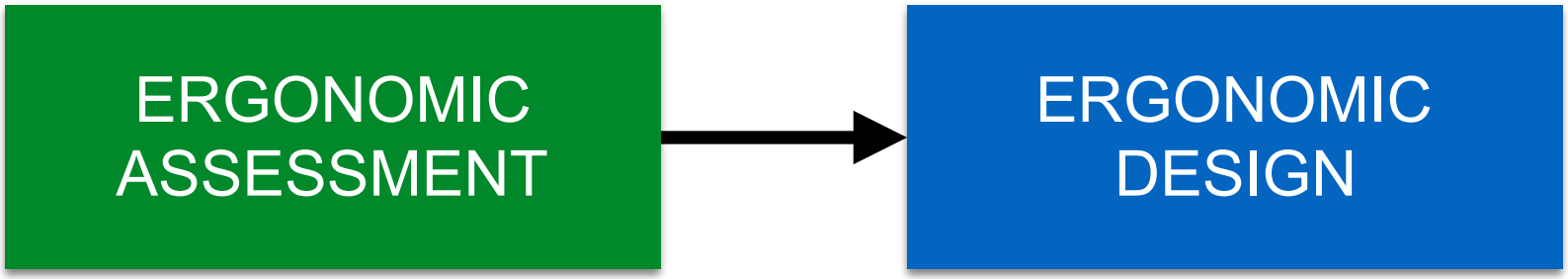
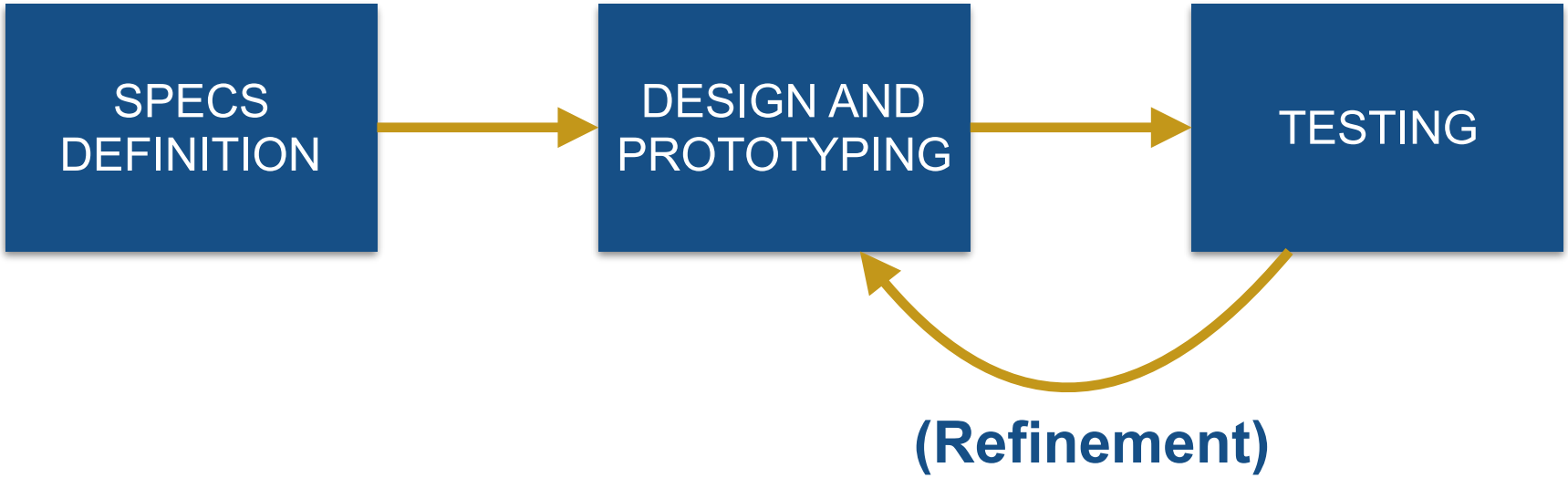
POLITECNICO DI MILANO



Ergonomic design

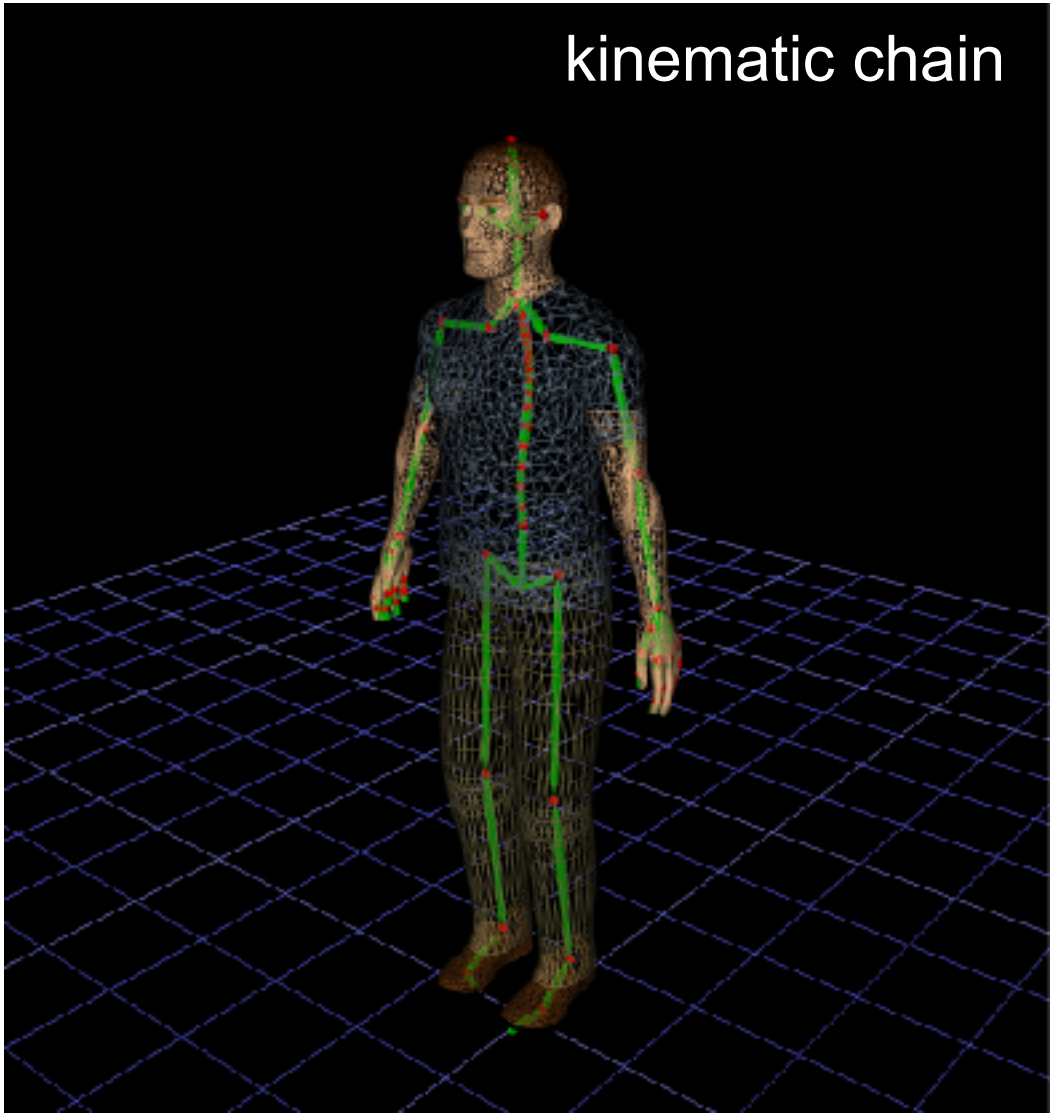

ERGONOMIC ASSESSMENT
ERGONOMIC DESIGN

Ergonomic design

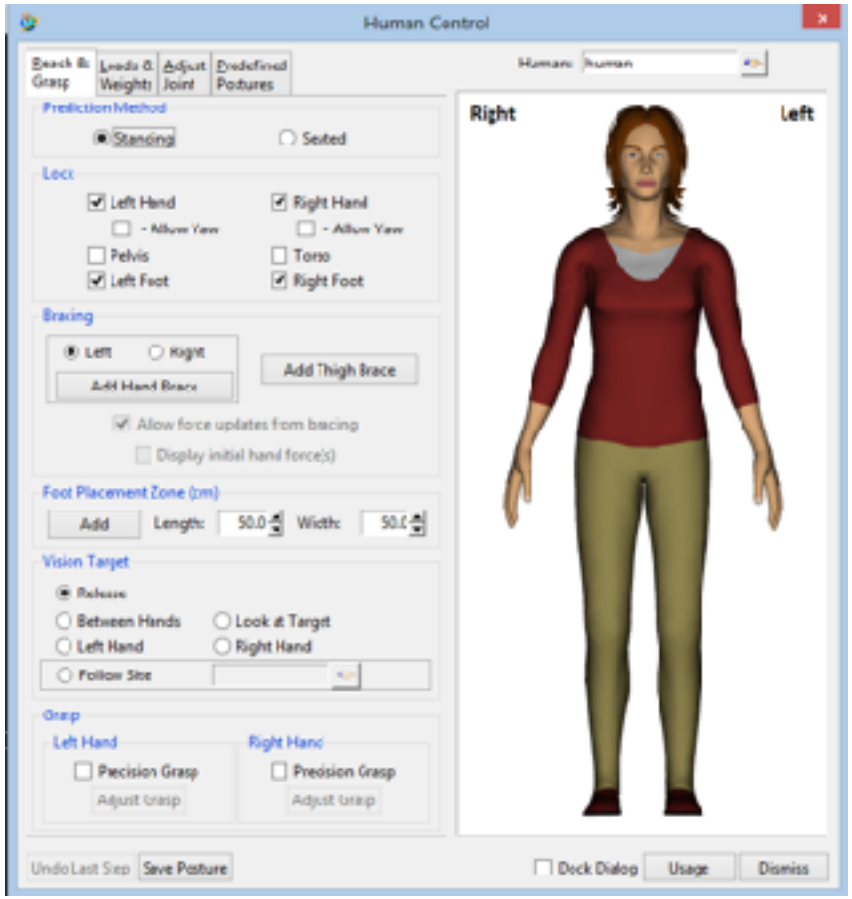


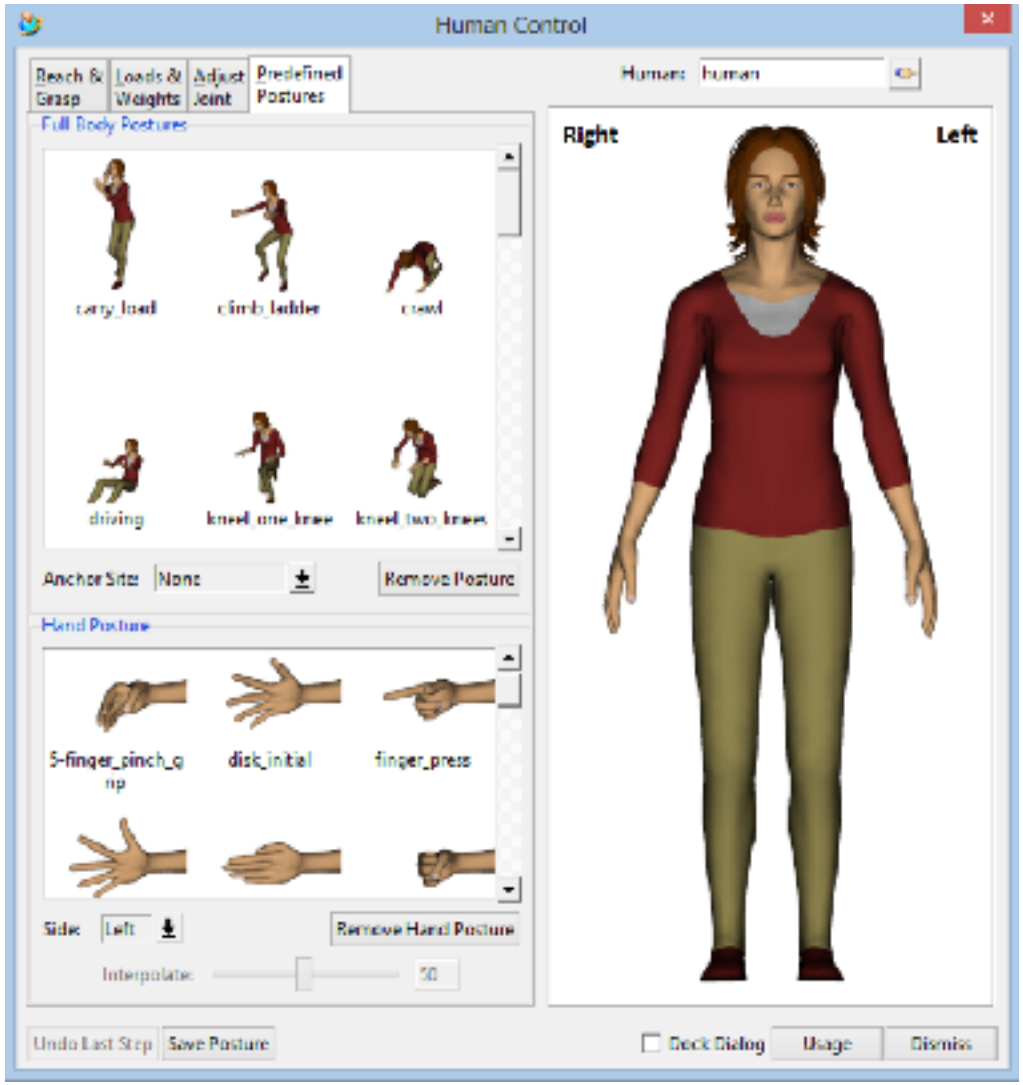
Tools for Ergonomic Design:
MANNEQUINS

Jack's skeleton

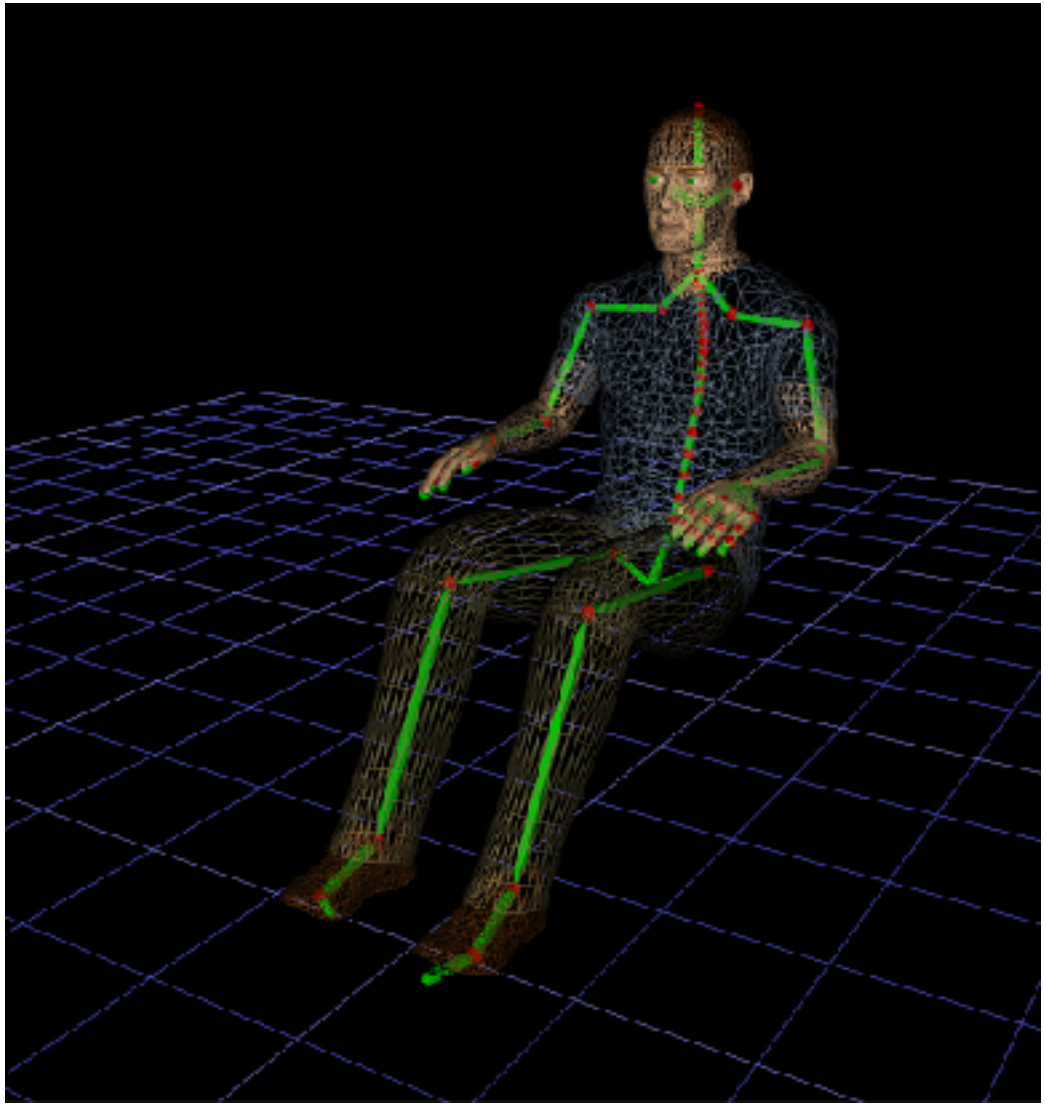


Postures


Human Control
Reach & Grasp
Loads & Weights
Adjust Joint
Predefined Postures
Human: human
Prediction Method
Standing
Seated
Locs
Left Hand
Right Hand
Pelvis
Torso
Left Foot
Right Foot
Bracing
Left
Right
Add Thigh Brace
Allow force updates from bracing
Display initial hand force(s)
Foot Placement Zone (cm)
Add
Length:
Width:
Vision Target
Between Hands
Look at Target
Left Hand
Right Hand
Follow Site
Grasp
Left Hand
Right Hand
Precision Grasp
Adjust Grasp
Undo Last Step
Save Posture
Dock Dialog
Usage
Dismiss
Right
Left


Human Control
Reach & Grasp
Loads & Weights
Adjust Joint
Predefined Postures
Human: human
Full Body Postures
carry_load
climb_ladder
crawl
driving
kneel_one_knee
kneel_two_knees
Anchor Site:
None
Remove Posture
Hand Posture
5-finger_pinch_grip
disk_initial
finger_press
Side:
Left
Remove Hand Posture
Interpolate:
Undo Last Step
Save Posture
Dock Dialog
Usage
Dismiss
Right
Left

Postures



INTERNATIONAL STANDARD **ISO 7250-1**

First edition
2008-02-15

Basic human body measurements for technological design —

Part 1: Body measurement definitions and landmarks

Définitions des mesures de base du corps humain pour la conception technologique —

Partie 1: Définitions des mesures du corps et repères

Reference number
ISO 7250-1:2008(E)

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INTERNATIONAL STANDARD **ISO 7250-3**

First edition
2015-08-15

Basic human body measurements for technological design —

Part 3: Worldwide and regional design ranges for use in product standards

Définitions des mesures de base du corps humain pour la conception technologique —

Partie 3: Gammes de conception régionales et mondiales pour utilisation dans les normes de produits

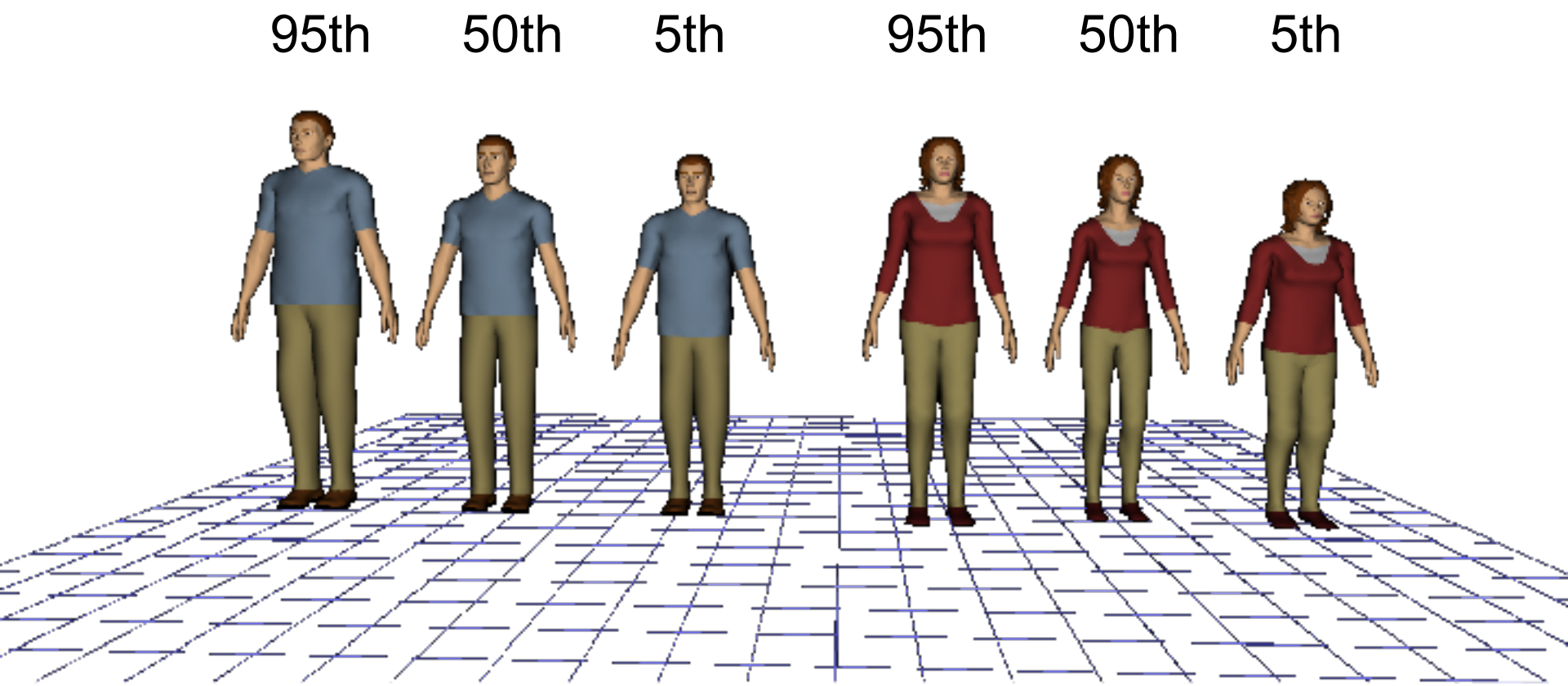
Reference number
ISO 7250-3:2015(E)

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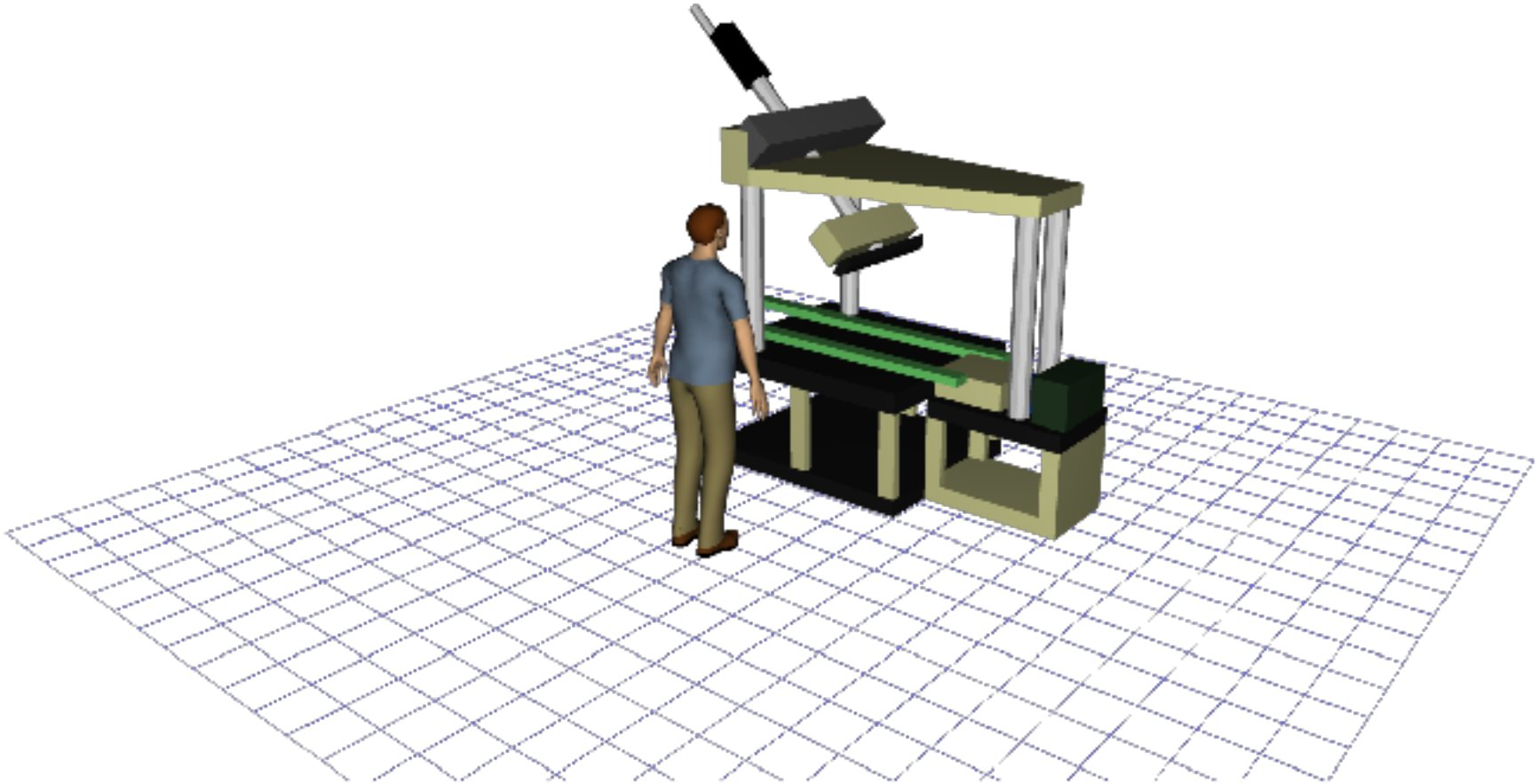
Anthropometric Scaling



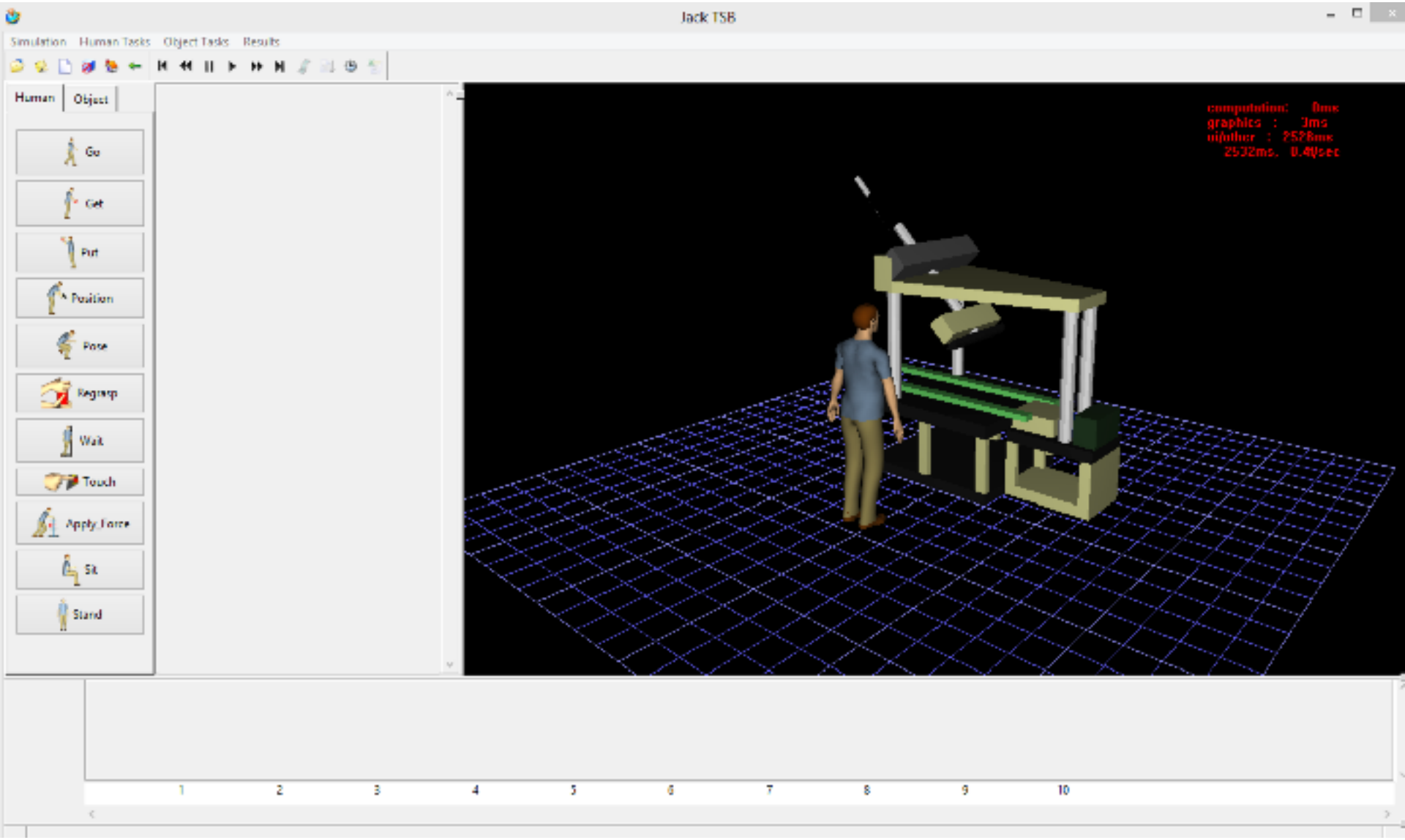
ANSUR database

Import Geometries

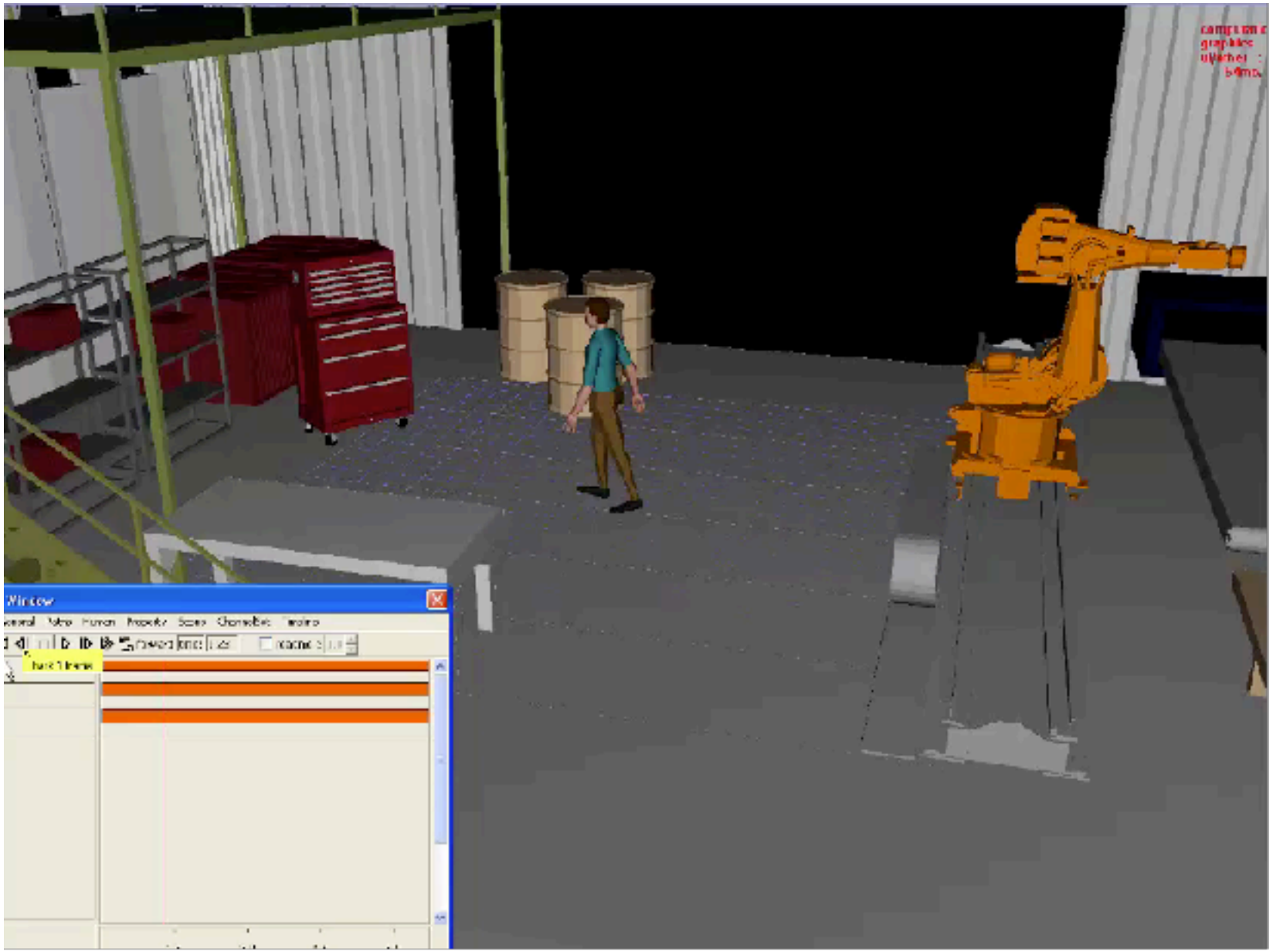
Geometries created with CAD systems can be imported

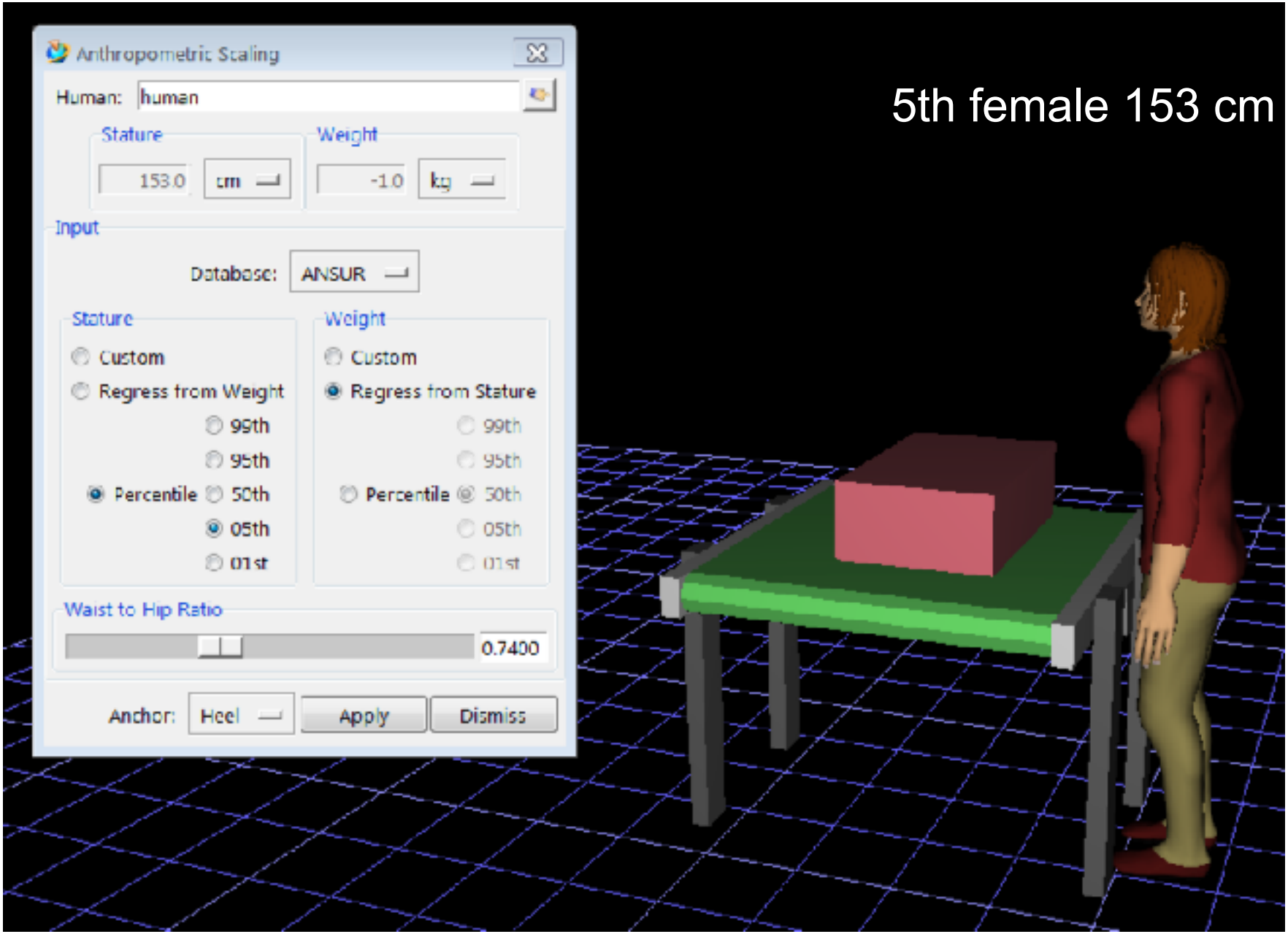


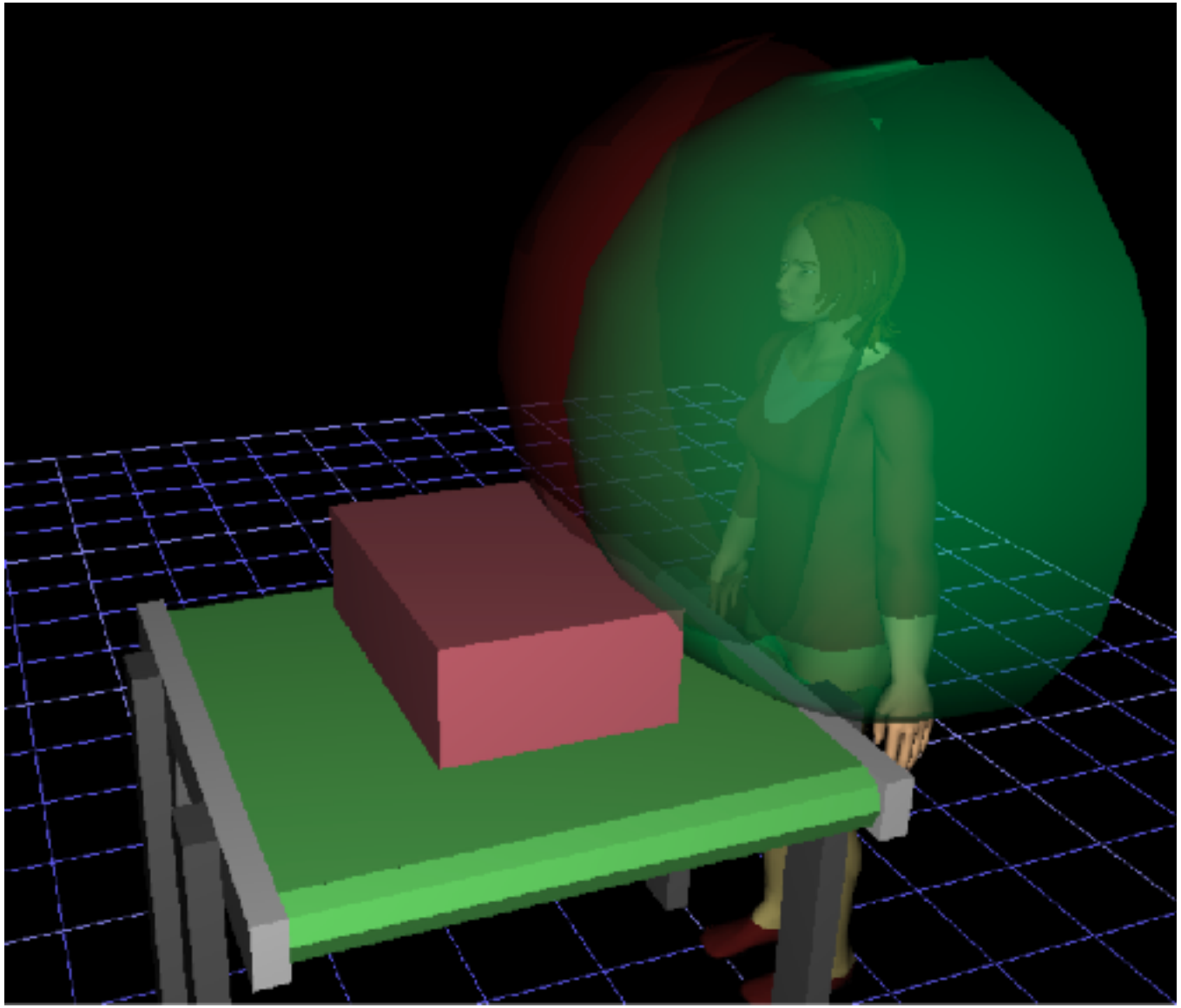
Task Simulator

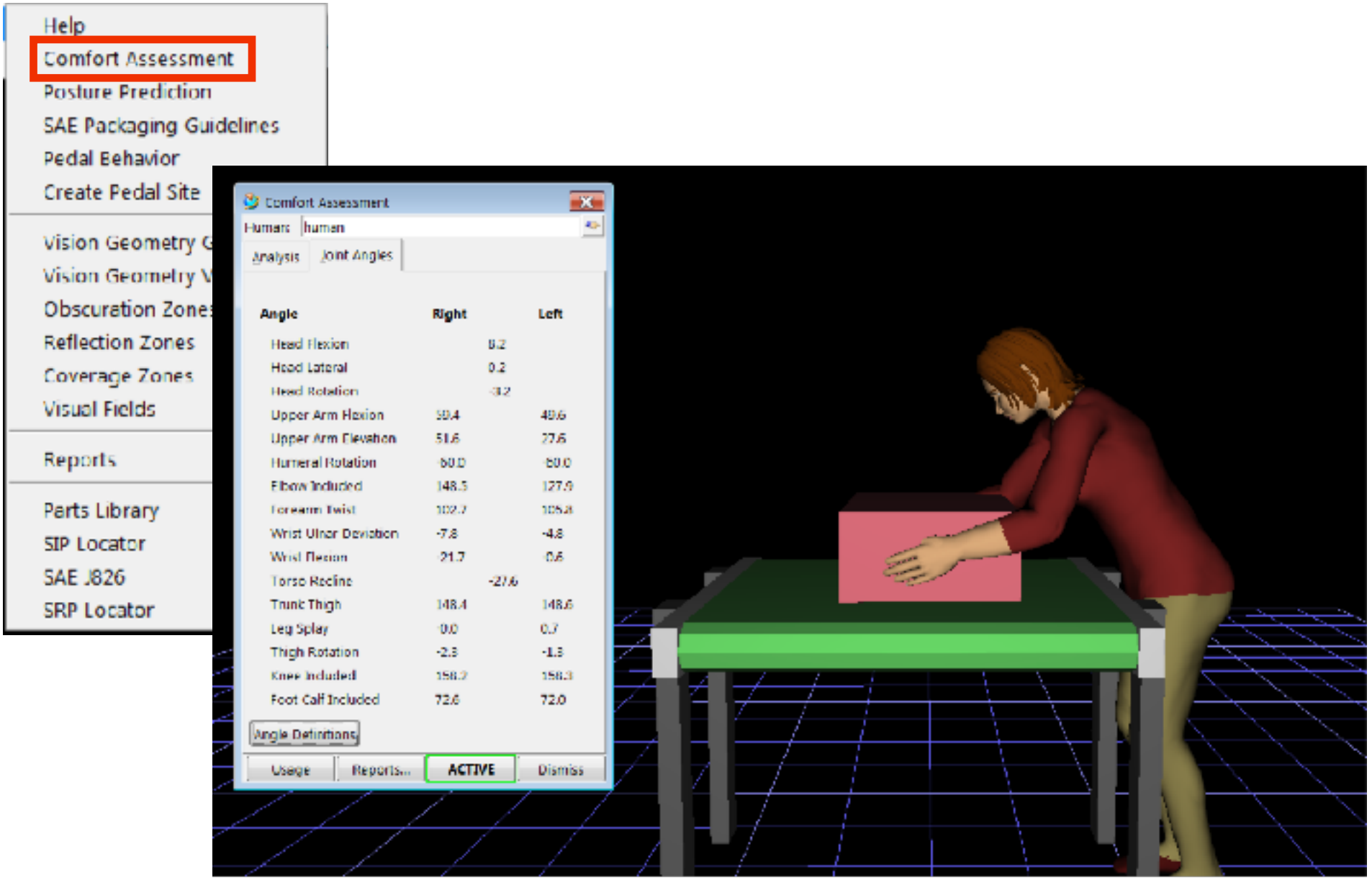


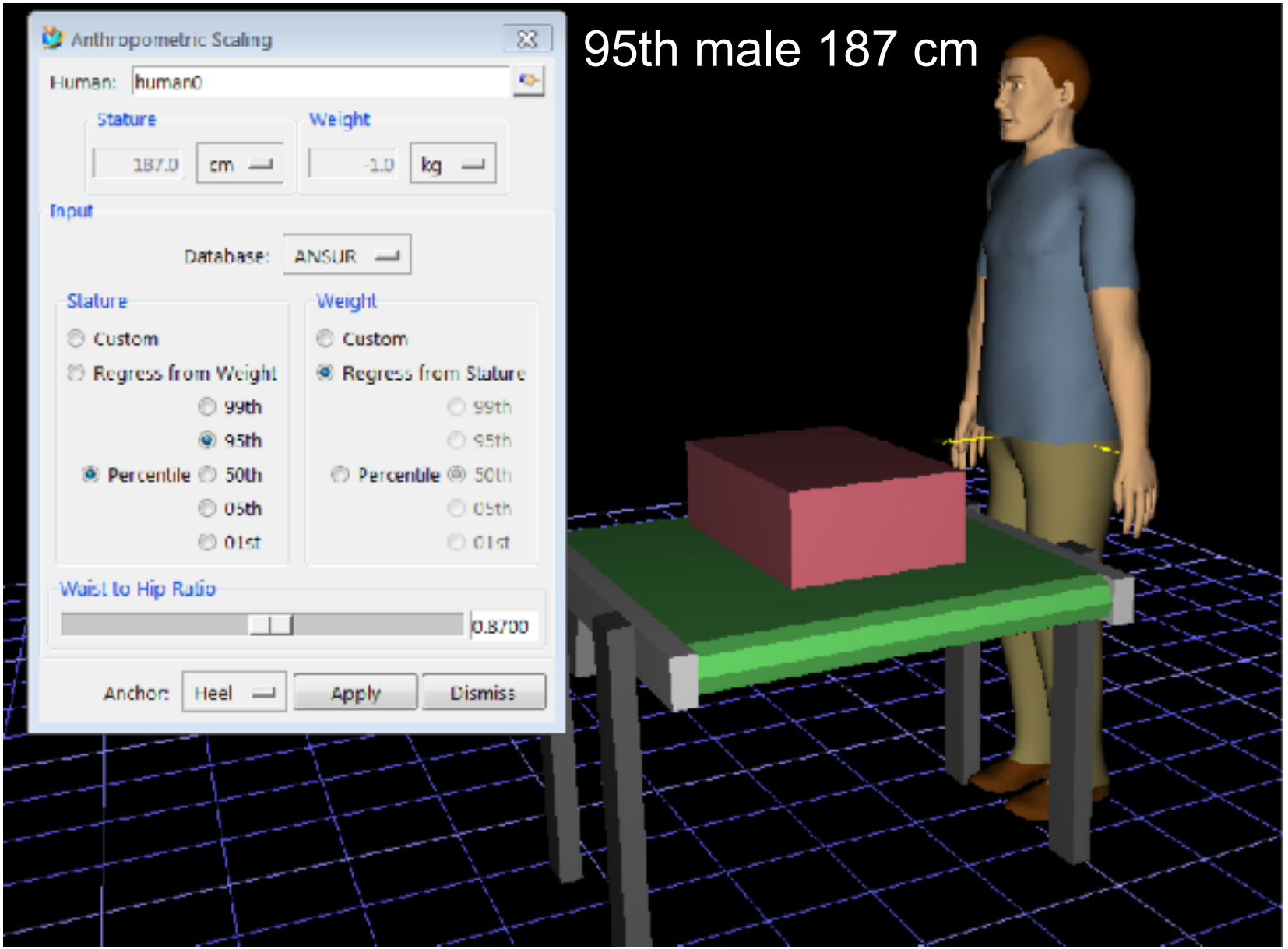
Video

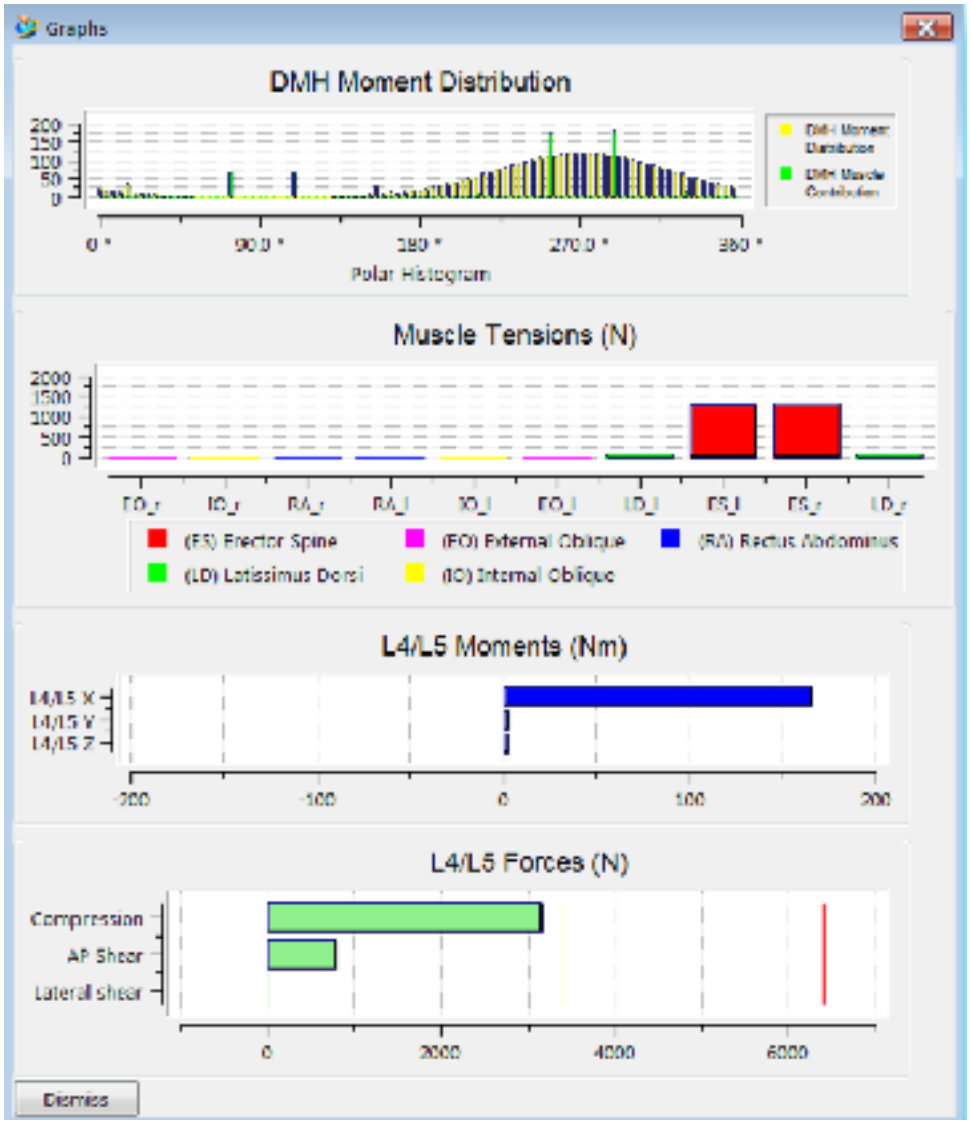


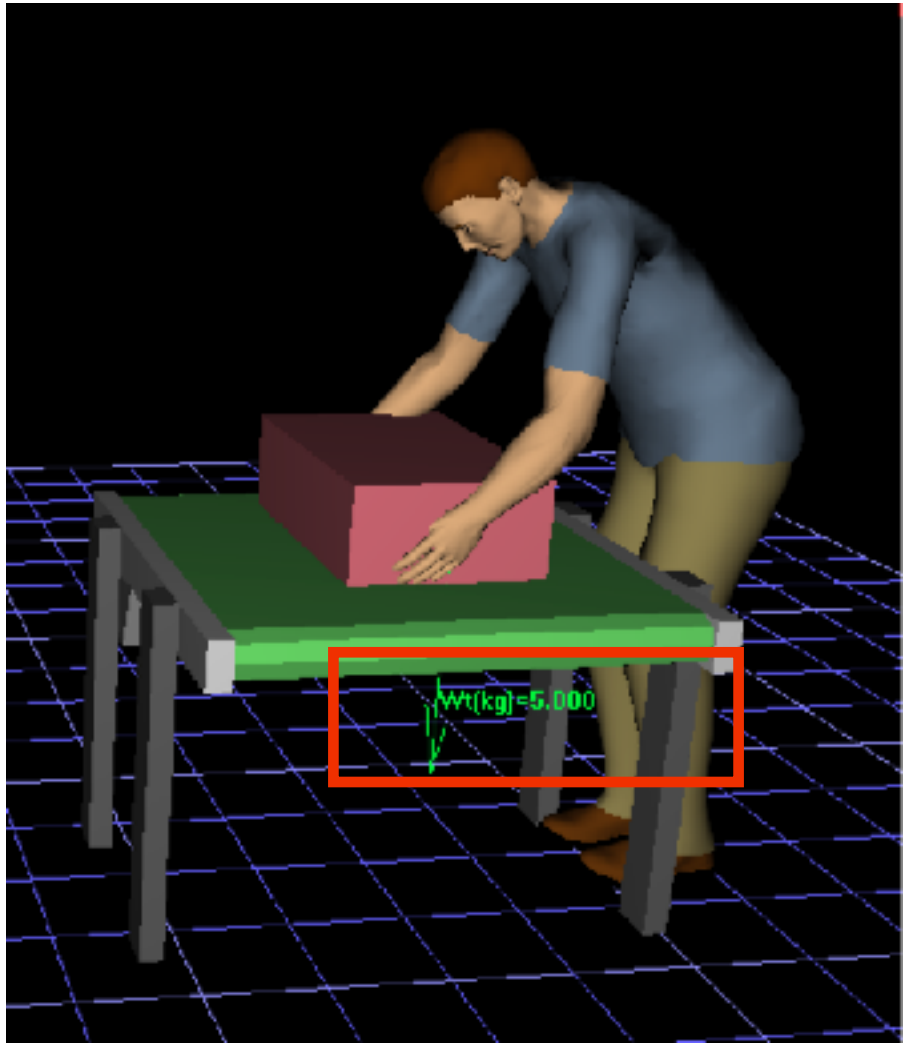

Anthropometric Scaling
Human: human
Stature
153.0
cm
Weight
-1.0
kg
Input
Database: ANSUR
Stature
Custom
Regress from Weight
99th
95th
Percentile 50th
05th
01st
Weight
Custom
Regress from Stature
99th
95th
Percentile 50th
05th
01st
Waist to Hip Ratio
0.7400
Anchor: Heel
Apply
Dismiss
5th female 153 cm



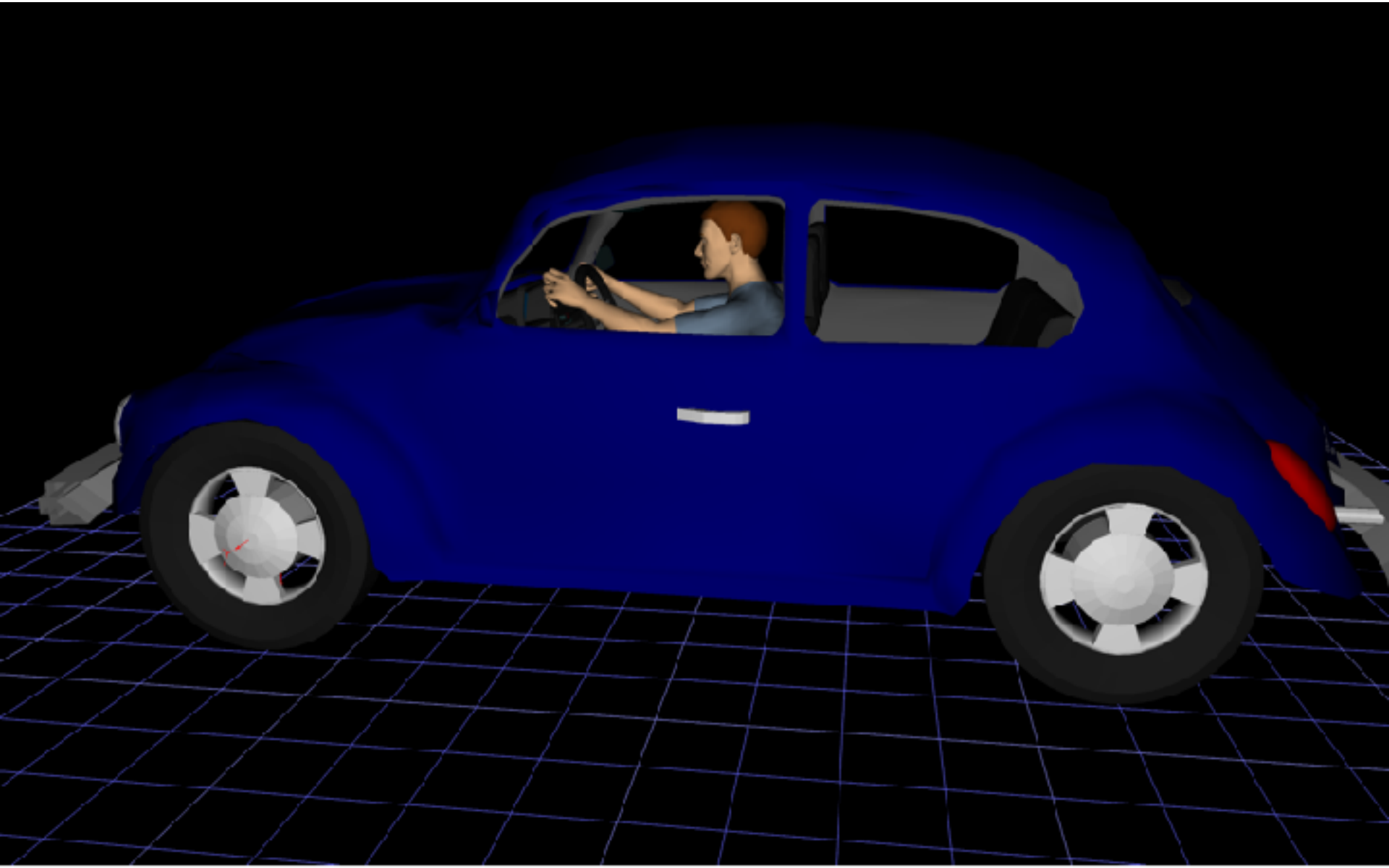

Help
Comfort Assessment
Posture Prediction
SAE Packaging Guidelines
Pedal Behavior
Create Pedal Site
Vision Geometry G
Vision Geometry V
Obscuration Zones
Reflection Zones
Coverage Zones
Visual Fields
Reports
Parts Library
SIP Locator
SAE J826
SRP Locator
Comfort Assessment
Humans human
Analysis
Joint Angles
Angle
Right
Left
Head Flexion 8.2
Head Lateral 0.2
Head Rotation -3.2
Upper Arm Flexion 50.4 48.6
Upper Arm Elevation 51.6 27.6
Humeral Rotation 60.0 60.0
Elbow Included 148.5 127.9
Forearm Twist 102.7 105.8
Wrist Ulnar Deviation -7.8 -4.8
Wrist Flexion 21.7 0.6
Torso Recline -27.6
Trunk Thigh 148.4 148.6
Leg Splay 0.0 0.7
Thigh Rotation -2.3 -1.3
Knee Included 158.2 158.3
Foot Calf Included 72.6 72.0
Angle Definitions
Usage
Reports...
ACTIVE
Dismiss

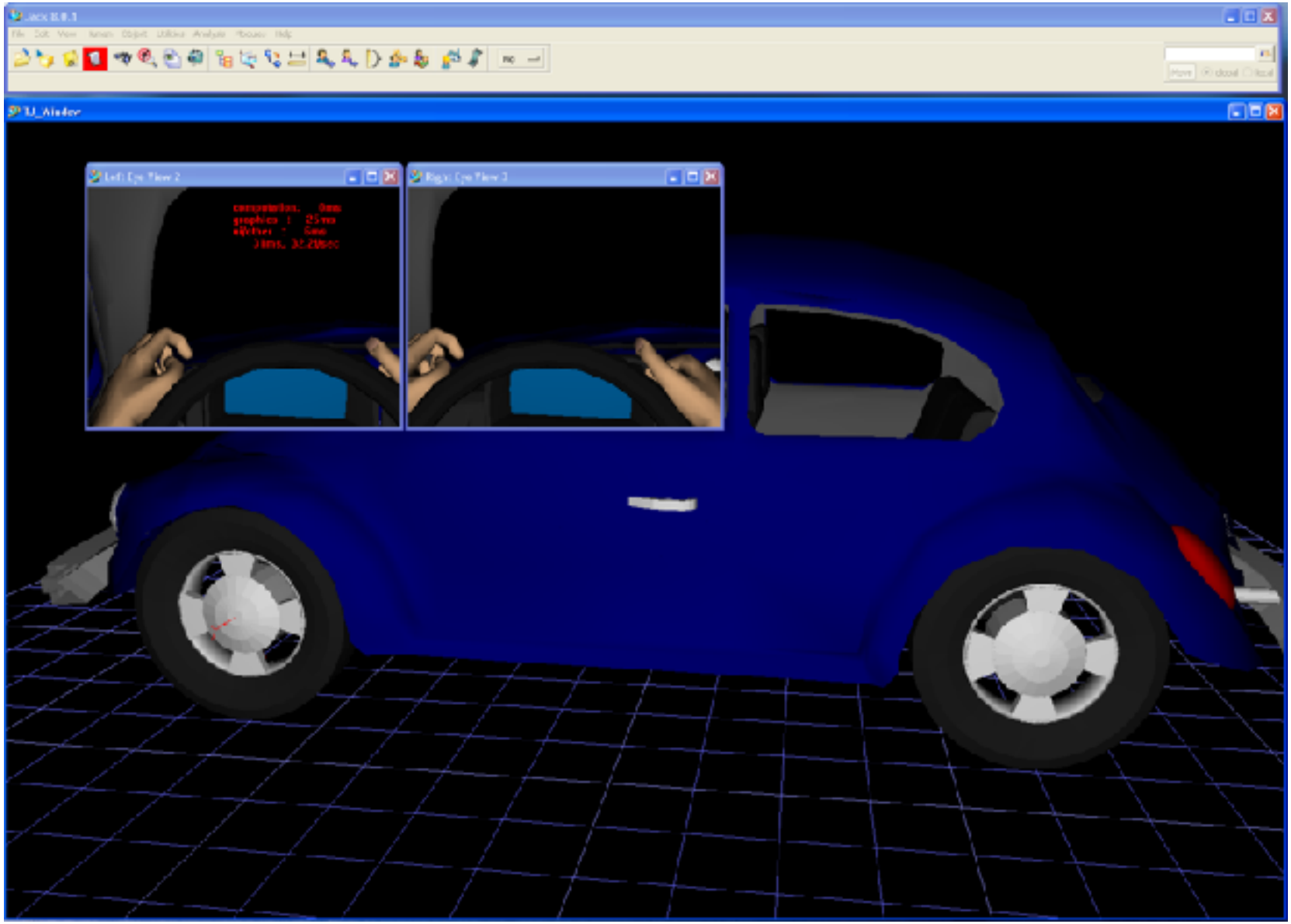

Anthropometric Scaling
Human: human0
Stature
187.0
cm
Weight
1.0
kg
Input
Database: ANSUR
Stature
Custom
Regress from Weight
99th
95th
Percentile
50th
05th
01st
Weight
Custom
Regress from Stature
99th
95th
Percentile
50th
05th
01st
Waist to Hip Ratio
0.8700
Anchor: Heel
Apply
Dismiss
95th male 187 cm

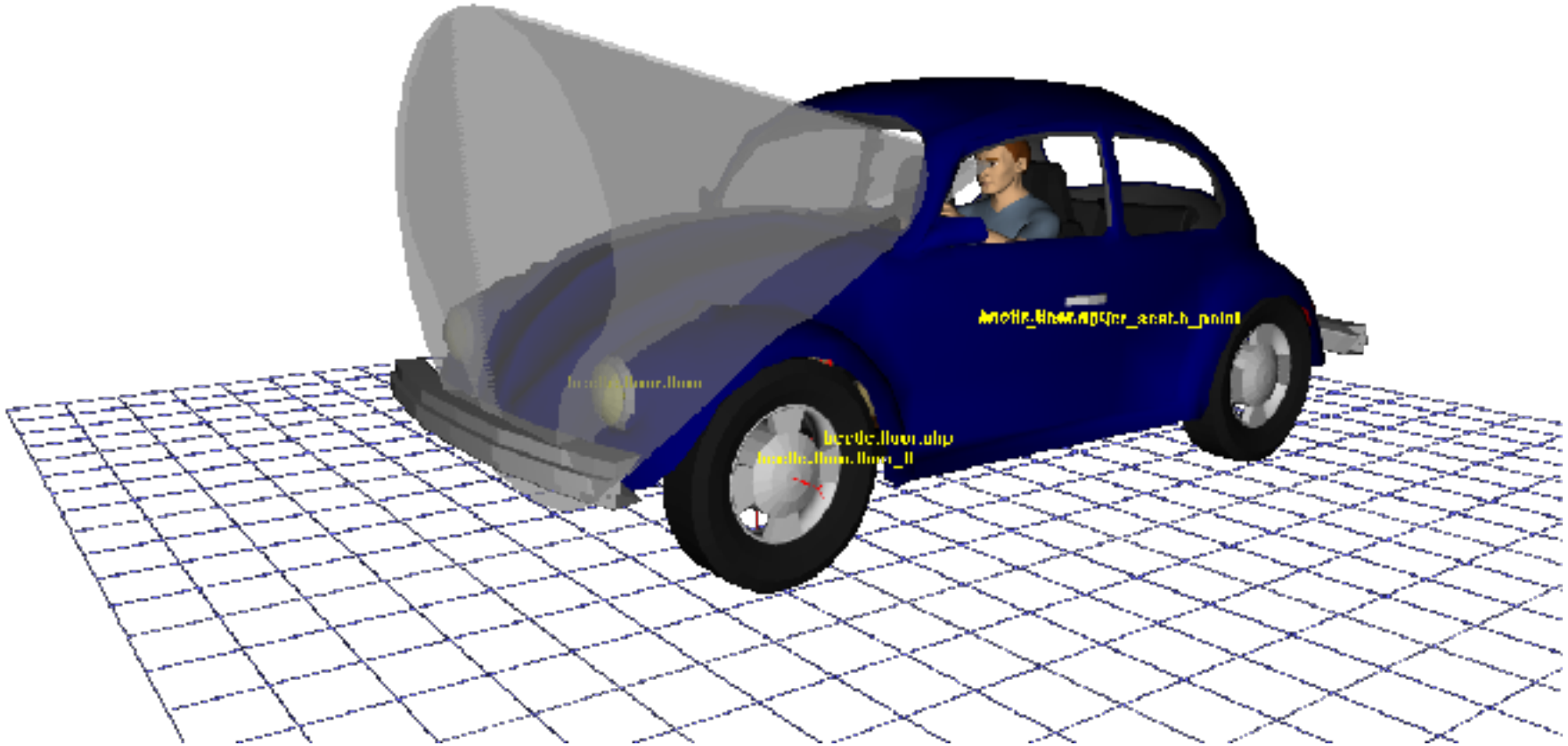

Graphs
DMH Moment Distribution
200
150
100
50
0
0 °
90.0 °
180 °
270.0 °
360 °
Polar Histogram
Muscle Tensions (N)
2000
1500
1000
500
0
(ES) Erector Spine
(EO) External Oblique
(RA) Rectus Abdominus
(LD) Latissimus Dorsi
(IO) Internal Oblique
L4/L5 Moments (Nm)
L4/L5 X
L4/L5 Y
L4/L5 Z
-200
-100
0
100
200
L4/L5 Forces (N)
Compression
AP Shear
Lateral shear
0
2000
4000
6000
Dismiss

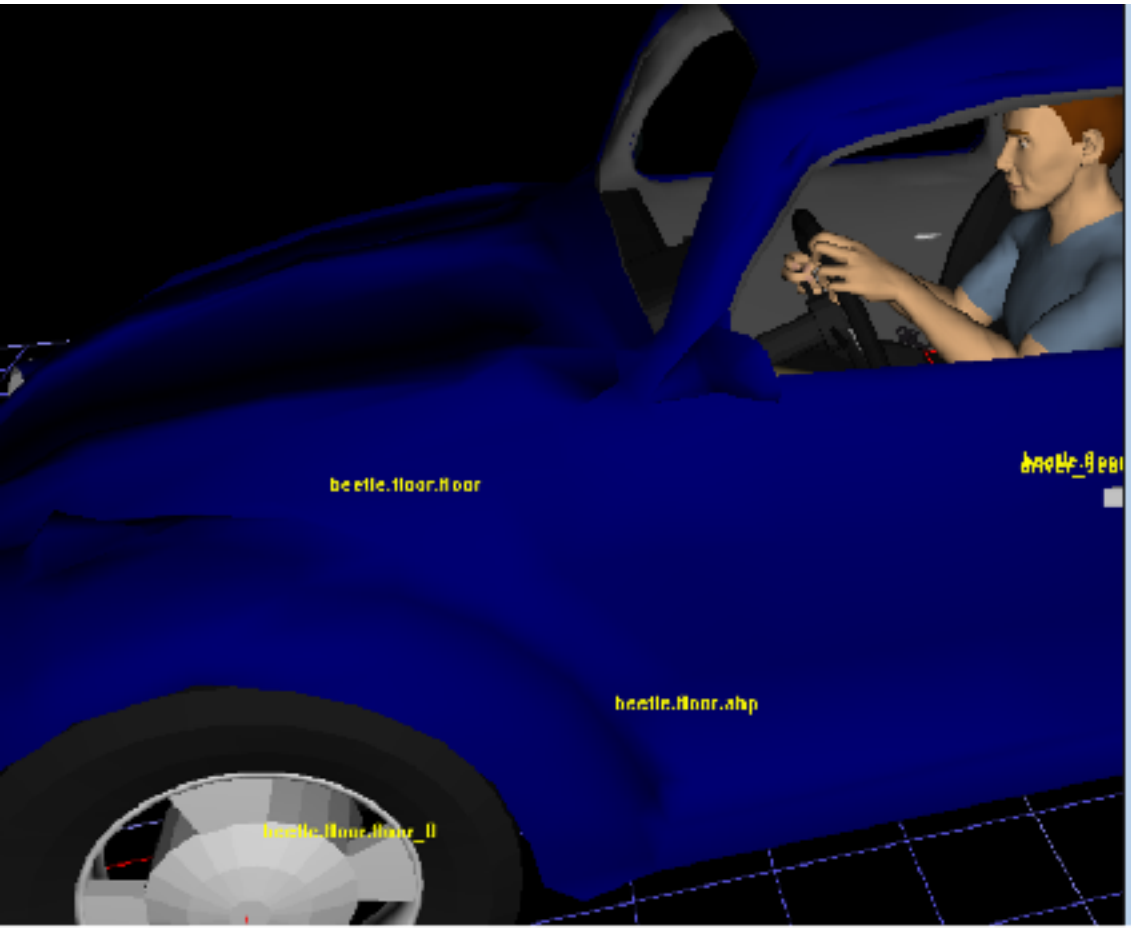

Wt(kg)=5.000

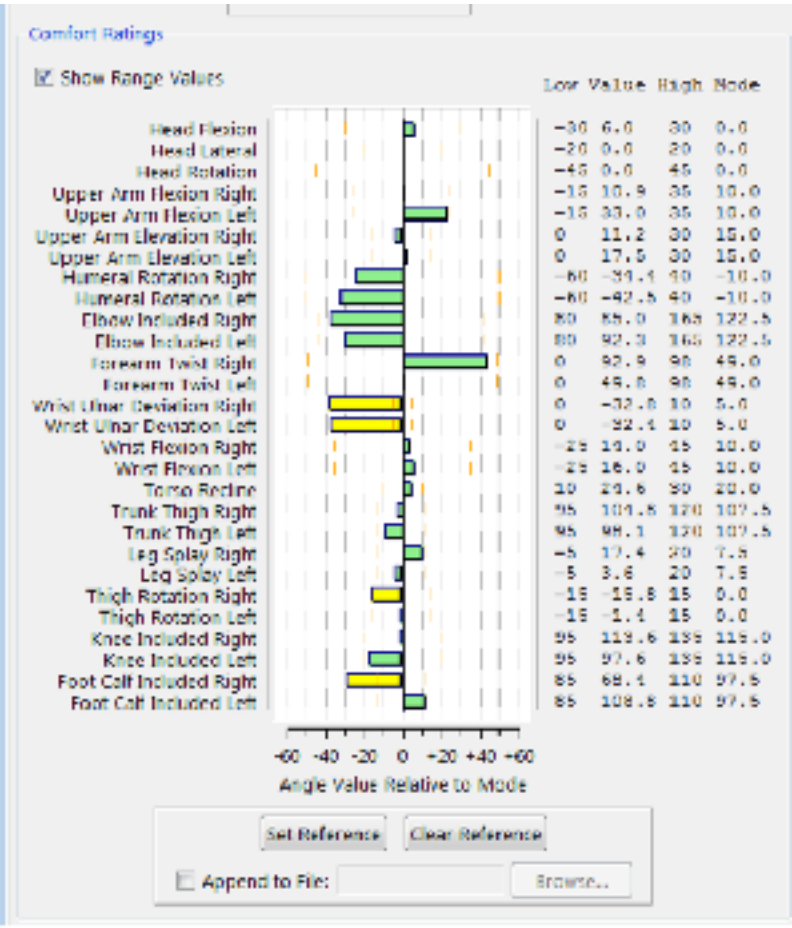
Example 2







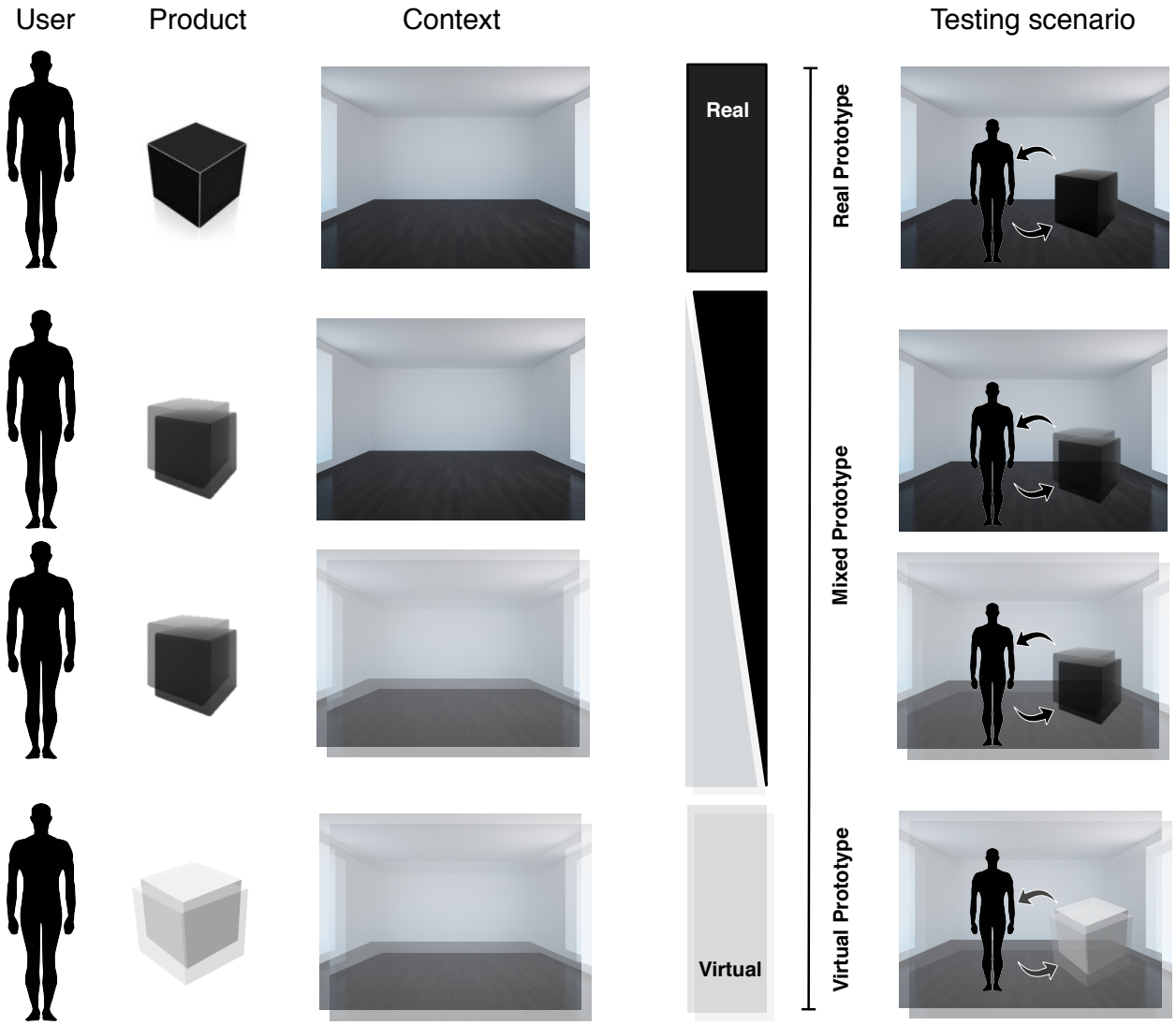

beetle.floor.floor
beetle.floor.sbp


Comfort Ratings
Show Range Values
Low Value High Mode
Head Flexion -30 6.0 30 0.0
Head Lateral -20 0.0 20 0.0
Head Rotation -45 0.0 45 0.0
Upper Arm Flexion Right -15 10.9 35 10.0
Upper Arm Flexion Left -15 33.0 35 10.0
Upper Arm Elevation Right 0 11.2 30 15.0
Upper Arm Elevation Left 0 17.5 30 15.0
Humeral Rotation Right -60 -31.1 40 -10.0
Humeral Rotation Left -60 -42.5 40 -10.0
Elbow Included Right 80 85.0 165 122.5
Elbow Included Left 80 92.3 165 122.5
Forearm Twist Right 0 92.9 90 45.0
Forearm Twist Left 0 45.6 90 45.0
Wrist Ulnar Deviation Right 0 -32.6 10 5.0
Wrist Ulnar Deviation Left 0 -32.4 10 5.0
Wrist Flexion Right -25 10.0 45 10.0
Wrist Flexion Left -25 16.0 45 10.0
Torso Recline 10 20.6 30 20.0
Trunk Thigh Right 95 104.8 120 107.5
Trunk Thigh Left 95 98.1 120 107.5
Leg Splay Right -5 17.4 20 7.5
Leg Splay Left -5 3.6 20 7.5
Thigh Rotation Right -15 -15.8 15 0.0
Thigh Rotation Left -15 -1.4 15 0.0
Knee Included Right 95 119.6 135 115.0
Knee Included Left 95 97.6 135 115.0
Foot Calf Included Right 85 68.1 110 97.5
Foot Calf Included Left 85 108.8 110 97.5
-60 -40 -20 0 +20 +40 +60
Angle Value Relative to Mode
Set Reference
Clear Reference
Append to File:
Browse...

How to make a real human interact with a simulated world

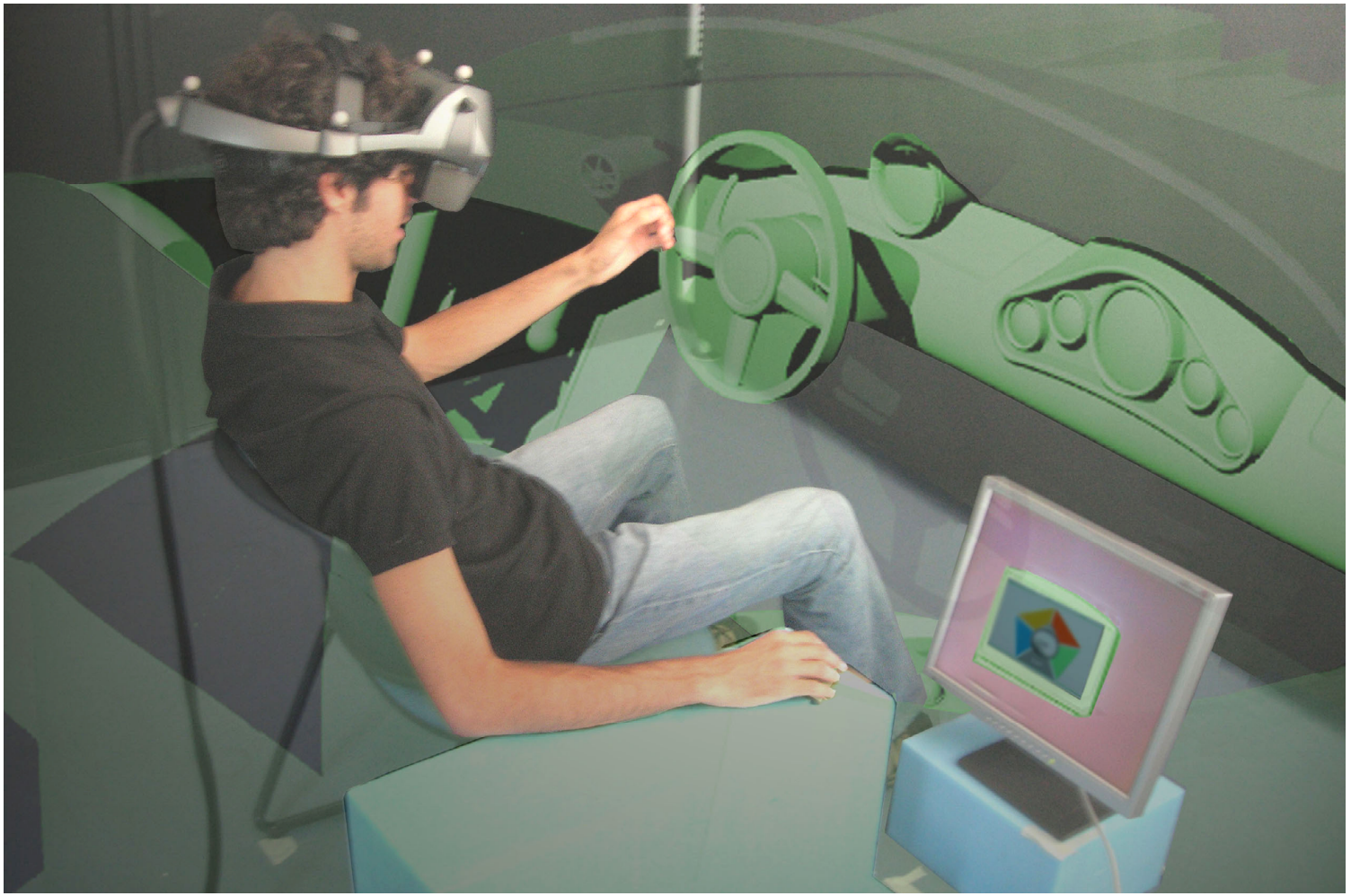
Through the Use of Virtual Reality technologies

Virtual/Mixed/Augmented Prototypes



Ferrise, F., Graziosi, S., & Bordegoni, M. (2015). Prototyping strategies for multisensory product experience engineering. *Journal of Intelligent Manufacturing*, 1-13.

Example

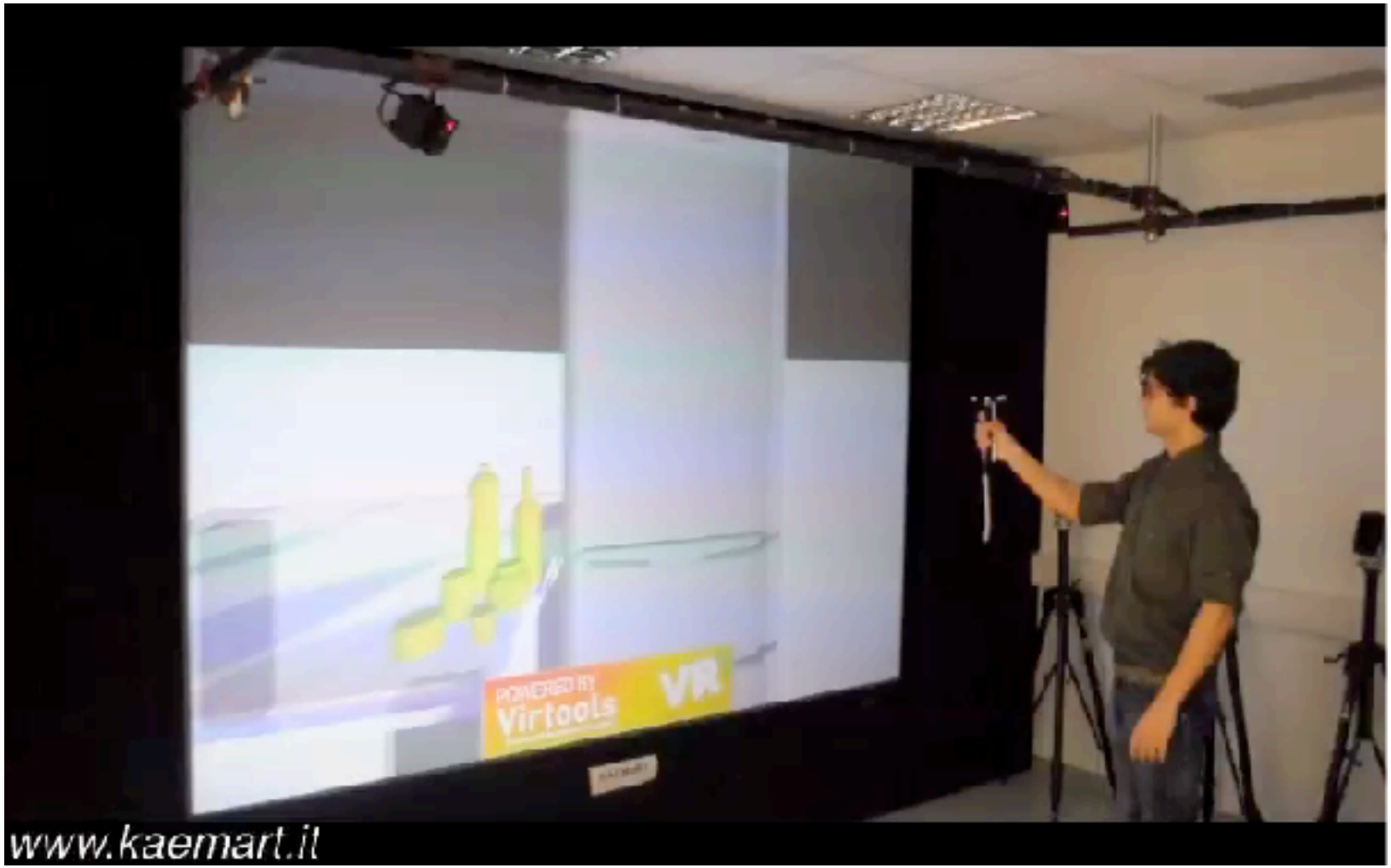


Bordegoni, M., Giraudo, U., Caruso, G., & Ferrise, F. (2007). Ergonomic interactive testing in a mixed-reality environment. In *Virtual Reality* (pp. 431-440). Springer Berlin Heidelberg.

Case 1 - Validation of ergonomics and use through direct interaction



Video



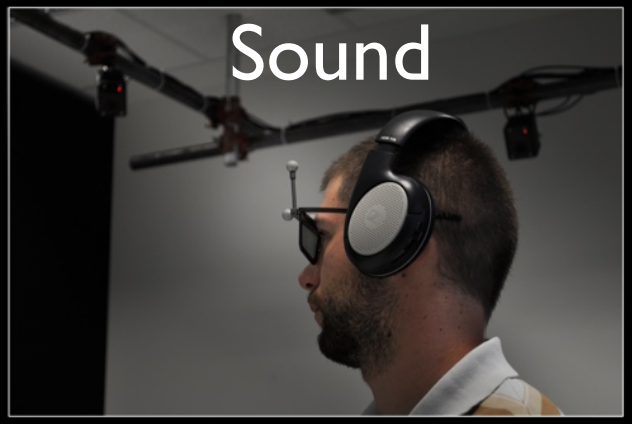
Case 2 – Virtual Prototypes to perform human interaction analyses





Case 2 - Hardware Setup







Video 1



M. Bordegoni, F. Ferrise, J. Lizaranzu "Use of Interactive Virtual Prototypes to define product design specifications: a pilot study on consumer products", Proceedings of IEEE - ISVRI 2011, Singapore, 19-23 March 2011

Case 3 - Virtual Maintenance



Conclusions

- Need to create new tools and methodologies for ergonomic design
- Create multidisciplinary design teams
- Teach engineers the basics of ergonomic design