DIY X3D: Learning, Teaching and Doing X3D Graphics with HTML5

Medical and Scientific Visualization

Wole Oyekoya, PhD

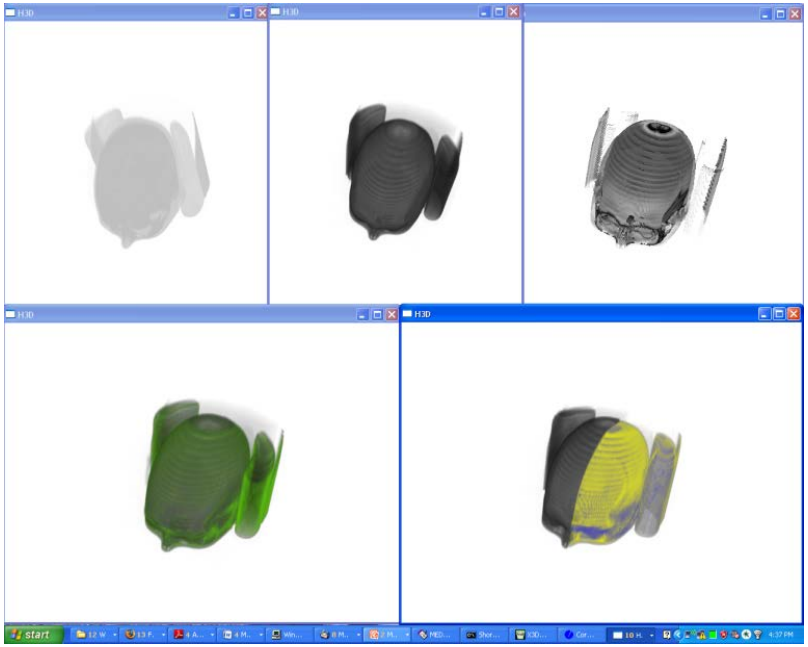
Vancouver, Canada 8 - 10 August 2014

Overview

- Scientific & Medical X3D Visualization
- Web3D publishing
- Virginia Tech Visionarium

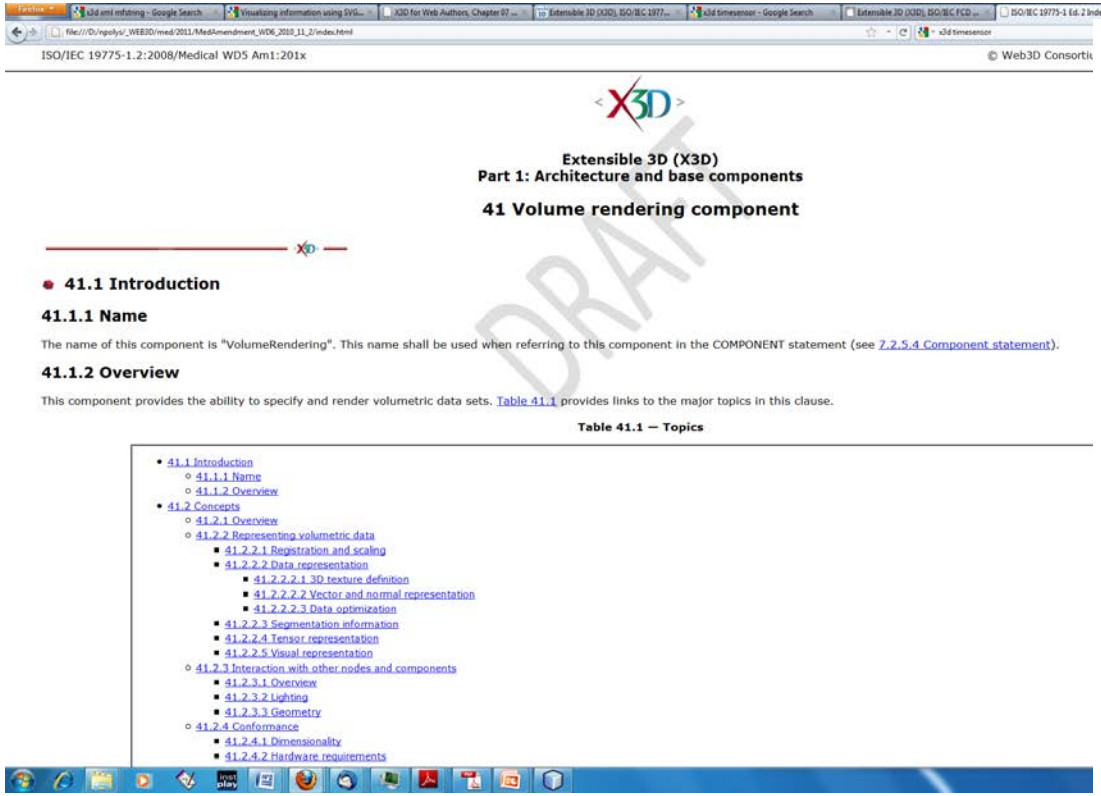
X3D Volume Rendering

- Necessary and Sufficient node set for industry's greatest common denominator:
  - **Volume Component**: render styles, clip planes
  - **X3D version 3.3**
- Two independent implementations:
  - www.h3d.org
  - www.instantreality.org



X3D Volume Rendering Component

X3D 3.3 -> ISO SC24
June 2011


ISO/IEC 19775-1.2:2008/Medical WD5 Am1:201x

Extensible 3D (X3D)
Part 1: Architecture and base components

41 Volume rendering component

DRAFT

41.1 Introduction

41.1.1 Name

The name of this component is "VolumeRendering". This name shall be used when referring to this component in the COMPONENT statement (see 7.2.5.4 Component statement).

41.1.2 Overview

This component provides the ability to specify and render volumetric data sets. Table 41.1 provides links to the major topics in this clause.

Table 41.1 — Topics

Example Volume Rendering Style

(Torso example , XML encoding)

```
<Transform rotation='1 0 0 1.5785'>
    <VolumeData DEF='volume' dimensions='2 2 2'>
            <OpacityMapVolumeStyle/>
            <Image3DTexture containerField='voxels' url='IM-0001-0001.dcm'/>
    </VolumeData>
    <!-- url="C:\_WEB3D\med\med\med\IM-0001-0001.dcm" /> -->
  </Transform>
```

Example Volume Rendering Style

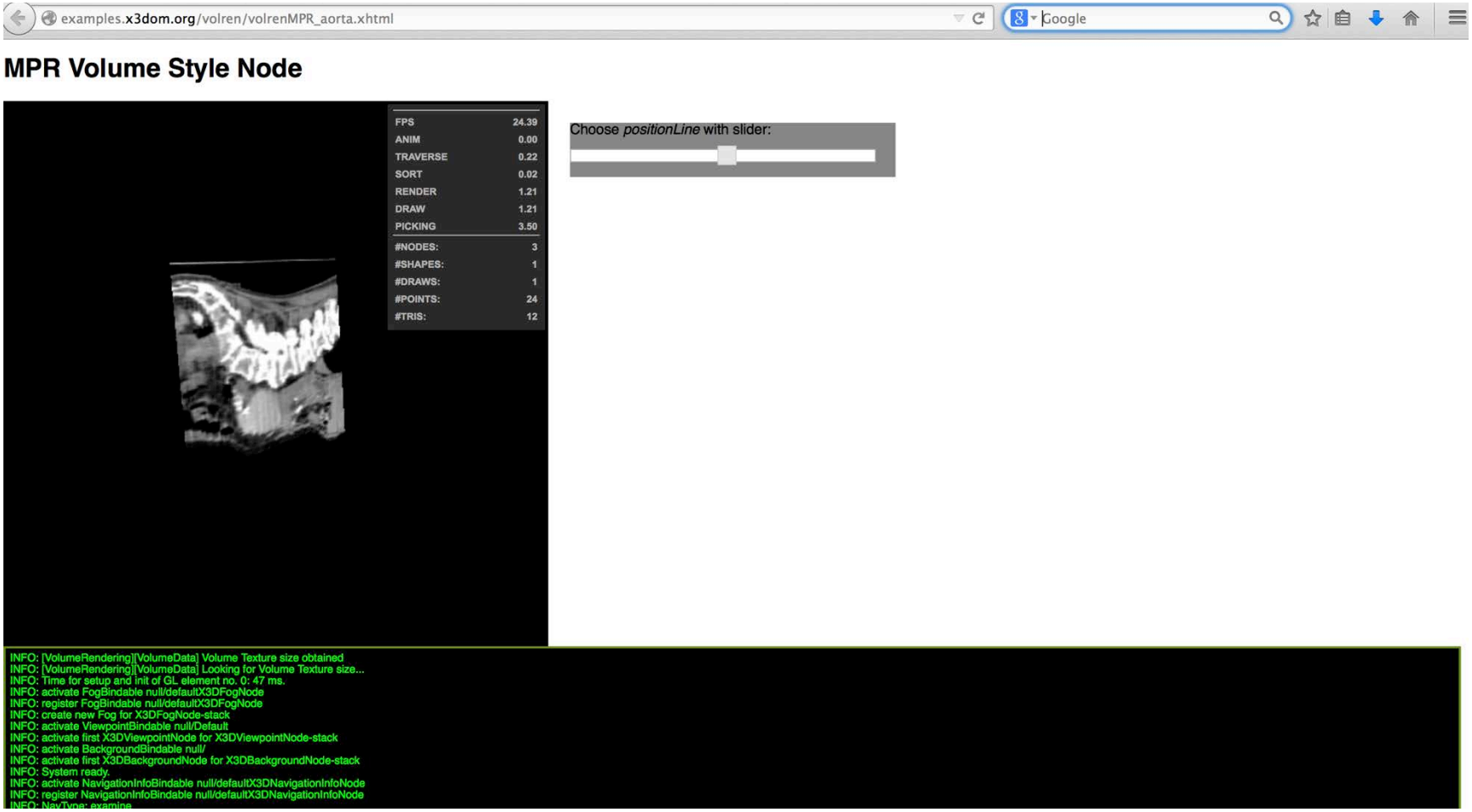
(Foot example, XML encoding)

```
<ISOSurfaceVolumeData dimensions='1.28 1.28 1.28' surfaceValues='0.02 0.3'>
    <ImageTexture3D DEF='vol' containerField='voxels' url='"../data/foot.nrrd"'>
      <TextureProperties DEF='foot_TP' boundaryModeR='CLAMP_TO_EDGE'
  boundaryModeS='CLAMP_TO_EDGE' boundaryModeT='CLAMP_TO_EDGE'
  magnificationFilter='AVG_PIXEL' minificationFilter='AVG_PIXEL'/>
    </ImageTexture3D>
    <ShadedVolumeStyle lighting='true'>
      <Material diffuseColor='0.843137 0.898039 0.607843' transparency='0.37'/>
    </ShadedVolumeStyle>
    <CartoonVolumeStyle/>
  </ISOSurfaceVolumeData>
```

Example Volume Rendering Style

```
Shape {
    appearance Appearance {
        # [...] }
    geometry DEF tri IndexedFaceSet {
        coord DEF coord Coordinate {}
    }
}
DEF iso IsoSurfaceGenerator {
    volumeUrl "Engine.nrrd"
    isoValue 0.2
    resolutionScale 4
    genIndices TRUE
}
ROUTE iso.coord_changed TO coord.set_point
ROUTE iso.index TO tri.coordIndex
```

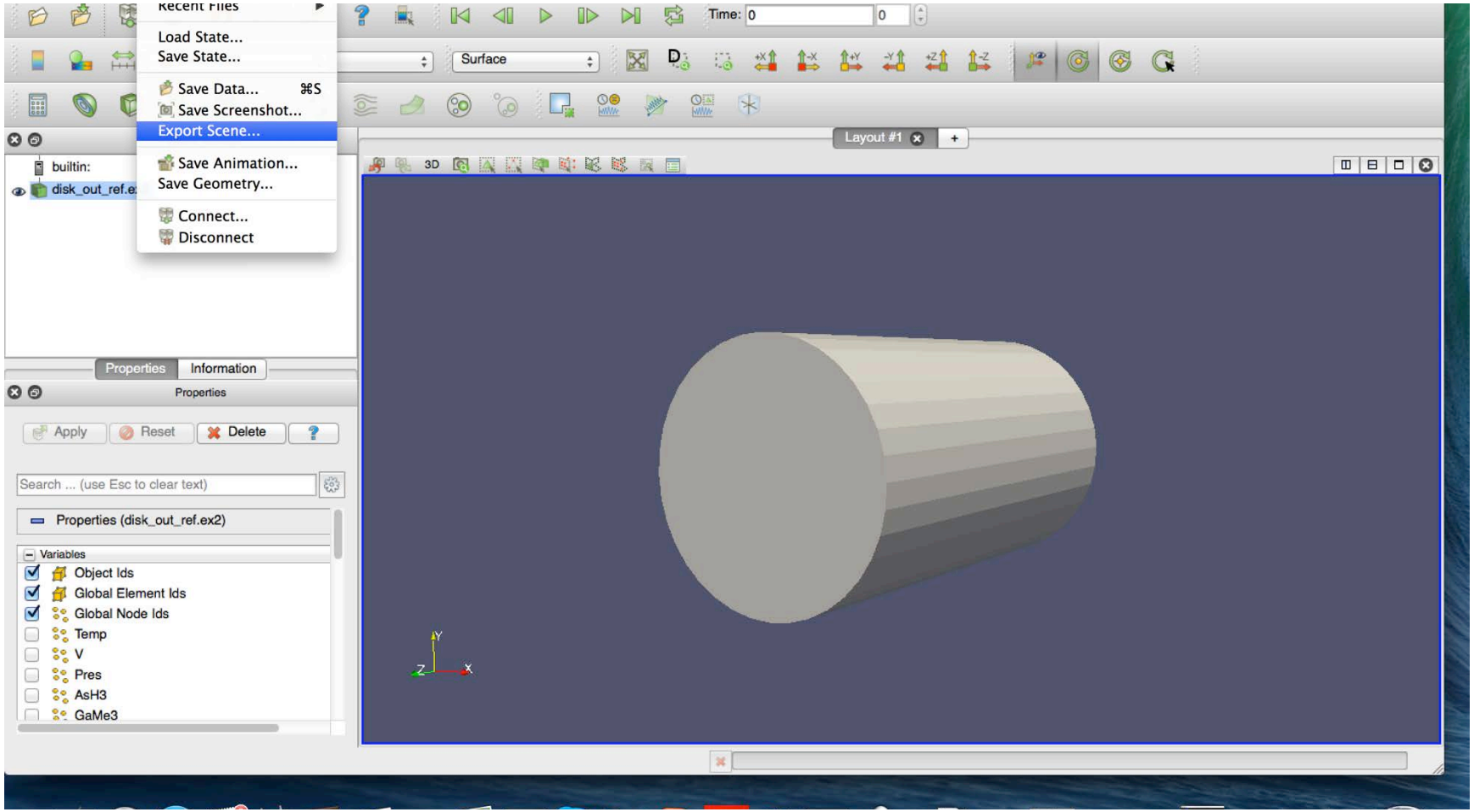
X3DOM Volume Rendering



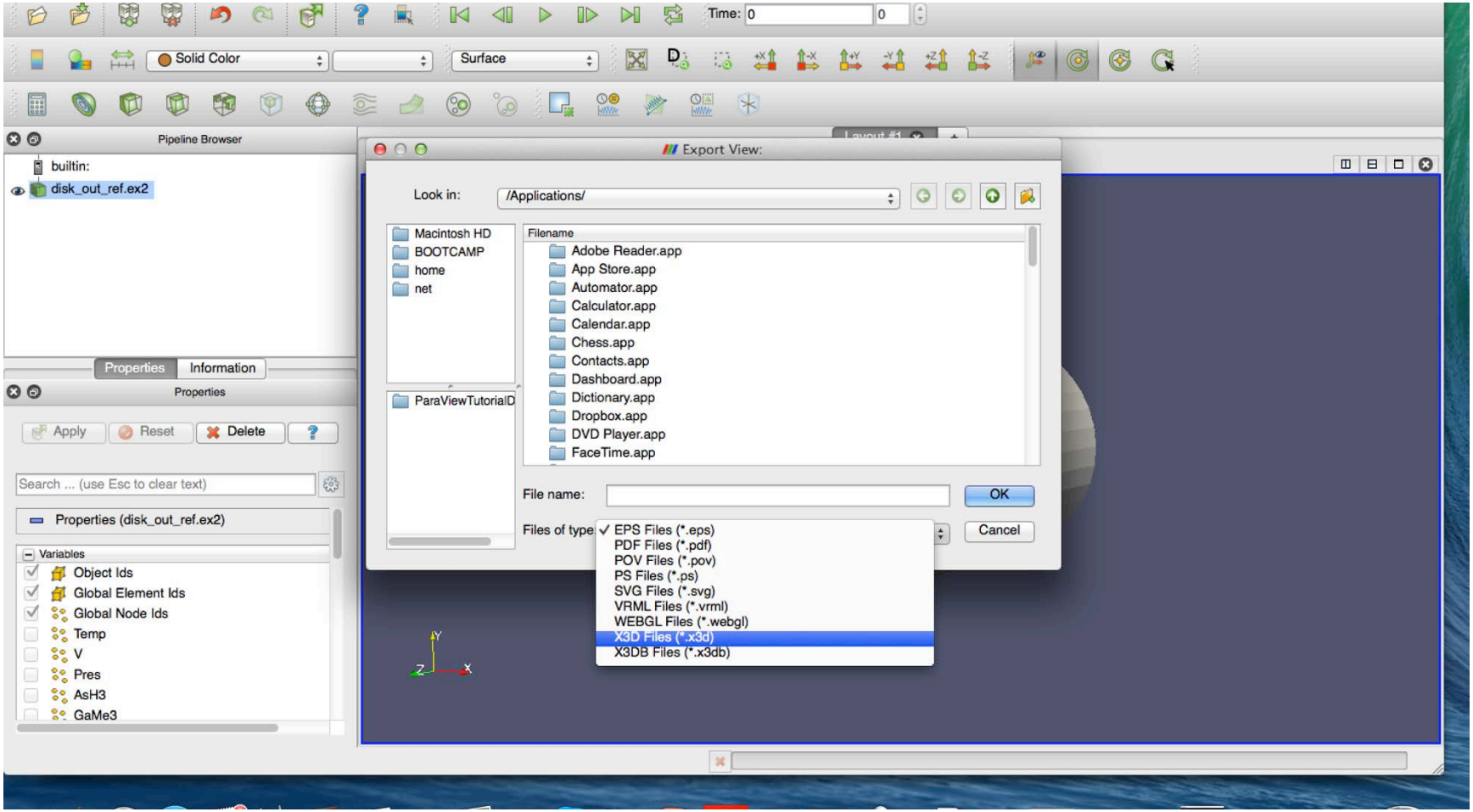
Authoring Web3D

- Many existing scientific and engineering tools support the export VRML or X3D or a translate-able format:
  - Paraview
  - VMD
  - Blender, Max/Maya
  - …

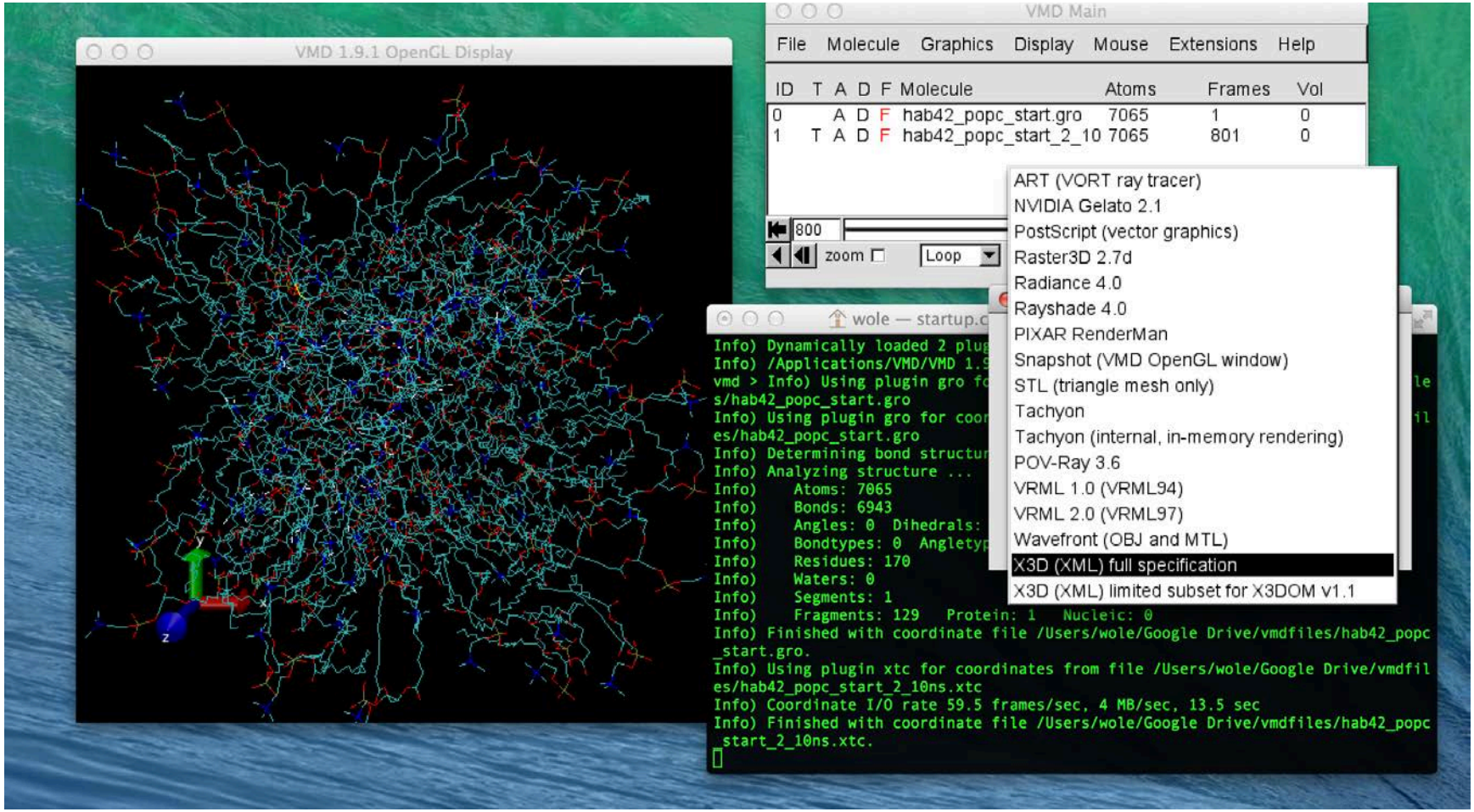
Paraview Export



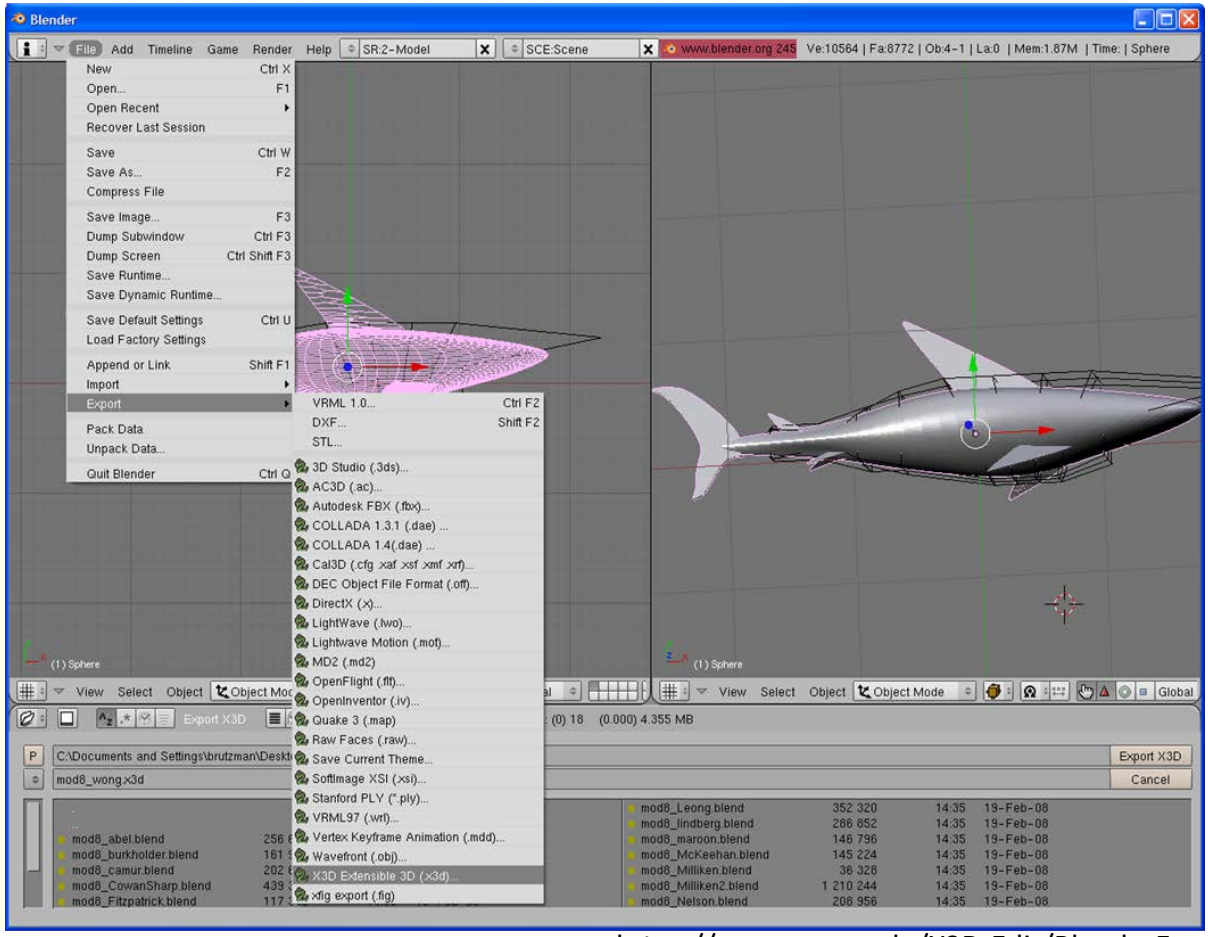
Paraview Export



VMD Export


VMD 1.9.1 OpenGL Display
VMD Main
File Molecule Graphics Display Mouse Extensions Help
ID T A D F Molecule Atoms Frames Vol
0 A D F hab42_popc_start.gro 7065 1 0
1 T A D F hab42_popc_start_2_10 7065 801 0
800
zoom
Loop
ART (VORT ray tracer)
NVIDIA Gelato 2.1
PostScript (vector graphics)
Raster3D 2.7d
Radiance 4.0
Rayshade 4.0
PIXAR RenderMan
Snapshot (VMD OpenGL window)
STL (triangle mesh only)
Tachyon
Tachyon (internal, in-memory rendering)
POV-Ray 3.6
VRML 1.0 (VRML94)
VRML 2.0 (VRML97)
Wavefront (OBJ and MTL)
X3D (XML) full specification
X3D (XML) limited subset for X3DOM v1.1
wole — startup.c
Info) Dynamically loaded 2 plug
Info) /Applications/VMD/VMD 1.9
vmd > Info) Using plugin gro fo
s/hab42_popc_start.gro
Info) Using plugin gro for coor
es/hab42_popc_start.gro
Info) Determining bond structur
Info) Analyzing structure ...
Info) Atoms: 7065
Info) Bonds: 6943
Info) Angles: 0 Dihedrals:
Info) Bondtypes: 0 Angletyp
Info) Residues: 170
Info) Waters: 0
Info) Segments: 1
Info) Fragments: 129 Protein: 1 Nucleic: 0
Info) Finished with coordinate file /Users/wole/Google Drive/vmdfiles/hab42_popc
_start.gro.
Info) Using plugin xtc for coordinates from file /Users/wole/Google Drive/vmdfil
es/hab42_popc_start_2_10ns.xtc
Info) Coordinate I/O rate 59.5 frames/sec, 4 MB/sec, 13.5 sec
Info) Finished with coordinate file /Users/wole/Google Drive/vmdfiles/hab42_popc
_start_2_10ns.xtc.

Blender: Export to X3D

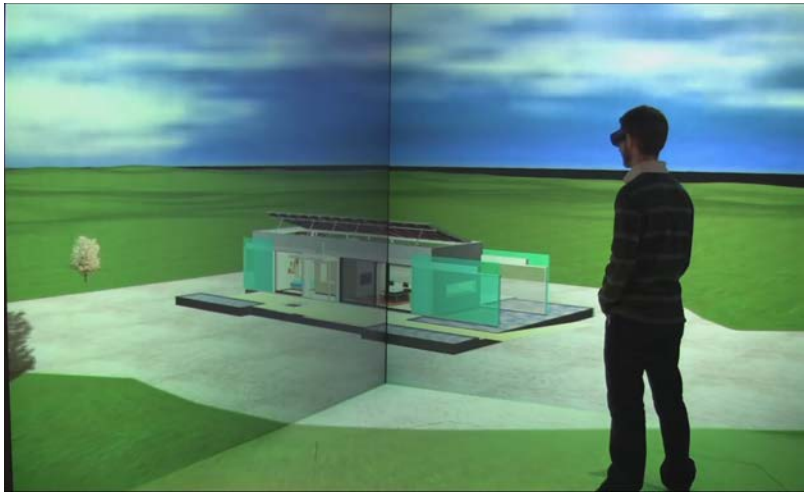


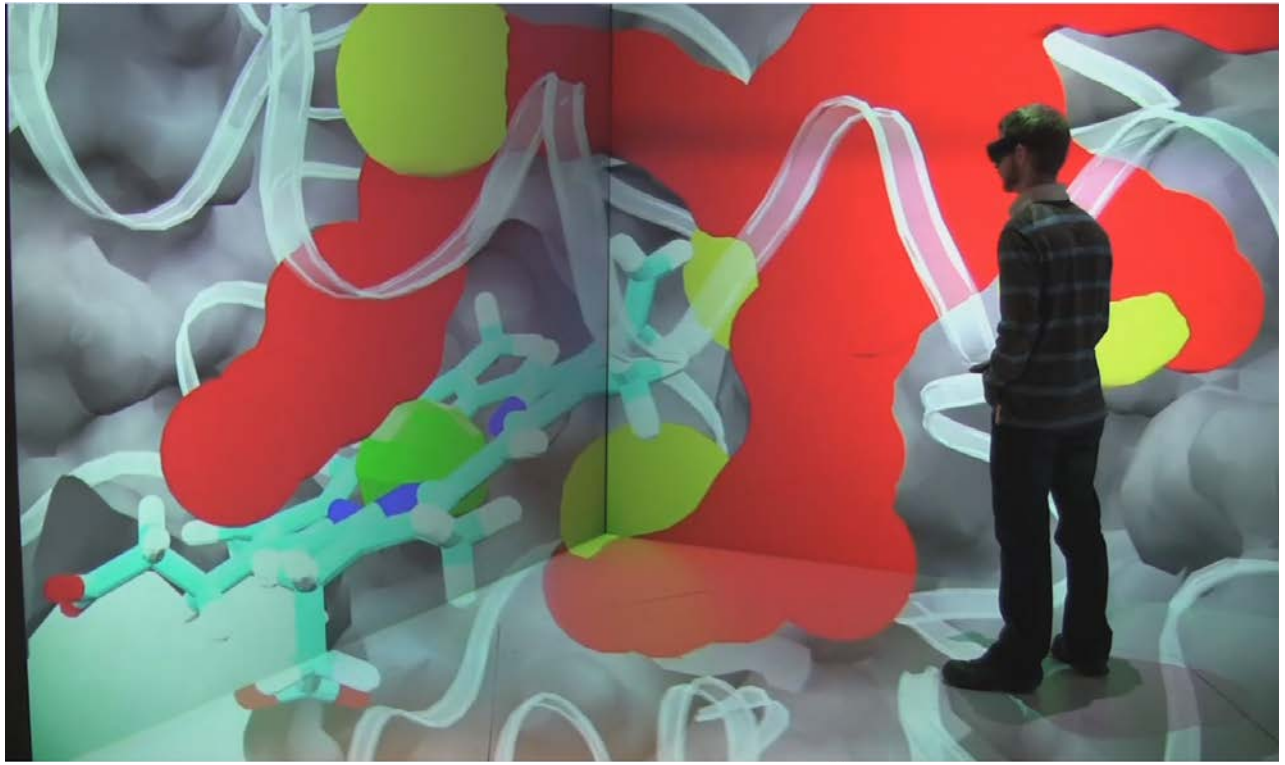
https://savage.nps.edu/X3D-Edit/BlenderExportToX3d.html

Virginia Tech Visionarium

Using the benefits of immersion

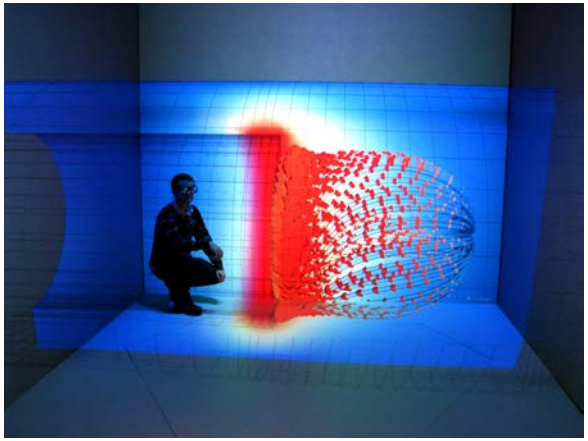
- VisCube (10” 1920x1920 walls, floor)
- Deep Six (6 x 30”)
- Multi-Touch HD (52”)
- Stereo HD (65”)
- Stereo wall

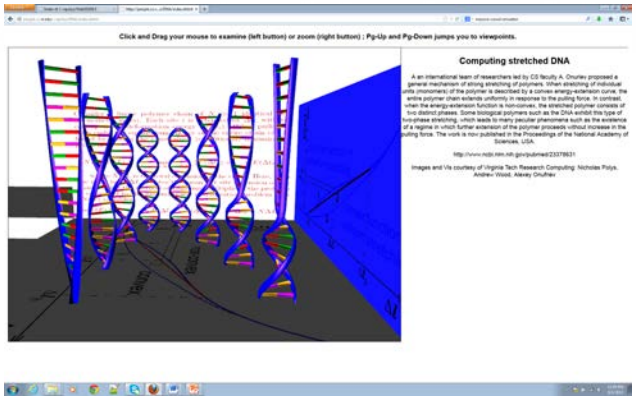


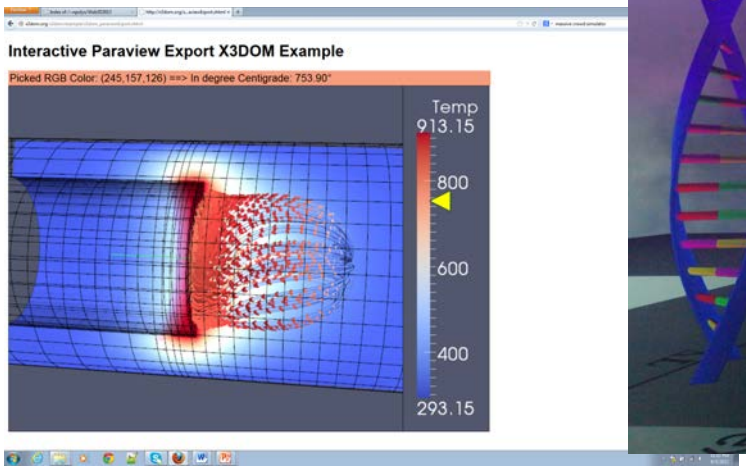


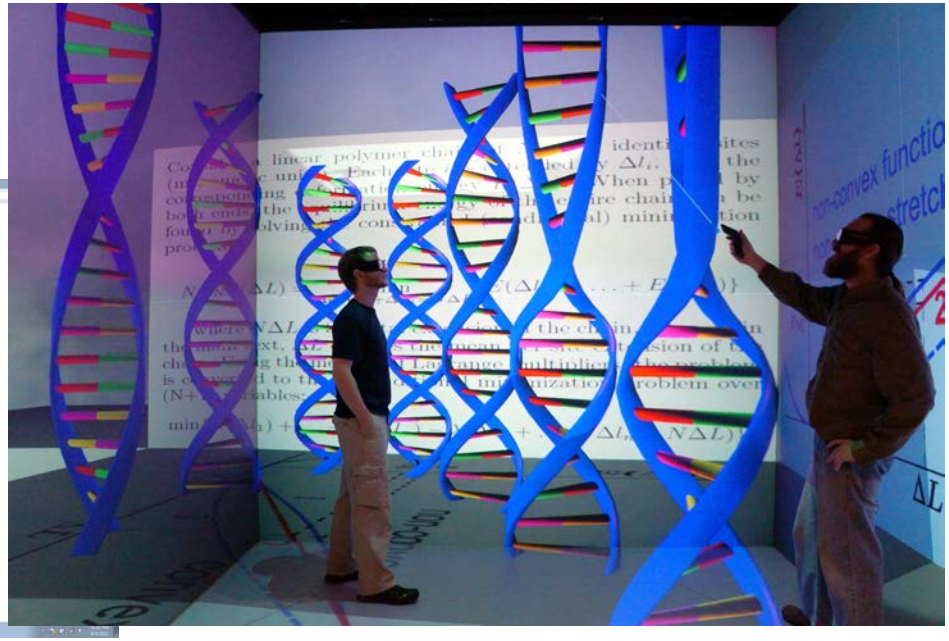
Jory Z. Ruscio, Deept Kumar, Maulik Shukla, Michael G. Prisant, T. M. Murali, and Alexey V. Onufriev, ``Atomic level computational identification of ligand migration pathways between solvent and binding site in myoglobin'', Proceedings of the National Academy of Sciences, (USA), 15, 9204-9209 (2008).

Cross-platform Interactive Content with X3D



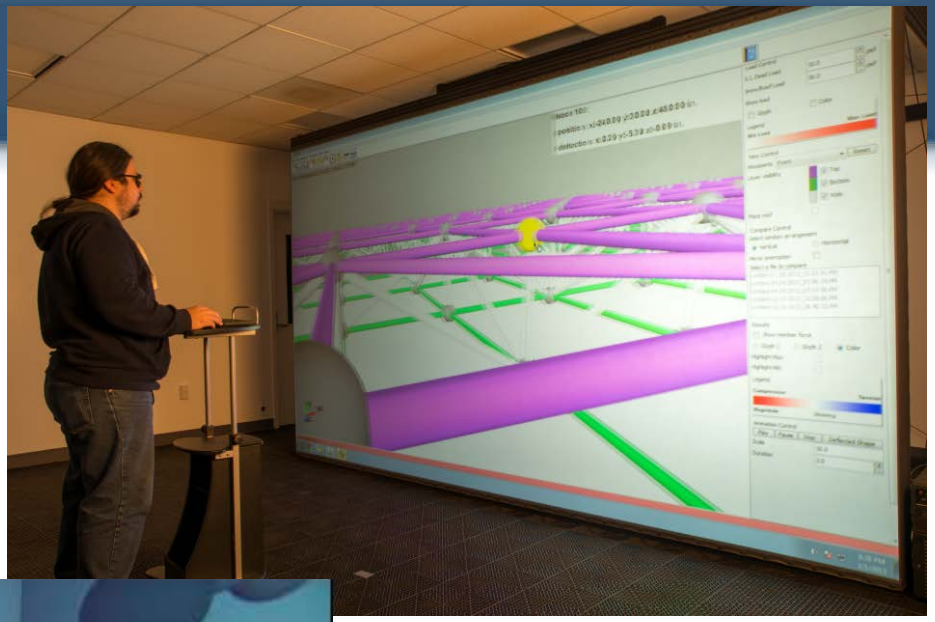


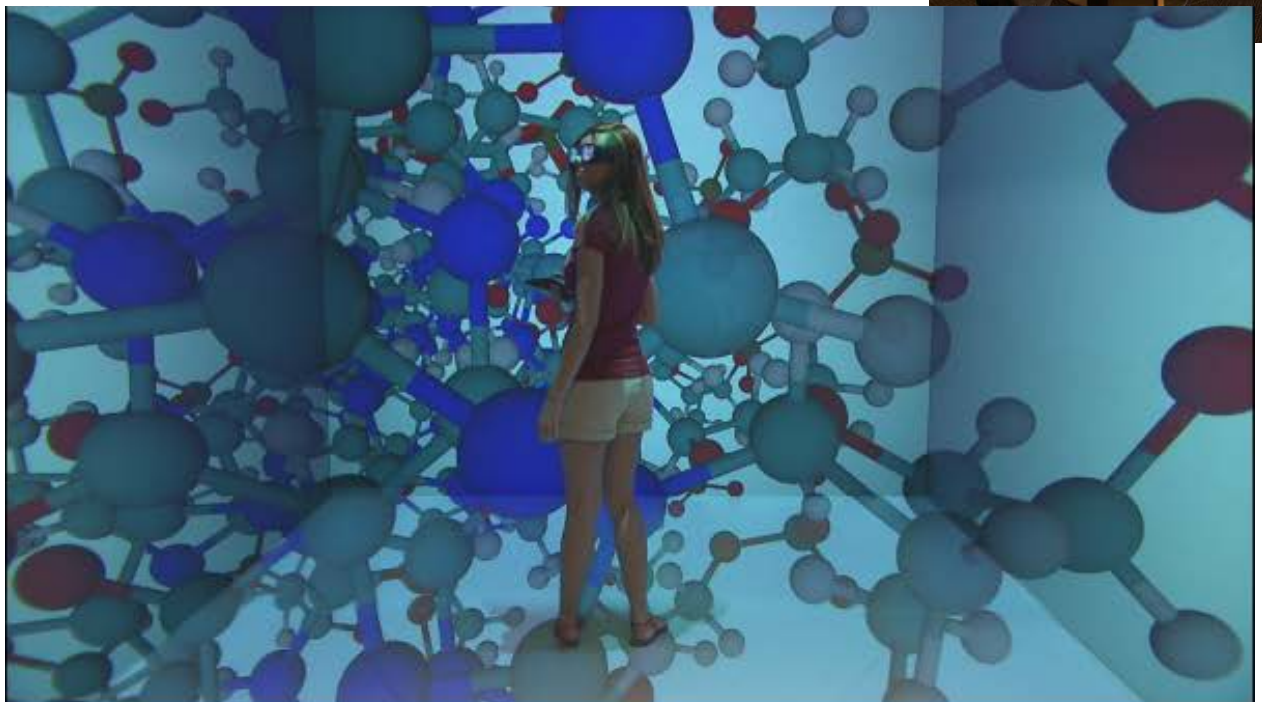




Immersive Displays

- Stereo wall --->
- VisCube





THANKS!

QUESTIONS?

wolex@vt.edu