

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

Medical and Scientific Visualization

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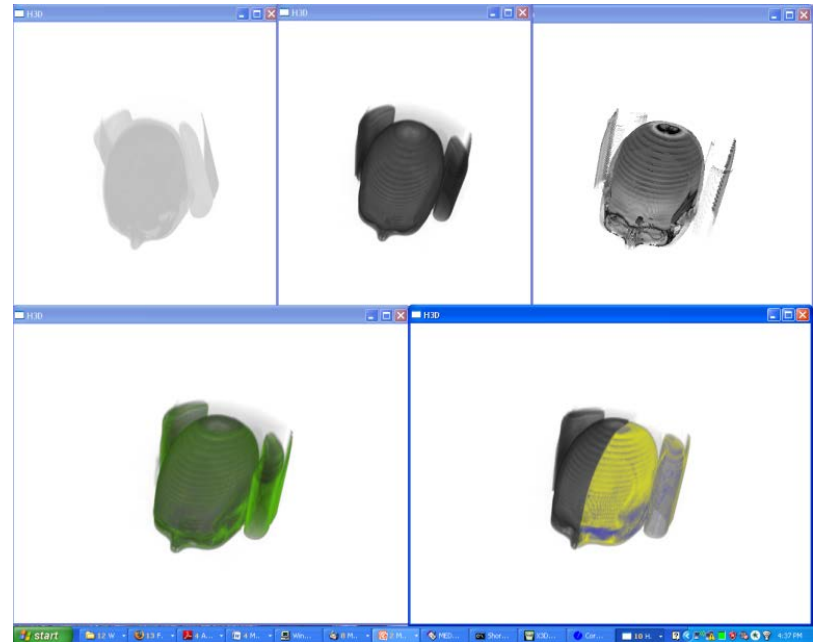
Overview

- 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

X3D 3.3 -> ISO SC24
June 2011

Component

ISO/IEC 19775-1:2:2008/Amendment WDS Aml:201x

X3D

Extensible 3D (X3D)
Part 1: Architecture and base components
41 Volume rendering component

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

- 41.1 Introduction
 - 41.1.1 Name
 - 41.1.2 Overview
- 41.2 Concepts
 - 41.2.1 Overview
 - 41.2.2 Representing volumetric data
 - 41.2.2.1 Registration and scaling
 - 41.2.2.2 Data representation
 - 41.2.2.2.1 3D texture definition
 - 41.2.2.2.2 Vector and normal representation
 - 41.2.2.2.3 Data optimization
 - 41.2.2.3 Segmentation information
 - 41.2.2.4 Tensor representation
 - 41.2.2.5 Visual representation
 - 41.2.3 Interaction with other nodes and components
 - 41.2.3.1 Overview
 - 41.2.3.2 Lighting
 - 41.2.3.3 Geometry
 - 41.2.4 Conformance
 - 41.2.4.1 Dimensionality
 - 41.2.4.2 Hardware requirements

- [41.3 Abstract types](#)
- [41.3.1 X3DComposableVolumeRenderStyleNode](#)
- [41.3.2 X3DVolumeDataNode](#)
- [41.3.3 X3DVolumeRenderStyleNode](#)
- [41.4 Node reference](#)
- [41.4.1 BlendedVolumeStyle](#)
- [41.4.2 BoundaryEnhancementVolumeStyle](#)
- [41.4.3 CartoonVolumeStyle](#)
- [41.4.4 ComposedVolumeStyle](#)
- [41.4.5 EdgeEnhancementVolumeStyle](#)
- [41.4.6 IsoSurfaceVolumeData](#)
- [41.4.7 OpacityMapVolumeStyle](#)
- [41.4.8 ProjectionVolumeStyle](#)
- [41.4.9 SegmentedVolumeData](#)
- [41.4.10 ShadedVolumeStyle](#)
- [41.4.11 SilhouetteEnhancementVolumeStyle](#)
- [41.4.12 ToneMappedVolumeStyle](#)
- [41.4.13 VolumeData](#)

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

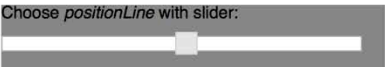


MPR Volume Style Node



FPS	24.39
ANIM	0.00
TRAVERSE	0.22
SORT	0.02
RENDER	1.21
DRAW	1.21
PICKING	3.50
<hr/>	
#NODES:	3
#SHAPES:	1
#DRAWS:	1
#POINTS:	24
#TRIS:	12

Choose *positionLine* with slider:

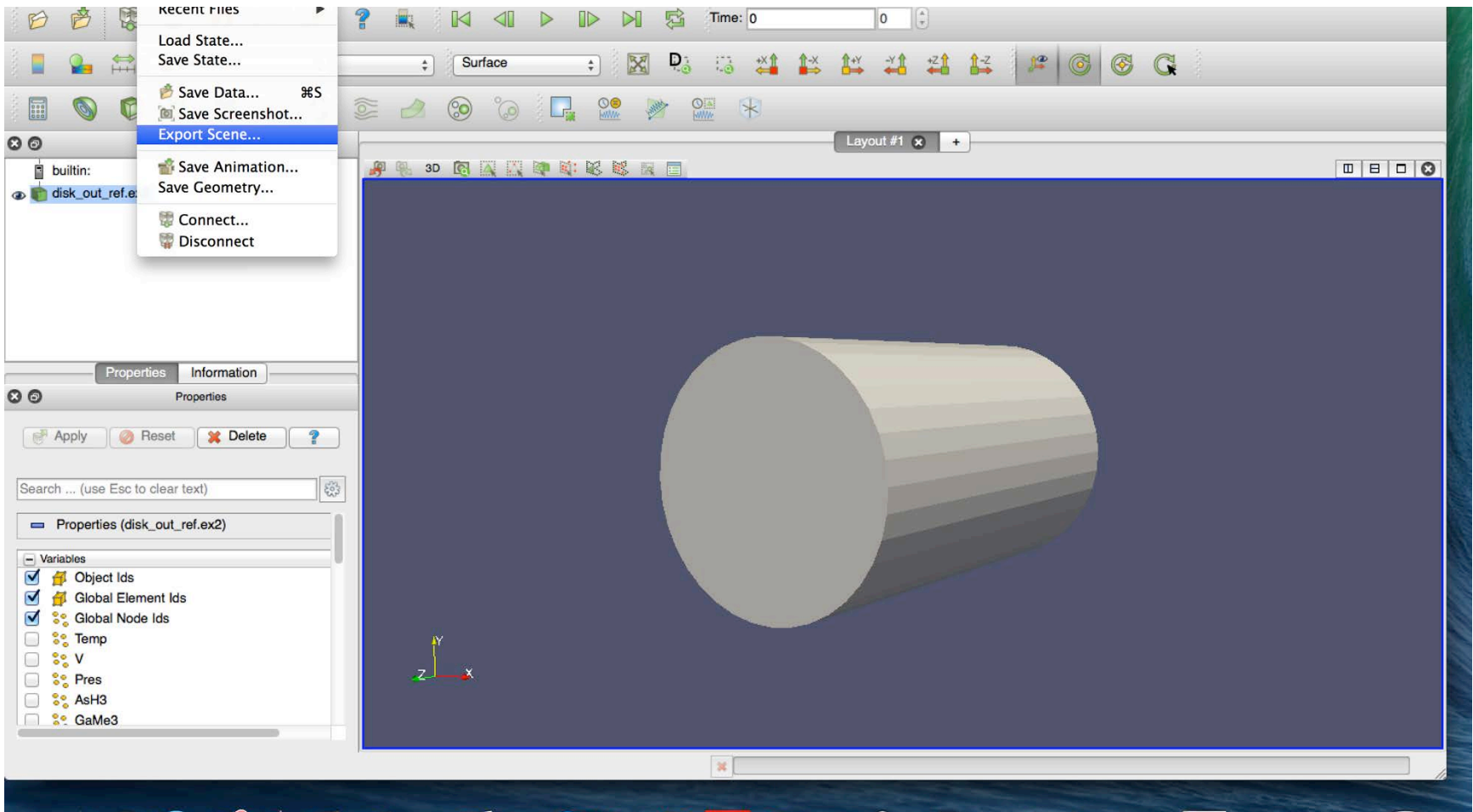


```
INFO: [VolumeRendering][VolumeData] Volume Texture size obtained
INFO: [VolumeRendering][VolumeData] Looking for Volume Texture size...
INFO: Time for setup and init of GL- element no. 0: 47 ms.
INFO: activate FogBindable null/defaultX3DFogNode
INFO: register FogBindable null/defaultX3DFogNode
INFO: create new Fog for X3DFogNode-stack
INFO: activate ViewpointBindable null/Default
INFO: activate first X3DViewpointNode for X3DViewpointNode-stack
INFO: activate BackgroundBindable null/
INFO: activate first X3DBackgroundNode for X3DBackgroundNode-stack
INFO: System ready.
INFO: activate NavigationInfoBindable null/defaultX3DNavigationInfoNode
INFO: register NavigationInfoBindable null/defaultX3DNavigationInfoNode
INFO: NavType: examine
```

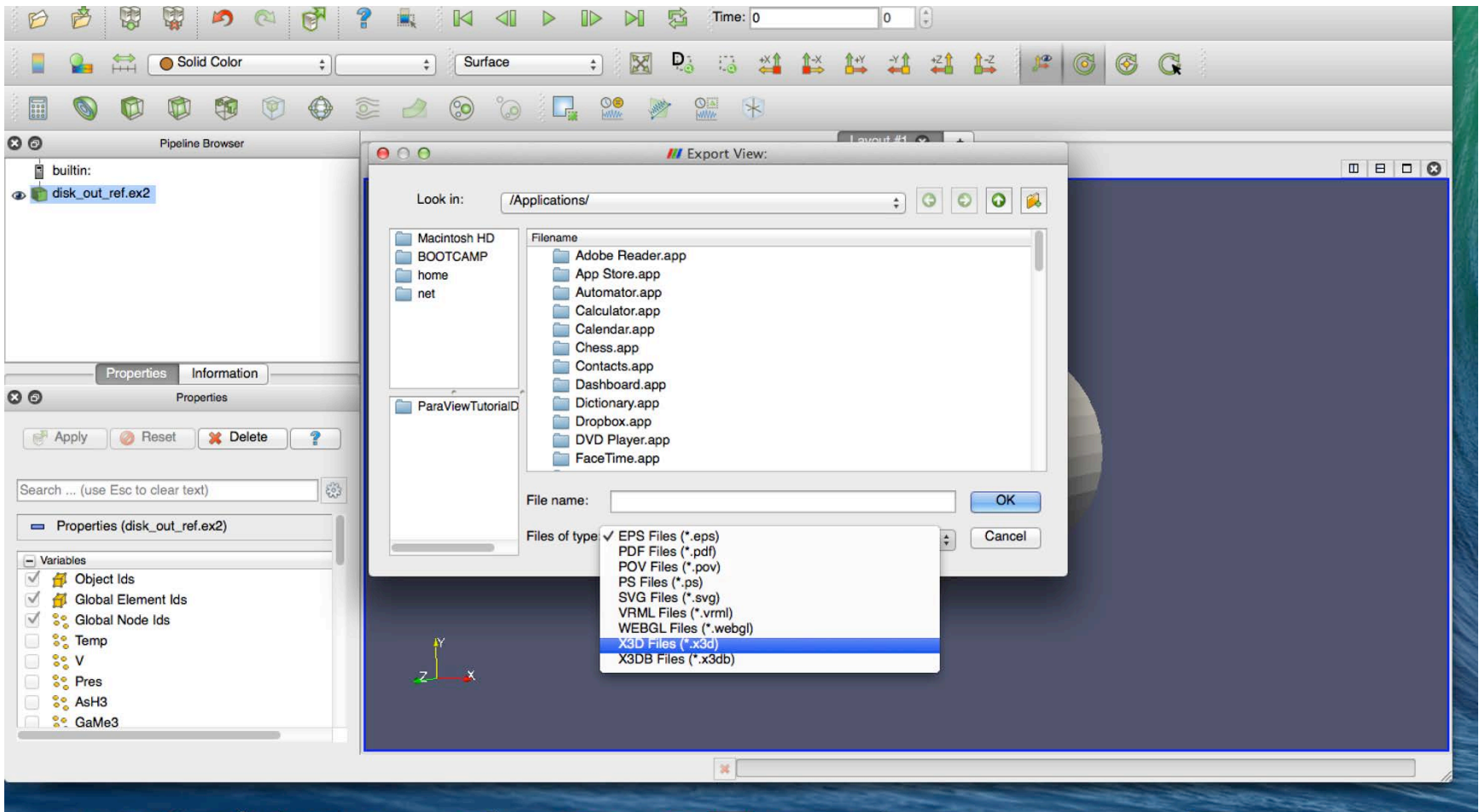
Authoring Web3D

- 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

The screenshot displays the VMD (Visual Molecular Dynamics) interface. On the left, a window titled 'VMD 1.9.1 OpenGL Display' shows a complex 3D molecular structure with atoms represented by small spheres and bonds by thin lines. The main window, 'VMD Main', features a menu bar (File, Molecule, Graphics, Display, Mouse, Extensions, Help) and a table of loaded molecules:

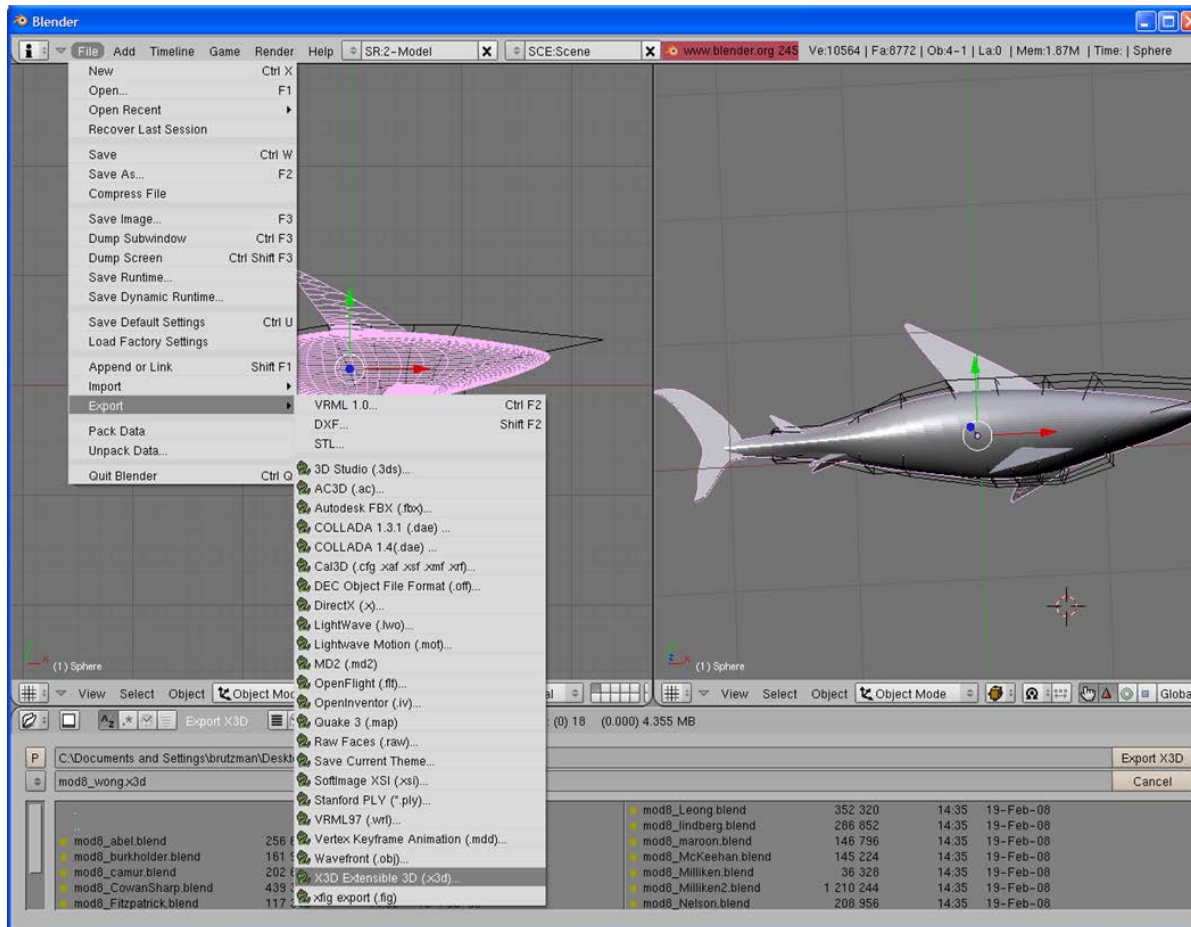
ID	T	A	D	F	Molecule	Atoms	Frames	Vol
0		A	D	F	hab42_popc_start.gro	7065	1	0
1	T	A	D	F	hab42_popc_start_2_10	7065	801	0

Below the table, a 'zoom' slider is set to 800, and a 'Loop' button is visible. A context menu is open over the 'Extensions' menu, listing various rendering engines and export options. The 'X3D (XML) full specification' option is highlighted. At the bottom, a terminal window shows the following output:

```

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 coo
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/vmdfiles/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



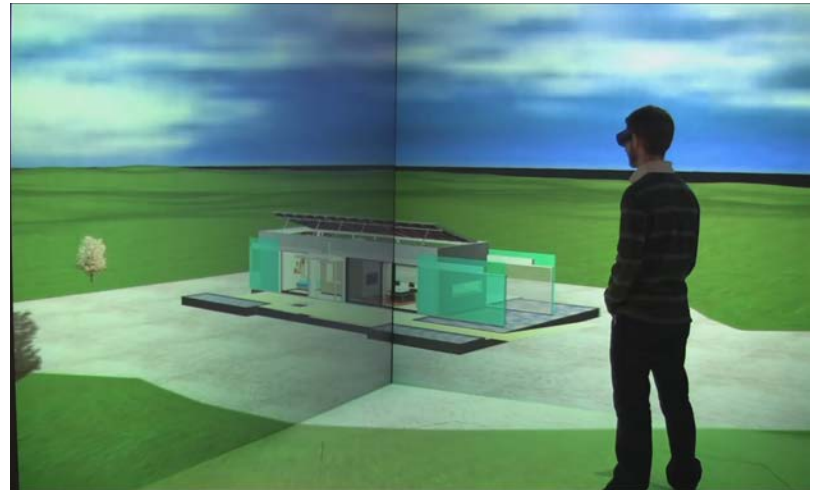
<https://savage.nps.edu/X3D-Edit/BlenderExportToX3d.html>

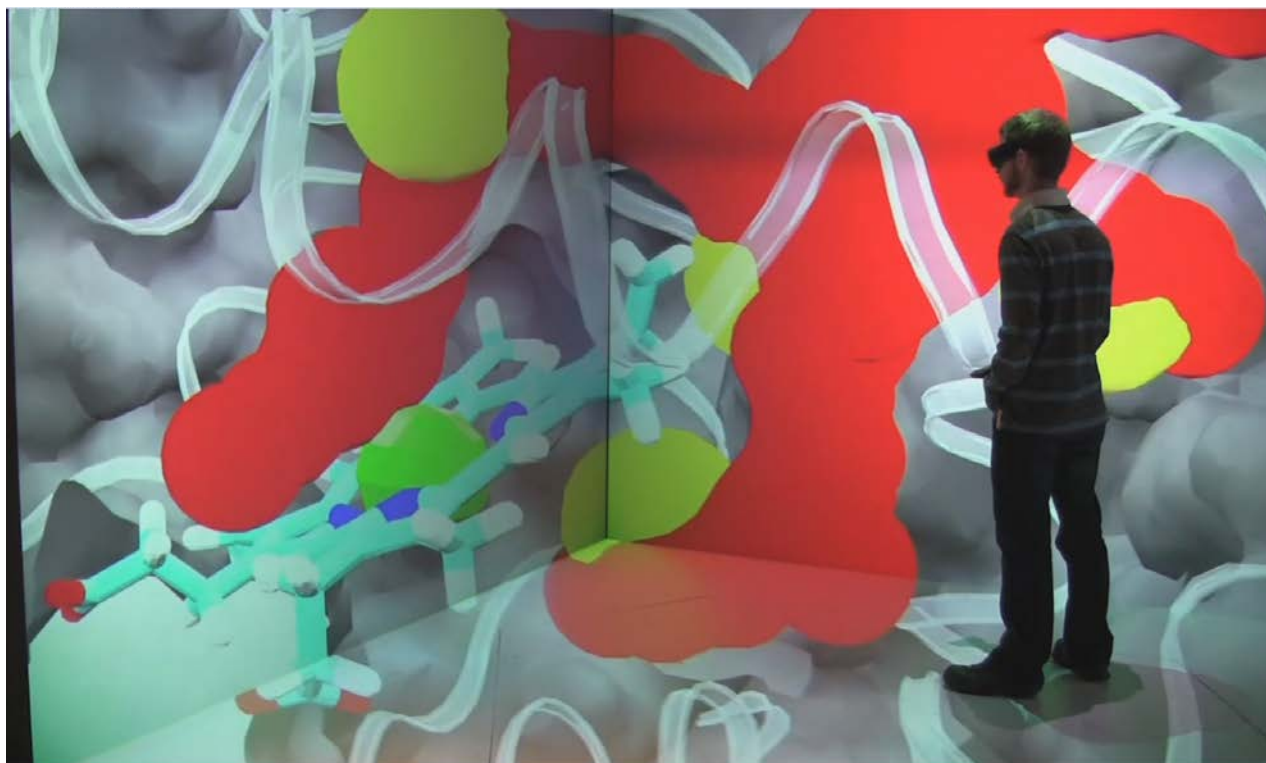
Vancouver, Canada 8 - 10 August 2014

Virginia Tech Visionarium

Using the benefits of immersion

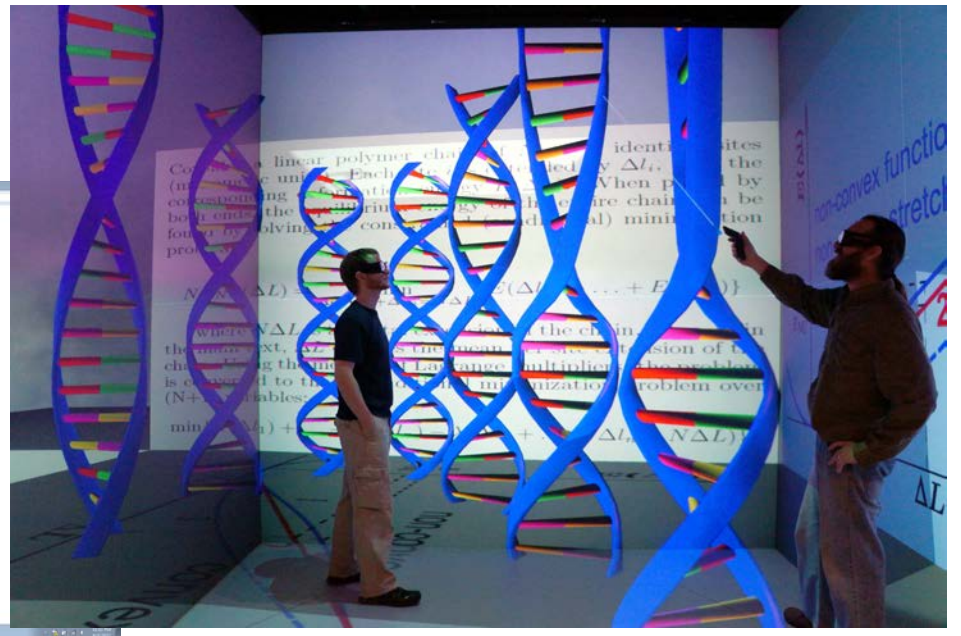
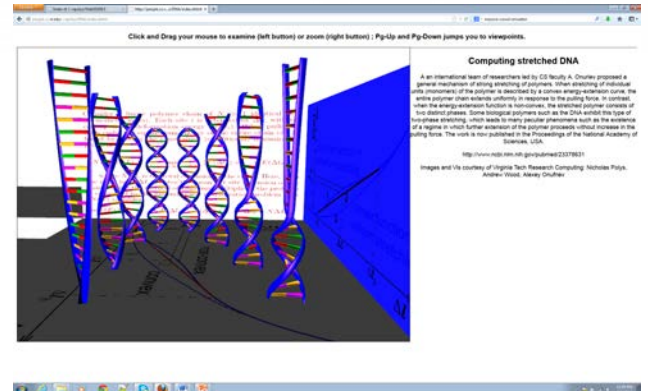
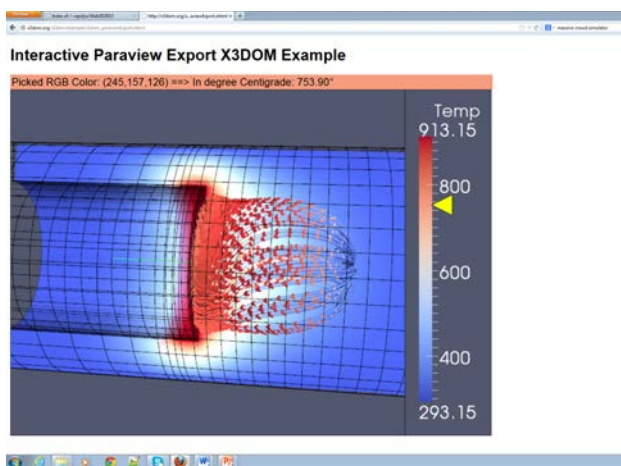
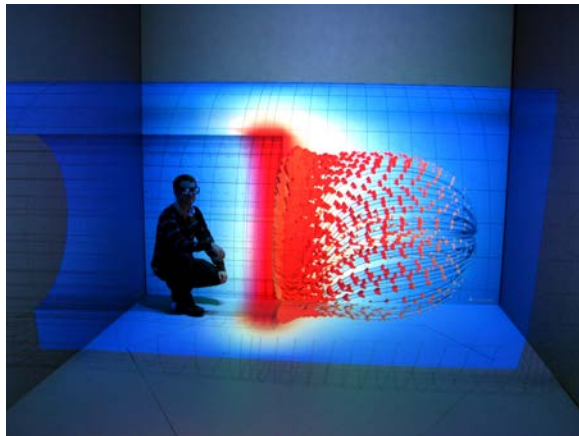
- VisCube (10" 1920x1920 walls, floor)
- Deep Six (6 x 30")
- Multi-Touch HD (52")
- Stereo HD (65")
- Stereo wall





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).

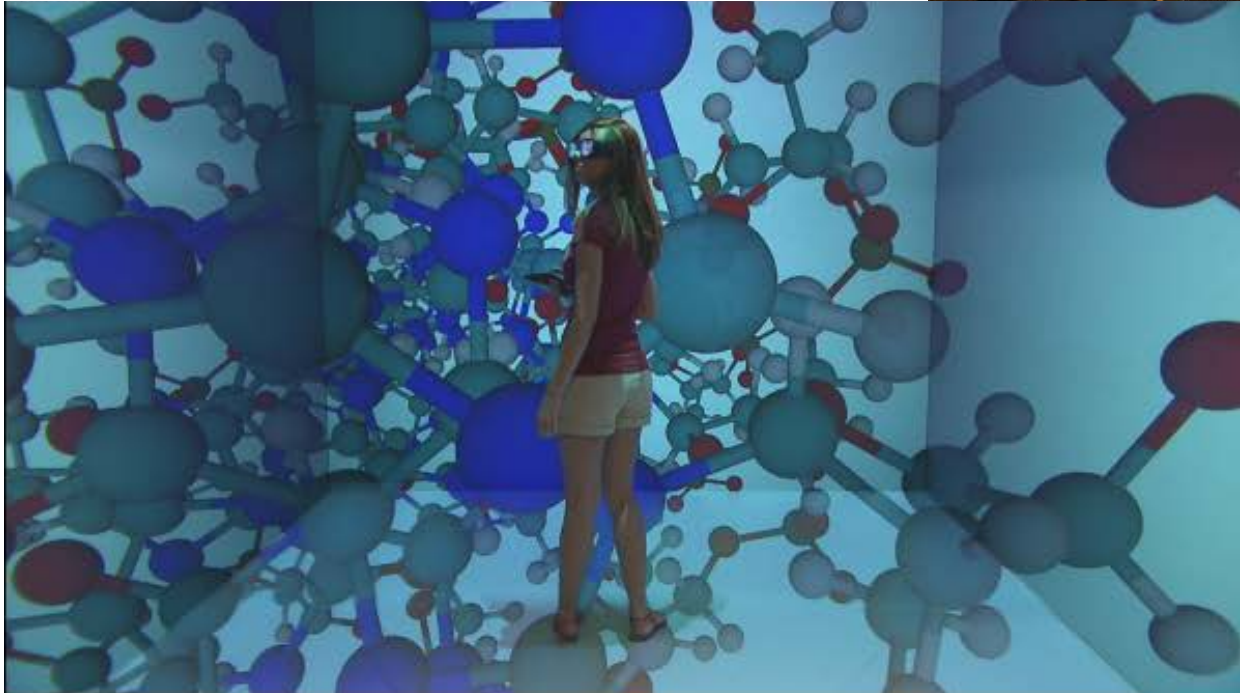
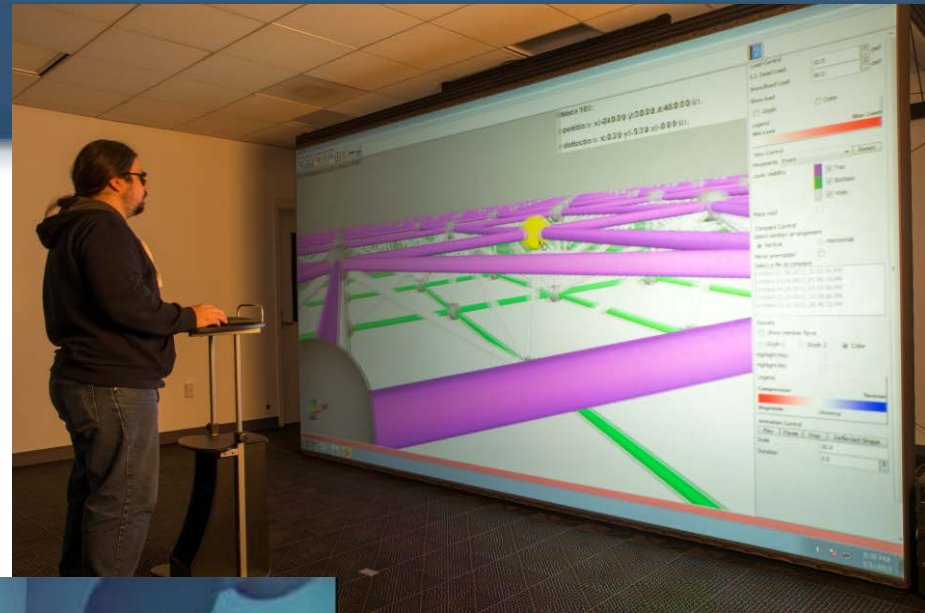
Cross-platform Interactive Content with X3D



web|3D

Immersive Displays

- Stereo wall --->
- VisCube



THANKS!

QUESTIONS?

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