Part 1: Web3D Overview

The Semantic Web3D

Semweb.pro 2019
Paris, France
December 3, 2019

web|3D CONSORTIUM

Part 1: Web3D Overview

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www.web3d.org

Towards comprehensive representation of 3D content on the semantic web

Don **Brutzman**, John **Carlson**, **Jakub Flotyński**, Felix **Hamza-Lup** , Athanasios **Malamos**, Christophe **Mouton**, Marc **Petit**, Nicholas **Polys**, Leslie **Sikos**, Krzysztof **Walczak**

Our Standards X3D **and** H|anim

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Our Standards X3D and HAnim

Founded in 1997, Web3D is an open, non-profit, member-driven industry consortium developing royalty-free 3D ISO standards

Paving the Road to Interoperable 3D Graphics with Open Standards

Our Members

Academia
Industry
Research Institutes
Universities
Government
Professionals

We are based in Mountain View, California

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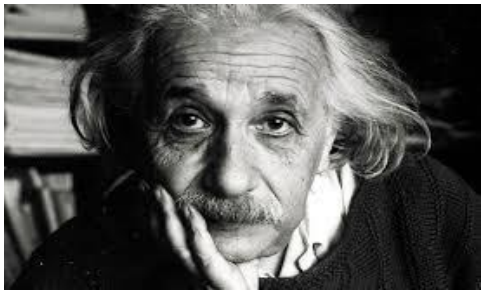
Objective:

- Overview of Web3D Standards
- Web3D and the Semantic Web
- Example
- Conclusion and take-away

Current State of 3D on the Web?



Factors Influencing 3D technology today

- Growth of re-built 3D content
- Less hardware and network limitations
- Rendering high quality graphics in real-time
- Growth of VR devices
- Web is our platform

Active Web3D Standards

eXtensible 3D Version 3.3

File Format and Rendering Engine

HAnim Version 2

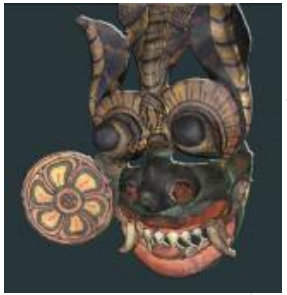
Humanoid Animation

X3D standards and HANIM
Ratified by
ISO/IEC JTC 1/SC 24

Delivering New Dimensions on the Web

X3D: Used in many Industry Verticals

Cultural Heritage



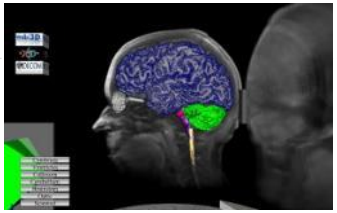
Geospatial

CAD

3D Printing

Mixed Augmented Reality

Medical



HAnim

3D Scanning

What is X3D?

Second Generation VRML
A complete Solution for 3D on the Web
*** Enterprise 3D ***

Real-Time * Web Based * Interactive * Animation * Extensible * Scriptable

+

File Formats:
XML, ClassicVRML, Binary

Run-Time Engine:
Two Open source Implementations –
X_ITE and X3DOM

Meshes * Lights * Cameras * Materials * Textures * Shaders * Annotation * Volume * Audio/Video * AR/VR * Security * Metadata

Scene graph for real-time interactive 3D

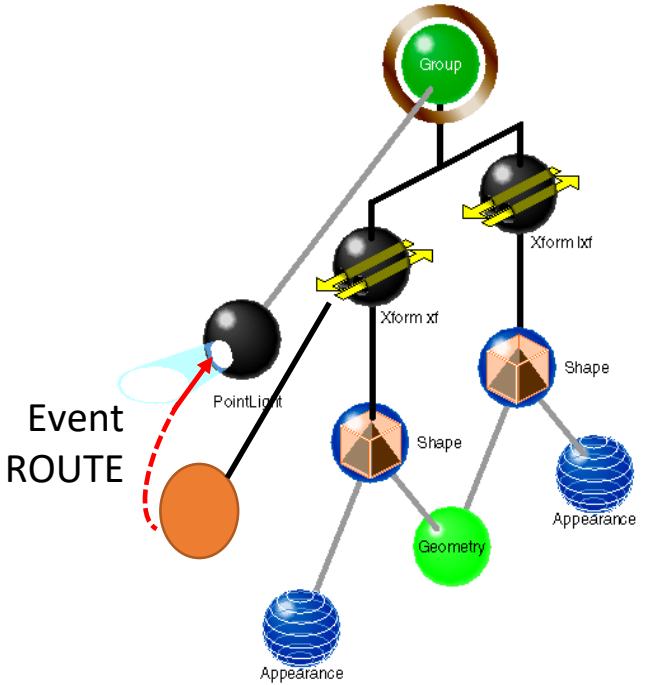
Delivery of virtual environments over the web

Multiple encodings

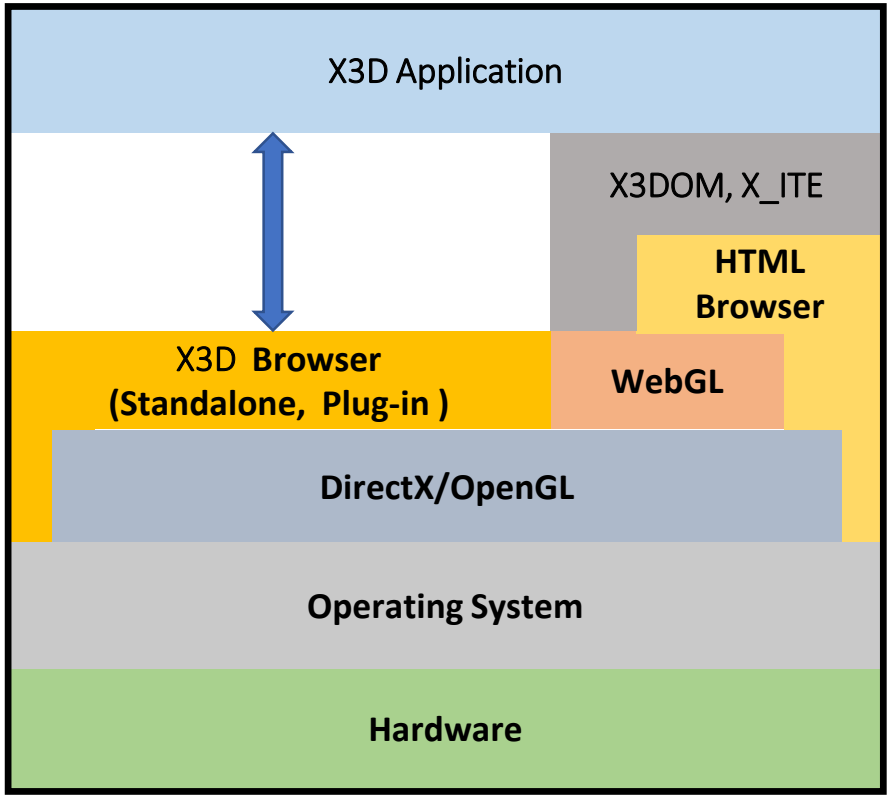
- XML (.x3d)
- Classic VRML (.x3dv)
- Compressed Binary (.x3db)
- JSON

Multiple APIs

- Javascript,
- Java,
- C#, C++, C,
- Python



The X3D graphics stack



X3D for Web Authors Vs WebGL for 3D graphics application programmers

Open Source X3D Browsers

X3DOM http://www.x3dom.org

X_ITE http://create3000.de/x_ite

Standalone – Instant Reality

Two approaches of 3D in HTML

Completes graphics technologies

Web Programmers

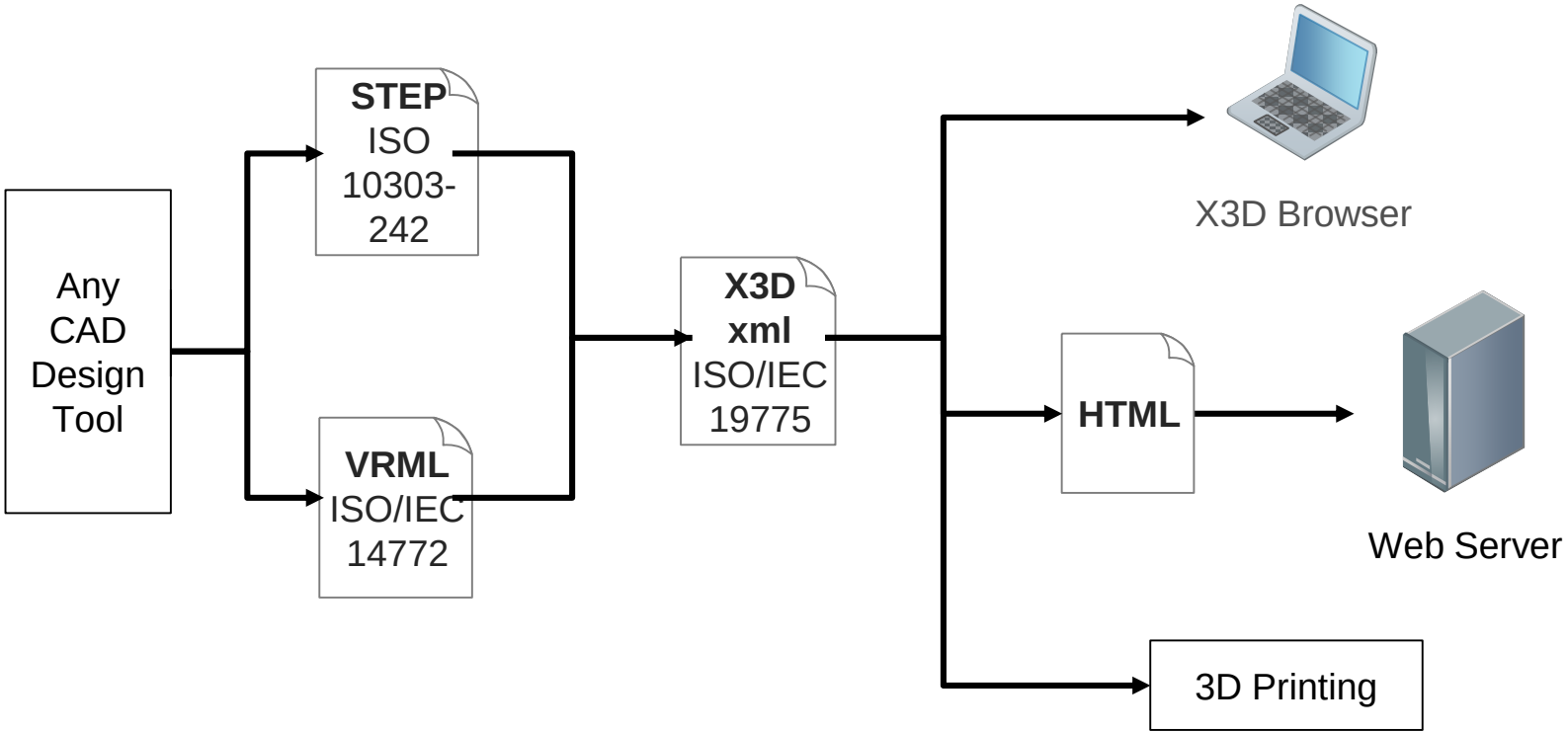
	2D	3D HTML5
Declarative Scenegraph Part of HTML-document DOM Integration CSS/ Events	SVG	X3D x3dom X_ITE X3D open source solutions
Imperative Procedural API Drawing context Flexible	<canvas>	**Graphics Programmers** WebGL three.js

Why is Declarative 3D important to Enterprise 3D

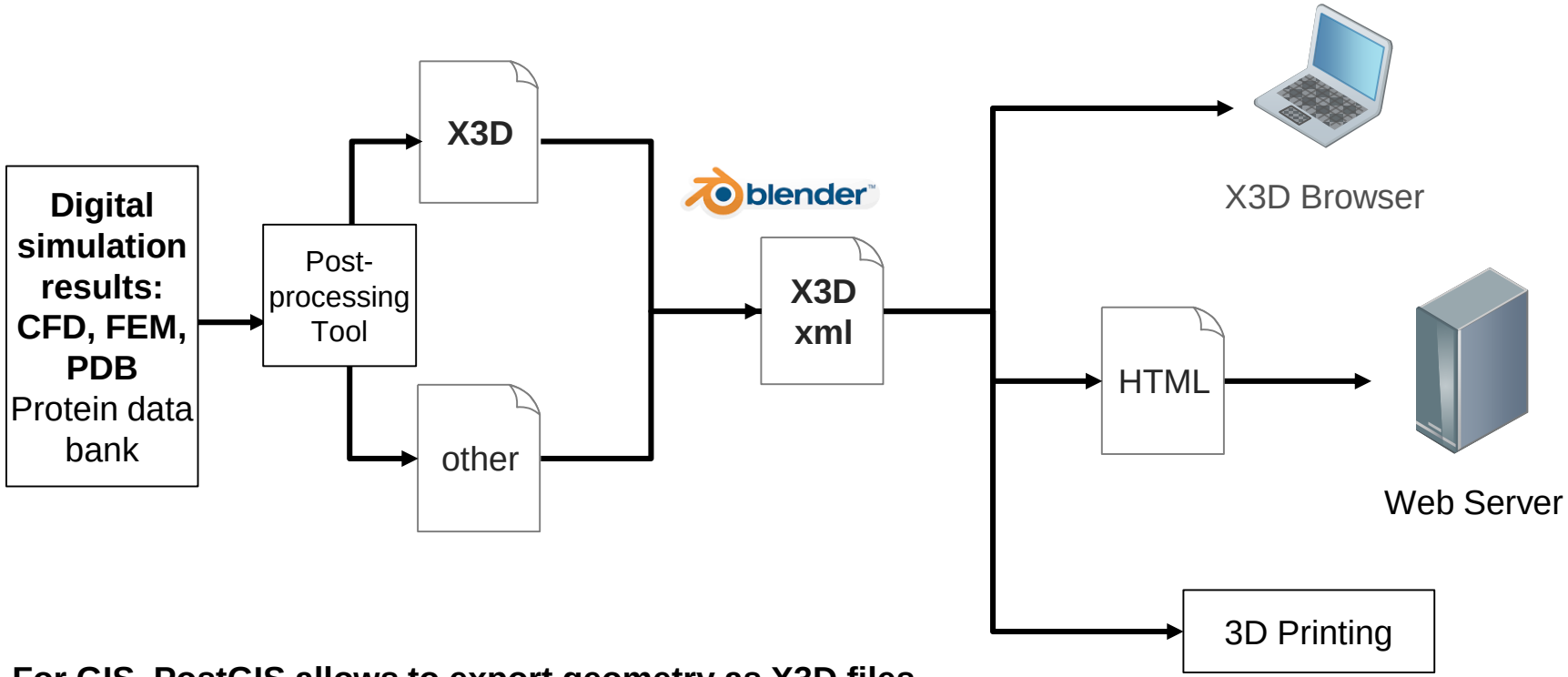
- **Interactive 3D objects in HTML5 web pages**
- **Allows easy creation and sharing of 3D graphics using HTML**
- **Bridges the gap between graphics programmers and Web programmers**

Declarative
Scenegraph
Part of HTML-document
DOM Integration
CSS/ Events

CAD/Computer aided Design Workflow



Scientific Visualization Workflow



For GIS, PostGIS allows to export geometry as X3D files

X3D is Evolving - X3Dv4

Always backward compatible

X3Dv4 in Development

X3D Unified Object Model (X3DUOM)

X3Dv4 Highlights

- **Improve the search-ability of 3D models**.
- 3D printing of models
- 3D scanning of objects, and toolchain workflow support for point clouds
- CAD interoperability includes model structure **complete metadata**.
- Volume visualization
- **Annotation**
- glTF inline Capabilities
- **Archival publishing of cultural and natural heritage**

Open-source implementations, X3DOM and X_ITE

Timeline - Dec 2019 - Feature set freeze
Draft Specification in 2020 followed by ISO Ratification

Available to members since 2018 in github
https://github.com/Web3dConsortium
Released public draft

Authors have the archival stability of a well-tested long-lasting specification to build upon

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Altar.wrl

```
28
29  NavigationInfo { type [ "EXAMINE" "ANY" ] } ###  Default X3D NavigationInfo
30
31  Background {
32    skyColor [ 1 1 1 ]
33  }
34  DEF Colonna1 Transform {
35    translation 0.7 0 -0.7
36    children [
37        Shape {
38          geometry Box {
39            size 0.4 1.2 0.4
40          }
41          appearance DEF WoodAppearance Appearance {
42            texture DEF Wood ImageTexture {
43              url [ "images/Wood.jpg" "http://X3dGraphics.com/examples/X3dForAdvancedModeling/SanCarlosCathedral/images/Wood.jpg" ]
44            }
45          }
46        }
47    ]
48  }
49  DEF Colonna2 Transform {
50    translation -0.7 0 -0.7
51    children [
52        Shape {
53          geometry Box {
54            size 0.4 1.2 0.4
55          }
56          appearance USE WoodAppearance
57        }
58    ]
59  }
60  DEF Colonna3 Transform {
61    translation 0.7 0 0.7
62    children [
63        Shape {
64          geometry Box {
65            size 0.4 1.2 0.4
66          }
67          appearance USE WoodAppearance
```

example

Line 11, Column 1 Spaces: 2 Plain Text

Web3D is so… semantic (web)!

- **Structural semantic info in 3D models, scene graphs…**

• Geometry • Motion • Color	• Textures • Viewpoints • Lighting	• etc.

- Examples: number of index values, curvature, velocity, color, Texture pattern, brightness…..

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Ready for the machine-readable standards (SemWeb?)

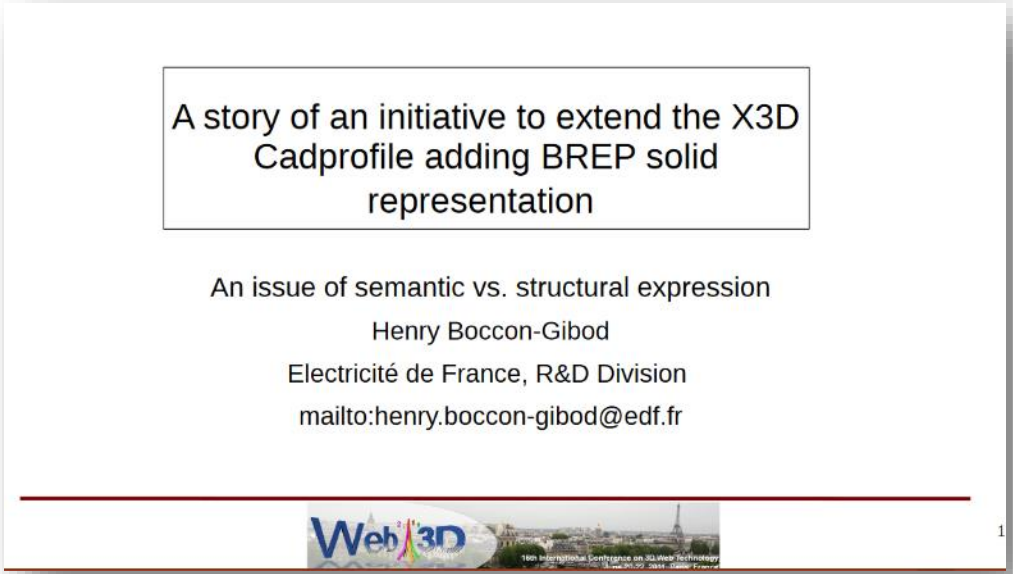
	*Disjoint*	(RectA.xMax <= RectB.xMin || RectA.xMin >= RectB.xMax) || (RectA.yMax <= RectB.yMin || RectA.yMin >= RectB.yMax) || (RectA.zMax <= RectB.zMin || RectA.zMin >= RectB.zMax)
	*Touch*	
	*Equal*	(RectA.xMin == RectB.xMin && RectA.xMax == RectB.xMax) && (RectA.yMin == RectB.yMin && RectA.yMax == RectB.yMax) && (RectA.zMin == RectB.zMin && RectA.zMax == RectB.zMax)
	*Within*	(RectA.xMin >= RectB.xMin && RectA.xMax <= RectB.xMax) && (RectA.yMin >= RectB.yMin && RectA.yMax <= RectB.yMax) && (RectA.zMin >= RectB.zMin && RectA.zMax <= RectB.zMax)
		Complementary relation: *CoveredBy*
		Opposite MBB relations: *Contains*, *Covers*
	*Contains*	(RectA.xMin <= RectB.xMin && RectA.xMax >= RectB.xMax) && (RectA.yMin <= RectB.yMin && RectA.yMax >= RectB.yMax) && (RectA.zMin <= RectB.zMin && RectA.zMax >= RectB.zMax)
		Complementary relation: *Covers*
		Opposite MBB relations: *Within*, *CoveredBy*
	*Overlap*	(SearchRect.xMin < Rect.xMax && SearchRect.xMax > Rect.xMin) && (SearchRect.yMin < Rect.yMax && SearchRect.yMax > Rect.yMin) && (SearchRect.zMin < Rect.zMax && SearchRect.zMax > Rect.zMin)

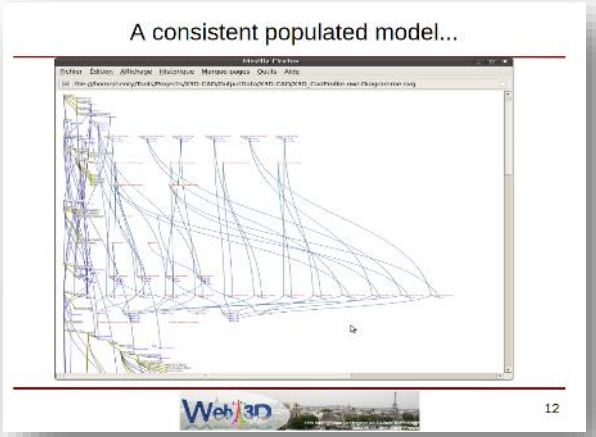
Table 1. *Topological criteria for 3D R-tree structure*

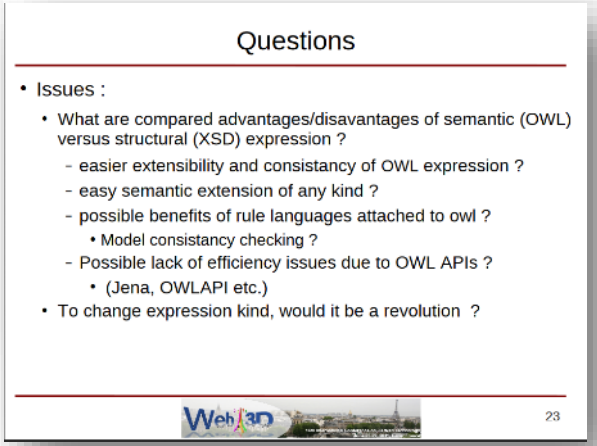
- **More and more references for VR, AR, MR, Digital Twin…**
- K. Kontakis, A. G. Malamos, M. Steiakaki, S. Panagiotakis and J. A. Ware,"Object Identification Based on the Automated Extraction of Spatial Semantics from Web3D Scenes," Annals of Emerging Technologies in Computing (AETiC) Vol. 2, No. 4, 2018
- Flotyński, J., K. Walczak, Ontology-based Representation and Modeling of Synthetic 3D Content: a State of the Art Review, in: Computer Graphics Forum, Wiley, ISSN: 0167-7055

Reference to paper: http://aetic.theiaer.org/archive/v2n4/p1.html

Web3D 2011 ACM conference, Paris, France



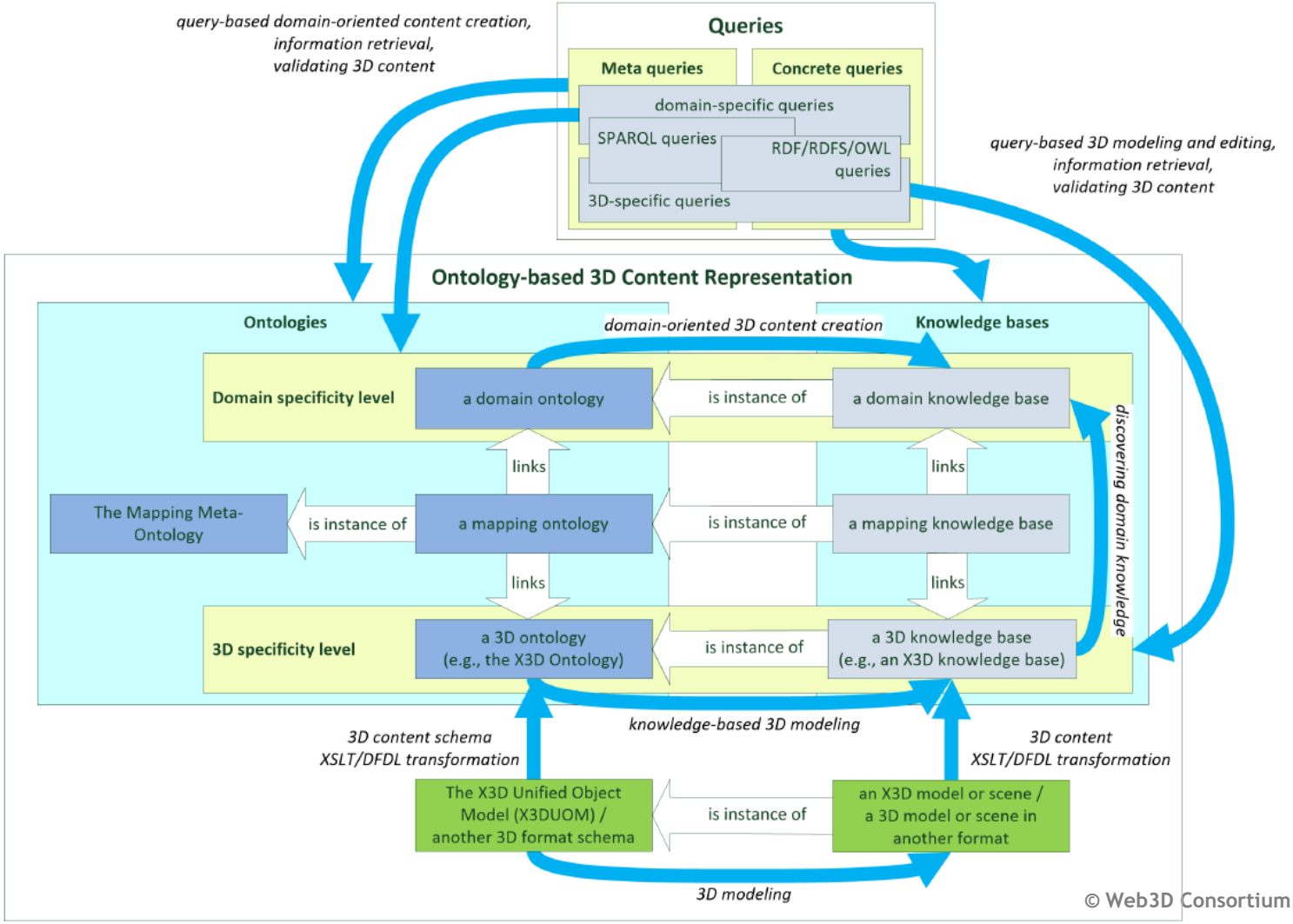




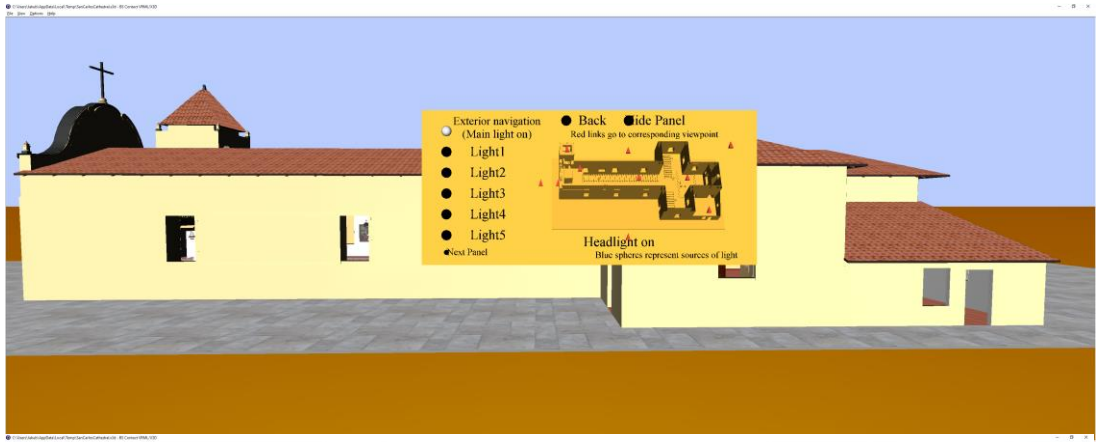
https://web3d2011.web3d.org/p/WorkShop-CAD-Boccon-Gibod.pdf

What could we do with semantics for 3D contents? (the SemWeb-expert way)

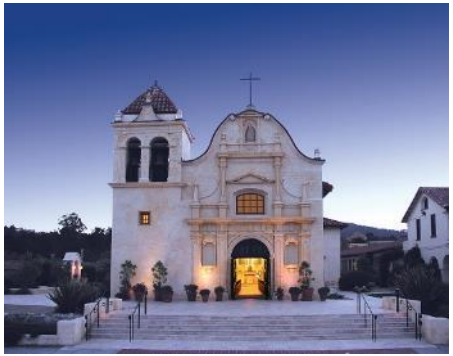
- A semantic description of a 3D scene is an expression that can **answer to semantic reasoning and queries** about the scene
- Reasoning and queries may cover **geometrical, structural, presentational and behavioral** properties of 3D objects at the **3D-specific and domain-specific** levels of abstraction
  - Structural, e.g.,
    - How many polygons does a 3D model have? (3D-specific)
    - What are components of a virtual car? (domain-specific)
  - Presentational, e.g.,
    - Which objects in a scene use a common texture? (3D-specific)
    - Which objects in a scene are made of wood? (domain-specific)
  - Behavioral, e.g.,
    - What scripts describe the behavior of an object? (3D-specific)
    - What is the exercise performed by an avatar? (domain-specific)
- Different 3D- and domain-specific ontologies could be used together to describe 3D content, in particular through **mapping**, e.g., a virtual museum ontology mapped to a 3D ontology



Example



Copyright © 2019 San Carlos Cathedral



X3D for Advanced Modeling Ex

https://x3dgraphics.com/examples/X3dForAdvancedModeling/SanCarlosCathedral/SanCarlosCathedralInd

Rechercher

Les plus visités | Débuter avec Firefox | standards.iso.org/iso/t...

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

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

X3D model
ClassicVRML
VRML97
Canonical XML
annotated documentation
.py python

X_ITE
X3DOM
.json (check)
.x3db Binary
.java source (Javadoc)
.ttl Turtle (query)

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.3//EN" "http://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 =' http://www.web3d.org/specifications/x3d-3.3.xsd '>
    <head>
        <meta name='title' content='SanCarlosCathedral.x3d'/>
        <meta name='description' content='San Carlos Cathedral is 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='5 December 2014'/>
        <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='SanCarlosCathedralFrontAbove.2012February.png'/>
        <meta name='reference' content='originals/ModelSanCarlosChurchFeb-3-2012.x3d'/>
        <meta name=' warning ' content=' under development '/>
        <meta name='identifier' content=' http://X3dGraphics.com/examples/X3dForAdvancedModeling/SanCarlosCathedral/SanCarlosCathedral.x3d '/>
        <meta name='generator' content='X3D-Edit 3.3, https://savage.nps.edu/X3D-Edit'/>
        <meta name='license' content=' ../license.html'/>
    </head>
```

The VRML encoding

Altar.wrl

```
28
29  NavigationInfo { type [ "EXAMINE" "ANY" ] } ###  Default X3D NavigationInfo
30
31  Background {
32    skyColor [ 1 1 1 ]
33  }
34  DEF Colonna1 Transform {
35    translation 0.7 0 -0.7
36    children [
37        Shape {
38          geometry Box {
39            size 0.4 1.2 0.4
40          }
41          appearance DEF WoodAppearance Appearance {
42            texture DEF Wood ImageTexture {
43              url [ "images/Wood.jpg" "http://X3dGraphics.com/examples/X3dForAdvancedModeling/SanCarlosCathedral/images/Wood.jpg" ]
44            }
45          }
46        }
47    ]
48  }
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61    translation 0.7 0 0.7
62    children [
63        Shape {
64          geometry Box {
65            size 0.4 1.2 0.4
66          }
67          appearance USE WoodAppearance
```

Line 11, Column 1 Spaces: 2 Plain Text

```
# Prefixes: 'x3do', ':', 'rdf' and 'owl' indicate: the X3D
      Ontology and knowledge base as well as RDF and OWL.

:scene rdf:type owl:NamedIndividual , x3do:Scene .
:scene x3do:hasBackground :background .
:background rdf:type owl:NamedIndividual, x3do:Background;
  x3do:skyColor (0.7216 0.8 0.9922).
:scene x3do:hasTransform :Colonna1 .
:Colonna1 rdf:type owl:NamedIndividual , x3do:Transform ;
  x3do:translation (0.7 0 -0.7) .
:Colonna1 x3do:hasShape :woodenElement1 .
:woodenElement1 rdf:type owl:NamedIndividual , x3do:Shape.
:woodenElement1 x3do:hasBox :woodenElement1Box .
:woodenElement1Box rdf:type owl:NamedIndividual, x3do:Box;
  x3do:size (0.4 1.2 0.4) .
:woodenElement1 x3do:hasAppearance :WoodAppearance .
:WoodAppearance rdf:type owl:NamedIndividual , x3do:
    Appearance .
:WoodAppearance x3do:hasTexture :Wood .
:Wood rdf:type owl:NamedIndividual , x3do:ImageTexture ;
    x3do:url ".../Wood.jpg" .
```

Where is the texture file?

```
SELECT ?textureUrl WHERE {
  ?x x3do:hasTexture ?texture .
  ?texture x3do:url ?textureUrl . }
ORDER by ASC(?textureUrl)
```

```
1  # Prefixes: 'x3do', ':', 'rdf' and 'owl' indicate: the X3D
       Ontology and knowledge base as well as RDF and OWL.
2
3  :scene rdf:type owl:NamedIndividual , x3do:Scene .
4  :scene x3do:hasBackground :background .
5  :background rdf:type owl:NamedIndividual, x3do:Background;
6    x3do:skyColor (0.7216 0.8 0.9922).
7  :scene x3do:hasTransform :Colonna1 .
8  :Colonna1 rdf:type owl:NamedIndividual , x3do:Transform ;
9    x3do:translation (0.7 0 -0.7) .
10 :Colonna1 x3do:hasShape :woodenElement1 .
11 :woodenElement1 rdf:type owl:NamedIndividual , x3do:Shape.
12 :woodenElement1 x3do:hasBox :woodenElement1Box .
13 :woodenElement1Box rdf:type owl:NamedIndividual, x3do:Box;
14   x3do:size (0.4 1.2 0.4) .
15 :woodenElement1 x3do:hasAppearance :WoodAppearance .
16 :WoodAppearance rdf:type owl:NamedIndividual , x3do:
       Appearance .
17 :WoodAppearance x3do:hasTexture :Wood .
18 :Wood rdf:type owl:NamedIndividual , x3do:ImageTexture ;
       x3do:url ".../Wood.jpg" .
```

Which RGB color is the sky?

```
SELECT ?skyColorListVal WHERE {                                    1
  ?background rdf:type x3do:Background ;                           2
    x3do:skyColor/rdf:rest*/rdf:first ?skyColorListVal . }         3
```

```
1  # Prefixes: 'x3do', ':', 'rdf' and 'owl' indicate: the X3D
       Ontology and knowledge base as well as RDF and OWL.
2
3  :scene rdf:type owl:NamedIndividual , x3do:Scene .
4  :scene x3do:hasBackground :background .
5  :background rdf:type owl:NamedIndividual, x3do:Background;
6   x3do:skyColor (0.7216 0.8 0.9922).
7  :scene x3do:hasTransform :Colonna1 .
8  :Colonna1 rdf:type owl:NamedIndividual , x3do:Transform ;
9   x3do:translation (0.7 0 -0.7) .
10 :Colonna1 x3do:hasShape :woodenElement1 .
11 :woodenElement1 rdf:type owl:NamedIndividual , x3do:Shape.
12 :woodenElement1 x3do:hasBox :woodenElement1Box .
13 :woodenElement1Box rdf:type owl:NamedIndividual, x3do:Box;
14  x3do:size (0.4 1.2 0.4) .
15 :woodenElement1 x3do:hasAppearance :WoodAppearance .
16 :WoodAppearance rdf:type owl:NamedIndividual , x3do:
       Appearance .
17 :WoodAppearance x3do:hasTexture :Wood .
18 :Wood rdf:type owl:NamedIndividual , x3do:ImageTexture ;
       x3do:url ".../Wood.jpg" .
```

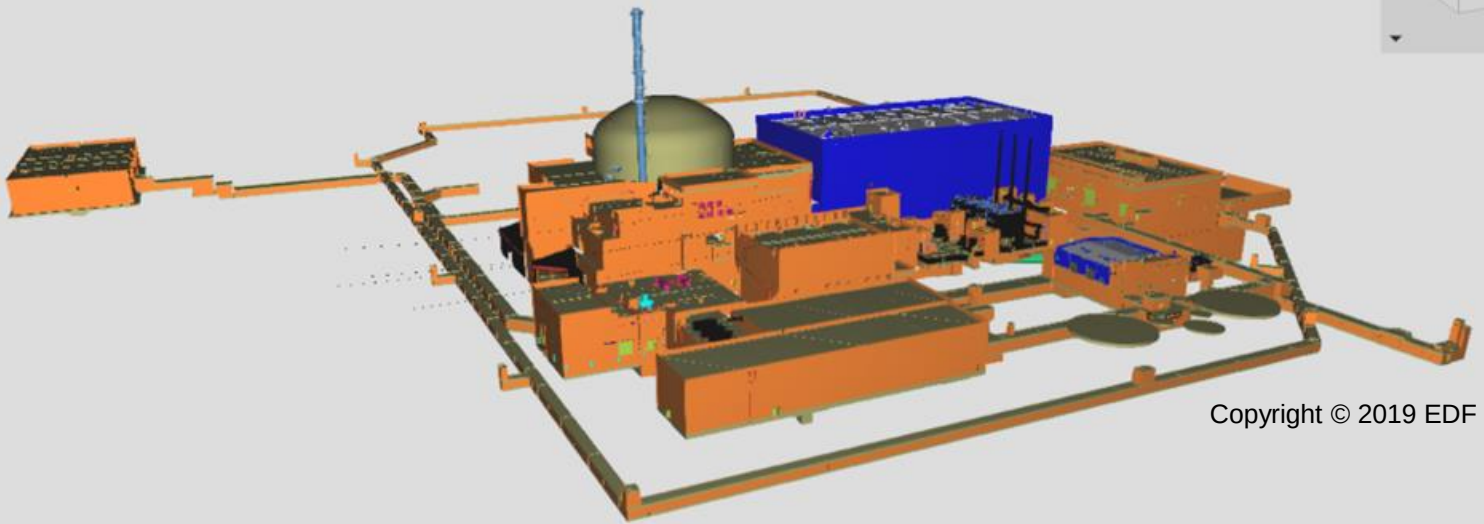
How many shapes ?

```
SELECT (count(distinct ?shape) as ?num) WHERE {          1
  ?shape rdf:type x3do:Shape . }                         2
```

What could do semantics for 3D contents for me? (the industrial-final-user way)

- Knowledge-based 3D modeling,
- Domain-oriented 3D content creation,
- Query-based 3D modeling and editing,
- Generating mappings,
- Discovering domain knowledge,
- Information retrieval,
- Validating 3D content,
- Transforming available 3D content to semantic 3D content,
- Rendering ontology-based 3D scenes

The digital twin



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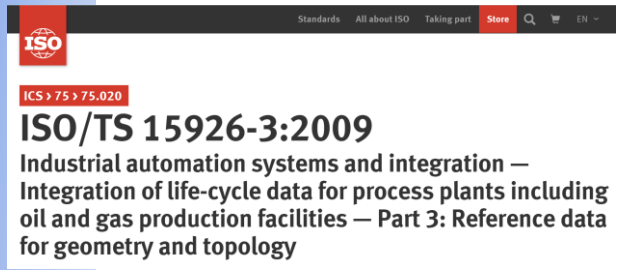
the semantic-web(3D) one!

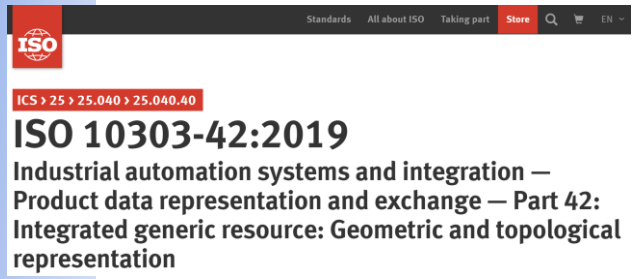
References: SemWeb.pro 2017 poster and « A plant engineering "digital rosetta stone": towards data-centric multidimensional CAD web portal", Web3D 2016 ACM conference: https://doi.org/10.1145/2945292.2945321

ISO/TC 184/SC 4 Plenary Meeting 78
2019.NOV Marina del Rey (Los Angeles), USA
N3412 Final Resolutions: Resolution "K"

Resolution: "K"

Title: Establish PWI on ontology for geometry and topology
WG 12





Introduction:
Meetings took place between WG12 (T1), WG3, JWG 16 at the SC 4 meetings in Chicago and Toulouse to consider the way in which geometry and topology can be handled with a semantic web environment. Many industrial applications are now being developed for this environment, and many of these require a geometry and topology capability. The PWI will produce a technical report. The report will include a study that takes a part of ISO 10303-42 and provides an equivalent representation in OWL. Aspects to be reported on include: the ability of OWL profiles to represent the same information with equal precision; the effort required to create the OWL representation; the capability of having geometry and topology ontology to provide a capability for shape and location by being imported into any industrial ontology; the capability of the ontology to support both product and plant geometry and GIS applications; the practicality of the ontology for the representation of large data sets. An annex will list existing ontologies for geometry and topology ontologies and review the state of the art. The capability of the ontology may be illustrated by a simple use case with example instances.

Objective:
Establish a PWI to create a Technical Report

Resolution:
SC 4 establishes a PWI to create a Technical Report on Ontology for geometry and topology.

The report is to be delivered in May 2020 for review at the next SC 4 meeting.

SC4 nominates Ben Urick (US) as project leader with appreciation to serve in this capacity and requests member bodies and liaisons to nominate experts to this preliminary work.

Interested by the semantic web3D?

Public mailing-list : semantics-public@web3d.org

The WG: https://www.web3d.org/working-groups/x3d-semantic-web

The deliverables: https://www.web3d.org/x3d/content/semantics/semantics.html

X3D Ontology for Semantic Web

The X3D Ontology for Semantic Web provides terms of reference for semantic query of X3D models.

Motivation | Availability | Design and Design Patterns | OWLDoc | Queries | References | Tools | TODO | Contact

Motivation

The X3D Semantic Web Working Group mission is to publish models to the Web using X3D in order to best gain Web interoperability and enable intelligent 3D applications, feature-based 3D model querying, and reasoning over 3D scenes.

Motivating insights:

"The answer to your question is the response to the query." Jim Hendler and Dean Allemang

"Trying to use the Semantic Web without SPARQL is like trying to use a relational database without SQL." Tim Berners-Lee

"The proof of the pudding is in the eating." Wiktionary

Some Take-away from X3D semantic web WG chairs

Don Brutzman, Naval Post-Graduate School, USA, brutzman[at]nps.edu
Jakub Flotyński, Poznan University, Ploand, flotynski[at]kti.ue.poznan.pl

« Much exciting activity to apply Semantic Web standards is occurring at Web3D Consortium.

We are steadily unlocking the entire media domain of 3D models for semantic query.

Slidesets and papers are provided for their continuing scrutiny, all insight and participation is welcome. »

https://www.web3d.org/working-groups/x3d-semantic-web

Looking for European and international collaborations and projects on semantic web(3D)?

Please contact the team:

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Marc Petit, EDF Lab, France, marc-f.petit[at]edf.fr
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Web3D International Mobilization

- Annual Outreach activates engage communities of interest
- SIGGRAPH/ Eurogaphics Web3D Conference (25 years)
- Workshops & exhibits at SIGGRAPH
- VR Hackathons worldwide
- Showcases & regional meetings
- X3D and members appear regularly at:

  IEEE VR, Supercomputing, MMVR, IITSEC,
- ISO/IEC JTC 1/SC 24 and ISO/TC 184/SC 4 Working Groups

Web3D Resources

Membership: www.Web3D.org/join

Web3D Standards: www.Web3D.org/standards

Work Groups: www.Web3d.org/working-groups

Workshop: www.Web3d.org/Web3d-quickstart

Examples: www.web3d.org/x3d/content/examples/Basic/

Events: www.Web3D.org/events

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Join and Participate

Participants always welcome

- http://www.web3d.org/join

Suggestions are always welcome

- x3d-public@web3d.org

Contact
Anita Havele
Executive Director,
Web3D Consortium
Anita.Havele@Web3D.org
Phone: +1 248342 7662

Join us at:

- **Web3D 2020** **June 24-26 – Seoul, South Korea**
- **SIGGRAPH 2020** **July 19-23 – Washington D.C.**

CFP in January 2020!
Semantic web is a major topic

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Thank You for Considering Web3D Standards!

We look forward to the chance to work together

Resources and contacts

- Web3D Website
  - http://www.web3d.org
- Nicholas Polys, President
  - npolys@vt.edu
- Anita Havele, Executive Director
  - anita.havele@web3d.org

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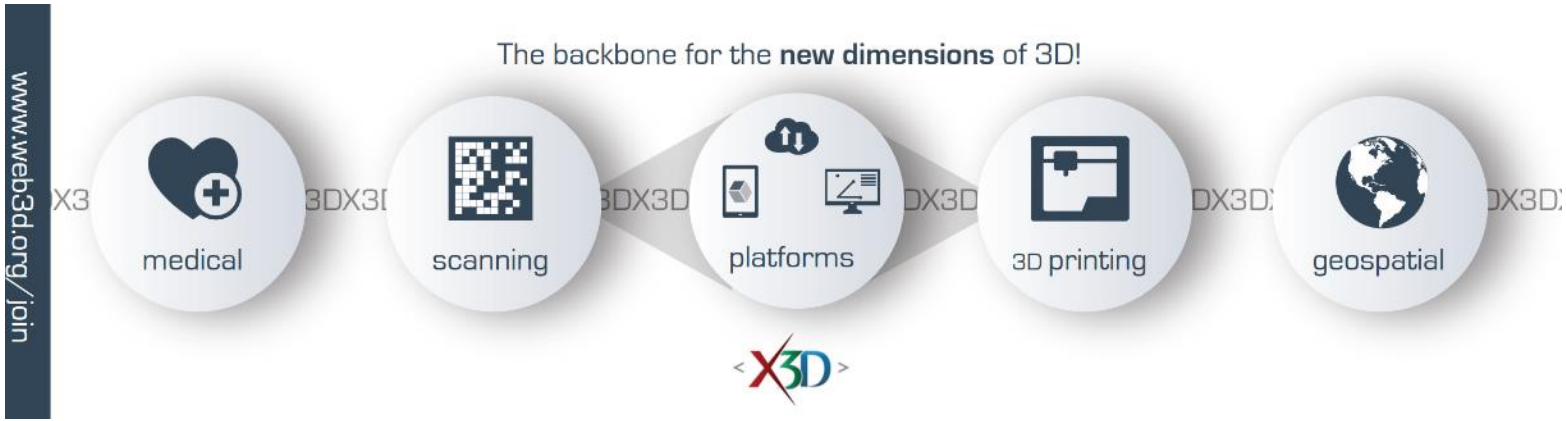
Thank you for your attention!

The Web3D Vision

An immersive world in which everyone can **securely** access and **share** 3D data **when and where** they need it.

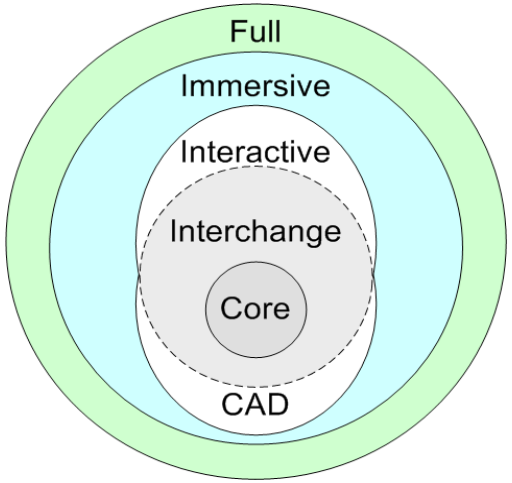
The Web3D Mission

To provide standards that empower **efficient** and **secure** 3D Graphics that is **interoperable** and **archiveable**.



X3D Profiles

https://www.web3d.org/x3d/profiles



Profiles are X3D subsets

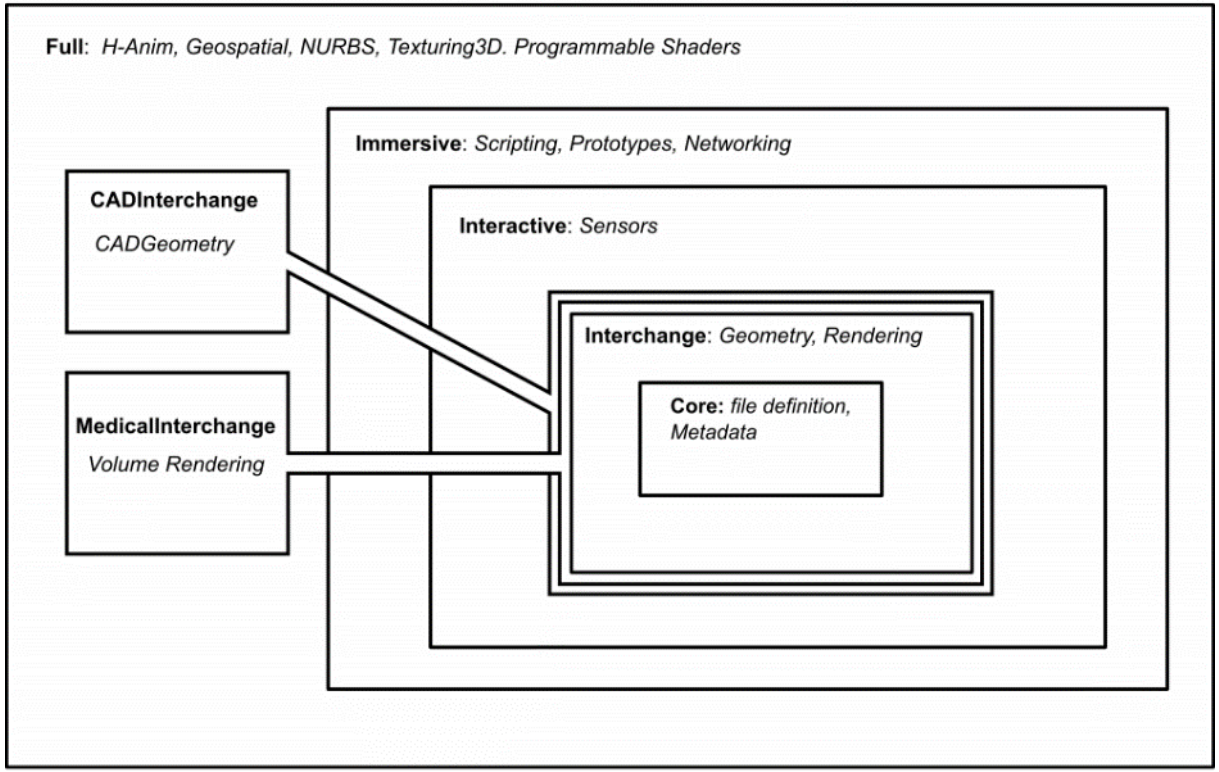
- Collection of X3D nodes for author's palette
- Interchange suitable for simple geometry conversion
- Interactive adds simple user interactivity (clicking etc.)
- Immersive matches VRML97, plus a bit more
- Full profile includes all nodes
- Components are collections of X3D nodes that perform similar operations, displays, or functions.

General Goal:

- A 3D visualization component for any runtime environment
- Reduced complexity and implementation effort

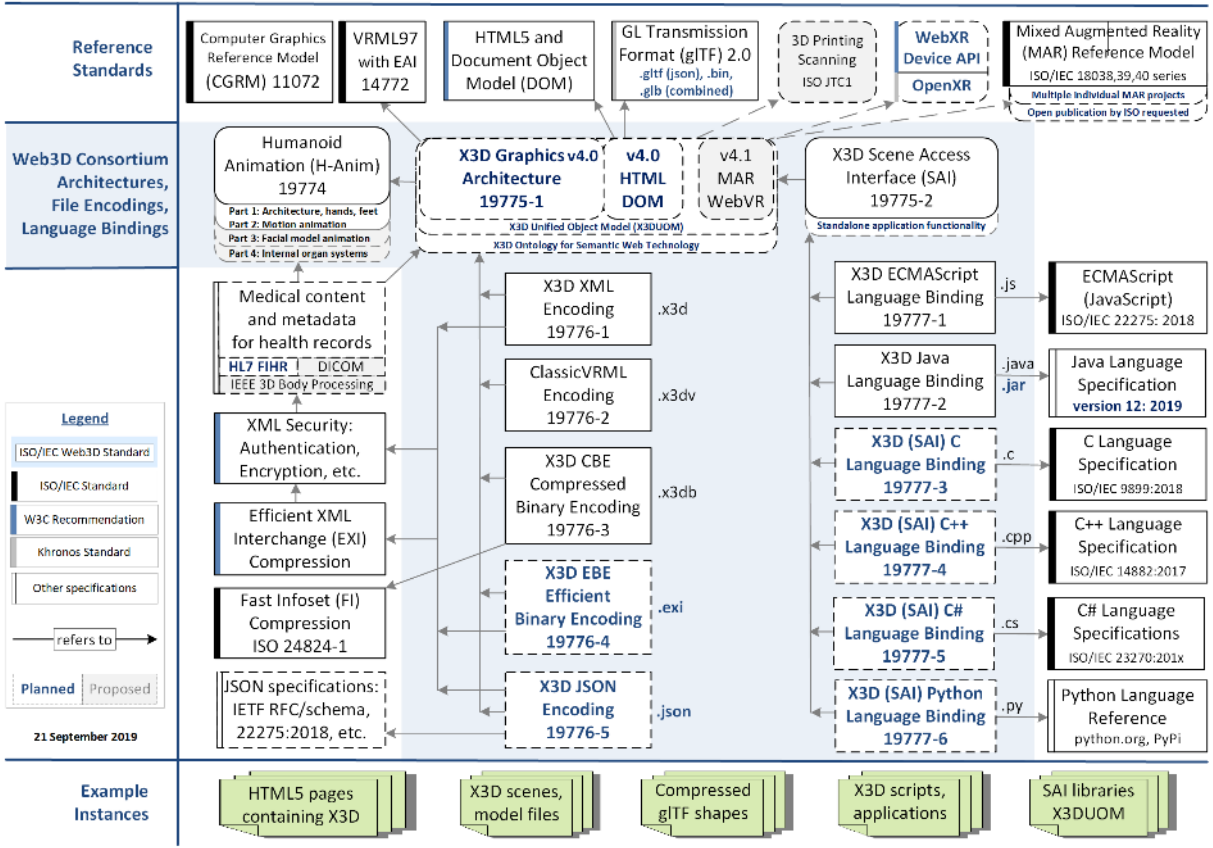
X3D Node Set
https://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/nodeIndex.html

X3D Profile Relationships



Rev: April 4 2018

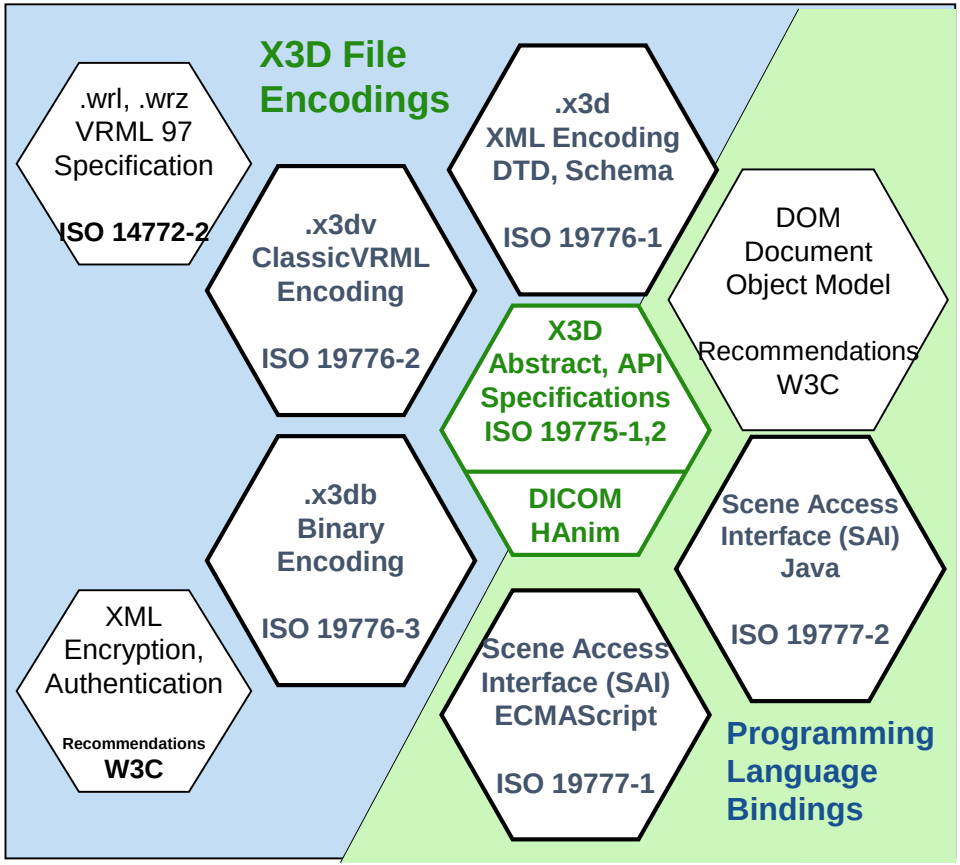
X3D Graphics Standards Relationships



Family of ISO Standards

https://www.web3d.org/standards

X3D Specifications



Fundamentals of X3D

Based on VRML, supports several APIs

- **Modular components, Extensible, Scriptable**
- **Efficient and Scalable Open Standards**
- **Open source and royalty-fee ISO standard**
- **Quality Assurance tools for conformance**
- **Interoperable with other standards**
- **Secure (Binary Encryption, Digital Signature, Compression)**
- **Platform Agnostic (All platforms all browsers)**
- **Stable that stands the test of time (Archiveable)**

IEEE 3DBP WG Feature Needs table (X3D offers most of the feature requests)

Web3D Standardization Process

Volunteers and Members work together on Standards

Development

Web3D Working Groups:

- X3D
- Medical
- Geospatial
- Mixed Reality
- Heritage
- Semantics
- Design Printing & Scanning

Interoperability

SDO Partnerships:

W3C WORLD WIDE WEB consortium

ISO

OGC Open Geospatial Consortium, Inc.

HL7 INTERNATIONAL

KHRONOS GROUP

DICOM Digital Imaging and Communications in Medicine

IEEE

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Adoption Process

1. Identify Standard or Extension to existing standards

- Study Market Trends/Requirements
- Identify Consortium Members' Interest
- Identify if this requirement falls under an existing working group charter
- Form a new working group if this does not

2. Create Standard or Extension

- Follow Consortium's IP Policy, Ensure Open and Consensus based solution
- Identify at least two independent and interoperable
- Create conformance testing suites
- Announce member/public review of 30 days
- Review comments and incorporate or discard with cause.
- Complete standard or extension for submission

3. Submit Standard or Extension for Board approval and Member vote

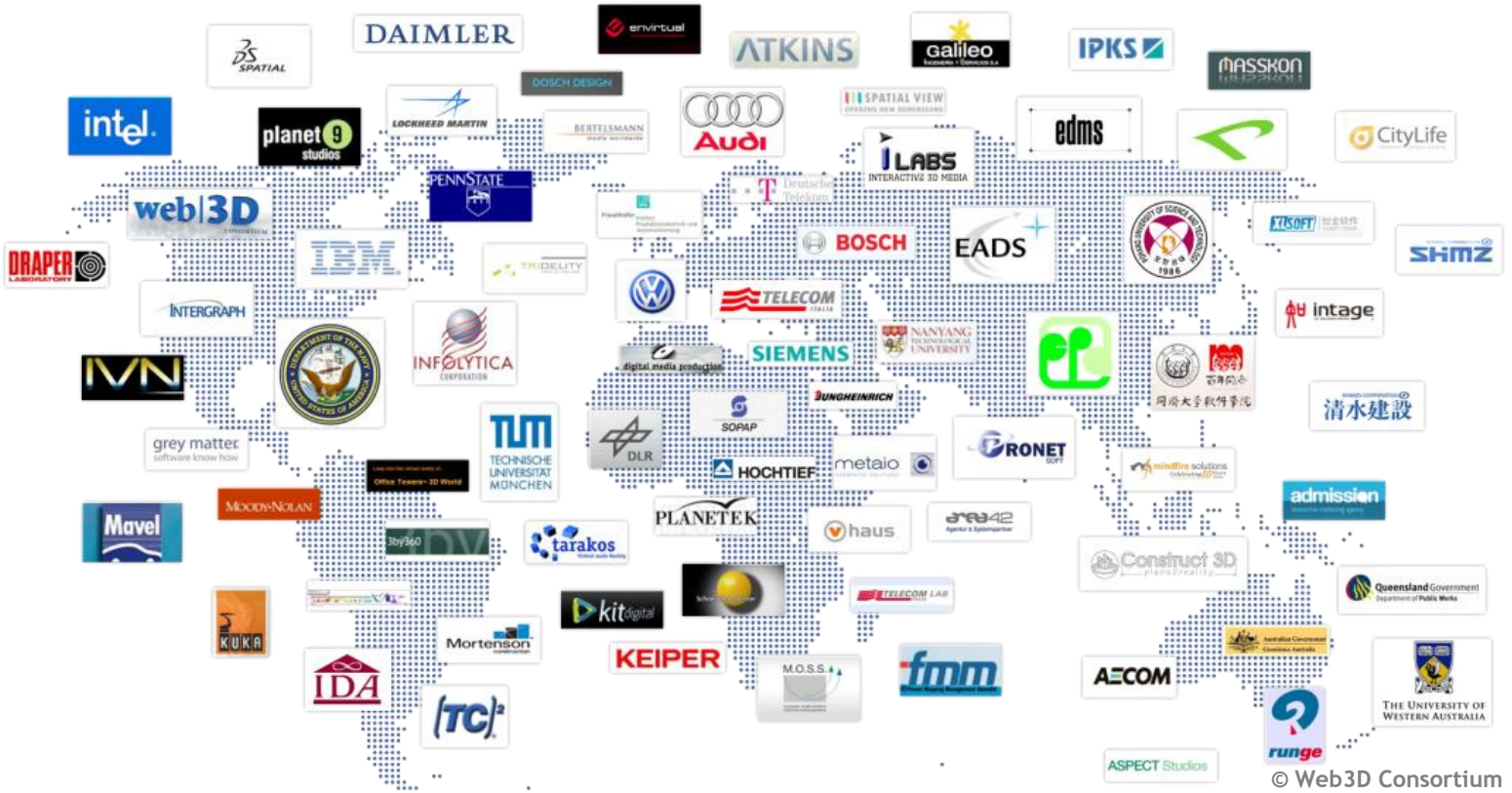
- Web3D Consortium Board of Directors review
- Board determines if a Web3D Members vote is necessary
- Tabulate Member vote results
- Start ISO certification process after final Board approval

4. ISO Certification - Follows ISO policy for all standards

File Format

Rendering Engine

Who is using X3D?



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X3D ISO Standard High-Level Features

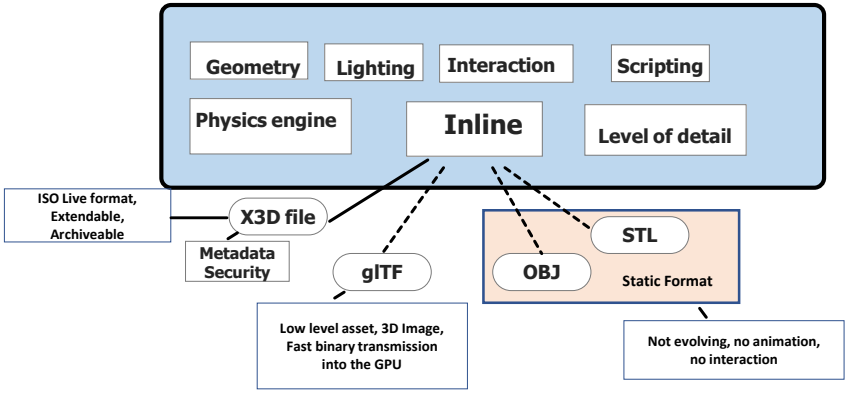
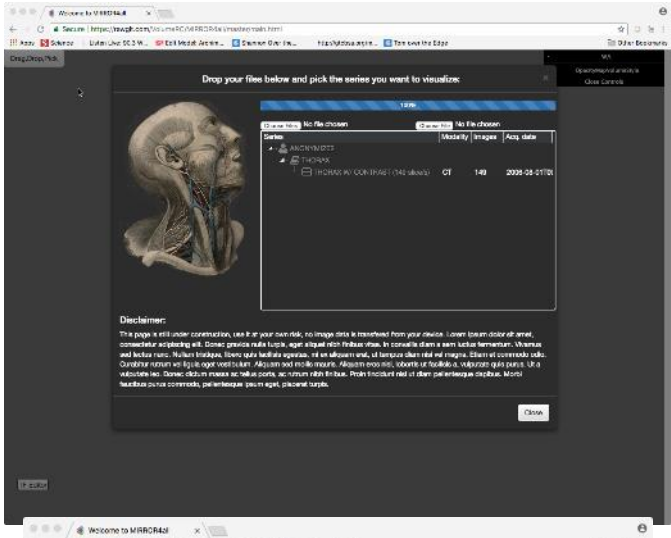


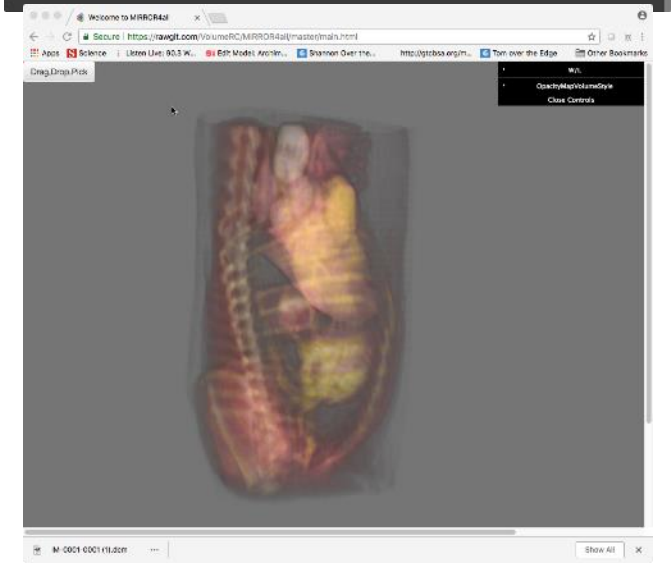
Illustration of the relation between high-level features of X3D enabling constructing dynamic, interactive, 3D scenes; and the ability to load contents, or assets, from external sources including other X3D files.
The ability to include other X3D content is a part of the current ISO standard X3D v 3.3; the inclusion of glTF is planned for the upcoming X3D v4.
Inclusion of glTF, OBJ, STL is already an extension offered by X3D viewers such as X3DOM and Castle Game Engine.

Web Volume Rendering

HTML5 + WebGL + X3D

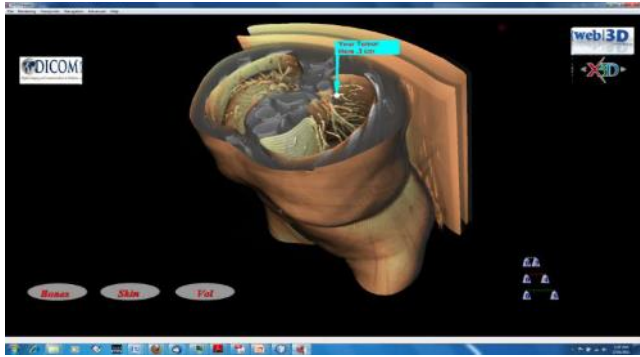
- VICOMTech: Volumerc.org
- Online drag-and-drop service for DICOM:
  - To HTML5/WebGL/X3DOM
  - Mirror4All by VICOMTECH and Kshell

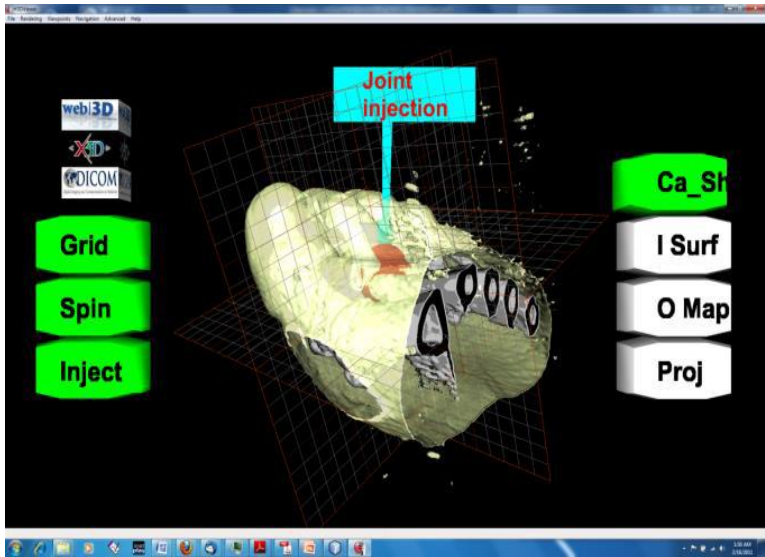




WWW and VR

- X3D: desktop, mobile, immersive VR/MR/AR
- Imaging
  - X3D Volume Rendering
  - TIFF stacks, DICOM, NRRD, PNG
  - Scripted automated conversions
- Molecular Visualization
- Immune Simulation
- Genomic alignment
- Polygons and volumes living together!
- VR and 3D printing !!!





WebVR

X3D and HTML5 files Uses the browser as the platform

Many headsets

Support X3D

Samsung Gear

Oculus