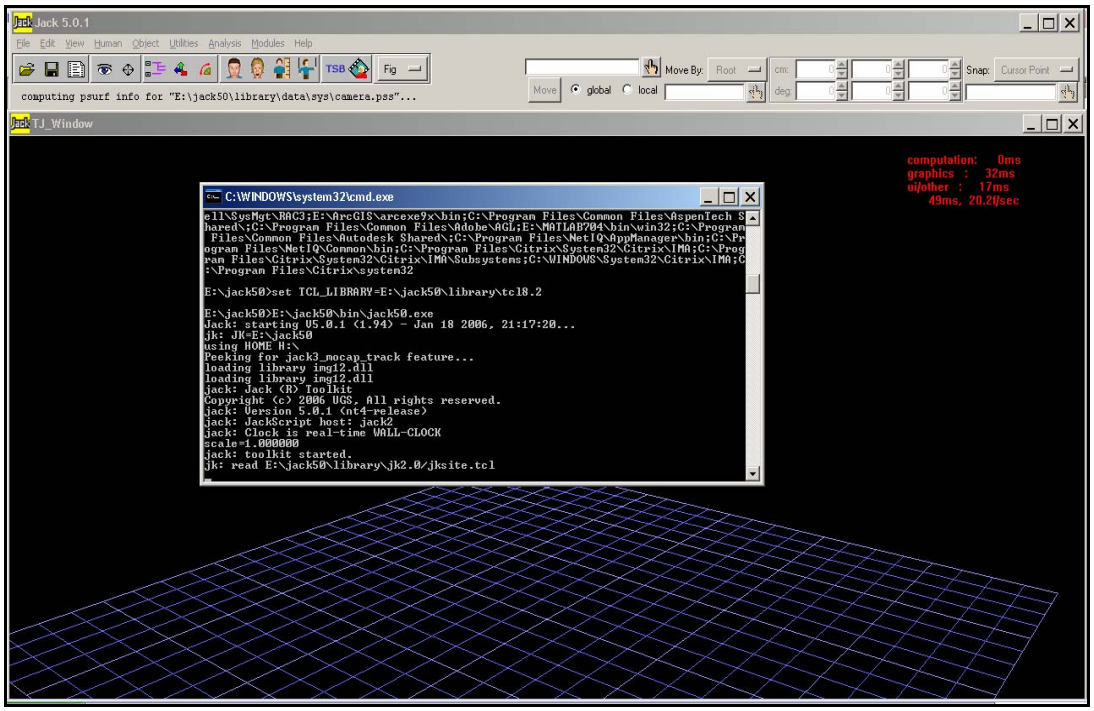
9. After successfully login to the remote access page, double click the Jack 5 icon to initiate the software.



10. Click *OK* when the *"Client File Security"* pop-up window appears.



11. The Jack 5 software should be running and a command box should be initiated. Do not close the command box, just minimize it!

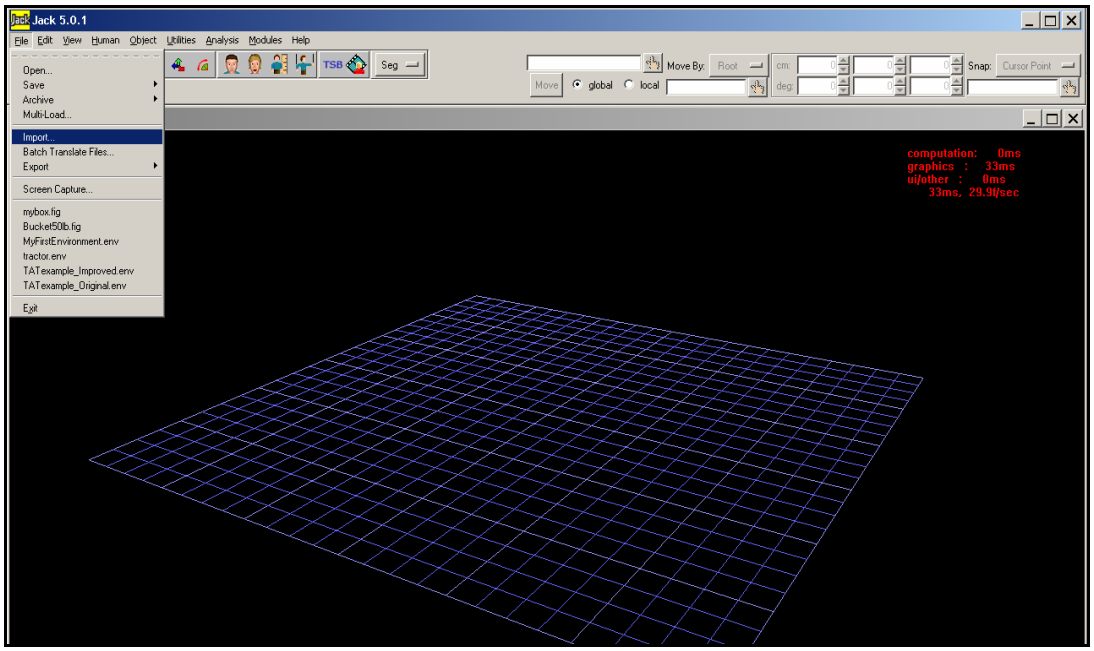


How to open a Jack 5 environment file

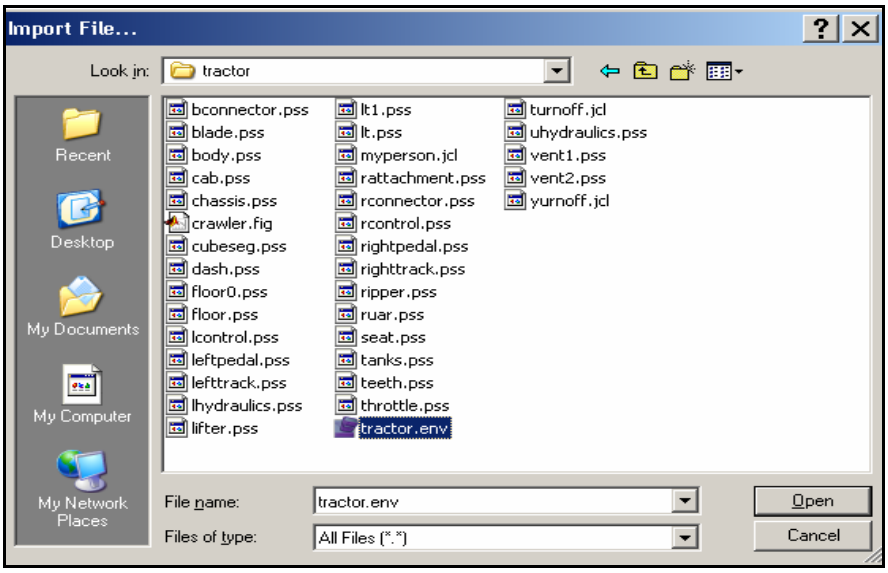
1. From WebCT or from any source right click the environment you wish to initialize. "Save to Desktop" or to another folder, your selected Jack file with .env extension. (factory.env or tractor.env).

2. Open Jack 5 software.

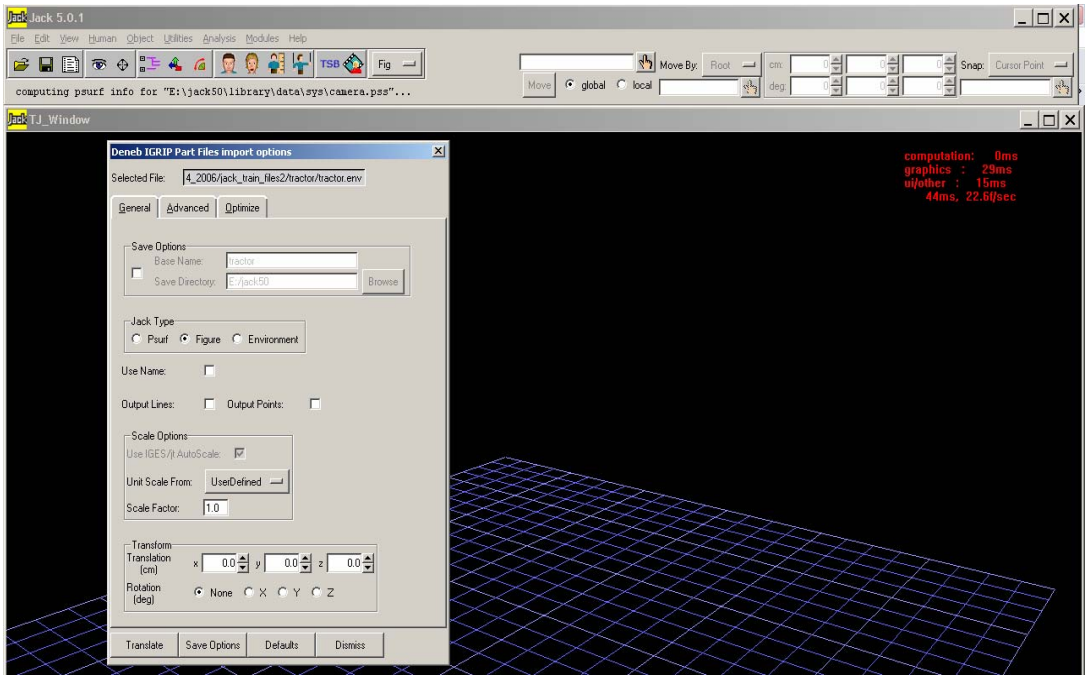
3. From menu select *File>Import*



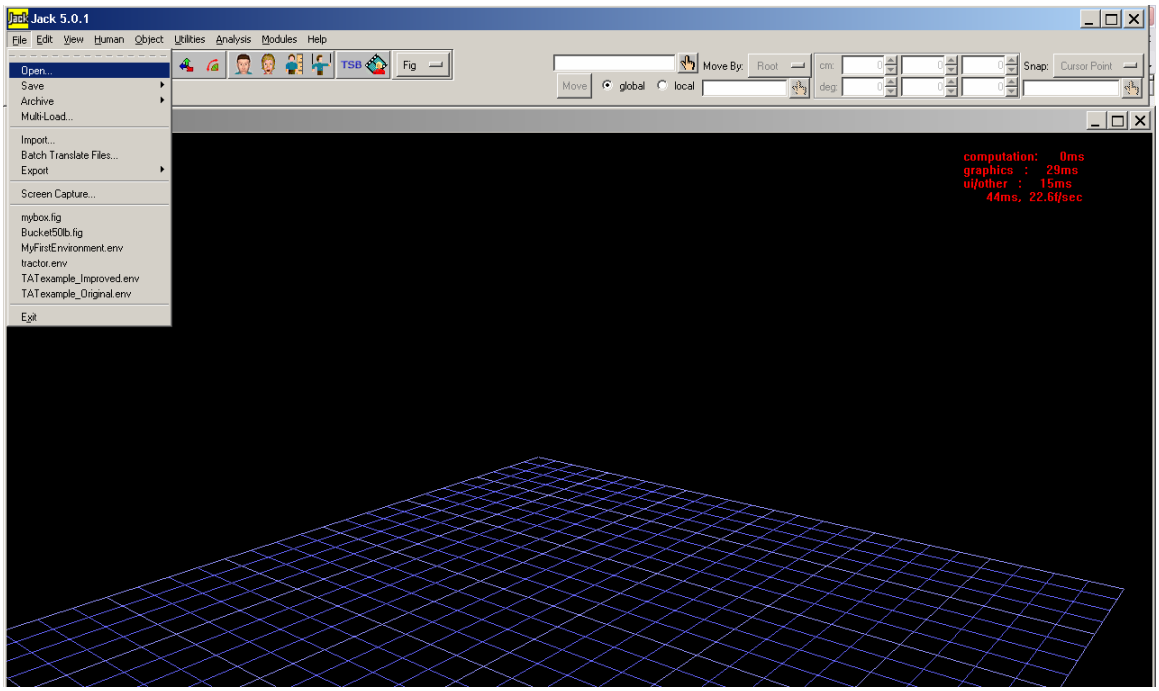
4. Import your selected file.



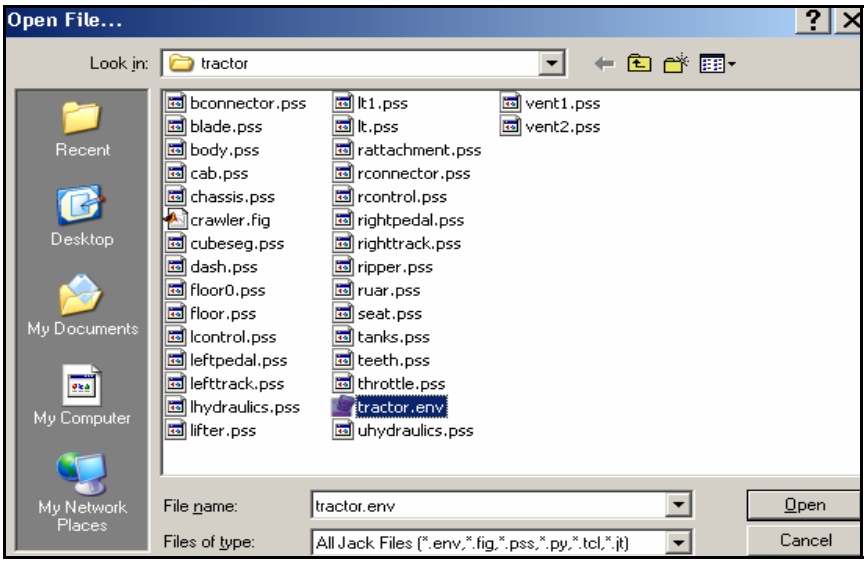
5. Next click *Dismiss* when below window appears.



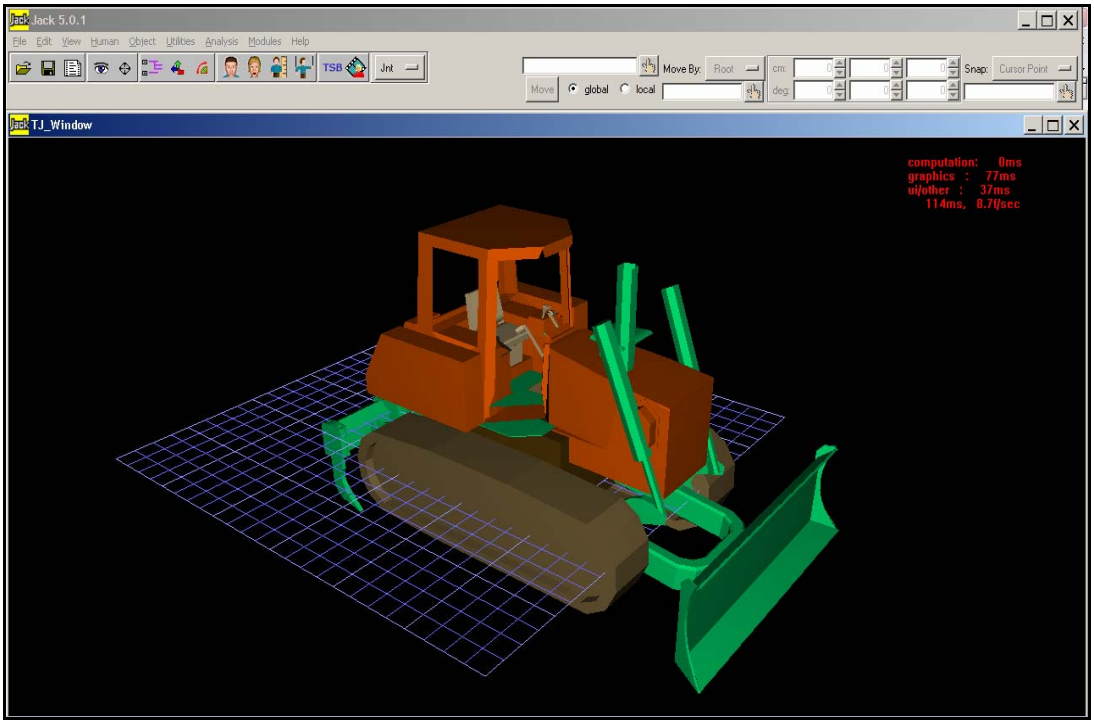
4. From menu select *File>Open*



5. Open your previously imported file.



6. You environment should open in Jack 5 view screen.



Appendix

B

UGS TECNOMATIX JACK 5.0

User Manual and Examples

Appendix B

- Professor Vincent G. Duffy, Purdue University, School of Industrial Engineering
  315 N. Grant Street, West Lafayette, IN 47907-2023
  - *Purdue University, School of Industrial Engineering*
    IE 656 – Digital Human Modeling for Design
    http://web.ics.purdue.edu/~duffy/index656
  - *Purdue University, School of Industrial Engineering*
    IE 590 – Applied Ergonomics
    http://web.ics.purdue.edu/~duffy/index590D
- Robert, T., Verriest, J.P., Leveque, D. and Fayet, M., 2006. Kinematic modeling of balance recovery movements of a standing passenger following its support surface translation, Society of Automotive Engineers Conference on Digital Human Modeling, Lyon, France. SAE-DHM-2006-01-2367.
- Zong, Z., and Lam, K., 2002. Biodynamic Response of Shipboard Sitting Subject to Ship Shock Motion, Journal of Biomechanics, 35, pp. 35-43.
- William J. Peine, School of Mechanical Engineering, Purdue University, 585 Purdue Mall, West Lafayette, IN 47907-2088
  - *Lower cost, portable surgical robots*
    http://www.purdue.edu/UNS/html4ever/2006/060302.Peine.robots.html
- University of Michigan, Center of Ergonomics, http://www.engin.umich.edu/dept/ioe/C4E/
  - *3D SSPP Software, http://www.engin.umich.edu/dept/ioe/3DSSPP/index.html*
- The University of Iowa, Virtual Soldier Research
  - *Virtual Soldier Research Program*
    http://www.digital-humans.org/
- Naval Postgraduate School, www.nps.edu
  - *Ship Shock Trials, http://www.nps.edu/Research/ShipShock.html*
  - *Ship Shock Trial Simulation of USS Winston S. Churchill (DDG 81):*
    Modeling and Simulation Strategy and Surrounding Fluid Volume Effects
    Young S. Shin and Nathan A. Schneider, Department of Mechanical Engineering, Naval Postgraduate School, Monterey, California 93943
- INRETS, Institut National de Recherce Sur Les Trasnportes et Leur Securite
  - *Biodynamics and Human Modeling Laboratory*
    http://www.inrets.fr/ur/lbmh/english/index.html

- UGS: Product Lifecycle Management (PLM) Solutions, www.ugs.com
  - *UGS Tecnomatix Jack software*
    http://www.ugs.com/products/tecnomatix/human_performance/jack/
- DESSAULT SYSTMES: Product Lifecycle Management Solutions, www.3ds.com
  - *CATIA, ENOVIA, DELMIA*
    http://www.3ds.com/products-solutions/brands/CATIA/
- SAE, Society of Automotive Engineers, www.sae.org
  - *http://www.sae.org/events/dhm/brochure.pdf*
- Wolfel Beratende Ingenieure
  - Biomechanics and Seating Comfort,
    http://www.woelfel.de/wbieng/biomechanik-sitzkomfort/biomechanik-sitzkomfort.html

Jack human modeling and simulation

Virtual people, virtual places, real solutions

fact sheet

Summary

The Jack human modeling and simulation tool helps organizations in various industries improve the ergonomics of product designs and refine workplace tasks. Jack and its optional toolkits bring human-centered design tools to your virtual environments for comprehensive analysis of the human factors of your new designs – before any physical prototypes are built. The Jack (and Jill) human models can be sized to represent your user populations, and allow engineers to evaluate their concept designs in terms of human performance, including reach, vision, injury risk, fatigue, comfort and other important ergonomics information.

Features

Create and visualize digital mock-ups

Jack gives you all the advanced graphical tools for importing design data to the virtual world or creating simple concept models. Use texture mapping, lighting and other graphical tools to give your environments visual realism.

Analyze human factors in designs

Jack's bio-fidelic kinematics and advanced anthropometric scaling give you virtual humans that can accurately predict reach, vision, comfort and fit requirements.

Study humans in the simulated workplace

Jack enables you to design the safest most efficient and most productive workplaces. Jack's real-time posturing and animation capabilities help you quickly assign Jack to perform tasks to evaluate your designs.

Evaluate manual handling operations

Lifting heavy objects, performing tasks with awkward postures, and working while fatigued all place workers at increased risk of injury. Jack's comprehensive collection of human performance tools provide quantitative feedback on injury risk, strength capability, posture analysis, fatigue and task timing.

The Jack advantage

Countless organizations in a variety of industries are facing the same problem: the human element is not being considered early or thoroughly enough in the design, assembly and maintenance of products. More importantly, this is having a devastating impact on cost, time to market, quality and safety. For a growing number of organizations, however, factoring the human element into design, manufacturing and maintenance is no longer a problem; it's a competitive advantage. These organizations are using Jack to realize benefits such as:

- Shorter design time
- Lower development costs
- Improved quality
- Increased productivity
- Enhanced safety
- Heightened morale

Jack's business value

Jack is an ergonomics and human factors product that helps enterprises in various industries to improve the ergonomics of product designs and workplace tasks. This software enables users to position biomechanically accurate digital humans in virtual environments, assign them tasks and analyze their performance. Jack (and Jill) digital humans can tell engineers what they can see and reach, how comfortable they are, when and why they're getting hurt, when they're getting tired and other important ergonomics information. The information you obtain from Jack can help you design safer, more ergonomically sound products, workplaces and processes faster and for less cost.

System requirements

Windows XP and 2000

Minimum:
300 MHz
128 Mb Ram
175 MB free disk space

Recommended:
2.2 GHz
512 Mb RAM
175 MB free disk space
128 MB dedicated Video Ram

HPUX v11

Minimum:
C180 level machine
256 MB Ram
200 MB disk space

Recommended:
B2600
1 GB Ram
200 MB disk space

IRIX 6.5.x

Minimum:
O2 level machine
200 MB free disk space
256 byte Ram

Recommended:
Octane level machine
1 GB Ram
200 MB free disk space

Using Jack

Step 1: Build a virtual environment

In addition to its strength as a human modeler, Jack is a powerful interactive, real-time visual simulation solution. Jack's kinematic modeling capability allows you to easily joint figures to create complex mechanisms. Real time inverse kinematics and constraint solvers automatically can be applied to your mechanisms.

Step 2: Create a virtual human

Jack provides the industry's most biomechanicaly accurate human models based on body dimension measurements taken from the most up-to-date anthropometric databases including ANSUR 88, NHANES, and CAESAR. Boundary manikin methods can be used to create a family of sized manikins to efficiently test your designs for accommodation.

Step 3: Position the human in your environment

Jack allows you to posture the figure using advanced empirical models, inverse kinematics or direct joint manipulation. In all cases, the manipulation of the complex figure is quick and the postures are physiologically realistic.

Step 4: Assign your human tasks

Jack's full animation capabilities allow human tasks and mechanism motions to be defined and played back for review or analysis. In addition, a wide range of VR hardware is supported for real-time capture of complex human movements. Simulations can be easily exported to .mpg movies.

Step 5: Analyze how your human performs

Jack features the industry's leading collection of tools to help you evaluate the performance of your virtual humans. Many of the functionalities are assembled in add-on modules including the Occupant Packaging and Task Analysis toolkits. Functionalities include:

- Vehicle accommodation tools – posture prediction, SAE J standards
- Vision analysis including 3D vision obscuration, refection or target visibility zones
- Analysis of human performance capability including strength, posture, injury risk, fatigue and task timing

Contact
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44-1276-705170

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852-2230-3333

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