

## A Web3D Based CAESAR Viewer

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### Abstract

The CAESAR (Civilian American and European Surface Anthropometry Resource) project completed in 2002 has collected 3D scans of over 5000 subjects. We have created a 3D interface, the NIST CAESAR Viewer (NCV), utilizing the Virtual Reality Modeling Language (VRML) to provide 3D access via the Web. In addition to simply viewing the 3D scans we have augmented the display of the body with interactive anthropometric landmarks and contour line displays. The landmarks and viewpoints associated with the landmarks are automatically placed onto the body as a visual anthropometric glossary. Display of the contours boundaries are adjusted by the user moving sagittal, coronal and transverse cutting planes. This paper describes the functionality of the evolving NCV viewer.

**Keywords:** VRML, Web3D, anthropometry

### 1. Introduction

The NIST CAESAR Viewer (NCV) enables users to view and manipulate the display of CAESAR 3D body scans. NCV is a work in progress and several versions of the interface exist with varying functionality. The key advantage of NCV is that users, with appropriate access to the CAESAR database of bodies, can view the surface scans on inexpensive PCs or any computing platform with a VRML browser [1]. Anthropometric landmarks are easily visualized by showing the landmark locations on the body. It is a natural extension to create 3D illustrations of the landmarks by placing them on 3D computer generated bodies. Figure 1 illustrates the display of a single body with landmarks and contours. In addition to simple displays of the bodies, users can view multiple bodies and the data associated with the anthropometric landmarks. The user can toggle the display of landmarks, contour lines or the body surface as desired.

The NCV provides the anthropometry standards community a way of producing 3D illustrations for data visualization, and facilitates communication among members. In addition creation of a 3D anthropometric glossary allows non-professionals a simple way of introducing anthropometric concepts. As the NCV becomes more robust we intend on using it as a low-cost tool for anthropometric measurements and analysis of 3D scans.

DISCLAIMER: Mention of trade names does not imply endorsement by NIST.

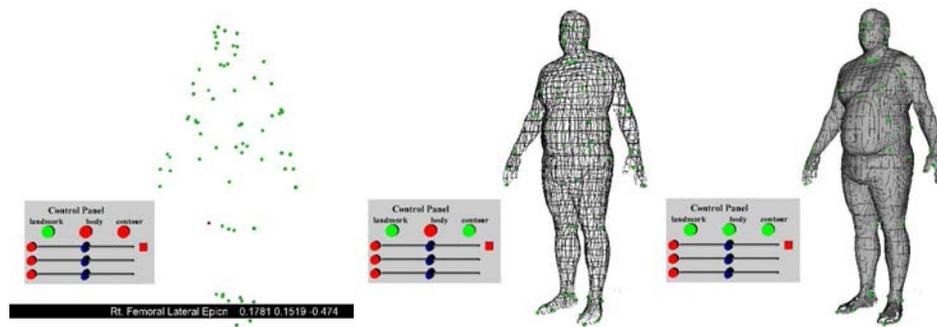


Fig 1. : Body with landmarks, contours and surfaces toggled on.

## 2. System Evolution and Background

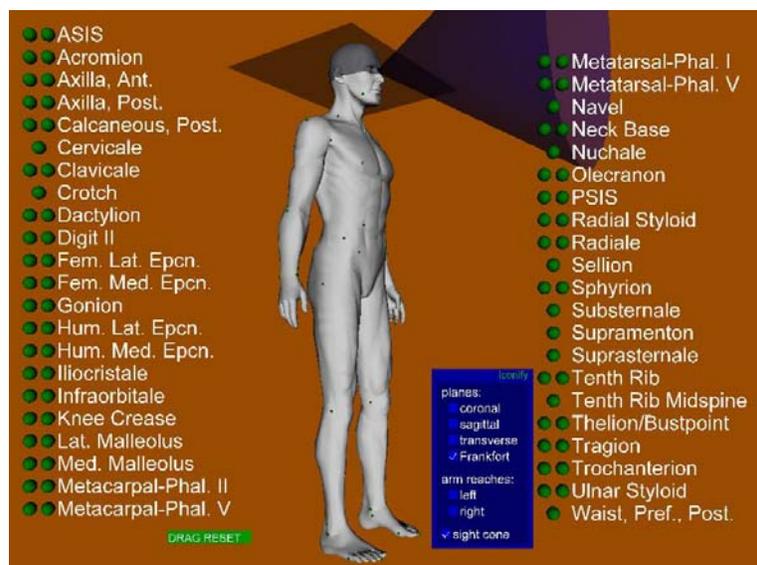


Fig 2. : AnthroGloss screen layout with Frankfort plane and sight cone indicators turned on.

Before our direct involvement in the use of CAESAR body scans we created a system called “AnthroGloss” [2] shown in Figure 2, which uses a synthetically created body. We placed anthropometric landmark spheres on the body by hand, a laborious process. In AnthroGloss users select a sphere causing a change in the viewpoint and the name of the selected landmark appears in a large size font in the middle of the display. The list of landmarks can be repositioned by dragging the entire column of names. Reference planes can be toggled on and off via the control panel. The glossary system also allows users to toggle on or off a variety of display indicators. These include the Frankfort plane, and a sagittal, coronal and transverse cutting planes. The planes were derived from illustrations in *Anthropometric Methods* [3]. Arm reach volumes, partial spherical areas, can also be displayed. The areas for the arm reaches were based on standard illustrations [4,5]. Also,

the user can select from among several types of landmark nomenclatures. Currently the SAE G13 Human Modeling Technology Committee is working on a comprehensive anthropometric landmark dictionary, spearheaded by John Roebuck. Roebuck was kind enough to supply an early version of this dictionary and we have included this version of the SAE AIR 5408 [6] names in our latest version of the visual glossary.

### **3. Display Interactions in NCV**

The NCV system uses landmark coordinates from the CAESAR data set to automatically place the landmark spheres on the surface of the scans. Each sphere is made interactive. This was implemented by using VRML TouchSensors so that the landmark data pops up when the user places the cursor over the landmark spheres. We automatically generate points of view, using VRML Viewpoint Nodes, associated with each landmark to allow the user to get close-up views of the landmarks in context of the body. We generate the viewpoints by surrounding the body with an enclosing cylinder and drawing a vector from the landmark to the cylinder. The intersection point between the vector and the cylinder becomes the viewpoint for that landmark. The end result is a system that automatically generates views of the landmark spheres, places them on the body and automatically generates associated viewpoints for each landmark. These interactive bodies are the equivalent of our previous “AnthroGloss” body however they are now generated automatically for each CAESAR body rather than manually constructed for a particular synthetic body.

Figure 3 illustrates the most complex version of the system. This version includes the ability to toggle on or off body textures, landmarks, and contours. It also provides the ability to select a color for the entire body. Labels for the control slider change as appropriate to match the particular functionality selected.

The controls currently available to the user allow for the display of multiple (up to 10) bodies. The control panel operates on the “current” body indicated by a box surrounding the body. The “current” body is selected by simply clicking the body. Contour lines associated with sagittal, coronal and transverse cutting planes can be displayed. When the user selects a cutting plane an animated display of the contour cut plane is created and the user can drag the cutting plane through the body watching the effect on the contour. Finally the user can measure distances on the contour display by selecting start and end points on the contour lines. The distances are in the same units as the original CAESAR data.

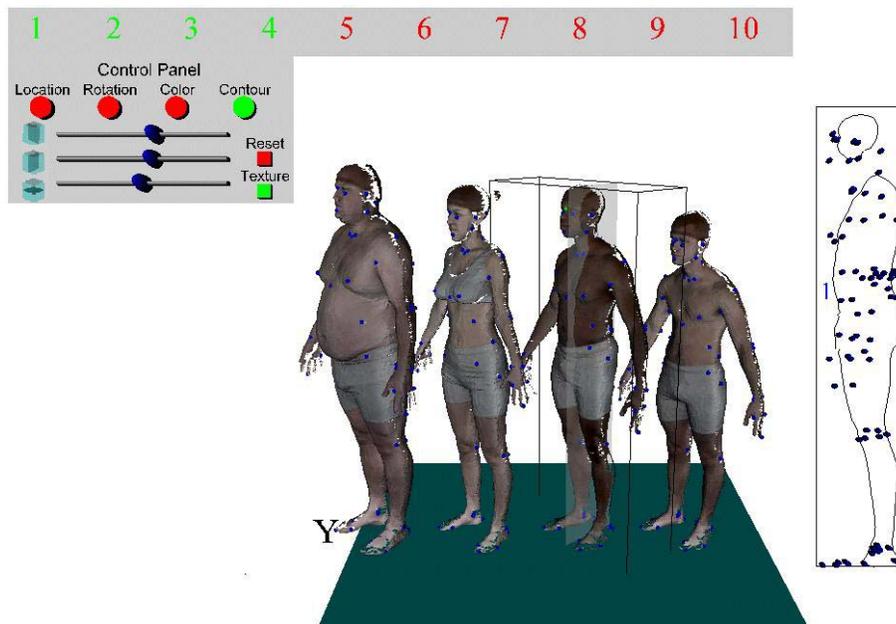


Fig. 3: Textured body display with multiple bodies and contours.

#### 4. Issues, Problems and Future Work

Currently there are only three widely used VRML browsers, CosmoPlayer ([www.sgi.com/software/cosmo/player.html](http://www.sgi.com/software/cosmo/player.html)), Contact ([www.blaxxun.com](http://www.blaxxun.com)) and Cortona ([www.parallelgraphics.com](http://www.parallelgraphics.com)). CosmoPlayer is a discontinued product, for PCs, and is no longer maintained, however it is supported by SGI for their IRIX workstations. Contact and Cortona are both being actively developed and expanded. It is often a challenge to create VRML content that plays satisfactorily in multiple browsers. The NCV display generally does play back correctly but does on occasion exhibit idiosyncrasies due to the different behavior of the browsers. It may be more effective to use a proprietary Web3D technology such as Viewpoint ([www.viewpoint.com](http://www.viewpoint.com)) or Shockwave 3D ([www.macromedia.com](http://www.macromedia.com)), as these are both available on a number of common platforms and may provide superior displays and download times via geometric compression.

We have also begun to examine the advantages of using a large format wall size 3D display. True 3D is achieved by the use of LCD shutter glasses and the image is projected life size. We use a pair of FakeSpace Rave [7] walls arranged in a corner configuration. The life-size nature of the display gives the user an intuitive perception the physical size of the human who was scanned. Standing in front of a 3D life-size gives one a powerful sense of presence and a clear sense of the size and distances of the data. Interaction with data in this 3D space remains problematic. However we expect to tackle that issue in the future through the use of new input devices.

We also intend on integrating this type of visualization with a set of children's anthropometric data we have made available on the "AnthroKids" web site. AnthroKids [8] data is based on the only comprehensive anthropometric survey of children ever conducted in the USA [9] and remains a valuable resource. Visualization of children's anthropometry should prove useful for a variety of design issues.

We expect to make the NCV available to the general public for free and intend on making it a valuable resource for both people using CAESAR data and other 3D body scans. The proliferation of inexpensive high quality computer graphics hardware will make NCV more useful as time goes on.

### **Acknowledgements**

The VRML versions of the CAESAR bodies (geometry only) were created by Eric Paquett of the NRC. Thanks to Kathleen Robinette (of CARD Lab and CAESAR project leader) for feedback on NCV and explaining the CAESAR project, and John Roebuck (of Roebuck Research & Consulting) for providing invaluable advice on anthropometry

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