Web3D Publishing Tools and Techniques

X3D Toolchain for Repositories and Model Management

Web3D Webinar update 16 March 2026

Digital Heritage Congress and Web3D 2025 Conference Tutorial
Siena Italy, 8-10 September 2025

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Repositories and Model Management

- X3D Book, X3D Resources, X3D Scene Authoring Hints, X3D Tooltips
- X3D Example Archives ~4000 models with full Quality Assurance (QA)
- Live Code editors: X_ITE and X3DOM (with Jupyter python planned)
- X3D authoring tools: X3D-Edit, Sunrize, Castle Game Engine
- X3D export and import using converters and authoring tools
- Archival metadata and provenance
- Summary of numerous online resources
- San Carlos Cathedral example and others
- Recommendations for all of us

Tutorial in long form is available online:

X3D Assets and X3D-Edit Authoring Tool

Web3D 2024 Conference web3d.siggraph.org

Guimarães Portugal, 25-27 September 2024

Online with X3D-Edit

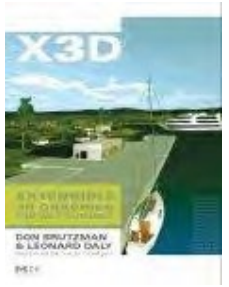
X3D offers full Web-page integration, animation, user interaction, archival stability for 3D models as an ISO International Standard, hyperlinks, Web scalability, provenance metadata, etc. etc.

Web3D Conference, 30 years online

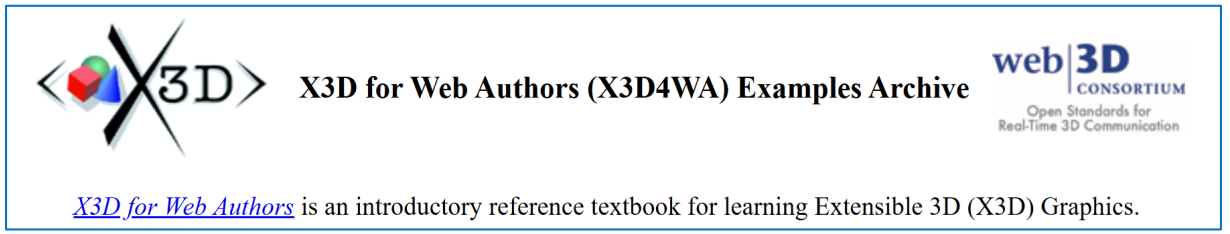
3D technologies for the World Wide Web

- The annual ACM Web3D Conference is a major event which unites researchers, developers, entrepreneurs, experimenters, artists and content creators in a dynamic learning environment. The conference also focuses on recent trends in interactive 3D graphics, information integration and usability in the wide range of Web3D applications from mobile devices to high-end immersive environments.
- Amazing cumulative contributions, supports our evolving challenges
- One step at a time… yes, we can change the world! Again and again!
- dl.acm.org provides ongoing **availability, influence and impact**
- What paper will you work on and write for next year's conference?

Book: X3D for Web Authors



- https://x3dgraphics.com by Don Brutzman and Leonard Daly
- Building and interacting with 3D graphics is a "hands on" experience. Throughout this book there are lots of examples to study and modify. Practice helps you learn how X3D works.
- Corresponding online course includes examples, slidesets, and videos, maintained at web3d.org and matching every chapter
- The book presents the essential ideas needed to understand how an X3D world is constructed. Book chapters build upon each other, progressing from simple ideas to sophisticated concepts.
- X3D: Extensible 3D Graphics for Web Authors assumes only that you are interested in learning more about 3D graphics. Some experience with other Web technologies (such as HTML or XML) is helpful. No prior programming experience is needed.



X3D Application Stack: Presentation Layer Alternatives

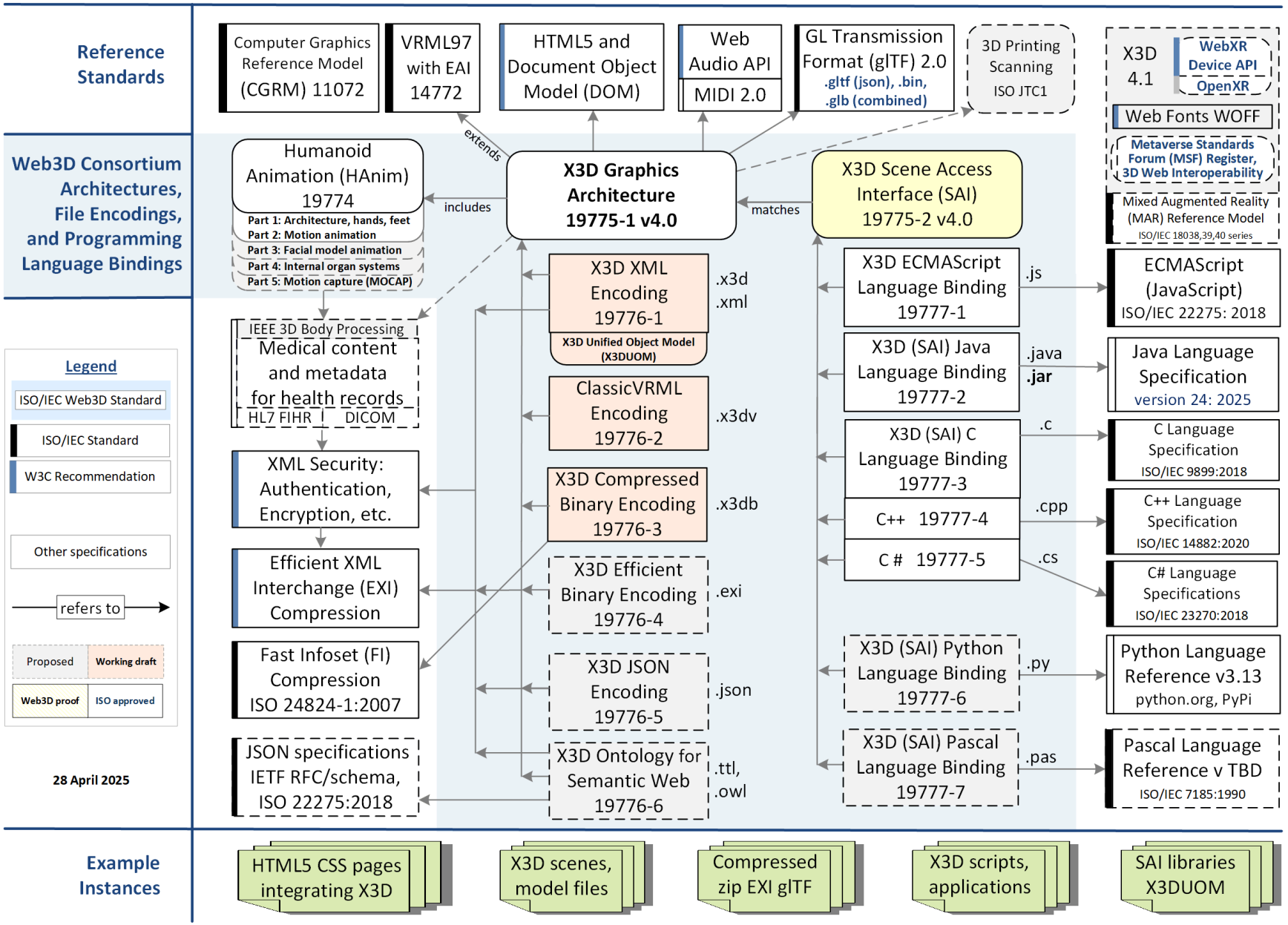
User Experience	HTML5, CSS, JavaScript	Native GUI Application	XR headset, immersive displays
3D Modeling	X3D, ClassicVRML	glTF2, extensions	Import, conversion of numerous 3D formats
Programming Libraries	X3DOM, X_ITE	Castle Game Engine, FreeWrl, others	Web authoring tools and 3D translators
3D Rendering	WebGL, others	WebAudio, MIDI2, streaming formats	WebXR, others
Hardware	CPU and GPU	Visual Display, Spatial Sound	User Interaction Devices

online

X3D is interoperable with diverse technologies, providing multiple choices for developers.

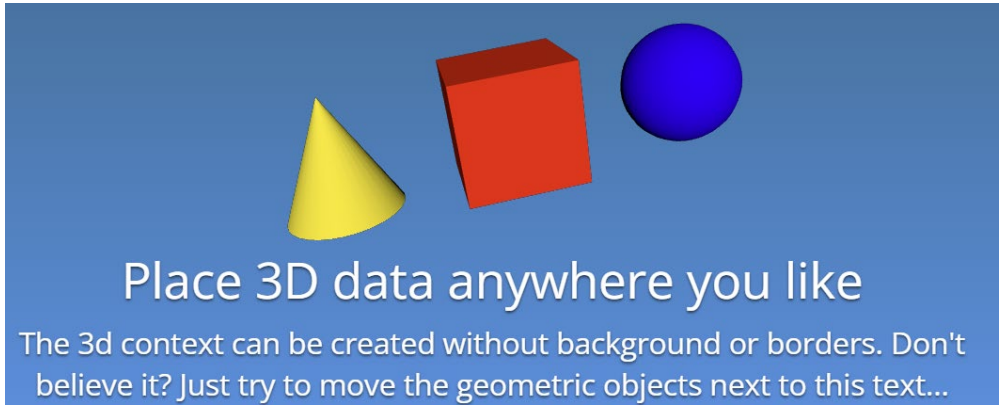
Many equivalent standards, all X3D

X3D Graphics Standards Relationships



online

X3DOM



- https://www.x3dom.org
- Integrate 3D content seamlessly into your webpage - the scene is directly written into the HTML markup. No Plugins needed. Simply include a JavaScript file. Free for non-commercial and commercial purposes.
- Good time to get involved, “wish list” for developers is circulating

X_ITE

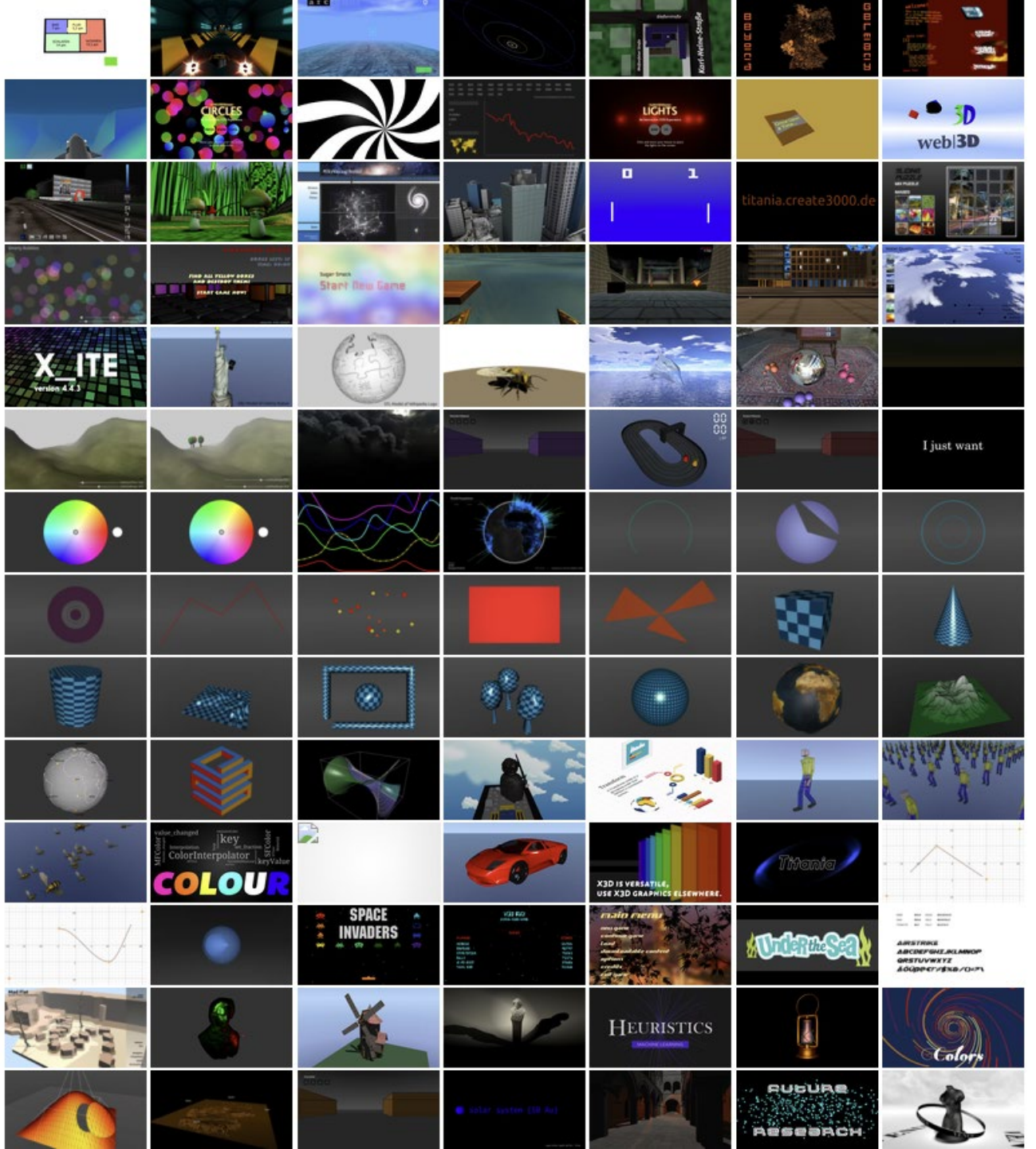
https://create3000.github.io/x_ite

X_ITE is a comprehensive 3D library entirely written in JavaScript which uses WebGL for 3D rendering.

Authors can publish X3D, VRML, glTF and other 3D file formats online within an HTML5 page.

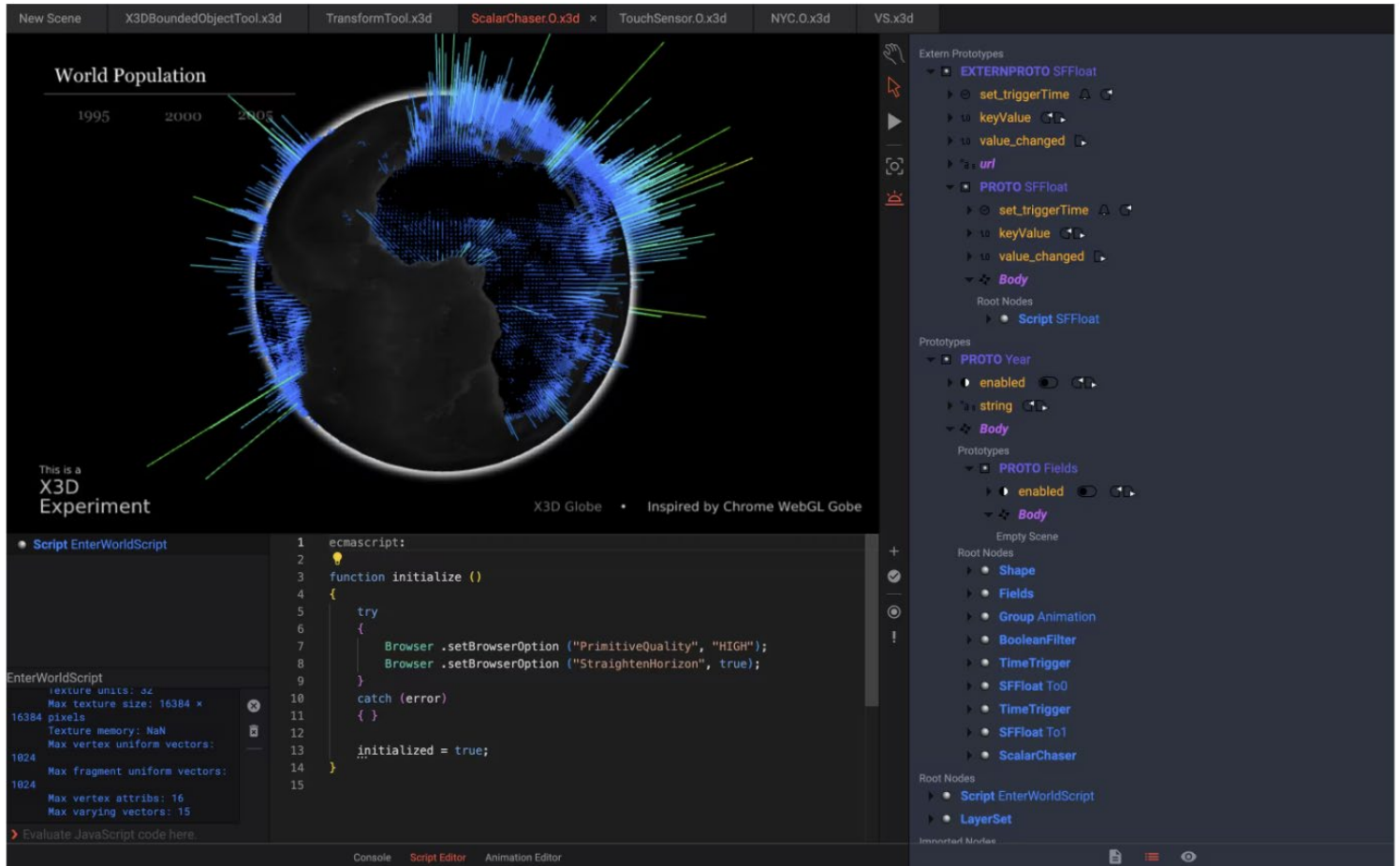
X_ITE works with web browsers **without** prior plug-in installation.

- 329K downloads September 2025
- 618K downloads March 2025 (today)



X_ITE Sunrize — A Multi-Platform X3D Editor

Sunrize is an easy-to-use editor for X3D files based on X_ITE framework and launched via node.js JavaScript engine.



Castle Game Engine's convert everything to X3D online page

Online Converter for 3D and 2D Models

- **Convert from** any model format supported by Castle Game Engine: glTF, X3D, VRML, IFC, Wavefront OBJ, STL, Collada, 3DS, MD3, Spine JSON and more.
- **Convert to** X3D, IFC and STL. *We plan to add glTF as an additional output format soon.*

Can also be used to **convert between X3D encodings (classic, XML)** and pretty-print X3D and VRML models.

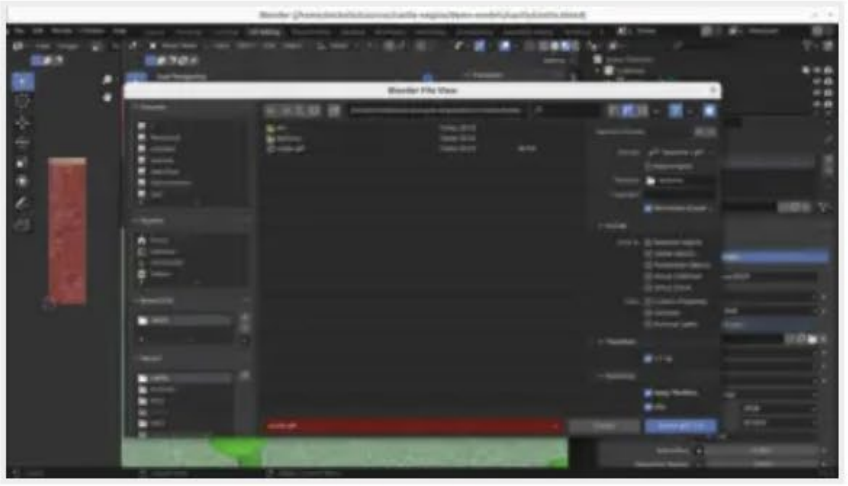
Choose Files | No file chosen | Convert

Output:

- (•) X3D, XML encoding (extension `.x3d`)
- ( ) X3D, classic encoding (extension `.x3dv`)
- ( ) STL, binary (extension `.stl`)
- ( ) IFC JSON (extension `.ifcjson`)

Blender model conversion to X3D

- Continuing improvements on native Blender improvements for X3D model export by X3D Ecology Working Group
- Castle also has detailed guidance on Blender
- https://castle-engine.io/blender


X3D Resources

- https://www.web3d.org/x3d/content/examples/X3dResources.html
- Extensible 3D (X3D) Graphics is the royalty-free open standard for publishing, viewing, printing and archiving interactive 3D models on the Web.
- Numerous resources are available to support both X3D Graphics and its compatible predecessor, the Virtual Reality Modeling Language (VRML).
- X3D Resources has convenient links to many players, converters, and modeling tools.

X3D Resources

web3D CONSORTIUM
Open Standards for Real-Time 3D Communication

Extensible 3D (X3D) Graphics is the royalty-free open standard for publishing, viewing, printing and archiving interactive 3D models on the Web.

Applications | Authoring Tools | Authoring Support | Books | Conformance | Conversions | Examples | Export and Import | Feedback | License | Mobile | Model Search | PowerPoint | Programming Languages | Quality Assurance (QA) | References | Security | Showcase | Training and Tutorials | Videos | VRML and Open Inventor | Wish List | X3D Developers Guide | X3D-Edit authoring tool | X3D Progress | X3D Scene Authoring Hints | X3D Tooltips | X3D Validator (currently offline) | Xj3D | Contact

Applications, Players and Plugins for X3D / VRML Viewing

Extensible 3D (X3D) is the third-generation successor to the Virtual Reality Modeling Language (VRML), providing full backwards compatibility and adding functionally equivalent XML and compressed-binary file encodings.

- Player support for X3D components provides a feature comparison of major X3D viewers, for each player and each X3D component.
- A simple example test scene is HelloWorld.x3d provided in a variety of X3D encodings and conversions:
  (.x3d XML, .x3dv ClassicVRML, .wrl VRML97, .html listing, .html X_ITE, .xhtml X3DOM, .java Java source, .json JavaScript Object Notation, .py Python source, .ttl Turtle source with SPARQL query, .x3db compression, XML canonicalization (C14N), and .png image)
- The HelloWorld.x3d scene is a simple authoring example that illustrates the minimalist X3D Interchange profile. Also available: internationalized Hello World Scenes.
- Please install one of the following X3D players to view X3D/VRML scenes and browse these examples.

X3D players and plugins from Web3D Consortium members:

1. InstantReality is a high-performance X3D player and Mixed Reality (MR) system by Fraunhofer IGD (Linux, macOS, Windows) (forum).
2. *Special mention.* X3DOM (pronounced "X-Freedom") implements a high-performance X3D player in open-source JavaScript. Authors can publish X3D source within an HTML5 page that works in modern Web browsers *without* prior plugin installation (get involved and forum).
3. FreeWRL/FreeX3D X3D/VRML browser (open-source C). (Linux, macOS, Windows) (contact, (bug tickets). Also described on Wikipedia.
4. H3D/H3DViewer is an open-source C++ API and X3D player (Linux, macOS, Windows) (forum).
   - Includes haptics support, Rigid Body Physics component, plus 3D texturing and the Volume Visualization component for the Medical Working Group.
5. Xj3D is an open-source Java viewer and application codebase for X3D graphics scenes.
   - Xj3D Evolution strategy describes how Web3D working-group stakeholders are implementing further improvements to Xj3D.
   - NPS source branch for Xj3D viewer describes current details for the active Xj3D Sourceforge project.
   - Xj3D.org original distribution includes a developer page.
6. GeoVrml Run-Time was originally used for VRML97 GeoVrml examples.
7. Dynamic-3D is a pure Java-based 3D Graphics Engine for web browsers. Open source renderer by Mitch Williams.

Wow!

A lot of X3D applications!

Other X3D players, not (yet?) Web3D Consortium members:

8. *Special mention.* X_ITE X3D Browser implements a high-performance X3D player in open-source JavaScript. Authors can publish X3D source within an HTML5 page that works with Web browsers *without* prior plugin installation.
9. BitManagement's BS Contact and BS Contact Geo X3D/VRML97 plugins for HTML web browsers (Linux, MacOS, Windows) (support).
10. Castle Model Viewer (formerly view3dscene) is a free cross-platform VRML/X3D browser that also supports other 3D model formats (FreeBSD, Linux, MacOS, Windows) built by Castle Game Engine (forum).
11. Cortona3D Viewer by Parallel Graphics, VRML plugin for Netscape or Internet Explorer (support).
12. GPAC is an Open Source multimedia framework for presentation technologies (graphics, animation and interactivity) and packaging formats such as MP4. (Linux, macOS, Windows).
13. Heilan X3D Browser open-source C++ browser for audio research (Linux, macOS, Windows).
14. libx3d open-source C++ libraries for X3D.
15. NuGraf by Okino provides a 3D rendering, translation, viewing & data optimization system (Windows + emulators and plugins for other authoring tools) (support).
16. Octaga Player 5.0 (and Octaga-only plugin test page) by Octaga VS is a high-performance X3D/VRML browser (Windows) (support). Downloads of prior Octaga Player 2.1 also available at c|net.
17. OpenVRML is a free cross-platform runtime for VRML and X3D (FreeBSD, Linux, macOS) (support).
18. Orbisnap is a free multi-platform standalone VRML97 viewer for visualizing virtual worlds, and can connect to a Simulink 3D Animation server (FreeBSD, macOS, Linux, Unix) (support).
19. SwirlX3D Free Player by Pine Coast Software (Windows) (support).
20. V-Slam browser for virtual and mixed reality devices, also released as open source based on Unity3D engine.

Authoring Tools and Programming Libraries for X3D Scenes

Many authoring tools have emerged since X3D can be used for any purpose without royalty fees.

Tool support for X3D components provides a feature comparison of major X3D authoring tools, for each player and each X3D component.

1. X3D-Edit is the primary authoring tool used at NPS to create the X3D, Sourcebook and Savage example archives. Available free.
   - *Latest version*. X3D-Edit is available for Windows, macOS, Linux, Solaris and Netbeans users (support).
   - *Original version*. X3D-Edit 3.1 is still available but no longer supported. X3D-Edit Authoring Tool for Extensible 3D (X3D) Graphics provides a 7-page summary of X3D-Edit 3.1 features and usage.
2. AC3D is a small, simple, easy-to-learn 3D authoring tool that includes support for X3D export (Linux, macOS, Windows) (contact).
3. Blender is an open-source 3D authoring tool that includes support for X3D import/export (FreeBSD Linux, macOS, Windows) (download).
   - *Castle Game Engine (Castle Model Viewer)* documentation provides excellent guidance on Exporting from Blender to X3D.
   - Blender has many import/export capabilities. Blender Model Export To X3D using X3D-Edit describes an example design & export session.
   - Further notes and improvements on Blender export to X3D are provided by Kambi modifications to Blender X3D exporter is a free export plug-in
   - BitManagement X3D exporter for Blender
4. BS Content Studio Tool for easy and fast creation of 3D scenes and applications, from BitManagement (support) November 2014: new update announced.
5. BS Editor is the original authoring tool from BitManagement.
6. bvhacker supports editing of Biovision BVH files, which is a file format for recording post-processed motion-capture data. BVH is the basis for Humanoid Animation (HAnim) Motion Data Animation capabilities, which are supported in X3D version 4, Human Animation component, HAnimMotion node.
7. insight3d is an open-source, image-based modeling tool for creation of buildings from photographs.
8. MeshLab is an open-source, portable, and extensible system for the processing and editing of unstructured 3D triangular meshes (Win64, MacOS, Linux Snap). Downloads are available there as official release, or else on the github repository as a developer release.
9. ParaView is a parallel visualization application to visualize large data sets.
10. RawKee X3D Exporter Plug-in for Maya by Aaron Bergstrom
11. Rez provides an open-source framework and tools for translating planetary terrain data and images to different formats including multi-resolution versions optimized for web browsing.
12. SwirlX3D Editor is an X3D/VRML authoring environment from Pinecoast Software (Windows) (support).
13. Seamless3d is open-source 3D modeling software designed for artists (support). Additional reference: Wikipedia-Seamless3d.
14. SubmarineX3D is a simple X3D Editor from University of Perugia Italy (Linux, macOS, Windows) (contact).
15. Titania X3D Editor is a free standalone X3D/VRML authoring tool primary developed for Ubuntu/Debian operating system.
16. VIM (Vi IMproved) Editor does syntax highlighting and folding (collapsing of blocks) for both XML and VRML97. Nothing specific for X3D yet.
17. Viper is a VRML97 source-code parser by NIST.
18. VrmlPad is a professional editor for VRML programming.
19. Visualization Toolkit (VTK) is an open-source toolkit, written in C++, for large scale 3D data visualization that offers X3D export.
    Related: Mayavi is a Python interactive scripting interface for VTK that includes X3D export of mesh-based surfaces.
    - Enthought Blog entry describes corresponding Mayavi capabilities for X3D.
    - X3D Pathway: Interactive HTML with Python and X3D describes two compelling examples and the production workflow used.
20. White Dune is a graphical VRML97/X3D editor, simple NURBS/Superformula 3D modeller, animation tool, and VRML97/X3DV command-line compiler. Also includes a converter from X3D to RenderMan Interface Bytestream (RIB) protocol. (FreeBSD, macOS, Linux, Unix, Windows).
21. Wings 3D is an advanced subdivision modeler that is both powerful and easy to use. It can be used as a free open-source X3D/VRML authoring environment (Linux, macOS, Windows) (forum).
22. Open-Source 3D Component Editor using X3DOM by Fraunhofer IGD is an example X3D scene editor that runs in a web browser.
23. Altova XMLSpy is an XML development environment for modeling, editing, debugging and transforming XML technologies.
    - XMLSpy provides built-in support for numerous file types, with native support support added in v2020r2 for X3D (Extensible 3D), "a file format used for representing and communicating 3D scenes and objects embedded in applications." Features include context-sensitive parent-child node relationships and attribute values, plus full validation (screenshot).
    - X3D-XmlSpyProject.spp (online) is an overview project for X3D specification-development work.
    - XMLSpy *ContentCatalog.spp project files are also provided with each of the X3D Example Archives.
24. X3DToolKit by INRIA Models and Algorithms for Visualization and Rendering (MAVERICK) is a portable LGPL free C++ toolkit for loading, displaying and processing X3D models, designed for 3D developers.
25. X3D Java Scene Access Interface Library (X3DJSAIL) provides standard X3D Java interfaces with concrete implementation classes, all as open source. This application programming interface (API) library is strongly typed to avoid authoring errors, and is autogenerated from the X3D XML schema and X3D Unified Object Model (X3DUOM) to ensure correctness.

Wow again!

A lot of X3D tools and software libraries!

X3D Scene Authoring Hints

- https://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html
- These hints provide a collection of style guidelines, authoring tips and best practices to improve the quality, consistency and maintainability of Extensible 3D (X3D) Graphics models.

X3D Scene Authoring Hints

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These hints provide a collection of style guidelines, authoring tips and best practices to improve the quality, consistency and maintainability of Extensible 3D (X3D) Graphics models.

Audio | Authoring | Color | containerField | Coordinate Systems, Rotations | CORS | Credits | Dates | Encodings | HTML | Images and Videos | Inlines and Prototypes | License | Meshes | meta Statements and Metadata Nodes | Motion Animation | Naming Conventions | Scale Factors and Unit Conversions | Scripts (Java, JavaScript, JSON) | Strings | SVG | URL Links | Validation | Viewpoints and Navigation | Volumes | VRML | X3D Developers Guide | X3D-Edit authoring tool | X3D Progress | X3D for Web Authors book | X3D Resources | X3D Tooltips | X3D Validator (currently offline) | Xj3D | Contact

X3D Tooltips

- https://www.web3d.org/x3d/tooltips/X3dTooltips.html
- X3D Tooltips provide authoring tips, hints and warnings for each node and field in X3D. Example: Viewpoint.description
- Source for the X3D Tooltips is in XML, enabling them to be used in programming APIS: Java X3DJSAIL, Python X3DPSAIL *x3d.py* etc.
- Multilingual versions also exist for earlier versions of X3D

Extensible 3D (X3D) 4.0 Tooltips

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X3D Tooltips provide authoring hints for each node and field found in X3D Architecture version 4 International Specification (IS).

X3D Tooltips provide context-sensitive support for authors and are usable within tools (such as X3D-Edit). These tooltips are primarily for X3D XML encoding, but other X3D file encodings and programming-language bindings are similar. Each node's table entry also provides appropriate links to the X3D Abstract Specification, X3D Schema Documentation, X3D DOCTYPE Documentation, X3D JSON Documentation (draft), X3D Regular Expressions (regexes), and X3D Java SAI Library (X3DJSAIL).

X3D Resources, Examples: Scene Archives for X3D

- https://www.web3d.org/x3d/content/examples/X3dResources.html#Examples
- The X3D Examples Archives demonstrate how X3D nodes and scenes work. Thousands of scenes are provided in all X3D encodings. You can browse them individually online or download fully complete, separately installable .zip archives.

Quick Links	X3D for Web Authors	X3D for Advanced Modeling	Basic	Conformance Nist	Humanoid Animation (HAnim)	VRML 2 Sourcebook	Savage
Overview, references:	README	README	README	README	README	README	README
Archive examples:	Online	Online	Online	Online	Online	Online	Online
Local links (if present):	Local	Local	Local	Local	Local	Local	Local
Java conversions:	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc	Javadoc
4142 total X3D scenes:	271	136	744	761	147	416	1253
Catalog metadata XML:	Content catalog, XMLSpy project	Content catalog, XMLSpy project	Content catalog, XMLSpy project	Content catalog, XMLSpy project	Content catalog, XMLSpy project	Content catalog, XMLSpy project	Content catalog, XMLSpy project
Ant build scripts:	build.xml	build.xml	build.xml	build.xml	build.xml	build.xml	build.xml
Quality Assurance (QA) regression tests: build.all.log.txt	build.all.log.txt (history)	build.all.log.txt (history)	build.all.log.txt (history)	build.all.log.txt (history)	build.all.log.txt (history)	build.all.log.txt (history)	build.all.log.txt (history)
Full download:	zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)	.zip (MD5 checksum)
Additional details:	see below	see below	see below	see below	see below	see below	see below

Web3D Consortium Open-Source License

Grants users royalty-free (RF) rights suitable for any legal purpose

- Background on BSD-style license details found at https://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#license
- X3D authors can place meta statements in a scene to document what license being applied. For example, one of the following is typically included in the X3D scenes found in the Web3D Consortium and NPS open-source example archives:

```
<meta name='license' content='../license.html'/>
```

Additional contributions to the X3D Examples Archives are welcome, as long as they are offered under an open-source license.

X3D Model Documentation: X3D to HTML

- XML-based .x3d model converted into HTML (here is an example)
- Annotations: note that **`meta`** tags have structure identical to HTML, using Dublin Core or other structured metadata vocabularies
- Line numbers, hyperlinks, tooltips, cross-links for event ROUTES
- Hover mouse to check images are present (or play audio)

X3D Model Documentation: GeometryPrimitiveNodesWhiteBackground.x3d

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.3//EN" "https://www.web3d.org/specifications/x3d-3.3.dtd">
3  <X3D profile='Immersive' version='3.3'  xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation='https://www.web3d.org/specifications/x3d-3.3.xsd'>
4     <head>
5        <meta name='title' content=' GeometryPrimitiveNodesWhiteBackground.x3d '/>
6        <meta name='description' content='Geometry Primitive Nodes: Shape, Box, Cone, Cylinder, Sphere, Text, FontStyle'/>
7        <meta name='creator' content='Don Brutzman'/>
8        <meta name='created' content='25 March 2005'/>
9        <meta name='modified' content='8 July 2023'/>
10       <meta name='Image' content='GeometryPrimitiveNodesWhiteBackground.png'/>
11       <meta name='Image' content='GeometryPrimitiveNodesWhiteBackgroundReducedQuality.png'/>
12       <meta name='hint' content='Default values have been added to geometry nodes for clarity, ordinarily default values are omitted following X3D Canonicalization (C14N).'/>
13       <meta name='rights' content='Copyright (c) Don Brutzman and Leonard Daly, 2005'/>
14       <meta name='identifier' content=' https://www.web3d.org/x3d/content/examples/X3dForWebAuthors/Chapter02GeometryPrimitives/GeometryPrimitiveNodesWhiteBackground.x3d '/>
15       <meta name='generator' content='X3D-Edit 3.3, https://www.web3d.org/x3d/tools/X3D-Edit'/>
16       <meta name='license' content='../license.html'/>
17    </head>
```

X3D Model Documentation: ROUTE tables

- X3D is declarative and strongly typed. Events can be sent by end users, interpolators, scripts, sensors, inline scenes, prototypes, etc.
- Any part of an X3D scene graph model can be animated!
- ROUTE statements connect sources to destinations. Example:

X3D Example Archives: **X3D4WA, X3D for Web Authors, Chapter 07 Event Animation Interpolation, Hello X3D Authors Animation Chain**

Fully developed animation-chain example showing spinning globe and text: Hello!

X3D model source .x3d
ClassicVRML .x3dv
VRML97
Canonical XML
X3D Model Documentation

X_ITE (Playground)
.java source (Javadoc)
.json (check)
.py python
.ttl Turtle (query)

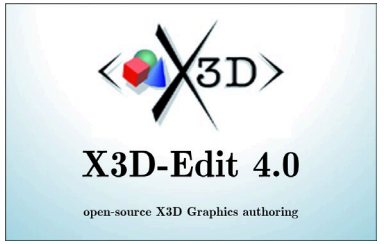
X3DOM (X3DOM editor)
.x3db Compressed Binary Encoding
Version control
Trouble tickets
Email x3d-public

Event Graph ROUTE Table entries with 3 ROUTE connections total, showing X3D event-model relationships for this scene.

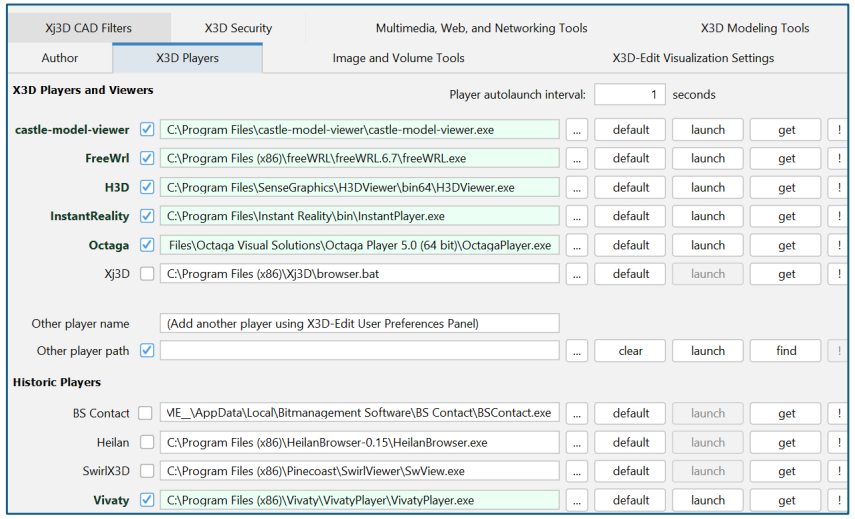
Each row shows an event cascade that may occur during a single timestamp interval between frame renderings, as part of the X3D execution model.

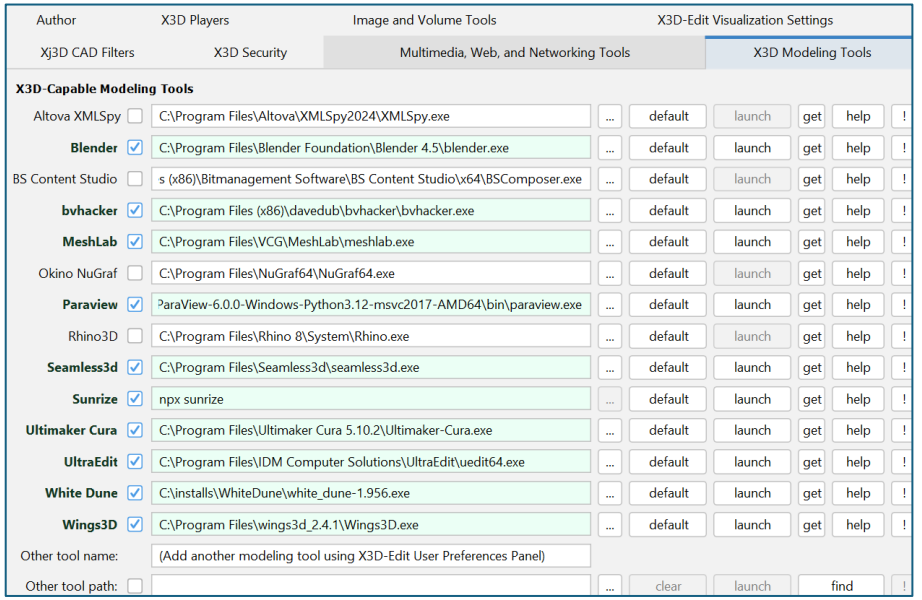
ClickTriggerTouchSensor **TouchSensor** **touchTime** SFTime	→ ROUTE event to (1)	OrbitalTimeInterval **TimeSensor** **startTime** SFTime	*then*	OrbitalTimeInterval **TimeSensor** **fraction_changed** SFFloat	→ ROUTE event to (2)	SpinThoseThings **OrientationInterpolator** **set_fraction** SFFloat	*then*	SpinThoseThings **OrientationInterpolator** **value_changed** SFRotation	→ ROUTE event to (3)	EarthCoordinateSystem **Transform** **set_rotation** SFRotation	

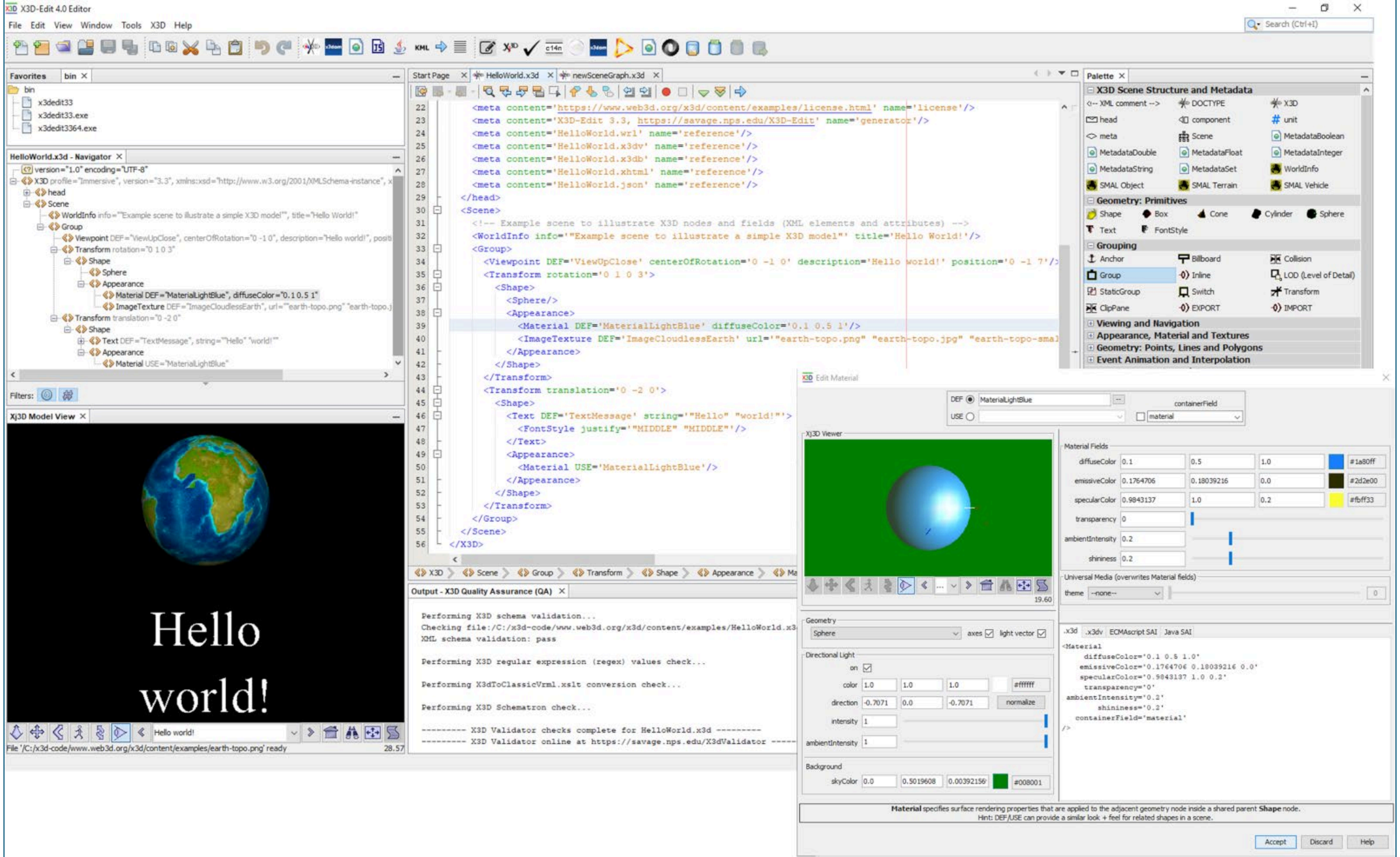
X3D-Edit Authoring Tool



- https://www.web3d.org/x3d/tools/X3D-Edit/X3D-Edit.html
- X3D-Edit is a free, open-source Extensible 3D (X3D) Graphics authoring tool for simple high-quality authoring, editing, import/export, validation and viewing of X3D scenes.
- X3D-Edit provides convenient links to many players, converters, and modeling tools.
- X3D-Edit Preferences include X3D Players, relevant Modeling Tools, Audio and Image tools, etc.



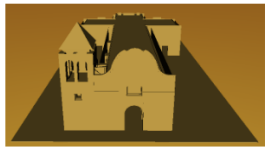



X3D-Edit 4.0 Editor
File Edit View Window Tools X3D Help
Favorites
bin
x3dedit33
x3dedit33.exe
x3dedit3364.exe
HelloWorld.x3d - Navigator
Xj3D Model View
Hello
world!
Start Page
HelloWorld.x3d
newSceneGraph.x3d
<meta content='https://www.web3d.org/x3d/content/examples/license.html' name='license'/>
<meta content='X3D-Edit 3.3, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='HelloWorld.wrl' name='reference'/>
<meta content='HelloWorld.x3dv' name='reference'/>
<meta content='HelloWorld.x3db' name='reference'/>
<meta content='HelloWorld.xhtml' name='reference'/>
<meta content='HelloWorld.json' name='reference'/>
</head>
<Scene>
<!-- Example scene to illustrate X3D nodes and fields (XML elements and attributes) -->
<WorldInfo info='"Example scene to illustrate a simple X3D model"' title='Hello World!'/>
<Group>
<Viewpoint DEF='ViewUpClose' centerOfRotation='0 -1 0' description='Hello world!' position='0 -1 7'/>
<Transform rotation='0 1 0 3'>
<Shape>
<Sphere/>
<Appearance>
<Material DEF='MaterialLightBlue' diffuseColor='0.1 0.5 1'/>
<ImageTexture DEF='ImageCloudlessEarth' url='"earth-topo.png" "earth-topo.jpg" "earth-topo-smal
</Appearance>
</Shape>
</Transform>
<Transform translation='0 -2 0'>
<Shape>
<Text DEF='TextMessage' string='"Hello" "world!"'>
<FontStyle justify='"MIDDLE" "MIDDLE"'/>
</Text>
<Appearance>
<Material USE='MaterialLightBlue'/>
</Appearance>
</Shape>
</Transform>
</Group>
</Scene>
</X3D>
Output - X3D Quality Assurance (QA)
Performing X3D schema validation...
Checking file:/C:/x3d-code/www.web3d.org/x3d/content/examples/HelloWorld.x3
XML schema validation: pass
Performing X3D regular expression (regex) values check...
Performing X3dToClassicVrml.xslt conversion check...
Performing X3D Schematron check...
--------- X3D Validator checks complete for HelloWorld.x3d ---------
--------- X3D Validator online at https://savage.nps.edu/X3dValidator -----
Palette
X3D Scene Structure and Metadata
Geometry: Primitives
Grouping
Viewing and Navigation
Appearance, Material and Textures
Geometry: Points, Lines and Polygons
Event Animation and Interpolation
Edit Material
DEF MaterialLightBlue
USE
containerField
material
X3D Viewer
Material Fields
diffuseColor 0.1 0.5 1.0 #1a80ff
emissiveColor 0.1764706 0.18039216 0.0 #2d2e00
specularColor 0.9843137 1.0 0.2 #fbff33
transparency 0
ambientIntensity 0.2
shininess 0.2
Universal Media (overwrites Material fields)
theme --none--
Geometry
Sphere
axes
light vector
Directional Light
on
color 1.0 1.0 1.0 #ffffff
direction -0.7071 0.0 -0.7071 normalize
intensity 1
ambientIntensity 1
Background
skyColor 0.0 0.5019608 0.00392156 #008001
.x3d .x3dv ECMAscript SAI Java SAI
<Material
diffuseColor='0.1 0.5 1.0'
emissiveColor='0.1764706 0.18039216 0.0'
specularColor='0.9843137 1.0 0.2'
transparency='0'
ambientIntensity='0.2'
shininess='0.2'
containerField='material'
/>
Material specifies surface rendering properties that are applied to the adjacent geometry node inside a shared parent Shape node.
Hint: DEF/USE can provide a similar look + feel for related shapes in a scene.
Accept
Discard
Help

X3D for Web Authors, San Carlos Cathedral by Michele Foti

X3D Example Archives: **X3D4AM, X3D for Advanced Modeling, San Carlos Cathedral**





We are building a large, detailed archival model of the San Carlos Cathedral in Monterey California in order to show low-cost modeling and photographic methods for documenting cultural heritage and supporting historic preservation. This work includes a case study paper, historical reference materials and a TODO list.

13 X3D Models		X3D Model Descriptions
	Altar	Altar for San Carlos Cathedral
	Bell	Bell for San Carlos Cathedral
	Bell Old	Bell for San Carlos Cathedral in mid 19th century
	Bench	Bench for San Carlos Cathedral
	Century 19th Model	San Carlos Cathedral is the oldest continuously functioning church and the first stone building in the State of California.

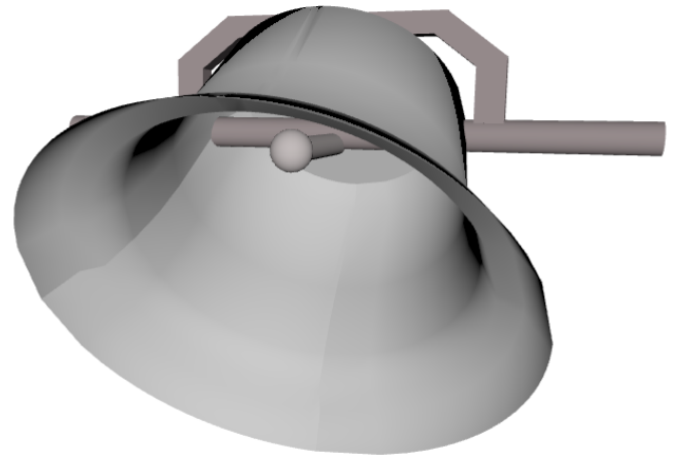
X3D also lets authors attach typed metadata sets to any object in a model's scene graph.

X3DOM Editor allows online changes (I added a Viewpoint)

X3DOM editor: Edit X3D code and click button to load: Update **or copy to clipboard as link:** Copy

Make sure to remove any initial white space. You can load external links with index.html?url=https://server/my.x3d . ⌨ K E Y B O A R D

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.3//EN" "https://www.web3d.org/specifications/x3d-3.3.dtd">
<X3D profile='Immersive' version='3.3' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
xsd:noNamespaceSchemaLocation='https://www.web3d.org/specifications/x3d-3.3.xsd'>
  <head>
    <meta content='Bell.x3d' name='title'/>
    <meta content='Bell for San Carlos Cathedral' name='description'/>
    <meta content='Michele Foti' name='creator'/>
    <meta content='8 March 2012' name='created'/>
    <meta content='8 December 2024' name='modified'/>
    <meta content='update bell sound with proper recording of actual bells at San Carlos' name='TODO'/>
    <meta content='TODO.html' name='reference'/>
    <meta content='invert geometry?' name='TODO'/>
    <meta content='http://www.sancarloscathedral.net' name='reference'/>
    <meta content='RoyalPresidioChapelHistoricalReferences.pdf' name='reference'/>
    <meta content='CulturalHeritageProjectSanCarlosCathedral.pdf' name='reference'/>
    <meta content='originals/' name='reference'/>
    <meta content='originals/ModelSanCarlosChurchFeb-3-2012.x3d' name='reference'/>
    <meta content='under development' name='warning'/>
    <meta content='https://www.audiomicro.com/church-bell-horns-bells-church-bell-free-sound-effects-45577' name='reference'/>
    <meta content='Audacity, https://audacity.sourceforge.net' name='generator'/>
    <meta content='https://www.web3d.org/x3d/content/examples/X3dForAdvancedModeling/SanCarlosCathedral/Bell.x3d' name='identifier'/>
    <meta content='X3D-Edit 3.3, https://savage.nps.edu/X3D-Edit' name='generator'/>
    <meta content='../license.html' name='license'/>
  </head>
  <Scene>
    <WorldInfo title='Bell.x3d'/>
    <Background skyColor='1 1 1'/>
    <Viewpoint  position='0 0 2'/>
    <Transform DEF='Bell' rotation='0 1 0 -1.57' translation='0.75 -0.8 0'>
      <!-- Bell shape -->
      <TouchSensor DEF='TouchButton' description='touch to activate'/>
      <Transform DEF='BellShape' center='0 0.55 0' scale='4.2 1.2 4.2' translation='-0.14 0.55 0.75'>
        <Shape>
          <Extrusion beginCap='false' convex='false' creaseAngle='1.57' crossSection='0.142 0 0.141822 0.0071 0.141288 0.0142 0.140393
0.0213 0.139131 0.0284 0.137491 0.0355 0.135459 0.0426 0.133018 0.0497 0.130145 0.0568 0.12681 0.0639 0.122976 0.071 0.118593 0.0781
0.1136 0.0852 0.107911 0.0923 0.101408 0.0994 0.093924 0.1065 0.0852 0.1136 0.074803 0.1207 0.061896 0.1278 0.044339 0.1349 0 0.142 -0
0.142 -0.044339 0.1349 -0.061896 0.1278 -0.074803 0.1207 -0.0852 0.1136 -0.093924 0.1065 -0.101408 0.0994 -0.107911 0.0923 -0.1136
0.0852 -0.118593 0.0781 -0.122976 0.071 -0.12681 0.0639 -0.130145 0.0568 -0.133018 0.0497 -0.135459 0.0426 -0.137491 0.0355 -0.139131
0.0284 -0.140393 0.0213 -0.141288 0.0142 -0.141822 0.0071 -0.142 0 -0.142 0 -0.1349 -0.044339 -0.1278 -0.061896 -0.1207 -0.074803
-0.1136 -0.0852 -0.1065 -0.093924 -0.0994 -0.101408 -0.0923 -0.107911 -0.0852 -0.1136 -0.0781 -0.118593 -0.071 -0.122976 -0.0639
-0.12681 -0.0568 -0.130145 -0.0497 -0.133018 -0.0426 -0.135459 -0.0355 -0.137491 -0.0284 -0.139131 -0.0213 -0.140393 -0.0142 -0.141288
-0.0071 -0.141822 0 -0.142 0.044339 -0.1349 0.061896 -0.1278 0.074803 -0.1207 0.0852 -0.1136 0.093924 -0.1065 0.101408 -0.0994
0.107911 -0.0923 0.1136 -0.0852 0.118593 -0.0781 0.122976 -0.071 0.12681 -0.0639 0.130145 -0.0568 0.133018 -0.0497 0.135459 -0.0426
0.137491 -0.0355 0.139131 -0.0284 0.140393 -0.0213 0.141288 -0.0142 0.141822 -0.0071 0.142 0' scale='1 1 0.9 0.9 0.8 0.8 0.73 0.73
0.68 0.68 0.65 0.65 0.595 0.595 0.5 0.5' solid='false' spine='0 0 0 0 0.08 0 0 0.1 0 0 0.183 0 0 0.266 0 0 0.35 0 0 0.6 0 0 0.65 0'/>
          <Appearance>
            <Material DEF='BellColor' diffuseColor='0.6 0.6 0.6'/>
          </Appearance>
        </Shape>
      </Transform>
```



X_ITE Playground for online editing

Auto Update

XML · VRML · JSON

```
Welcome to X_ITE X3D Browser v12.0.7:
   Current Graphics Renderer
      Name: Google Inc. (Intel) ANGLE (Intel, Intel(R) UHD Graphics (0x0000A788) Direct3D11 vs_5_0 ps_5_0
      WebGL version: WebGL 2.0 (OpenGL ES 3.0 Chromium)
      Shading language: WebGL GLSL ES 3.00 (OpenGL ES GLSL ES 3.0 Chromium)
      WebXR: true
   Rendering Properties
      ContentScale: 1
      Antialiased: true
      Max samples: 8
      Depth size: 24 bits
      Color depth: 128 bits
      Max clip planes per shape: 6
      Max lights per shape: 8
      Max textures per shape: 4
      Max texture size: 16384 x 16384 pixels
      Texture memory: n/a
      Texture units: 32
      Max vertex uniform vectors: 4096
      Max fragment uniform vectors: 1024
      Max vertex attribs: 16
      Max varying vectors: 30
```

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 4.0//EN" "https://www.web3d.org/specifications/x3d-4.0.dtd">
<X3D profile='Immersive' version='4.0' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation='https://www.web3d.org/specifications/x3d-4.0.xsd'>
  <head>
    <meta name='title' content='Bell.x3d'/>
    <meta name='description' content='Bell for San Carlos Cathedral'/>
    <meta name='creator' content='Michele Foti'/>
    <meta name='created' content='8 March 2012'/>
    <meta name='modified' content='8 December 2024'/>
    <meta name='TODO' content='update bell sound with proper recording of actual bells at San Carlos'/>
    <meta name='TODO' content='invert geometry?'/>
    <meta name='reference' content='TODO.html'/>
    <meta name='reference' content='http://www.sancarloscathedral.net'/>
    <meta name='reference' content='RoyalPresidioChapelHistoricalReferences.pdf'/>
    <meta name='reference' content='CulturalHeritageProjectSanCarlosCathedral.pdf'/>
    <meta name='reference' content='originals/'/>
    <meta name='reference' content='originals/ModelSanCarlosChurchFeb-3-2012.x3d'/>
    <meta name='reference' content='https://www.audiomicro.com/church-bell-horns-bells-church-bell-free-sound-effects-45577'/>
    <meta name='warning' content='under development'/>
    <meta name='generator' content='Audacity, https://audacity.sourceforge.net'/>
    <meta name='generator' content='X3D-Edit 3.3, https://savage.nps.edu/X3D-Edit'/>
    <meta name='identifier' content='https://www.web3d.org/x3d/content/examples/X3dForAdvancedModeling/SanCarlosCathedral/Bell.x3d'/>
    <meta name='license' content='../license.html'/>
  </head>
  <Scene>
    <WorldInfo
        title='Bell.x3d'/>
    <Background
        skyColor='1 1 1'/>
    <Transform DEF='Bell'
        translation='0.75 -0.8 0'
        rotation='0 1 0 -1.57'>
      <TouchSensor DEF='TouchButton'
          description='touch to activate'/>
      <Transform DEF='BellShape'
          translation='-0.14 0.55 0.75'
          scale='4.2 1.2 4.2'
          center='0 0.55 0'>
        <Shape>
          <Appearance>
```

Let's explore San Carlos Cathedral!

X3D Example Archives: **X3D4AM, X3D for Advanced Modeling, San Carlos Cathedral, San Carlos Cathedral**

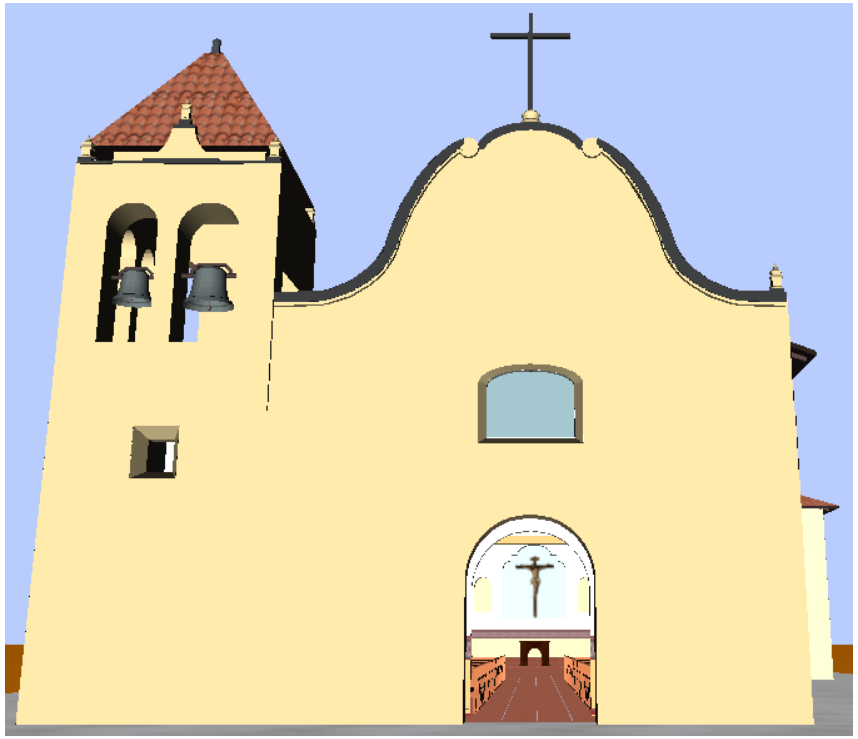
This model of the San Carlos Cathedral shows the oldest continuously functioning church and the first stone building in the State of California.

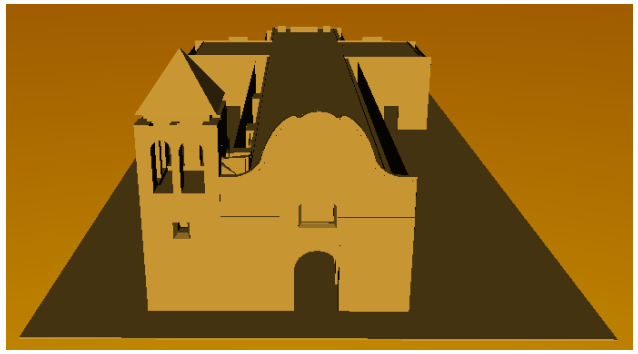
X3D model source .x3d	X_ITE (Playground)	X3DOM (X3DOM editor)
ClassicVRML .x3dv	.java source (Javadoc)	.x3db Compressed Binary Encoding
VRML97	.json (check)	Version control
Canonical XML	.py python	Trouble tickets
X3D Model Documentation	.ttl Turtle (query)	Email x3d-public

X3D Model Documentation: SanCarlosCathedral.x3d

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.3//EN" "https://www.web3d.org/specifications/x3d-3.3.dtd">
<X3D profile='Immersive' version='3.3'  xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation='https://www.web3d.org/specifications/x3d-3.3.xsd'>
    <head>
        <meta name='title' content=' SanCarlosCathedral.x3d '/>
        <meta name='description' content='This model of the San Carlos Cathedral shows the oldest continuously functioning church and the first stone building in the State of California.'/>
        <meta name='creator' content='Michele Foti, Don Brutzman'/>
        <meta name='created' content='15 December 2011'/>
        <meta name='modified' content='8 September 2025'/>
        <meta name='reference' content='documentation/'/>
        <meta name='reference' content='tests/'/>
        <meta name='reference' content=' TODO.html '/>
        <meta name='reference' content='http://www.sancarloscathedral.net'/>
        <meta name='reference' content=' RoyalPresidioChapelHistoricalReferences.pdf '/>
        <meta name='reference' content='originals/'/>
        <meta name='Image' content='snapshots/SanCarlosCathedralFrontPlazaMarch2012.png'/>
        <meta name='Image' content='snapshots/SanCarlosCathedralFrontAbove.2012February.png'/>
        <meta name='Image' content='snapshots/SanCarlosCathedralWithLightingFromBalcony.png'/>
        <meta name='reference' content=' originals/ModelSanCarlosChurchFeb-3-2012.x3d '/>
        <meta name='identifier' content=' https://www.web3d.org/x3d/content/examples/X3dForAdvancedModeling/SanCarlosCathedral/SanCarlosCathedral.x3d '/>
        <meta name='generator' content='X3D-Edit 4.0, https://www.web3d.org/x3d/tools/X3D-Edit'/>
        <meta name='license' content='../license.html'/>
    </head>
```

Let’s explore San Carlos Cathedral in X3D!





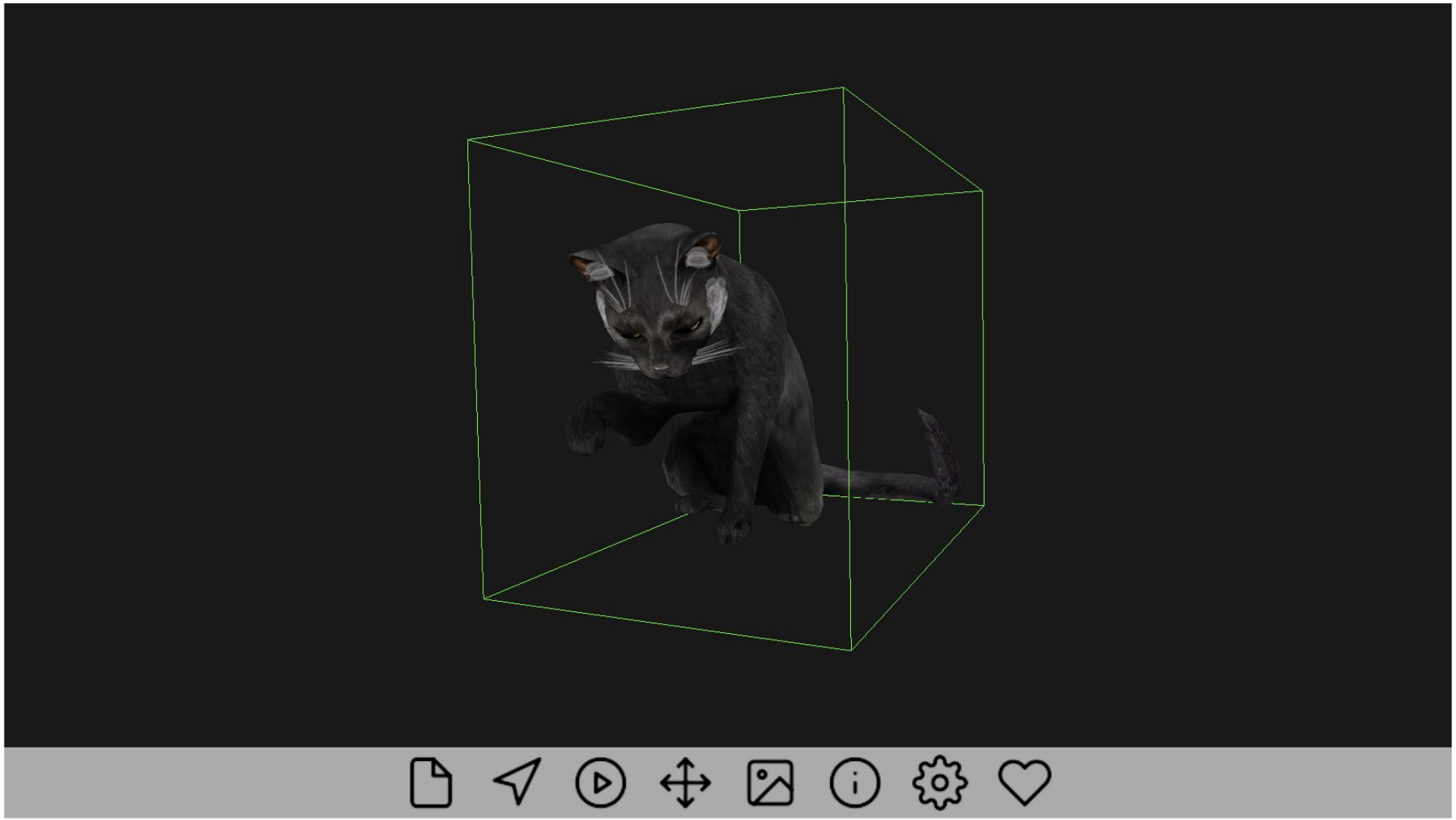
Old and New!

Can everything old be new again?

Consider: *are the 3D format wars over if they actually don't matter any more?*

Happy Xmas (War is Over)
John Lennon and Yoko Ono
(image credit)

Castle Model Viewer Mobile goes online!



History: Web3D Consortium website www.web3d.org

CultLab3D
Cultural Heritage (Greece)
US National Archives
©2014,
Cultural Heritage Working Group

Siena Cathedral 3D Online, ©2014

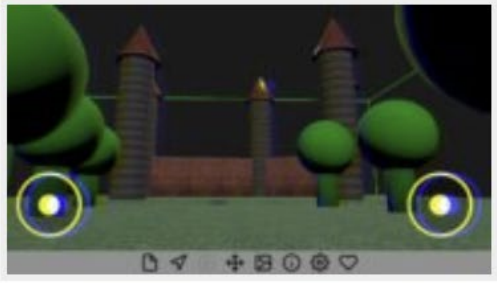
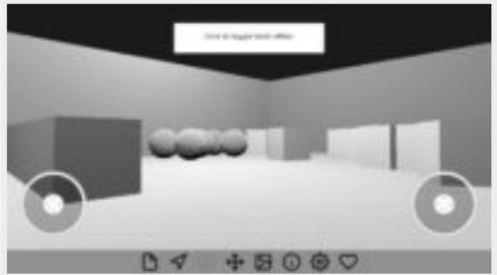
Fraunhofer IGD, VCST

Archival stability and repeatability matters!

Castle Viewer on iPhone on Android!

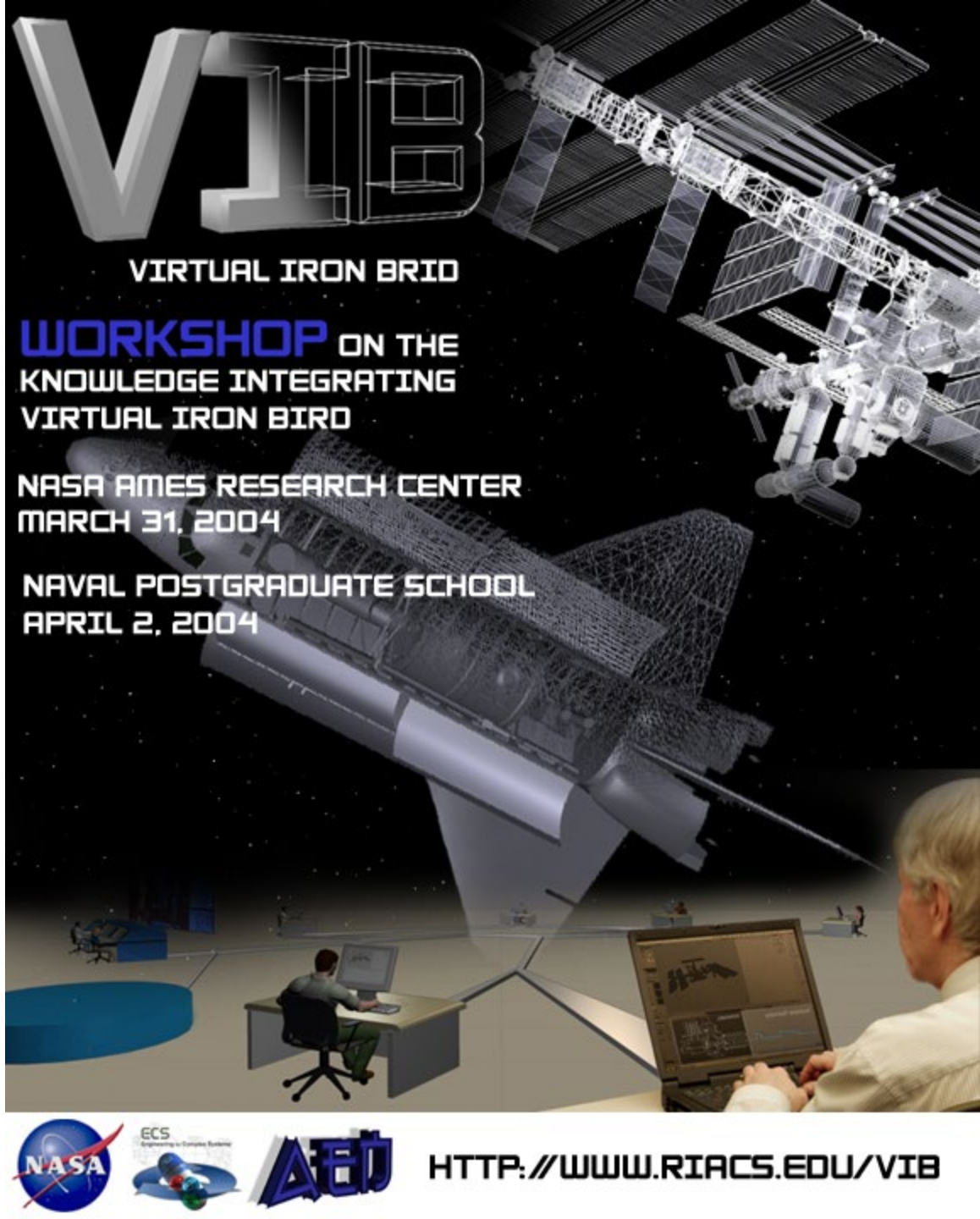
- Castle viewer is open-source player, converter and game engine written in object-oriented Pascal
- Castle lead Michalis Kamburelis is also primary design architect for integrating glTF 2.0 into X3D 4.0
- Thus glTF models are loadable in X3D and advanced physically based rendering is achieved equivalently
- Current work is deploying Castle viewer to online stores for iPhone and Android, shown by screenshots
- All open source, runs on Windows iOS Linux, fast!!



History: Virtual Iron Bird (VIB)

- 2004 NASA Workshop chaired by Dr. Julian E. Gómez
- How to move deliberately past decades of marked-up blueprints for Space Shuttle engineering into a new digital-capabilities era, comprehensively, without losing history of engineering changes?
- Aren't things like VIB key parts of our Digital Heritage as well?
- Potential project for recovery…



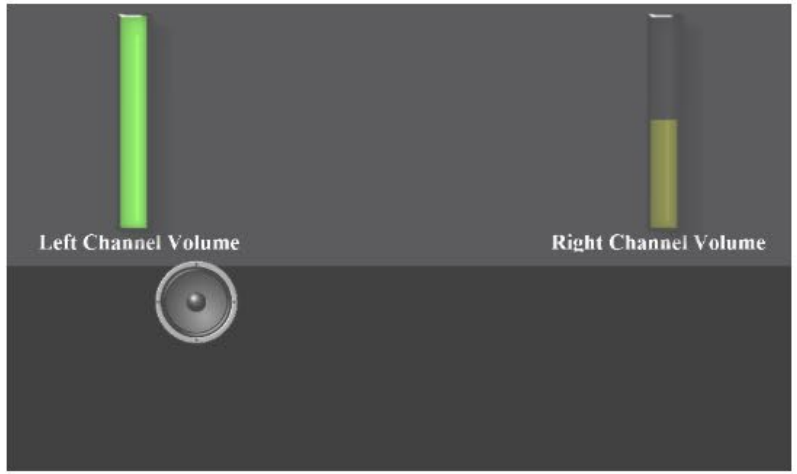
Audio and Spatialized Sound

- X3D4 has fully integrated W3C Web Audio API – powerful.
  - (examples) https://medialab.hmu.gr/minipages/x3domAudio

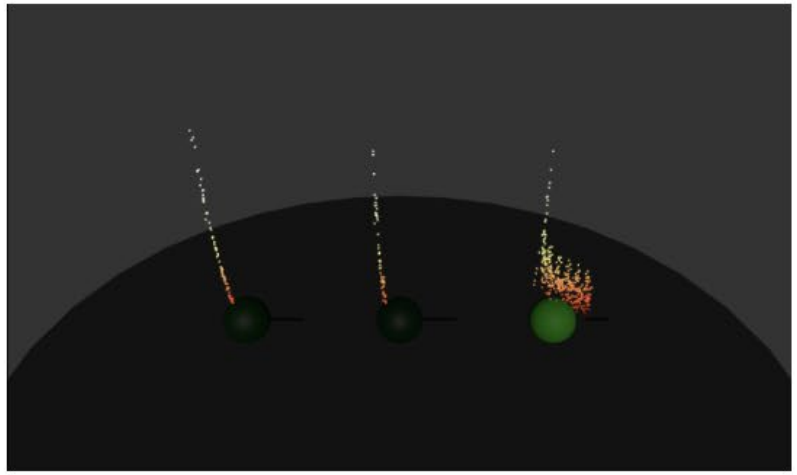
Bologna Italy that Thursday

- Thanos Malamos, Efi Lakka (remotely) and I are presenting at I3DA 2025 on initial implementation of *AcousticProperties* for physically based aural rendering of rooms, performance spaces.
- We are crossing a new horizon! Please stand by… 😀👂

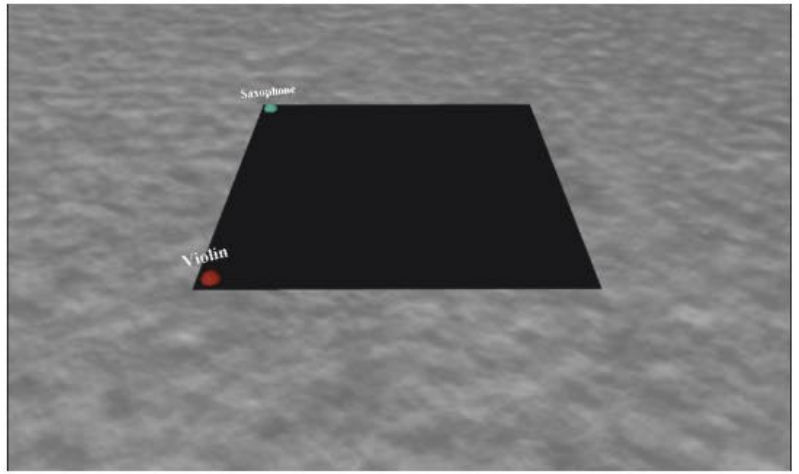
Split Channels



Filters



Spatial Audio Camera Animation

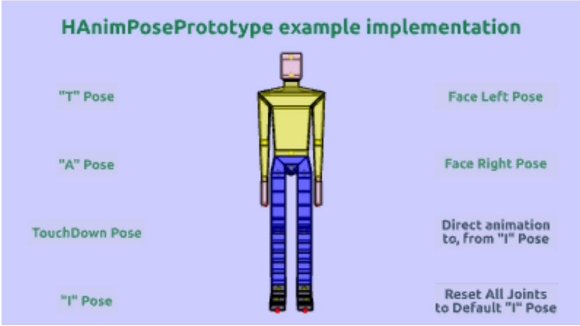


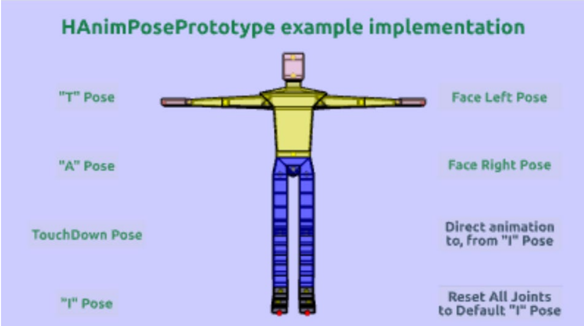
HAnim Architecture version 2.1 draft

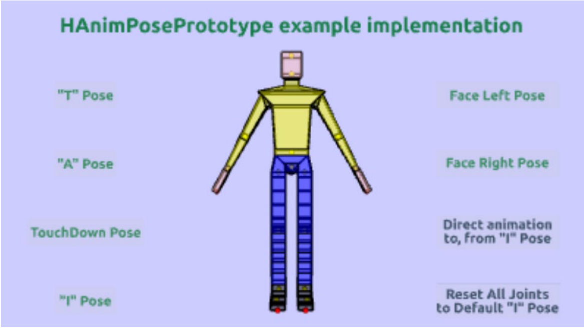
- Online at web3d.org
- Incremental approach by working groups, public review welcome
- Adding HAnimPose node (example Prototype implementation)
- Work in progress: RawKee export HAnim using Maya
- Considering Coveroid to match Humanoid for clothing, apparel, etc.
- Updated Skeleton bone models with rigorous LOA-4 naming, suitable for Inline re-use with InlineGeometry links also available
- X3D Standards Progress provides latest status of all specifications

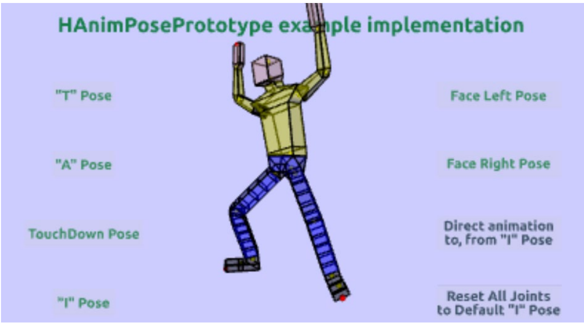
HAnimPose nodes demonstration

- HAnimPose supports setting HAnimJoint values in a corresponding HAnimHumanoid skeleton.
- See HAnim Architecture draft v2.1, 4.10.3 Poses and 6.5 Pose for functionality and fields
- Ongoing progress tracked in Mantis 1504 and X3D Example Archives: Humanoid Animation, Poses, HAnim Pose Prototype
- Expected work: build library of reusable poses to be sequenced and transitioned together, facilitating creation of sophisticated behaviors or recording medical data for diagnostic replay









X3D Architecture v4.1 draft: work in progress

- Online at X3D Architecture 4.1 draft - X3D Architecture
- Incremental approach by working groups, public review welcome
- Multiple nodes planned: EnvironmentLight, FontLibrary, HAnimPose, InlineGeometry (for .stl, .ply, extraction), and Tangent to maintain thorough glTF rendering compatibility
- OGC Geospatial Tiles being implemented in X3DOM
- Possible: MaterialX (examples) if X3D browsers agree to support

X3D Standards Progress provides latest status of all specifications

FontLibrary

- X3D Architecture draft 4.1, Text component, 15.4.1 FontLibrary
- The FontLibrary node specifies a collection of one or more font family definitions. A font family may include one or more related font style definitions. FontLibrary provides the ability to selectively load font files for use by FontStyle and ScreenFontStyle nodes.

```
FontLibrary : X3DChildNode, X3DUrlObject {
  SFTime    [in,out] autoRefresh          0.0    [0,∞)
  SFTime    [in,out] autoRefreshTimeLimit 3600.0 [0,∞)
  SFString  [in,out] description          ""
  SFString  [in,out] family               ""
  SFBool    [in,out] load                 TRUE
  SFNode    [in,out] metadata             NULL   [X3DMetadataObject]
  MFString  [in,out] url                  []     [URI]
}
```

Experimentation: use AI to create X3D models?

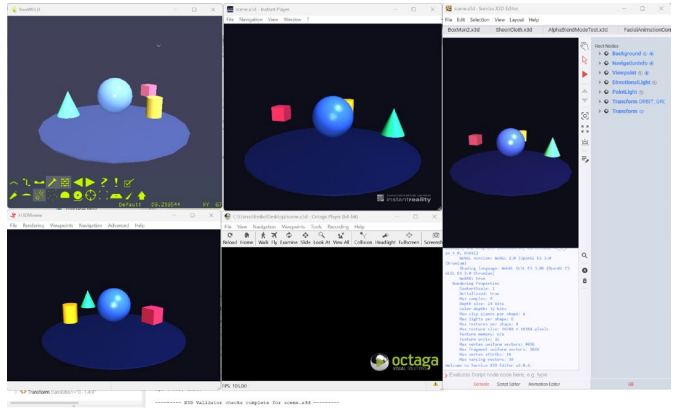
- X3D Example Archives: X3D4AM, X3D for Advanced Modeling, Large Language Models
- This chapter shows initial experiments asking Claude Code Large Language Model (LLM) to create simple X3D models, as described in the session chat log. These X3D models are corrected versions of the original models that are minimally modified for cataloging purposes.
- Here is the session chat log showing how these simple initial examples were created through interactive trial-and-error testing

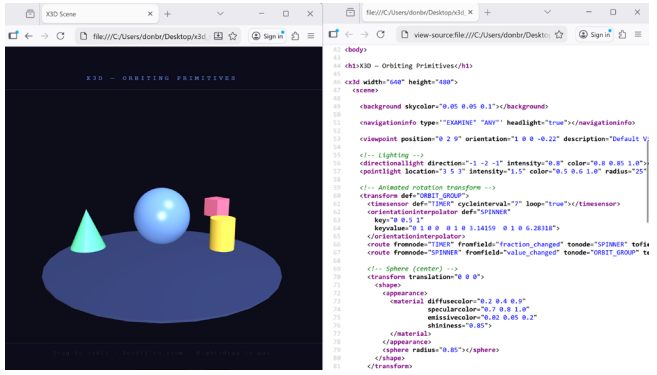
Authors must be careful when using these tools… further considerations can be found at

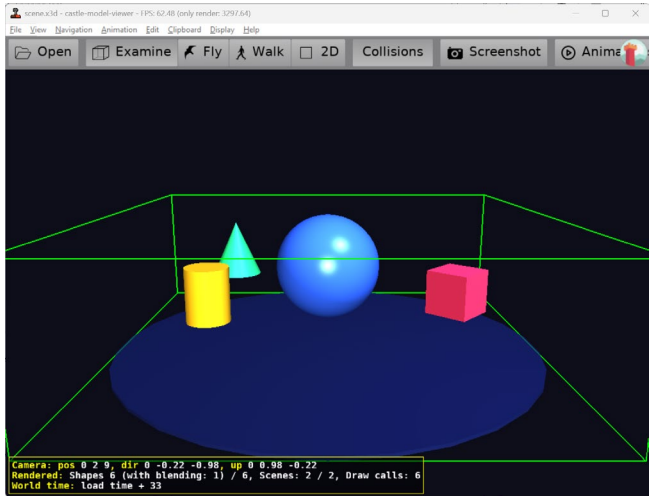
- Using AI when contributing to Castle Game Engine

Interested? Join others working on cool challenges

- Web3D Consortium *AI with X3D* Working Group



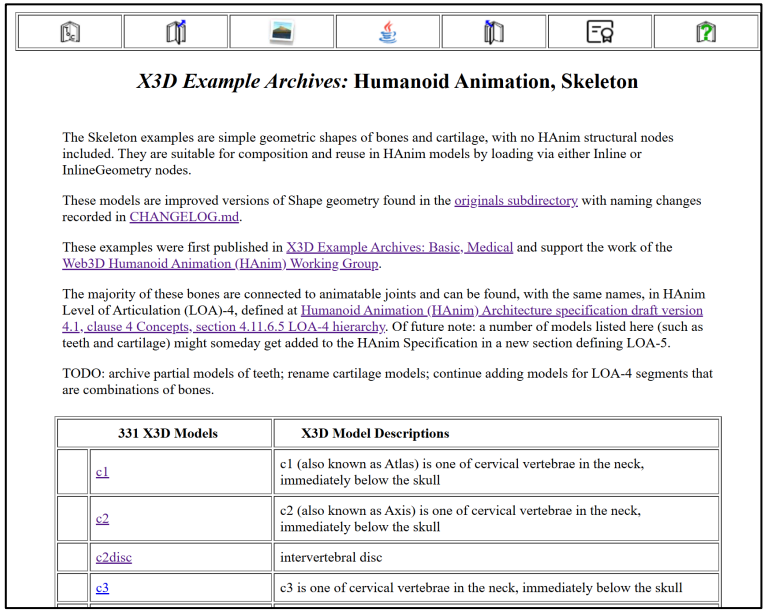




HAnim Human Bones Collection

Current work in progress

- Re-engineer large, excellent set of bone geometry
- Careful naming to exactly match conventions in Level of Articulation (LOA-4)
- Realization: might need LOA-5 for “non-animated” connections and cartilage in future draft spec
- Show interesting interaction techniques: TouchSensor pointer isActive for hint and highlight, selection for local “hidden” viewpoint
- Careful addition of metadata throughout
- Facilitate reuse in other models
- Preparation for possible medical use, someday



***X3D Example Archives:* Humanoid Animation, Skeleton**

The Skeleton examples are simple geometric shapes of bones and cartilage, with no HAnim structural nodes included. They are suitable for composition and reuse in HAnim models by loading via either Inline or InlineGeometry nodes.

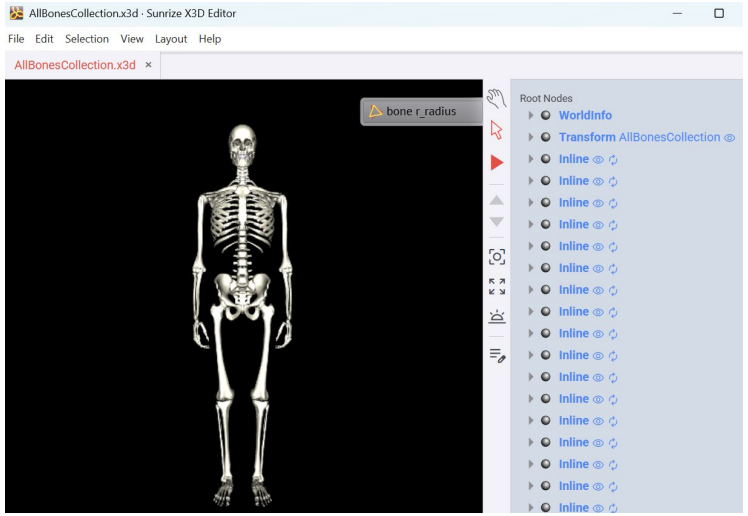
These models are improved versions of Shape geometry found in the originals subdirectory with naming changes recorded in CHANGELOG.md.

These examples were first published in X3D Example Archives: Basic, Medical and support the work of the Web3D Humanoid Animation (HAnim) Working Group.

The majority of these bones are connected to animatable joints and can be found, with the same names, in HAnim Level of Articulation (LOA)-4, defined at Humanoid Animation (HAnim) Architecture specification draft version 4.1, clause 4 Concepts, section 4.11.6.5 LOA-4 hierarchy. Of future note: a number of models listed here (such as teeth and cartilage) might someday get added to the HAnim Specification in a new section defining LOA-5.

TODO: archive partial models of teeth; rename cartilage models; continue adding models for LOA-4 segments that are combinations of bones.

331 X3D Models		X3D Model Descriptions
	c1	c1 (also known as Atlas) is one of cervical vertebrae in the neck, immediately below the skull
	c2	c2 (also known as Axis) is one of cervical vertebrae in the neck, immediately below the skull
	c2disc	intervertebral disc
	c3	c3 is one of cervical vertebrae in the neck, immediately below the skull



Recommendations

- Our cups overfloweth… No blockers remain, X3D is ready to go for you!
- World Wide Web remains the greatest database of the human race.
- Our 3D Digital Heritage deserves preservation… forever. Let’s do that.
- Everyone is welcome to collaborate using X3D tools and open standards.
- What are you doing next?

Robert Browning
1812-1889

Ah, but a man's reach should exceed his grasp,
Or what's a heaven for?

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X3D Standards Working Group

Web3D Consortium

Questions, insights and feedback are always welcome.

Have fun with X3D! 😀 👍