Augmented and Mixed Reality

SIGGRAPH 2013 BOF

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Agenda

- Introductions
- Fraunhofer IGD
- International Standardization efforts
- Intellectual Property
- ISO
- Web3D Consortium

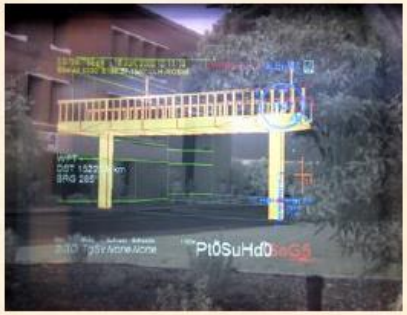
Definitions

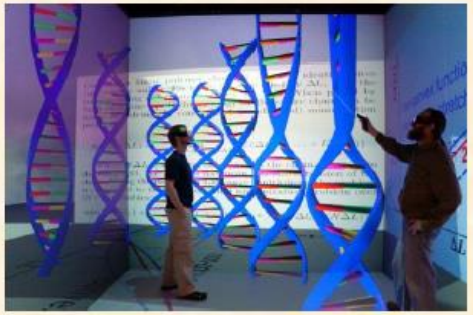
- **Augmented reality**: Refers to a system in which the user views and acts within an *enhanced* version of the real world. The enhancements are virtual (computer generated), and can include objects or information.
- **Mixed reality**: Refers to a system that combines real and virtual objects and information.

Theory: MR Continuum

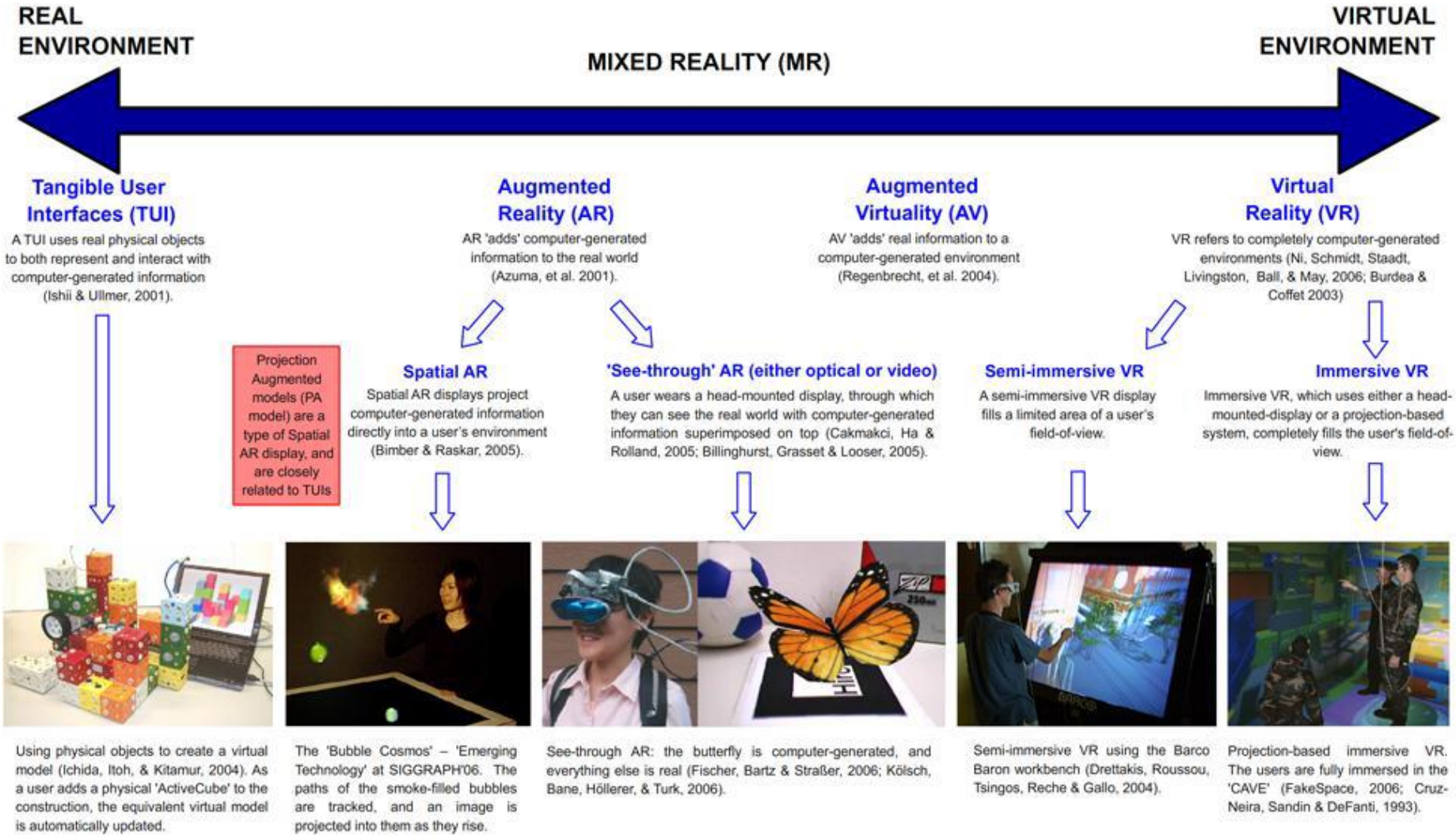
Milgram & Kishino, 1994

Reality — **Augmented Reality** — **Augmented Virtuality** — **Virtuality**





Scope: Augmented Reality Continuum



Using physical objects to create a virtual model (Ichida, Itoh, & Kitamur, 2004). As a user adds a physical 'ActiveCube' to the construction, the equivalent virtual model is automatically updated.

The 'Bubble Cosmos' – 'Emerging Technology' at SIGGRAPH'06. The paths of the smoke-filled bubbles are tracked, and an image is projected into them as they rise.

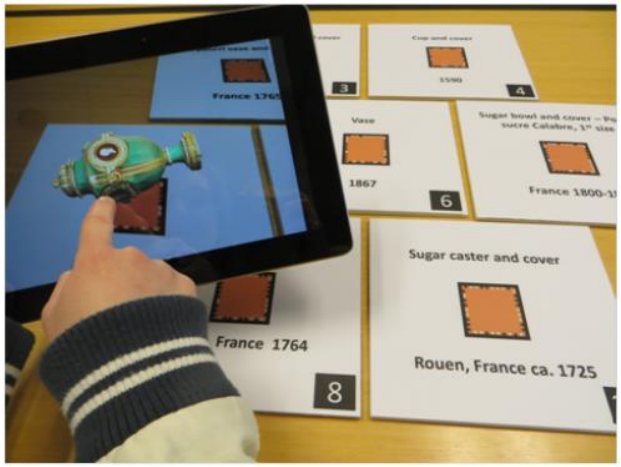
See-through AR: the butterfly is computer-generated, and everything else is real (Fischer, Bartz & Straßer, 2006; Kölsch, Bane, Höllerer, & Turk, 2006).

Semi-immersive VR using the Barco Baron workbench (Drettakis, Roussou, Tsingos, Reche & Gallo, 2004).

Projection-based immersive VR. The users are fully immersed in the 'CAVE' (FakeSpace, 2006; Cruz-Neira, Sandin & DeFanti, 1993).

AR/MR technology - displays

- **See-through HMDs:**
  - Optical see-through
  - Video see-through
- **Handheld displays**
- **Projection**



- Zeitz, Zeitz, Congwu & Polys 2013

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Key Factors

- **Field-Of-View (FOV) to real and virtual worlds**
- **Resolution of real and virtual worlds**
- **Registration between real and virtual worlds**
- **Proper occlusion between virtual & real**
- **Lighting issues, esp. outdoors**
- **E.g. optical see-through HMD:**
  - Virtual FOV = 40 deg.; Real FOV = 100 deg.
  - Virtual Res = 800x600 per eye; Real Res = unlimited

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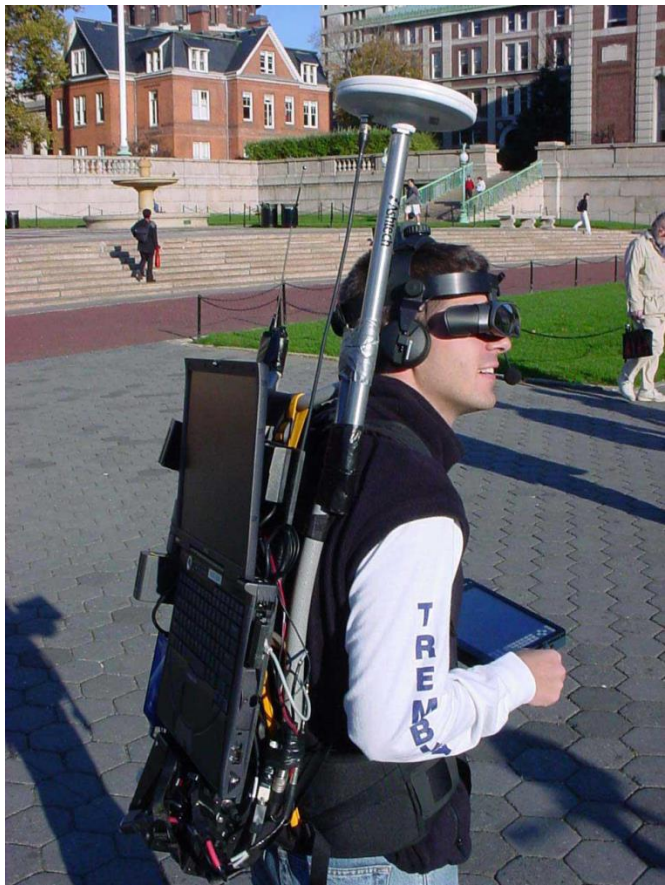
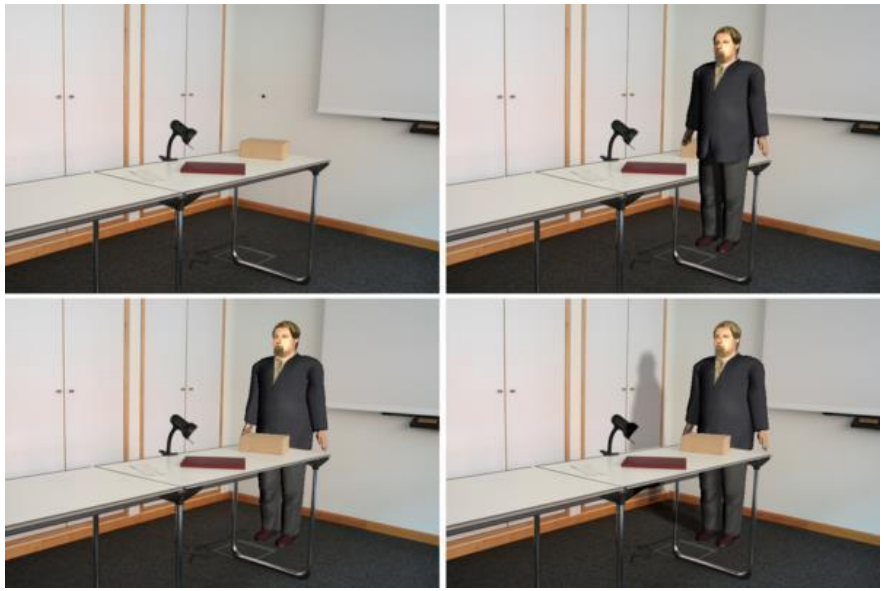
Challenges for ARC

- Conflict between real world and virtual
  - Not neatly separated anymore
  - Occlusion and depth perception
  - Weather conditions
- Limitations of displays
  - Precise, fast registration & tracking
  - Spatially seamless display, bulky HMD
  - Text display
- Limitations of controllers
  - Precise, fast registration & tracking
  - Spatially seamless interactivity



Depth Cues



- Compositing real and synthetic graphics:
  - Occlusion
  - Illumination & Shading
- One solution: Depth cameras like kinect

Consortium Member: Fraunhofer IGD

- *Tobias Franke presenting (AR Lighting)*

Consortium Member: Bitmanagement

- *Peter Schickel presenting - FINE project (EU)*

The Players

- ISO SC 24 & Web3D Consortium – Graphics description formats (VRML, H-Anim, X3D)
- ISO SC 29 – Encoding / Transmission (MPEG)
- OGC – ARML
- Khronos – Hardware APIs
- ARStandards.org – ad hoc community group

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The Landscape

- **Informal community groups:**
  - http://www.arstandards.org/
  - http://www.w3.org/community/ar/
- **OGC – ARML 2.0**
  http://www.opengeospatial.org/projects/groups/arml2.0swg
- **ARAF from MPEG**
- **ISO Reference Model from SC 24 / SC 29**
- **X3D/X3DOM Nodes proposed:**
  - CalibratedCameraSensor node
  - TrackingSensor
  - BackdropBackground, ImageBackdropBackground
  - Some changes to Viewpoint

http://www.web3d.org/wiki/index.php?title=AR_Proposal_Public_Review

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Intellectual Property

- Two articles published recently illustrate these issues in AR

  "Has Patent, Will Sue: An Alert to Corporate America," by DAVID SEGAL,
  New York Times, July 13, 2013.
  http://www.nytimes.com/2013/07/14/business/has-patent-will-sue-an-alert-to-corporate-america.html

  "How a Typical Patent Battle Took an Unexpected Turn," by DAVID SEGAL,
  New York Times, July 13, 2013.
  http://www.nytimes.com/2013/07/14/business/how-a-typical-patent-battle-took-an-unexpected-turn.html

AR Patent Trolls

News on Wasson's blog:

- http://www.wassom.com/augmented-reality-patent-troll-at-it-again.html?goback=.gde_1839260_member_235936308
- http://www.wassom.com/ar-trolls-patent-gets-re-examined.html?goback=.gde_67494_member_243806077

Open Standards for Interactive 3D on the Web

www.web3d.org

- Portability
- Durability
- Interoperability
- **Royalty-free**
- International recognition and support

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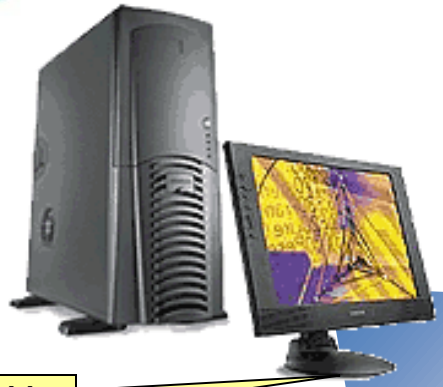
The ISO Standards for interactive 3D on the Web



Shared world wide

Shared between applications

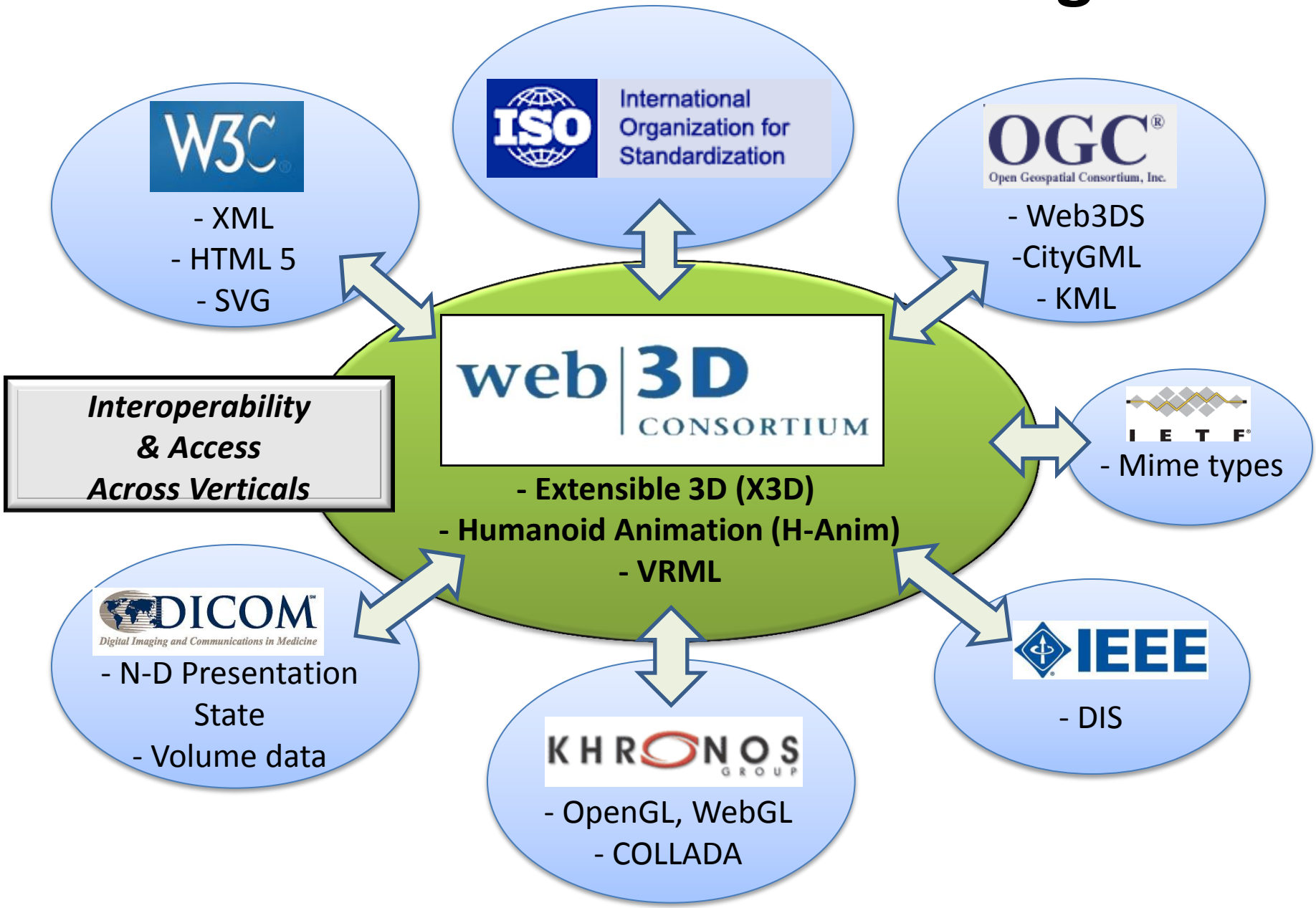
Royalty-free; Numerous implementations including Open source

"X3D enables the communication of real-time 3D across networks and XML-based web services"

Lasts the Test of Time

Shared between systems

Web3D Collaboration & Convergence



Progress with Standard Reference Model for Mixed and Augmented Reality

Web 3D BOF, SIGGRAPH 2013

Gerard J. Kim

Korea University / ISO JTC 1 SC 24 WG9

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What is a Reference Model?

- A reference model (for a given domain) defines an authoritative basis that outlines:
  - Set of principles
  - Terms and their precise definitions
  - Generic system model of mixed/augmented reality system
    - Major components and their functionalities
    - Inter-component interfaces (data and control)
    - @ the right abstraction level w.r.t. purpose
  - Validation use cases
- Purpose: Develop consistent and comprehensive standards
    - Used as a model architecture by MAR related standards developing organizations (SDO's) and MAR application and service developers
    - Promote fluid communication among MAR practitioners in the field

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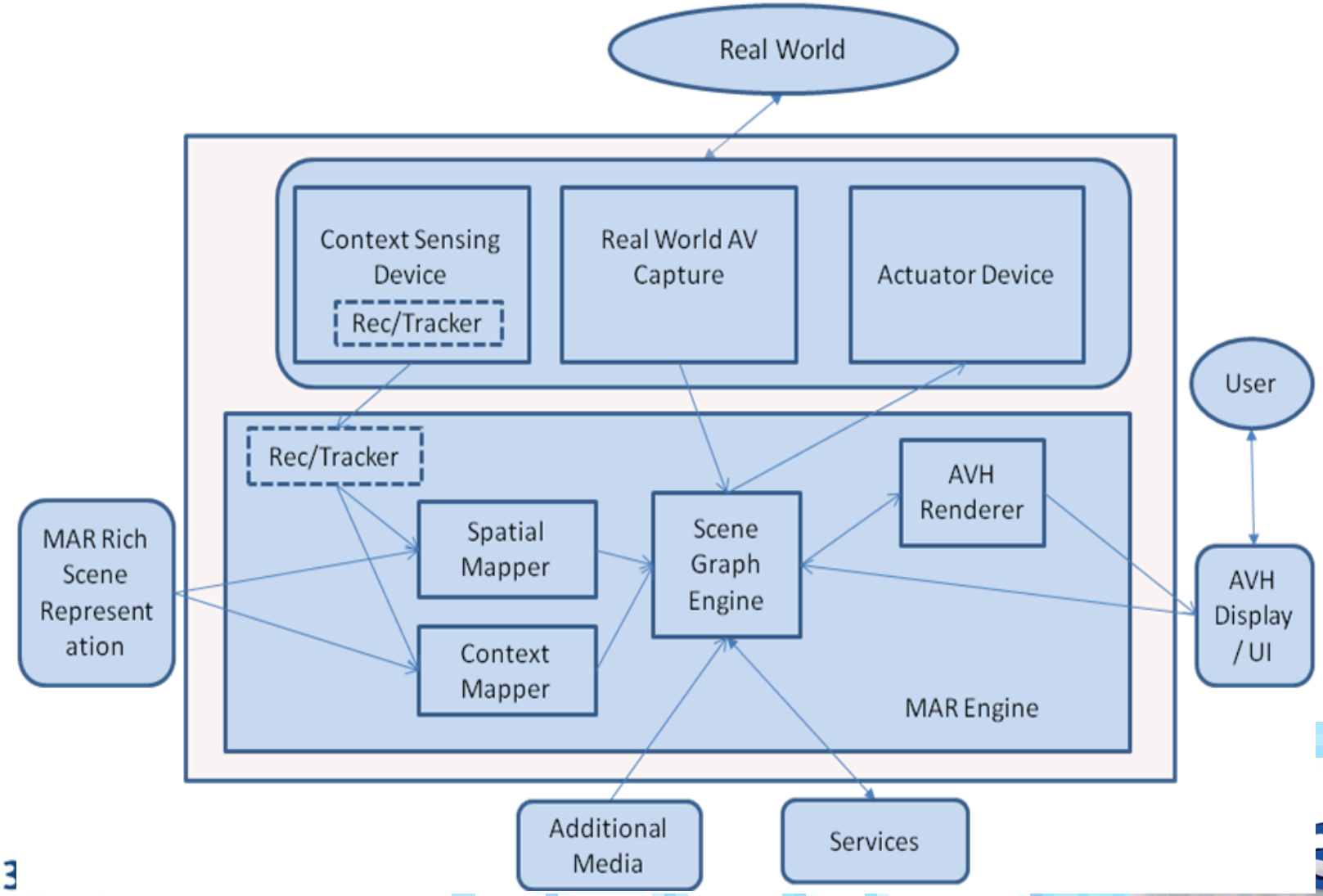
Example: Computational Architecture (still in progress)



History

- SC 24
  - Have developed standards for computer graphics and virtual environments such as OpenGL and X3D
  - Extension into mixed/augmented reality environment
  - Formation of WG 9 in 2011 (devoted to MAR)
    - Used the term “ARC: Augmented Reality Continuum”
- SC 29 (WG 11)
  - Have developed standards for video, mixed media representation and environment sensors
  - Extension of MPEG into AR applications
  - Joint work on AR ref. model with AR Standards Forum by C. Perey
- Joint Ad Hoc Group (JAhG) formed
  - 2012 JTC 1 resolution
  - SC 24, SC 29 and other SDOs
  - Derive single standard publications on MAR
  - Held the 2nd JAhG last Sunday

Recent Progress (1): Content Structure

- Scope
- MAR domain and concepts: MAR continuum
- MAR Reference Model usage example
  - Extend existing standards to integrate MAR functionalities
  - Conformance of a MAR system with this MAR reference model
  -
- Terminology
- MAR Reference System Architecture
  - Viewpoints
    - Enterprise Viewpoint
    - Computation Viewpoint
    - Information Viewpoint
- Use-cases

Recent Progress (2)

- The use of term “MAR: Mixed and Augmented Reality”
- Joint Ad Hoc Group Operations
  - Clarifying the (Immediate) Objective: Single ref. model for MAR
  - Meetings / Participants
  - Decision making process
- Procedures for handling of any intellectual property rights
- Resolving the issue of document ownership and co-publication (in progress)
- Continued editing of the ref. model itself
  - Goal: First draft by Jan 2014

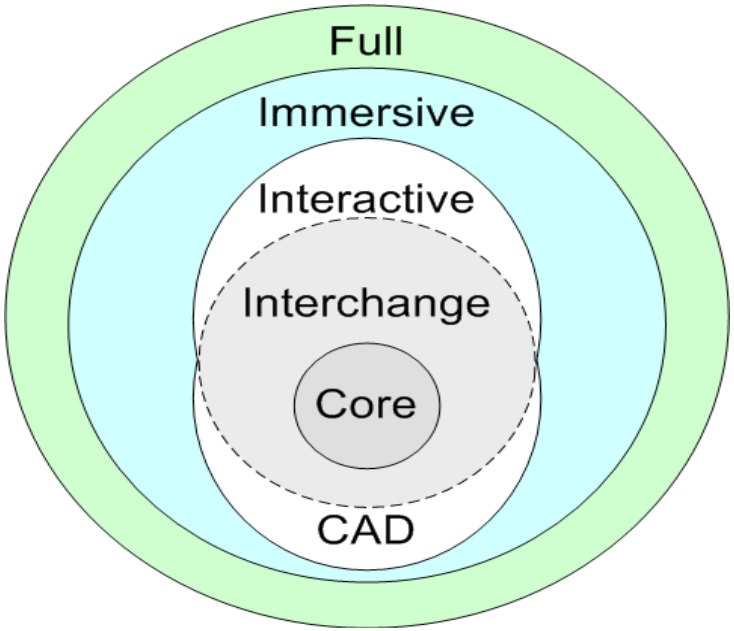
Conclusion

- Ref. model will help the MAR standards and industry design and implement interoperable systems and data representation
  - Promote proliferation of MAR technology and contents

- ISO (and other participating SDO) is working hard together to produce a consistent model and standards as related to MAR

- You are welcome and invited to join and make contribution as national body representative or MAR experts
  - Send mail to gjkim@korea.ac.kr

The modular architecture of X3D



8 Profiles for common use cases

35 X3D Components for modular design

Two Hundred Eighteen X3D Nodes for every little thing!

Modular architecture of X3D allows increased functionality for immersive environments

X3D AR Working Group

Overall Goal: Continue adoption and support of X3D models in AR applications

Extensible to existing frameworks
- Extend X3D Scene Graph to implement AR for X3D and X3DOM

General/Flexible
- Device/platform independence (mobile, desktop and HMD)
- Sensors and devices for vision, marker, and location

Continuing work with ISO SC-24 WG9 implementing the AR Reference Model

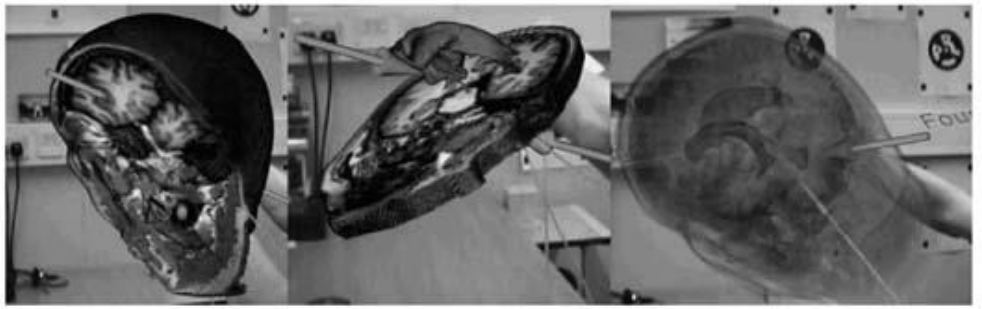
X3D-AR Requirements

- Supporting image (camera) sensors
- Live video
- Background and textures
- Tracking camera motion
- Camera calibration

Fraunhofer and Korea Chapter submitted proposals in 2012
currently in the final state of merger

http://web3d.org/wiki/index.php/X3D_and_Augmented_Reality

X3D Applications showing their use in various AR and MR markets



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X3D AR Proposal Details

New Nodes:

CalibratedCameraSensor and TrackingSensor nodes

- Device independent on end-user side
- Delegating specific device setup to browser/user

Backdrop node for background

- Independent from viewpoint orientation
- Naming following Fraunhofer's proposal

Reusing: PixelTexture node

Extensions: Minimal extension to Viewpoint node

- Subset of Fraunhofer proposal
- Camera calibration information to come from sensor nodes

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Proposed Changes to X3D

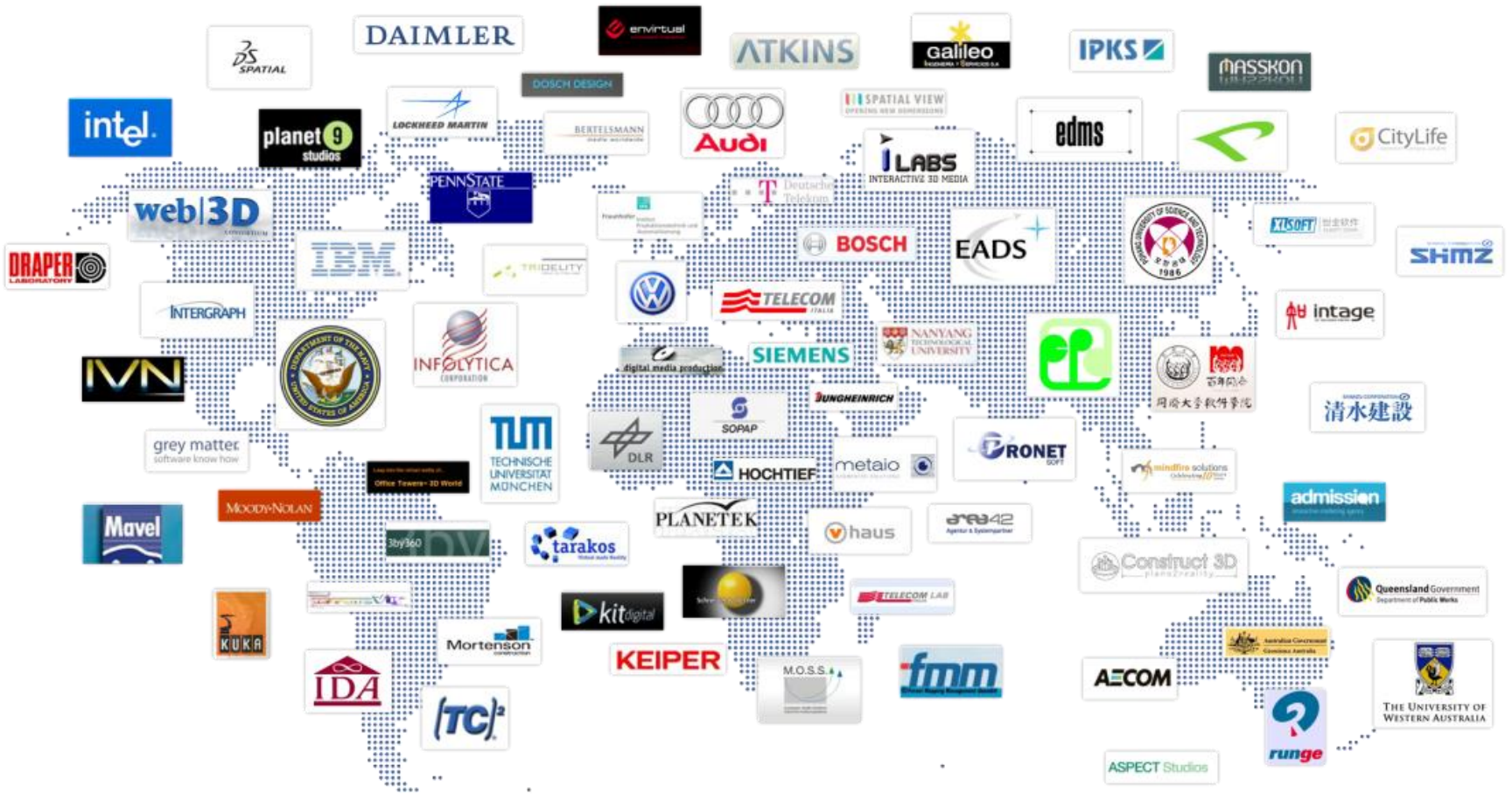
Modification of one node

- ViewPoint Node (extend)

Proposed New nodes

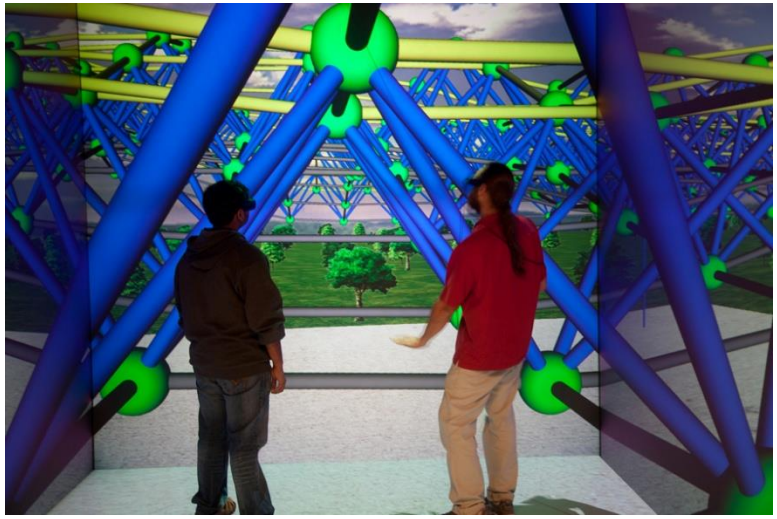
- TrackingSensor (Position and orientation)
- CalibratedCameraSensor (Calculate intrinsic camera parameters)
- Backdrop (To hold streamed camera images)

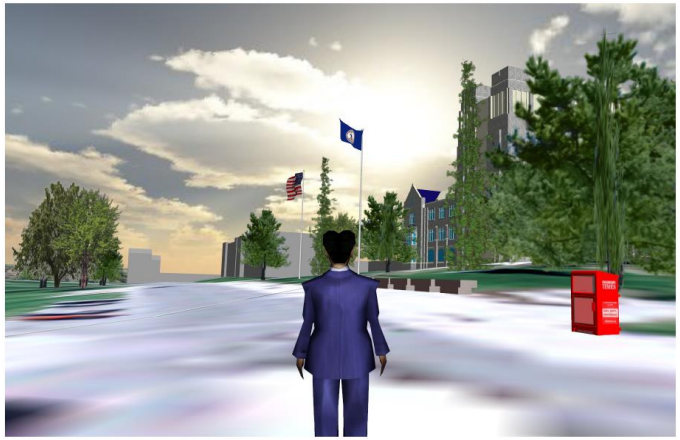
Adoption

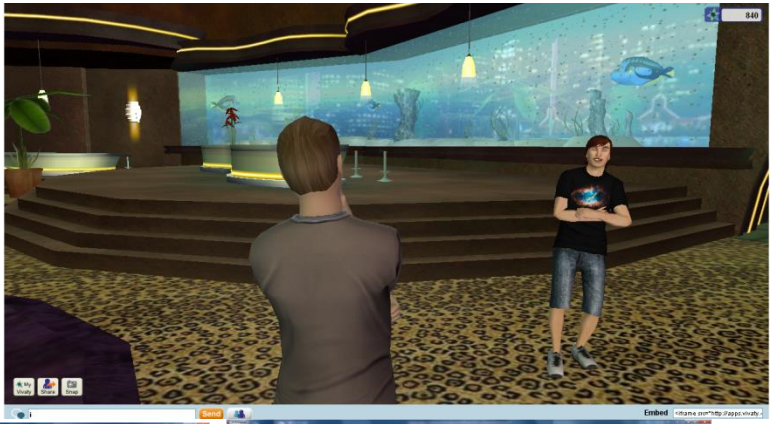


Too many to list them all!

Extensible 3D (X3D) , VRML, H-Anim

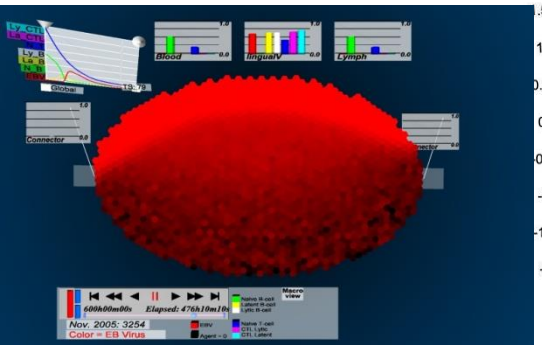


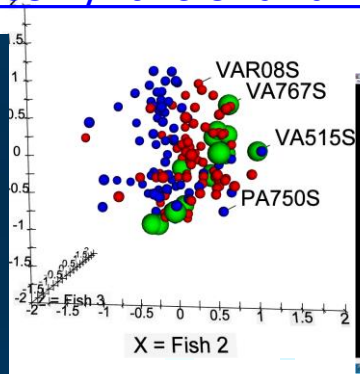


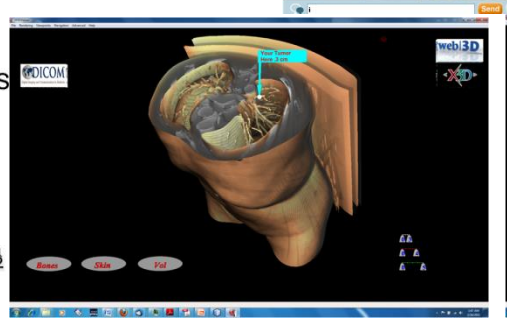


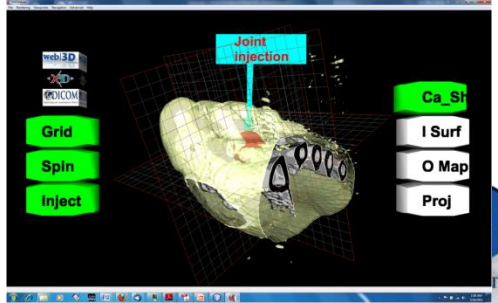
See videos and case studies at web3d.org:

- http://www.web3d.org/realtime-3d/case-studies
- http://www.web3d.org/realtime-3d/videos
- http://www.youtube.com/vtvisionarium









Participation

X3D AR WG participation is open to all

http://web3d.org/wiki/index.php/X3D_and_Augmented_Reality

Web3D Community

This means You!

- We all want our assets to be portable and durable
- We all have a stake in a royalty-free future for 3D on the web
- Active Working Groups organized around vertical applications of the X3D spec: CAD, Geospatial, Medical, Augmented Reality
- Join us – we are member-supported organization!

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Web3D C Member Benefits

- Early-access to technology
- Leadership in standardizing technology
- Co-marketing & Publicity (website, press releases, booth)
- Collaboration (proposals, projects)
- Discounted Conformance Testing
- Web3D / ACM / EG Conference Partners

The Web3D Consortium 2013

Directing Members

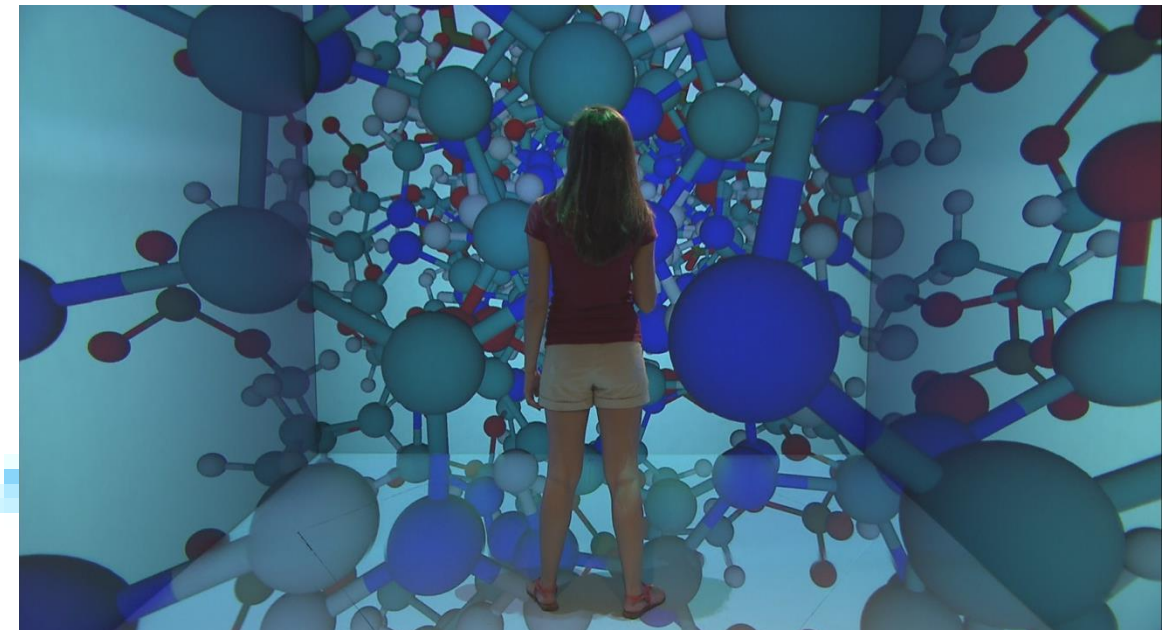
- Naval Postgraduate School
- Virginia Tech

Organizational Members

- Bitmanagement
- DFKI
- EDF
- Fraunhofer
- George Mason University C4I Center
- KAIST
- KIST
- MBARI
- NIST
- Suwon
- Vicomtech

Web3D Chapters

- Korea



Join Us!

Professional *and* Institutional opportunities!

- Anita Havele, Executive Director
  - Anita.havele@web3d.org
- Nicholas Polys, Ph.D., President
  - npolys@vt.edu

www.web3d.org

Events @ SIGGRAPH

- Web3D Booth # 233
- Tuesday
  - BOFs in 201D: CAD, Carto, Medical, TownHall Mtng
- Wednesday
  - BOFs in 201C: X3D Futures w/ HTML5, AR/MR
  - TechTalk (Exhibit Hall 3:45pm)

- ACM 19th Annual Web3D Conference to be Co-located with SIGGRAPH 2014, Vancouver

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