IEEE VR 2020
X3D Quick Start: Applications

http://metagrid2.sv.vt.edu/~n polys/VR2020/

Nicholas F. Polys, PhD
X3D Tutorial Outline

Technology Overview

Ecosystem

Break

Applications

Authoring
Extensible 3D (X3D) Applications

ISO Web3D is the greatest common denominator for 3D worlds - and its extensible!

Successful applications from CAD, BIM, GIS, to Medical!
Working on the WWW

Using urls provides for sophisticated informatics applications (eg. CGI scripts deliver dynamic content)

In HTML5 runtimes, it is especially easy to use WebSockets, gamepads, Leap, Camera (AR), etc
X3D : Research & Applications

... A Paper in this year’s Journal track!!
PRESENCE, MIXED REALITY, AND RISK-TAKING BEHAVIOR: A STUDY IN SAFETY INTERVENTIONS


by:
Sogand Hasanzadeh (Presenter)
Dr. Nicholas Polys
Prof. Jesus M. de la Garza
US Navy Facilities: Worldwide

- X3D Database
- X3DOM client

✓ Interactive 3D Models in Geospatial Context
✓ High Velocity Group Learning Environment
High spatial and temporal resolution body scans

www.3dmd.com

OBJ is not enough - need for rich metadata

X3D Authentication & Encryption
Examples

DNA http://people.cs.vt.edu/~npolys/DNA/index.xhtml

Zebrafish
http://metagrid2.sv.vt.edu/~npolys/NIH/Burgess/ZebraFishBrowser/ZebrafishBrowser.html

Catawba drone
http://metagrid2.sv.vt.edu/~npolys/Fusality_Fall2017/home.html
http://metagrid2.sv.vt.edu/~npolys/Fusality_Summer2016/Catawba/Local2Million.html

Catawba GIS
http://metagrid2.sv.vt.edu/~npolys/Fusality_Summer2016/catawba_deer_hunting_x3d/

PhotoSpheres
http://metagrid2.sv.vt.edu/~npolys/ForestFarming/McDaniels_NutGrove/grove1_Xb.html

Live Streamlab data
http://metagrid2.sv.vt.edu/~lance/proxy_test_Stroubles_Fall2016/Bridge1_SphereFeed2.html

Smithsonian
http://metagrid2.sv.vt.edu/~npolys/Web3DHeritage/smithsonian/
Molecules

- Chimera
- VMD
- *Mol
- CML

...
3dprint.nih.gov

- Molecules
- Cells & tissues
- Anatomical models
- Prosthetics
- Labware
- ...
Visit
3D Printing Support

- CURA,
- Netfab,
- Shapeways,
- ...

Native support of X3D for 3D Printing
(including color and metadata)!

Can always convert to-from STL with tools like:

- Blender
- Meshlab,
- 3DPrintExchange
- ...
Simulation

Helicopter landing dynamics at sea

Virginia Tech @VTEngineering team uses #X3D to visualize and test multiple control algorithms for ship and aircraft maneuvers, working to improve safety and increase insight. Cornel Sultan, Keren Chen, Nicholas Polys  Virginia Tech
Scientific Visualization: CFD

*Immersive X3D via Paraview*


https://vimeo.com/255413564
Particle Physics

Jefferson National Lab,
Center for Nuclear Femtography
CLAS-12 Instrument & Trajectories

https://youtu.be/TkrAqSFBgTE
http://metagrid2.sv.vt.edu/~oli1230/JLAB6/
Online Vis + Sim Services

VRS - RAPID

https://www.youtube.com/watch?v=1Q2ytjBrmXc&t=1s

• **VRS-RAPID** is a collaborative, interactive, and 3D virtual-reality **web-application** for real-time simulation of nuclear systems.

• Users connect to VRS-RAPID to collaborate on **modeling and simulation** of e.g., nuclear reactors.

• Valuable tool for nuclear industry operators and regulators, educators and students, and continuing and professional training.
X3D Blacksburg

Environmental Awareness  E.g. [https://youtu.be/ZIXbsR4KSzc](https://youtu.be/ZIXbsR4KSzc)

- Terrain
- Imagery, openstreetmap
- Town buildings
- Campus buildings
- Sketchup buildings
- Frog scans
- ...
3D Blacksburg Collaborative Planning
Immersive, Multi-user 3D Blacksburg

Remote site visits
Design & Planning examples

Exhibits

Landscapes
Design & Planning II

- Virtual Tours
  - photospheres
  - Structure.io scans
- Town Planning (Sketchup + X3D Blacksburg)
Wing It! - Award-winning Exhibit (2018)

https://segd.org/wing-it%E2%80%94-winged-insect-exhibit

https://designobserver.com/feature/wing-it-testing-out-exhibit-design-using-virtual-reality/39835

Town Planning (2017)

Smart Buildings

http://icat.vt.edu/mirrorworlds/

- VT Moss Arts Center
- Telepresence platform
- Multi-user online building (HTML5 + node.js)
e-NABLE Printed Prosthetics

http://enablingthefuture.org/
GIS

- ESRI
- OGC / Geoserver/ PostGIS


- GDAL


https://vimeo.com/vtgis/3dburg
X3D Blacksburg

• n-D City model
• Enterprise scale GIS infrastructure
• International standards:
  – Web3D (X3D)
  – OGC (Sensor Web)
• Integrates sensor feeds and crowd-sourced content
X3D Blacksburg
X3D Blacksburg Mirror World
CORNET 3D

https://www.youtube.com/watch?v=i8rqwmEDIUI

Real-time Wireless Spectrum Visualization
Catawba GIS & tree LOD

http://metagrid2.sv.vt.edu/~npolys/Fusality_Summer2016/catawba_deer_hunting_x3d/

Drone Lidar Pointclouds

200-300 GB .las files

Stroubles Creek, Catawba Lidar … -> binary X3D

http://metagrid2.sv.vt.edu/~npolys/Fusality_Fall2017/home.html
PointClouds and X3D Rendering

PointProperties in X3D 4.0

http://metagrid2.sv.vt.edu/~n polys/Fusality_Fall2017/home.html

http://metagrid2.sv.vt.edu/~yansh93/catawba50.html
Pipeline Risk

vis-a-vis Geology

http://metagrid2.sv.vt.edu/~npolys/NRVPipeline/Pipeline_in_NRV_binc.html
Remote site visits
Natural Resources

• 3D GIS
  • [http://metagrid2.sv.vt.edu/~npolys/Fusality_Summer2016/catawba_deer_hunting_x3d/](http://metagrid2.sv.vt.edu/~npolys/Fusality_Summer2016/catawba_deer_hunting_x3d/)

• Photosphere and Videosphere tours
  • [http://metagrid2.sv.vt.edu/~npolys/ForestFarming/McDaniels_NutGrove/grove1_X_bin.html](http://metagrid2.sv.vt.edu/~npolys/ForestFarming/McDaniels_NutGrove/grove1_X_bin.html)

• raw 3D scans from aerial, drone-based Lidar and photogrammetry
  • [http://metagrid2.sv.vt.edu/~npolys/Fusality_Fall2017/home.html](http://metagrid2.sv.vt.edu/~npolys/Fusality_Fall2017/home.html)
X3DOM Volume Rendering (cont’d)

- RadarVolumeStyle + ClipPlane
  - [https://examples.x3dom.org/example/RadarVolumeStyle/](https://examples.x3dom.org/example/RadarVolumeStyle/)

Toshiba, Web3d.org
Prosthetics and Implants

Detailed 3D visualizations of mechanical structures generated with Computer-Aided Design processes and interoperable ISO CAD standards.

3D CAD model and 2D drawings courtesy of Supreme Enterprises.

Kinematic Animation

http://www.kshell.com/pages/cmm poc/

Advanced Research Computing: arc.vt.edu
Assembly Animation

Locknut

Teflon Ring

Glass

Main Body

http://kshell.com/pages/exploded_view/

Advanced Research Computing: arc.vt.edu
Assembly Tree

[Diagram of an assembly tree with nodes labeled: LASER, LASER_CASE, CRYSTAL_HOUSING, M_PLATE, L_BLOCK, LASER, CRYSTAL1]
More Cool examples

Elphel using open standards and open source!

Cameras : Product Catalog & media products in X3D!
eTrout Citizen Science

w/ USGS & WebVR VideoSpheres - count the trout!

http://metagrid2.sv.vt.edu/~chris582/fish_pool_equirectangular/


BioPax Ontology Vis

Zebrafish Brain Browser

- NIH and the Burgess Lab
- VT Undergrad Intern
  - clip plane example

Zebrafish genetic and neuro atlas: zbbrowser.com
Volume data

- Cell Image library
- Fossils (CT)

- Zoology (Prof Hoffmann, Bonn)
  - http://vnhm.de/

- VICOMTech:
  - MIRROR4All
Fossils and Evolution


Surfaced:

Smithsonian Heritage + metadata in X3D

http://metagrid2.sv.vt.edu/~npolys/Web3DHeritage/smithsonian/
Natural & Cultural Heritage

- Virginia Tech Insect Collection v.1
- Smithsonian Tests
- Virtual Natural History Museum:  http://vnhm.de

- Australian National Insect Collection
  - https://www2.ala.org.au/chuong/

- ICONS of Greece
3D Graphs and Plotting with X3D

- **MatLab:**

- **R (vrmlgen):**
  - [http://ico2s.org/software/vrmlgen.html](http://ico2s.org/software/vrmlgen.html)

- **mayavi:**
  - the open source Python tool Mayavi has a built-in save function that exports to X3D such as `mlab.savefig('./fig.x3d')`  
    - [http://docs.enthought.com/mayavi/mayavi/](http://docs.enthought.com/mayavi/mayavi/)
Interactive X3D Graphing

https://dlmf.nist.gov/

Take-Aways

- X3D and open standards leadership helps Virginia Tech fulfill its mission everyday
- X3D supports interoperable data, unlocking value across the enterprise, application stovepipes, and hardware platforms
- X3D is durable, providing a data strategy longer than silicon valley life-cycles
3DMD
Immersive Displays

Gallery @ vis.arc.vt.edu

http://www.youtube.com/user/VTVisionarium

Youtube Channel!
SAFAS
Space Frame designer & Structural Simulator:

Creation and Visualization via Web3D Service

- CAVM stereo wall ->
- VisCube, HyperCube