

X3D Graphics for Advanced Modeling

Humanoid Animation (H-Anim)

*"Our bodies are our gardens,
to the which our wills are gardeners."*

William Shakespeare, *Othello*, Act I, Scene 3

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Chapter Overview

Overview

H-Anim Humanoid Animation is an ISO Standard co-evolving with (and supported by) X3D.

H-Anim is designed to be implementable by a variety of different 3D graphics technologies.

H-Anim models have regular patterns of Joints and Segments to create a movable skeleton. Sites and Displacers support feature animation.

Current work includes improved support for skin, face/hands/feet, motion capture (mocap) conversions for full-fidelity animation, including usability for medically accurate records.

Concepts

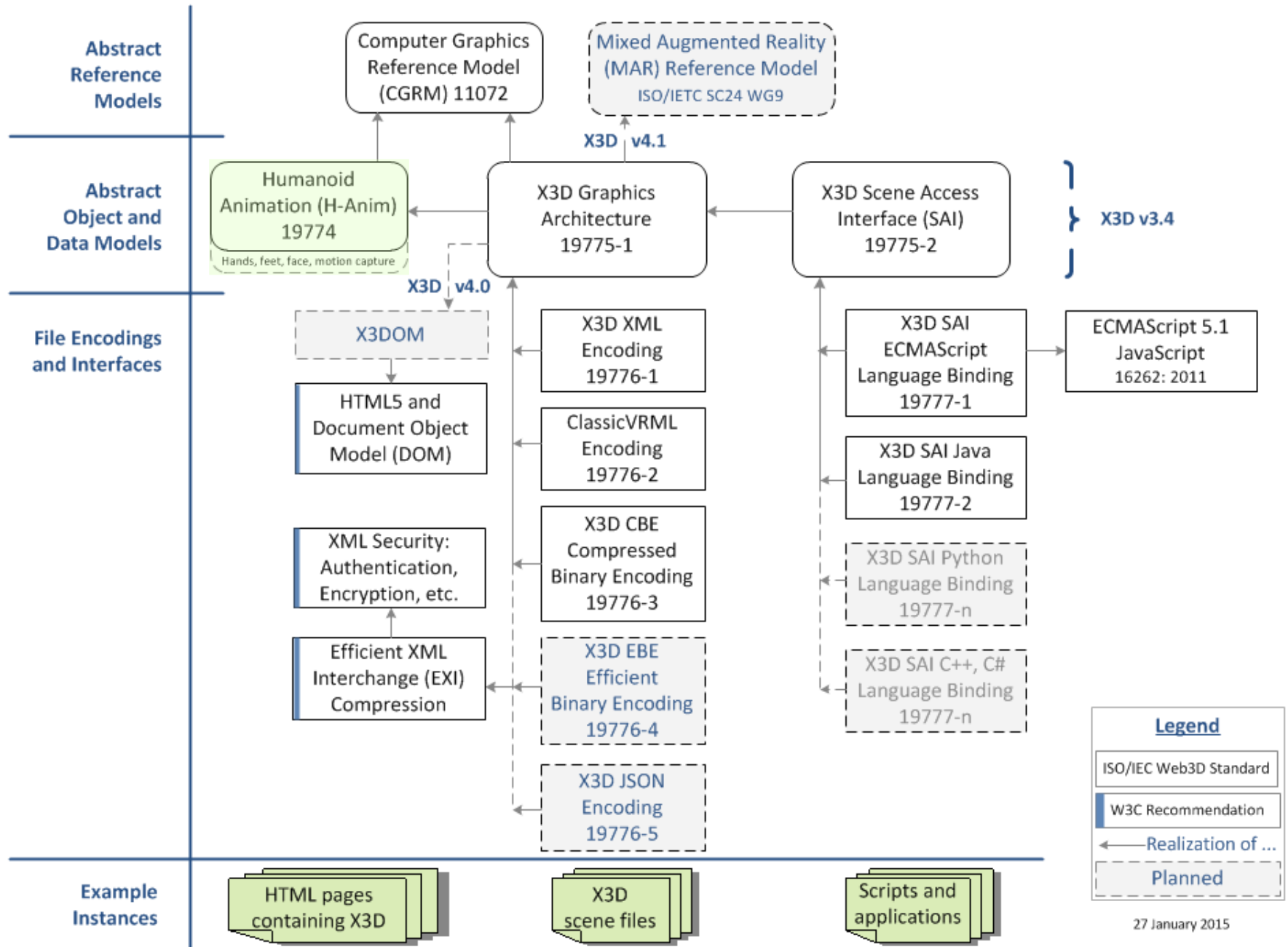
Motivation

- The H-Anim International Standard is an abstract representation for modeling the skeleton and skin of 3D human figures.
- H-Anim describes a standard representation of humanoids that allows creation of human figures that can be interoperably animated, using behavior scripts or motion capture data created by a variety of modeling tools.
- Current work includes mocap plus hand, feet and face models for full human anatomy.

Relevant Specifications

- Humanoid animation (H-Anim) specification ISO/IEC 19774:2006 version 2.0 describes full semantics of H-Anim models
- Usable in multiple languages: X3D, VRML97, etc.
- X3D Abstract Specification bindings are in Humanoid animation (H-Anim) component
- VRML97 support is provided by Prototype declarations which give full functionality

X3D Graphics Standards: Specification Relationships



Original design objectives

ISO/IEC 19774:2005, H-Anim version 1.0

Compatibility

- The features of an H-Anim human figure shall be implementable in any compliant browser.

Flexibility

- No assumptions shall be made about the types of applications that will use an H-Anim human figure.

Simplicity

- When in doubt, leave it out. The human figure specification can always be extended later.

H-Anim Specification versions

ISO approval of the current H-Anim
International Standard is dated 2006-02-16

- ISO/IEC 19774:2006
- Section 6.2 Humanoid states stable
version='2.0'

Partial work completed in 2009: PDAM

- Proposed Draft Amendment 1 to H-Anim,
- ISO/IEC 19774:2006/PDAM1:200x.
- Also states version 2.0 but some **version 2.1** models produced... Consistent correctness is important...

Future Hanim 2015 likely version='2.2'
experimental

H-Anim v2.2 design objectives

Skeleton

- New Level of Articulation (LOA) for hands and feet

Skin

- More examples to confirm skin functionality works
- Add facial animation model

Motion Capture (mocap)

- Dynamically interoperable mocap data conversion

Anatomical correctness

- Enable modeling of human body with full fidelity for medical records and simulation applications

Anatomically correct humans

H-Anim specification design put high premium on generality for any animated figure

- However most cartoon/game character physical models vary widely and are completely ad hoc
- Offered a capability but apparently didn't fill a need

Strong interest in enabling anatomically valid, medically correct humans in full detail

- Perhaps lead to standards for 3D medical records
- Shared challenge with X3D Medical Working Group
- Alternate humanoid characters also allowed

Current limitations in H-Anim

- Few skin examples have been produced, further verification of correctness needed
- It is difficult to compose and sequence multiple animation behaviors at run time
- Need library of reusable skeleton/skin bodies and composable motion-capture animations
- Future work: mocap streaming mechanisms need to operate compatibly with forthcoming continuous level of detail (CLOD) design for streamable X3D compression

H-Anim Working Group

- H-Anim Humanoid Animation Working Group
- The H-Anim Working group develops and demonstrates the ISO Humanoid Animation (H-Anim) standard.
- H-Anim supports a wide variety of articulated figures, including anatomically correct human models, incorporating haptic and kinematic interfaces in order to enable sharable skeletons, bodies and animations.
 - <http://www.web3d.org/working-groups/humanoid-animation-h-anim>

Levels of Articulation (LOAs)

Levels of Articulation (LOAs) 1

Level of articulation (LOA), refers to the number of articulations (or joints) that are defined for a humanoid figure.

- A humanoid figure with fourteen joints is said to have a “low level of articulation”, whereas a humanoid figure with 72 joints might be said to have a “high level of articulation”.
- A skeletal hierarchy containing only a HumanoidRoot Joint object is the lowest level of articulation that is allowed for an H-Anim figure.

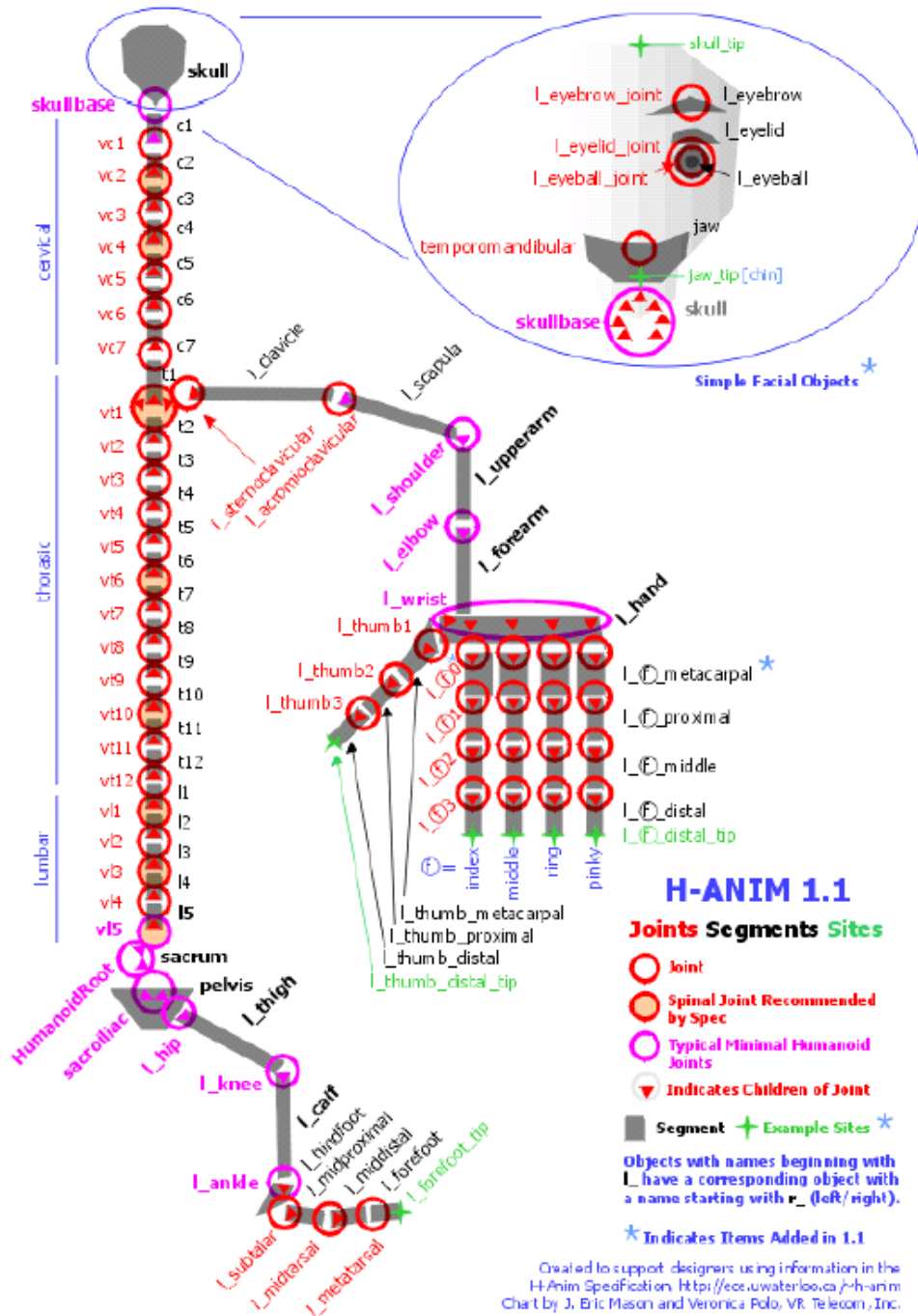
LOAs are composable, not strictly progressive

Levels of Articulation (LOAs) 2

Each LOA provides increased skeletal fidelity

LOA	Plain Text Data Tables	Specification Descriptions
0	HAnimHierarchyWeb3d-19774-V1.0.txt	Text-based node hierarchy from approved ISO standard: H-Anim Specification, 4.9.5 Hierarchy.
1	HAnimHierarchyWithSites.txt	Hierarchy of joints, segments with corresponding surface-feature sites (based on skeletal proximity)
2	HAnimJointNames19774V1.0.txt	List of approved HAnimJoint names. <ul style="list-style-type: none">• Table 4.2 - Body Joint object names• Table 4.3 - Hand Joint object names• Table 4.4 - Face Joint object names
3	HAnimSegmentNames19774V1.0.txt	Approved HAnimSegment names, excerpted from H-Anim Specification, 4.9.5 Hierarchy.
4	TODO, work in progress	

H-Anim Hierarchy



LOA 0

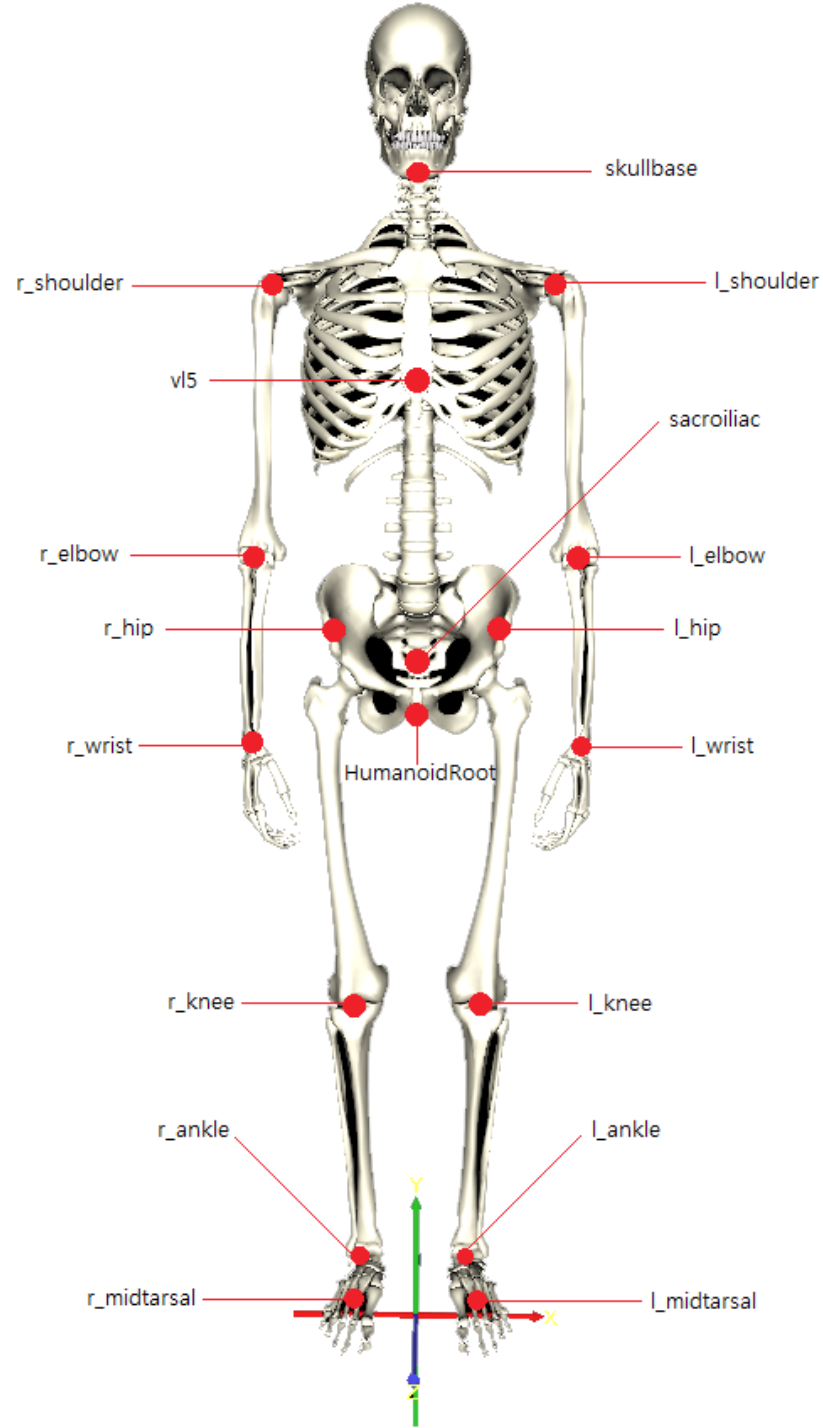
Single joint: HumanoidRoot

Very important: positions, orients virtual body anywhere in the virtual (or augmented) world

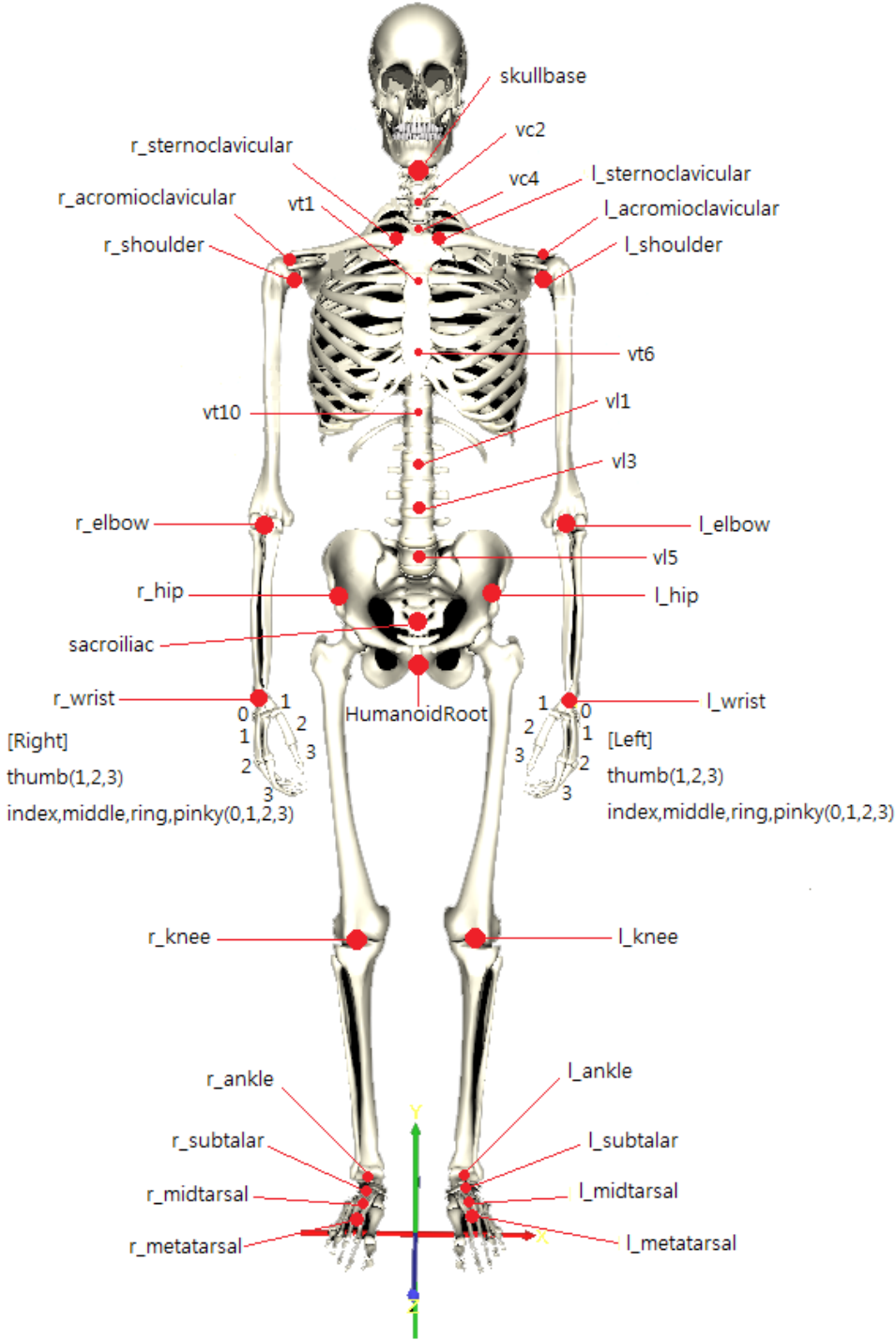
- Example: receives translation/rotation values from PositionInterpolator/OrientationInterpolator streams

TODO confirm: an LOA-0 scene can Inline additional parts of a body, without needing fully contiguous skeleton joints

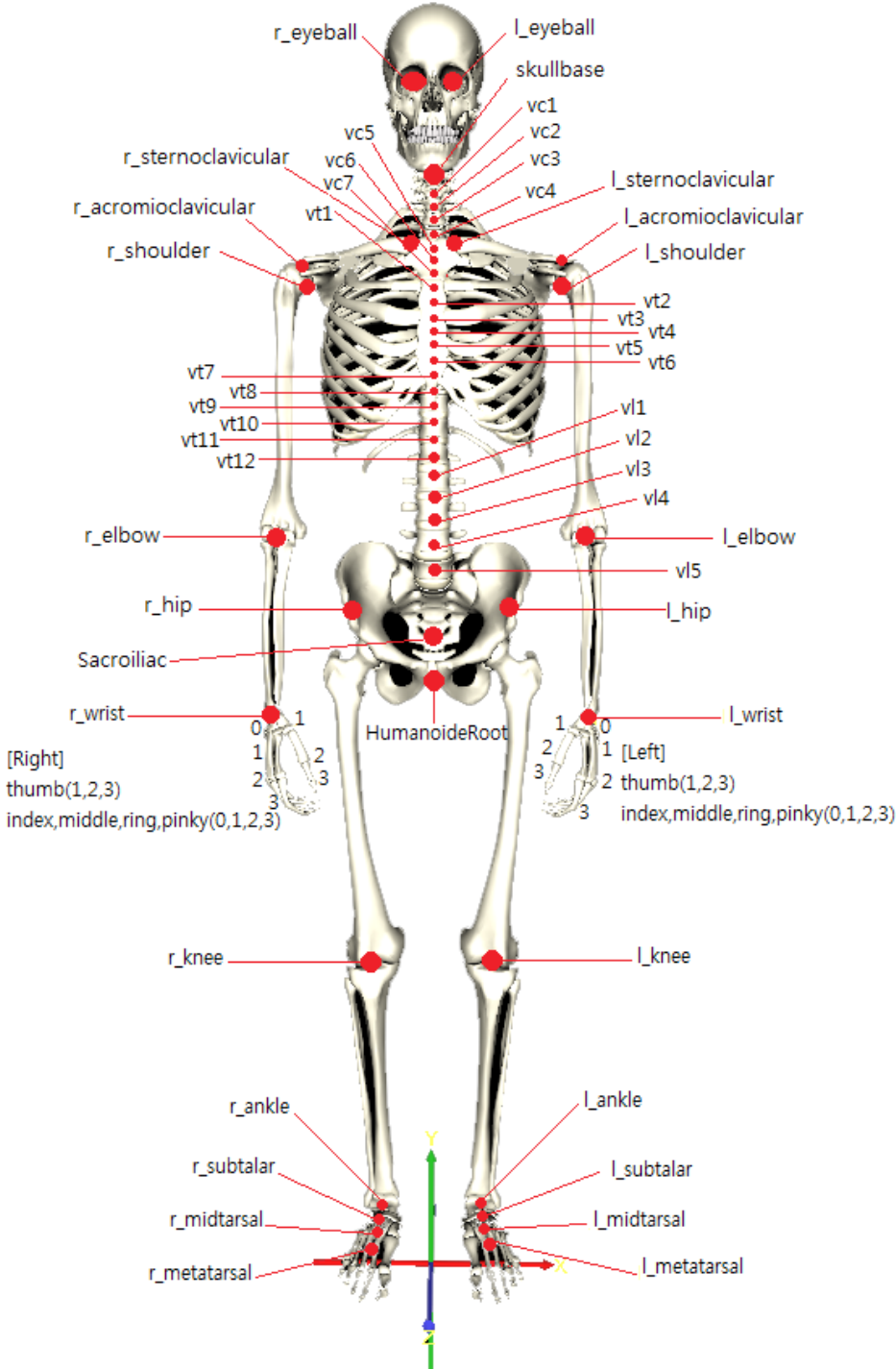
LOA 1



LOA 2



LOA 3



H-Anim LOA-3 Examples

X3D Example Archives: Basic, Humanoid Animation

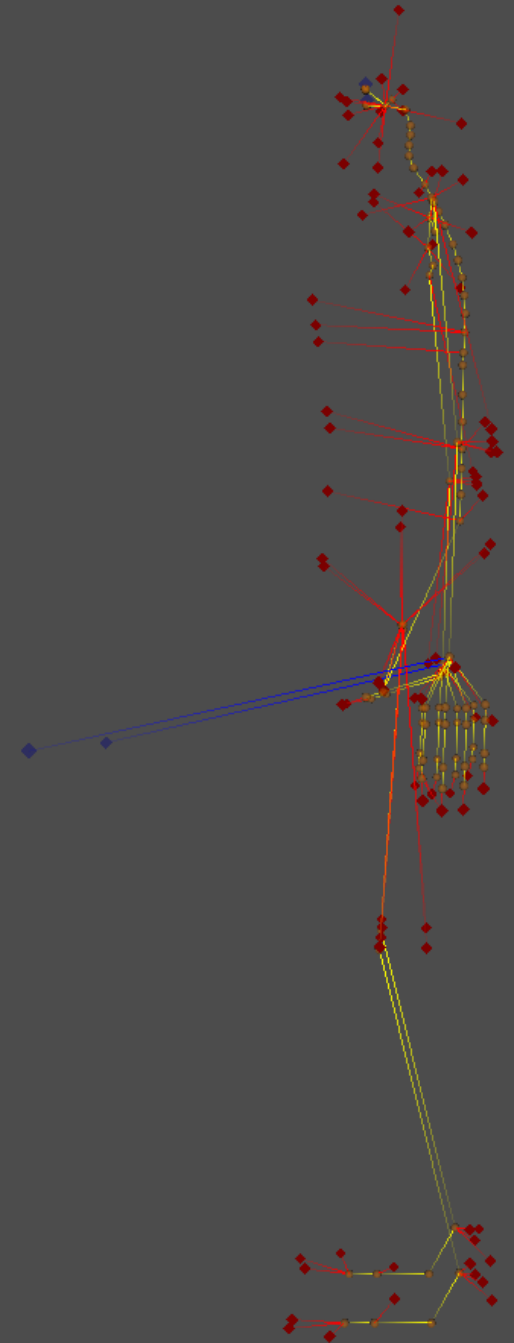
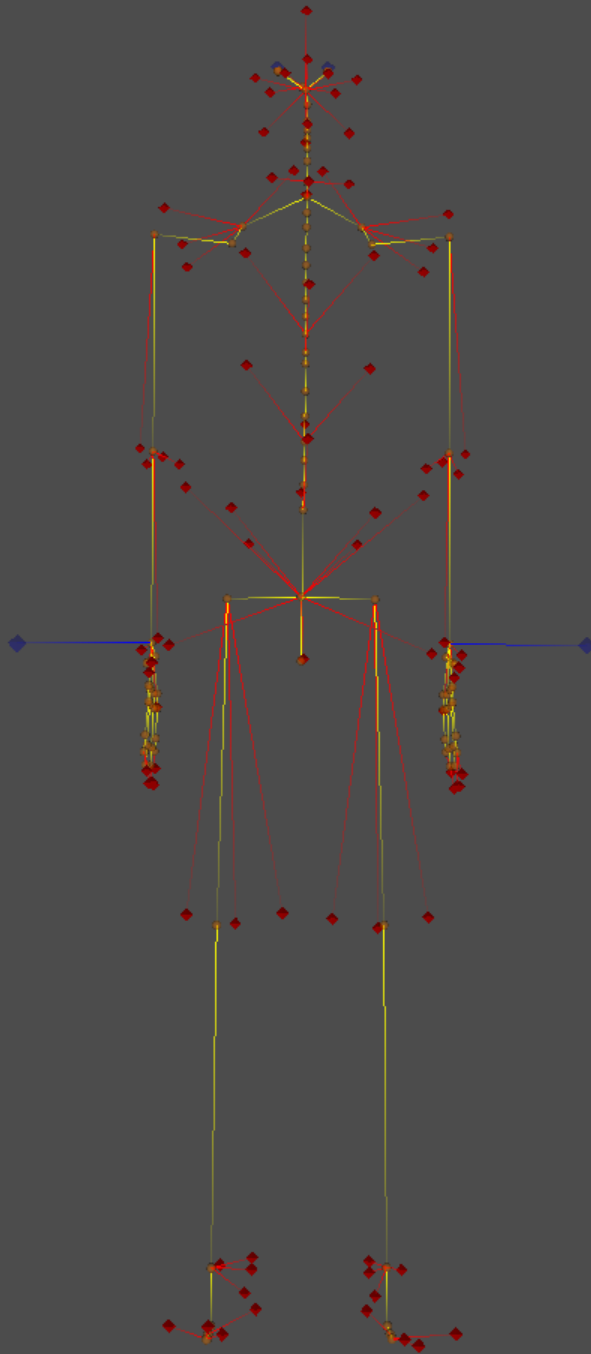


These Humanoid Animation (H-Anim) examples support the ISO [Humanoid Animation \(H-Anim\) Specification](#) with a corresponding specification for ISO [X3D Abstract Specification H-Anim component](#).

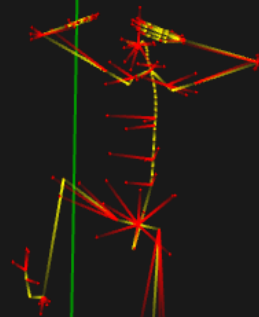
The [H-Anim Working Group Executive Summary](#) summarizes current capabilities. Prior original efforts can be found online at hanim.org. Significant additional work is being considered by renewed efforts documented on the [H-Anim Working Group Wiki](#). Tool builders may benefit from using convenient [tables of enumeration values](#) extracted from the H-Anim Specification. Related work appears in the [Medical](#) examples.

- [HanimSpecificationLOA3Invisible.x3d](#)
- [HanimSpecificationLOA3Illustrated.x3d](#)
- [HAnimSpecificationLOA3Motion.x3d](#)

Hanim Specification LOA3 Illustrated .x3d



HAnimSpecificationLOA3Motion.x3d



Stop
Default Pose

Stand

Pitch

Yaw

Roll

Walk

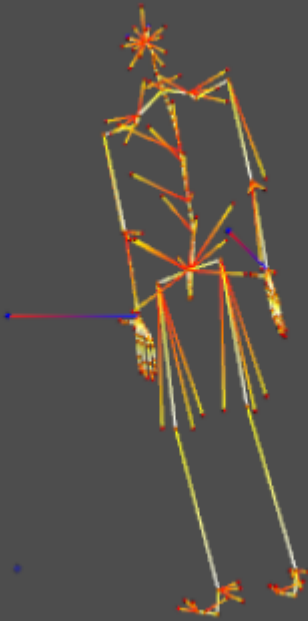
Run

Jump

Kick

H-Anim support by X3DOM

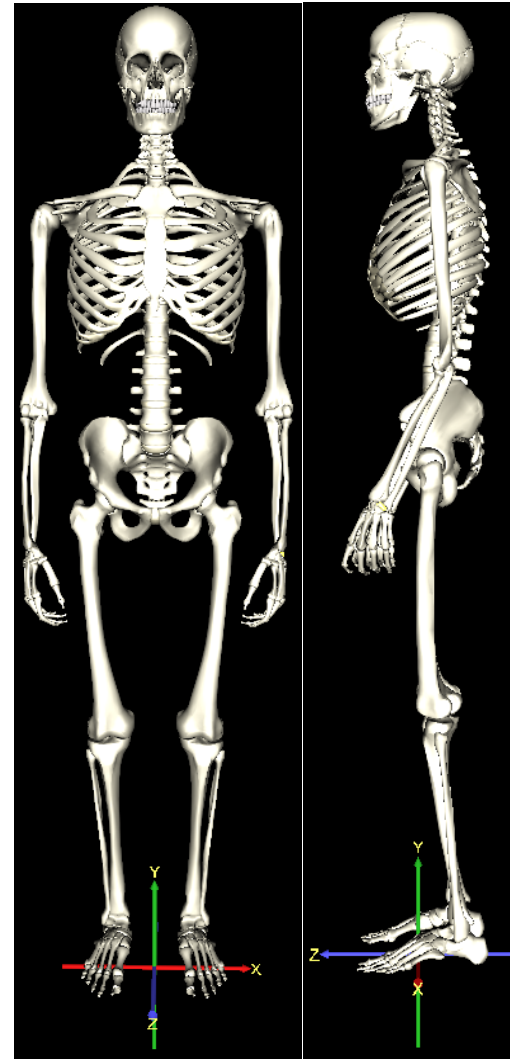
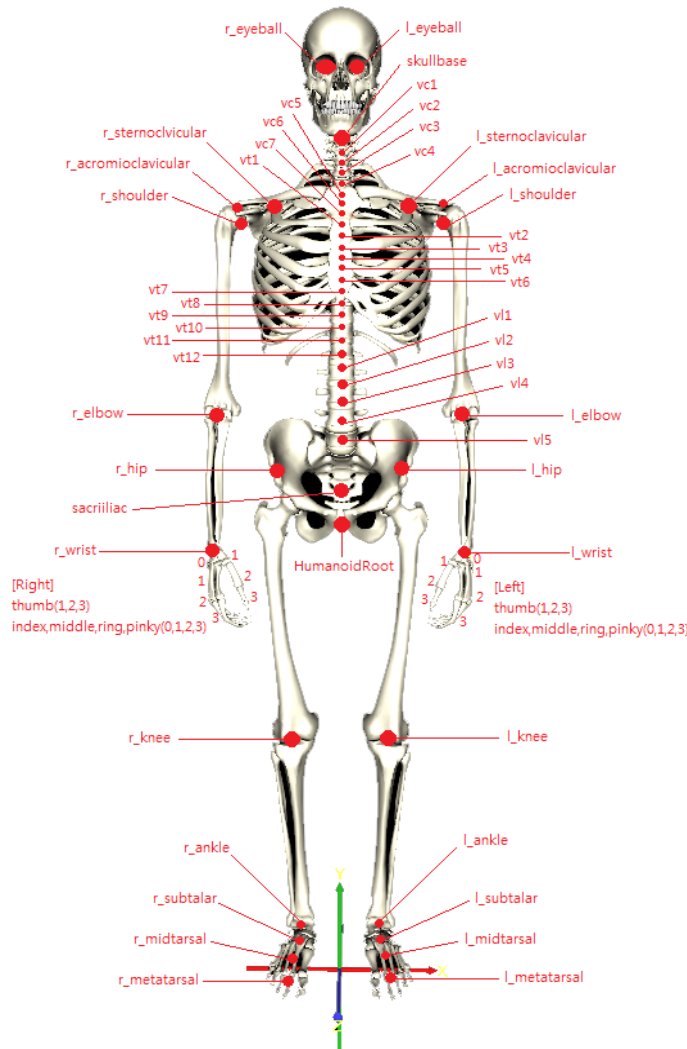
Zoom



FPS	0.09
ANIM	1.00
TRAVERSE	107.28
SORT	3.66
RENDER	223.03
DRAW	0.03
PICKING	155.17
<hr/>	
#NODES:	15,201
#SHAPES:	7,339
#DRAWS:	7,339
#POINTS:	1,243,282
#TRIS:	2,286,120

H-Anim skeleton available

<http://www.web3d.org/x3d-resources/content/examples/Basic/Medical>



LOA 4 (proposed)

Hands

- Finer detail of interior bones
- Directed Acyclic Graph (DAG) for complex joints
- More formal names for joints and segments

Feet

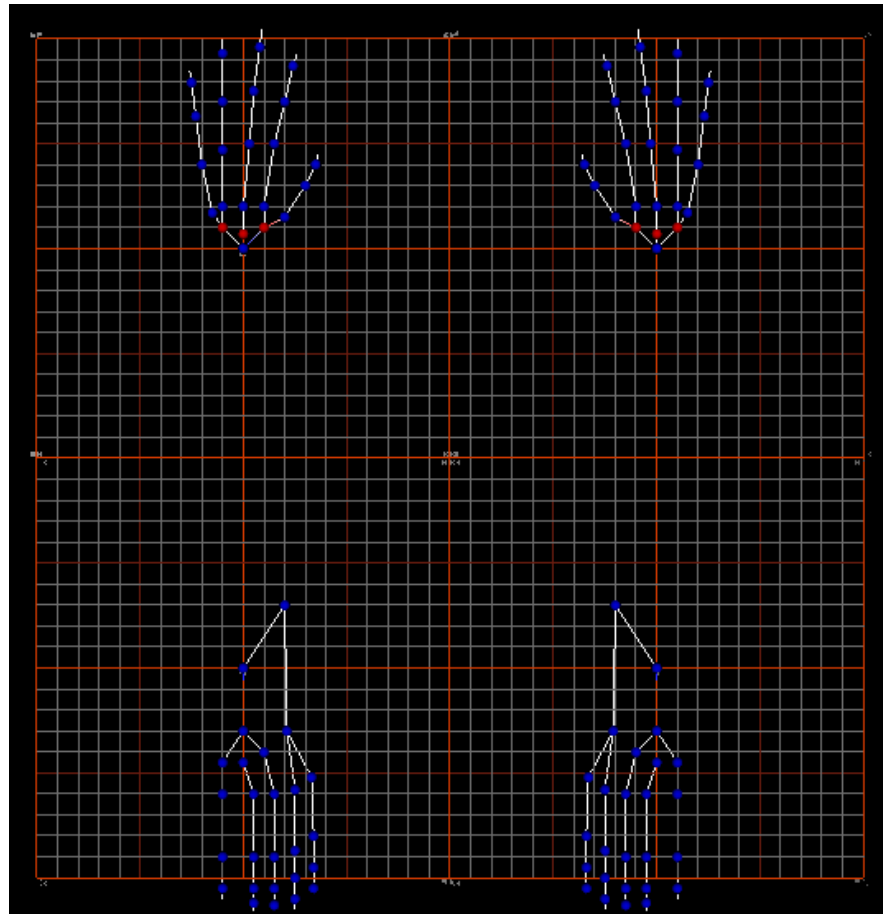
- Finer detail of interior bones
- Directed Acyclic Graph (DAG), avoid complex group

Face

- Control points for expressive skin animation

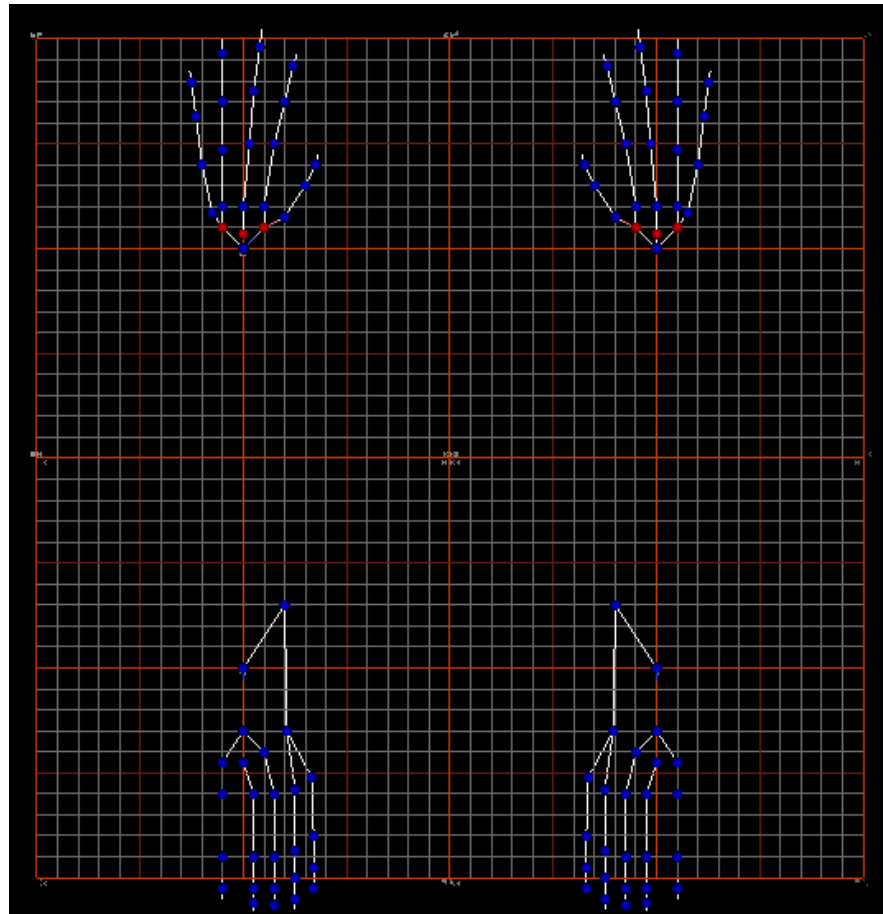
Hands

- TODO Hand model example work in progress



Feet

- TODO Foot model example work in progress



Face

- TODO initial face exemplar produced, further work in progress to create X3D exemplars

Higher LOAs? Different bodies?

Current + planned LOAs are thorough

- LOAs 0..4 can represent all externally visible human motion across fidelity range from simple animation to high-precision accuracy, compatibly increasing
- Also matches current capabilities for motion capture

Future H-Anim work might examine

- Non-visible or “floating” bones in human anatomy
- Conventions for other animals
- Conventions for cartoon characters

BVH mocap data format

History: popular mocap data format

- Biovision Hierarchy
- company now defunct, so little fear of lawsuits

Widely used and supported

- by many mocap tools and animation libraries

Informally defined

- Many ad hoc references, none appear authoritative

Add the full BVH mocap format description to H-Anim specification as informative annex?

- Precision important for what H-Anim does

BVH to X3D MOCAP conversion

Lengthy 2014 work, H-Anim Working Group

Algorithm documented on H-Anim wiki

- <http://www.web3d.org/wiki/index.php/Techniques>
- Paper by Myeong Won Lee et al.

Currently implemented in Suwon University C++
H-Anim Model and Mocap Editor

- TODO add matching Java source to X3D-Edit

NIST: BVH to H-ANIM motion capture process

- <http://ovrt.nist.gov/projects/wear/mocap>

X3D v3.4 proposed changes

H-Anim 2.x Specification functional changes

- Few (if any) major changes, better guidance
- H-Anim component level 2 adds hands, feet, face?
- Change, formalize name enumerations for hands
- Motion capture (mocap): possible new nodes?

Specification and validation

- X3D v3.4 DOCTYPE, Schema, Schematron available
- Continue to improve authoring tool support
- Hanim component level 2 needed in X3D spec?

X3D v4.0 potential changes

Integration with HTML5, X3DOM

- Already implemented in X3DOM
- Are any other specification changes expected?

X3D v4.1 potential changes

Integration with Mixed and Augmented Reality (MAR) Reference Model extensions for X3D

- Multiple aspects of MAR relate to H-Anim, including Part 3, Live Actor and Entity Representation in MAR
- Are any other specification changes for H-Anim in X3D expected?

Application Support

Players

- X3DOM, BSContact, Instant Reality, H3DViewer, OctagaVS, view3dscene, Xj3D

Authoring Tools

- Suwon University H-Anim Mocap Editor
- X3D-Edit
- BS Content Studio

Validation, Stylesheets

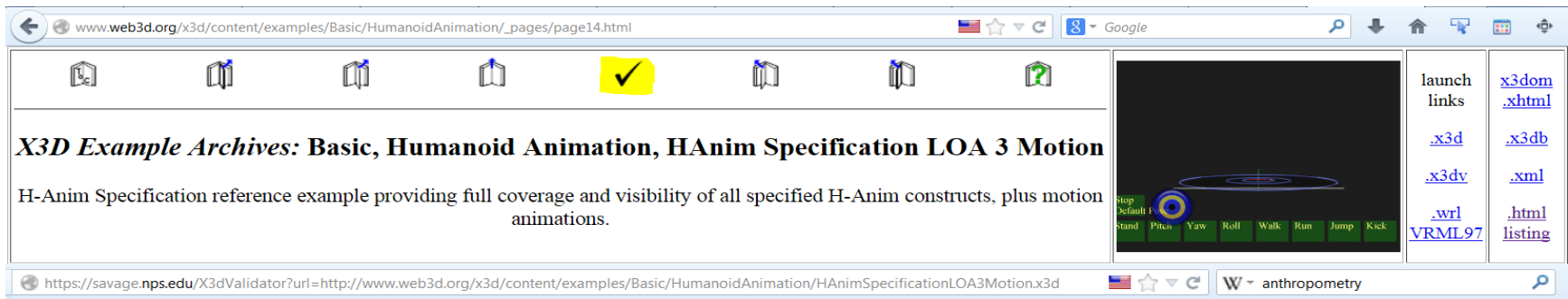
- X3D DTD, Schema, Schematron, X3D Validator
- X3D Tidy, X3dToXhtml.xslt

H-Anim implementations progress

- Reference examples found in X3D Basic archives for HumanoidAnimation
- Detailed X3D Quality Assurance (QA) tests using X3D Schematron, multiple other tests for in-depth validation of joints/segments
- X3dToXhtml.xslt stylesheet can provide automatic definition of visualization lines and shapes for illustrating H-Anim skeletons, available in X3D-Edit
- X3D Tidy conversions, visualization, cleanup

Validating H-Anim scenes

- H-Anim scenes can be quite length, complex
- Visual inspection can be insufficient – too hard!
- Use the X3D Validator to find, fix problems
- Clear all warnings to gain high confidence in results
- X3D-Edit can test correctness in all players



X3D Validator

This Web application checks X3D scene validity.



Choose a local .x3d scene:
 No file selected.

Enter an online .x3d url:

Quality Assurance (QA) Tests

X3D Header checks

- Confirm correct X3D DTD and Schema incantations

X3D DTD: element and attribute structure

- Requires approved names for joints, segments, sites

X3D Schema: strong typing value checks

- Requires approved names for joints, segments, sites

X3D Schematron

- Must have name field, DEFs meet name conventions
- Uniqueness, cross-referencing
- Matching hierarchies: Joints Segments Sites

X3dToXhtml.xslt

Pretty-print stylesheets for converting .x3d model source to .xhtml documentation

- AnyScene.x3d to AnyScene.xhtml

Includes feature for H-Anim that shows how to add geometry to visualize a skeleton

- Visualization report for HAnimHumanoid model
- HanimSpecificationLOA3Invisible.html was augmented and converted to become HAnimSpecificationLOA3Illustrated.x3d

HanimSpecificationLOA3Invisible.x3d annotations using X3dToXhtml.xslt pretty-print stylesheet

Visualization report for HAnimHumanoid model hanim_humanoid

Key to author-assist additions:

- **HAnimJoint** Suggested Shape geometry additions are provided to illustrate each HAnimJoint
- **HAnimSegment** Suggested IndexedLineSegment connections illustrate each HAnimSegment
- **HAnimSite** Suggested IndexedLineSegment and Shape geometry additions illustrate each HAnimSite
- **Viewpoint** Suggested Shape geometry additions illustrate each HAnimSite/Viewpoint combinations

```
<HAnimHumanoid DEF=hanim_humanoid name='humanoid' version ='2.0'
```

```
  info='  "authorName=Matthew T. Beitler Joe D. Williams Don Brutzman"
        "authorEmail=h-anim@web3D.org"
        "copyright=none"
        "creationDate=12 May 1999"
        "usageRestrictions=none"
        "humanoidVersion=2.0"
        "height=1.7504"
  >
```

- ```
<HAnimJoint DEF=hanim_HumanoidRoot name='HumanoidRoot' center ='0 0.824 0.0277' containerField ='skeleton' >
```

- ```
<HAnimSegment DEF=hanim_sacrum name='sacrum'>
```

- ```
<!-- <HAnimJoint name='HumanoidRoot'/> visualization sphere within <HAnimSegment name='sacrum'/> -->
```

- ```
<TouchSensor description='HAnimJoint HumanoidRoot, HAnimSegment sacrum'/>
```

- ```
<Transform translation='0 0.824 0.0277'> <Shape DEF=HAnimJointShape> <Sphere radius='0.006'/> <Appearance DEF='HAnimJointAppearance'> </Transform>
```

- ```
<!-- HAnimSegment visualization line segment from parent <HAnimJoint name='HumanoidRoot'/> to <HAnimJoint name='sacroiliac'/> -->
```

- ```
<Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.824 0.0277, 0 0.9149 0.0016'/> <ColorRGBA DEF=HAnimSegmentLineColorRGBA color=
```

- ```
<!-- HAnimSegment visualization line segment from parent <HAnimJoint name='HumanoidRoot'/> to <HAnimJoint name='v15'/> -->
```

- ```
<Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.824 0.0277, 0.0028 1.0568 -0.0776'/> <ColorRGBA USE=HAnimSegmentLineColorRGBA/
```

```
</HAnimSegment>
```

- ```
<HAnimJoint DEF=hanim_sacroiliac name='sacroiliac' center ='0 0.9149 0.0016' >
```

- ```
<HAnimSegment DEF=hanim_pelvis name='pelvis'>
```

- ```
<!-- <HAnimJoint name='sacroiliac'/> visualization sphere within <HAnimSegment name='pelvis'/> -->
```

- ```
<TouchSensor description='HAnimJoint sacroiliac, HAnimSegment pelvis'/>
```

- ```
<Transform translation='0 0.9149 0.0016'> <Shape USE=HAnimJointShape> </Transform>
```

- ```
<!-- HAnimSegment visualization line segment from parent <HAnimJoint name='sacroiliac'/> to <HAnimJoint name='l_hip'/> -->
```

- ```
<Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.9149 0.0016, 0.0961 0.9124 -0.0001'/> <ColorRGBA USE=HAnimSegmentLineColor
```

- ```
<!-- HAnimSegment visualization line segment from parent <HAnimJoint name='sacroiliac'/> to <HAnimJoint name='r_hip'/> -->
```

- ```
<Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.9149 0.0016, -0.0961 0.9124 -0.0001'/> <ColorRGBA USE=HAnimSegmentLineColor
```

X3D-Tidy 1

X3D Tidy is an XSLT stylesheet that checks for simple errors in X3D scenes and fixes them

- <http://www.web3d.org/x3d/stylesheets/X3dTidy.html>

Usage

- Selection parameters control filtering, additions
- Embedded in X3D-Edit

H-Anim functionality:

- Illustrating or cleaning HAnimHumanoid skeletons of HAnimJoint/HAnimSegment/HAnimSite nodes

X3D-Tidy 2

- Authors can use X3D Tidy to fix minor errors and apply best practices for X3D scene authoring.
- X3D Tidy provides an additional degree of Quality Assurance (QA) that helps achieve intended results in X3D scenes and metadata.
- X3D Tidy takes an .x3d scene (written using the X3D XML encoding) as input, and returns a modified .x3d scene as output. Any corrections are applied in place without changing the overall formatting or layout of the original X3D scene.
- X3D Tidy does not attempt to make scene corrections which might change intended scene content or require an authoring decision.

X3D Tidy for H-Anim

Special features for H-Anim

- Can automatically remove Shape geometry while leaving HAnimHumanoid joint/segment/site/viewpoint nodes (i.e. the skeleton) intact
- Can add visualization geometry to HAnim skeleton
- Thus automates pretty-print stylesheet capability
- TODO option to insert bone geometry for segments in HAnim skeleton

X3D Tidy launch panel in X3D-Edit

X3D Conversions: X3D Tidy

Conversions

- conversionRequired
- fixMFStringQuotes
- fixMetaNamesMatchDublinCore
- replaceBlackEmissiveColor
- modifyX3dVersion
- fixDateFormats
- changeJavascriptEcmaScript
- insertMissingEcmaScript

url addresses

- prependX3dBeforeWrIAddresses
- appendWrIAfterX3dAddresses
- fixUrlAdditionHttpAddresses
-
- insertMissingMetaLicense
-

Geospatial

- fixGeoSystemMetadata

Humanoid Animation (H-Anim)

- HAnimGeometryRemove
- HAnimSkeletonIllustrate
- HAnimSiteIllustrate
- HAnimViewpointIllustrate
- HAnimAddBoneSegments

HAnim Illustrate visualization preferences

| | | | |
|----------------|--------------------------------------|---------------------------------------|--------------------------------------|
| jointColor | <input type="text" value="1 0.5 0"/> | <input type="color" value="#ff8000"/> | <input type="text" value="#ff8000"/> |
| segmentColor | <input type="text" value="1 1 0"/> | <input type="color" value="#ffff00"/> | <input type="text" value="#ffff00"/> |
| siteColor | <input type="text" value="1 0 0"/> | <input type="color" value="#ff0000"/> | <input type="text" value="#ff0000"/> |
| viewpointColor | <input type="text" value="0 0 1"/> | <input type="color" value="#0000ff"/> | <input type="text" value="#0000ff"/> |

Continue Reset Cancel Help

X3D Nodes and Examples

Naming rules

Hanim nodes contain both *name*, DEF fields

- Match by adding humanoid's name as prefix to DEF
- Thus allows including multiple HanimHumanoids in a single scene without ambiguity
- Parent/child node relationships are strict for paired HanimJoint, corresponding HanimSegment nodes (preventing foot segment in mouth joint, etc.)
- X3D Schematron warns if names mismatch, helpful for validating full complexity of human models
- Can ignore name validation if non-human humanoid

HAnimHumanoid node 1

The HAnimHumanoid node is used to

- store references to the joints, segments, sites, skin and viewpoints,
- serve as a container for the entire humanoid,
- provide convenient way of moving the entire humanoid through its environment, and
- store human-readable data such as author and copyright information.

HAnimHumanoid top-level children can contain:

- HAnimJoint, HAnimSegment, HanimSite, Viewpoint, Coordinate/CoordinateDouble, Normal nodes

HAnimHumanoid node 2

- First child is HanimHumanoidRoot
- Viewpoint nodes DEFINed outside of skeleton can follow body without relative motion

USE nodes follow skeleton

- Provide easy references for H-Anim tool support
- Provide hooks for Inverse Kinematics (IK) engines

HAnimHumanoid panel X3D-Edit

Edit HAnimHumanoid

DEF hanim_Jin -- containerField

USE children

fields | info table

name Jin

version 2.0

translation 0 0 0 Apply scaling factor...

center 0 0 0 Apply scaling factor...

scale 0.0225 0.0225 0.0225 Insert scale factor...

rotation 0 0 1 0

scaleOrientation 0 0 1 0

normalize rotation and scaleOrientation values

bboxCenter 0 0 0

bboxSize -1 -1 -1

HAnimHumanoid serves as a container for the entire humanoid, provides a convenient way of moving the humanoid to different locations, and stores references to the joints, segments, sites, skin and viewpoint nodes.

Visualize

Edit HAnimHumanoid

DEF hanim_Jin -- containerField

USE children

fields | **info table**

| name | value |
|-------------------|----------------------------------|
| authorName | Chul Hee Jung and Myeong Won Lee |
| authorEmail | myeongwonlee@gmail.com |
| copyright | |
| creationDate | 31 March 2011 |
| usageRestrictions | |
| humanoidVersion | 2.0 |
| age | |
| gender | female |
| height | 1.5 |
| weight | |

Row edit:

Cell edit: Assign cell value: to selected cell

HAnimHumanoid serves as a container for the entire humanoid, provides a convenient way of moving the humanoid to different locations, and stores references to the joints, segments, sites, skin and viewpoint nodes.

Visualize

HAnimHumanoid attributes

- *name* is required, must be unique so that HAnimHumanoid can be identified at runtime for animation purposes
- *version* is required
 - *version*='2.0' for approved H-Anim ISO 19774,
 - *version*='2.2' for current experimentation
- *translation, rotation, scale, scaleOrientation, bboxCenter, bboxSize*: same as Transform
- *center* is translation offset from origin of the local coordinate system
- *containerField*='children' as regular child node

HAnimHumanoid *info* attribute

- *info* contains array of metadata settings expressed as MFString key=value pairs
- approved keyword terms: humanoidVersion
authorName authorEmail copyright
creationDate usageRestrictions age gender
height and weight
- Example: *info='* "authorName=Chul Hee Jung and Myeong Won Lee"
"authorEmail=myeongwonlee@gmail.com"
"creationDate=31 March 2011"
"humanoidVersion=2.0" "gender=female"
"height=1.5" *'*

HAnimHumanoid tooltips

| | | |
|---|---|--|
| <p> HAnimHumanoid</p> | <p>The HAnimHumanoid node is used to: (a) store references to the joints, segments, sites, skin and viewpoints, (b) serve as a container for the entire humanoid, (c) provide a convenient way of moving the humanoid through its environment, and (d) store human-readable data such as author and copyright information. HAnimHumanoid contains HAnimJoint, HAnimSegment, HAnimSite, Coordinate/CoordinateDouble, Normal, and Viewpoint nodes.</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Humanoid</p> <p>Hint: include <code><component name='H-Anim' level='1'/></code></p> | <p>X3D validation:
Schema, DOCTYPE</p> |
| <p>DEF</p> | <p>[DEF ID #IMPLIED]
DEF defines a unique ID name for this node, referencable by other nodes.
Hint: descriptive DEF names improve clarity and help document a model.
Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions</p> | |
| <p>USE</p> | <p>[USE IDREF #IMPLIED]
USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).
Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.
Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.
Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| <p>name</p> | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]
Unique name attribute must be defined so that HAnimHumanoid node can be identified at runtime for animation purposes.</p> | |
| <p>version</p> | <p>[version accessType inputOutput, type SFString CDATA (2.0) #REQUIRED]
HAnimHumanoid version, where standardized ISO 19774 value is 2.0.
Warning: prior versions of HAnim nodes might not validate correctly.</p> | |
| <p>info</p> | <p>[info accessType inputOutput, type MFString CDATA #IMPLIED]
Metadata keyword=value pairs, where approved keyword terms are humanoidVersion authorName authorEmail copyright creationDate usageRestrictions age gender height and weight.</p> | |
| <p>translation</p> | <p>[translation accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Position of children relative to local coordinate system.</p> | |
| <p>rotation</p> | <p>[rotation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
Orientation of children relative to local coordinate system.</p> | |
| <p>scale</p> | <p>[scale accessType inputOutput, type SFVec3f CDATA "1 1 1"]
Non-uniform x-y-z scale of child coordinate system, adjusted by center and scaleOrientation.</p> | |
| <p>scaleOrientation</p> | <p>[scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations).</p> | |
| <p>center</p> | <p>[center accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Translation offset from origin of local coordinate system.</p> | |
| <p>bboxCenter</p> | <p>[bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]
Bounding box center: position offset from origin of local coordinate system.</p> | |
| <p>bboxSize</p> | <p>[bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]
Bounding box size: automatically calculated, can be specified as an optimization or constraint.</p> | |
| <p>containerField</p> | <p>[containerField NMTOKEN "children"]
containerField is the field-label prefix indicating relationship to parent node.
Examples: geometry Box, children Group, proxy Shape.
Hint: containerField attribute is only supported in XML encoding of X3D scenes.</p> | |

HAnimJoint node, attributes

- Contained by HAnimHumanoid, HAnimJoint
- Contains HAnimSegment or HanimJoint with corresponding name from skeletal hierarchy
- *name* is required, must be unique so that HAnimJoint can be identified at runtime for animation and parent/child checks
- *translation, rotation, scale, scaleOrientation, bboxCenter, bboxSize*: same as Transform
- *center* is translation offset from origin of the local coordinate system
- *containerField*='children' as regular child node

HAnimJoint attributes 2

- *ulimit, llimit*: upper, lower limits for maximum joint rotation in radians. Always contains 3 values, one for each local axis.
- *limitOrientation*: orientation of upper/lower rotation limits, relative to HAnimJoint center.
- *skinCoordIndex*: coordinate index values referencing vertices influenced by the joint.
- *skinCoordWeight*: weight deformation values for corresponding *skinCoordIndex* values.
- *stiffness*: axial willingness of joint to move, larger values means greater resistance

HAnimJoint panel X3D-Edit

Edit HAnimJoint

DEF: hanim_HumanoidRoot containerField

USE: hanim_l_hip skeleton

name: HumanoidRoot

limit:

limitOrientation:

skinCoordIndex:

skinCoordWeight:

stiffness:

translation: Apply scaling factor...

center: Apply scaling factor...

scale: Insert scale factor...

rotation:

scaleOrientation:

bboxCenter:

bboxSize:

HAnimJoint is used to represent each joint in the body.
Parent node must be another **HAnimJoint** or else the HAnimHumanoid node.
HAnimJoint can only contain HAnimSegment or HAnimJoint as children nodes.

HAnimJoint tooltips 1

| | | |
|----------------------------|--|---|
| J <u>HAnimJoint</u> | <p>Each joint in the body is represented by an HAnimJoint node.</p> <p>Hint: HAnimJoint may only be a child of another HAnimJoint node, or skeleton field for the HAnimHumanoid.</p> <p>Hint: HAnimJoint can only contain HAnimSegment or HAnimJoint as children nodes.</p> <p>Warning: an HAnimJoint may not be a child of an HAnimSegment.</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Joint</p> <p>Hint: include <component name='H-Anim' level='1' /></p> | <p>X3D validation:
 Schema, DOCTYPE</p> |
| DEF | <p>[DEF ID #IMPLIED]</p> <p>DEF defines a unique ID name for this node, referencable by other nodes.</p> <p>Hint: descriptive DEF names improve clarity and help document a model.</p> <p>Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions</p> | |
| USE | <p>[USE IDREF #IMPLIED]</p> <p>USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).</p> <p>Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.</p> <p>Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.</p> <p>Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| name | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]</p> <p>Unique name attribute must be defined so that HAnimJoint node can be identified at runtime for animation purposes.</p> <p>Examples: HumanoidRoot sacroiliac 1_hip 1_knee 1_ankle etc. listed in H-Anim Specification.</p> <p>Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimJointNames19774V1.0.txt</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/concepts.html#Hierarchy</p> | |
| center | <p>[center accessType inputOutput, type SFVec3f CDATA "0 0 0"]</p> <p>Translation offset from origin of local coordinate system.</p> <p>Hint: usually HAnimJoint position is controlled by the center field, not the translation field.</p> | |
| translation | <p>[translation accessType inputOutput, type SFVec3f CDATA "0 0 0"]</p> <p>Position of children relative to local coordinate system.</p> <p>Warning: usually HAnimJoint position is controlled by the center field, not the translation field.</p> | |
| rotation | <p>[rotation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]</p> <p>Orientation of children relative to local coordinate system.</p> | |
| scale | <p>[scale accessType inputOutput, type SFVec3f CDATA "1 1 1"]</p> <p>Non-uniform x-y-z scale of child coordinate system, adjusted by center and scaleOrientation.</p> | |
| scaleOrientation | <p>[scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]</p> <p>Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations).</p> | |

HAnimJoint tooltips 2

| | |
|------------------|---|
| scaleOrientation | [scaleOrientation accessType inputOutput , type SFRotation CDATA "0 0 1 0"]
Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations). |
| ulimit | [ulimit accessType inputOutput , type MFFloat CDATA #IMPLIED]
Upper limit for maximum joint rotation in radians.
Hint: always contains 3 values, one for each local axis. |
| llimit | [llimit accessType inputOutput , type MFFloat CDATA #IMPLIED]
Lower limit for minimum joint rotation in radians.
Hint: always contains 3 values, one for each local axis. |
| limitOrientation | [limitOrientation accessType inputOutput , type SFRotation CDATA "0 0 1 0"]
Orientation of upper/lower rotation limits, relative to HAnimJoint center. |
| skinCoordIndex | [skinCoordIndex accessType inputOutput , type MFInt32 CDATA #IMPLIED]
Coordinate index values referencing which vertices are influenced by the joint. |
| skinCoordWeight | [skinCoordWeight accessType inputOutput , type MFFloat CDATA #IMPLIED]
Weight deformation values for the corresponding values in the skinCoordIndex field. |
| stiffness | [stiffness accessType inputOutput , type MFFloat CDATA "0 0 0" (0,1)]
value (0,1) indicating willingness of joint to move larger stiffness values means greater resistance (about local X, Y, Z axes).
Hint: used by inverse kinematics systems. |
| bboxCenter | [bboxCenter accessType initializeOnly , type SFVec3f CDATA "0 0 0"]
Bounding box center: position offset from origin of local coordinate system. |
| bboxSize | [bboxSize accessType initializeOnly , type SFVec3f CDATA "-1 -1 -1"]
Bounding box size: automatically calculated, can be specified as an optimization or constraint. |
| containerField | [containerField NMTOKEN "children"]
containerField is the field-label prefix indicating relationship to parent node.
Examples: geometry Box, children Group, proxy Shape.
Hint: containerField attribute is only supported in XML encoding of X3D scenes. |
| class | [class CDATA #IMPLIED]
class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes. |

HAnimSegment node, attributes

- Body segments are stored by HAnimSegment
- Contained by HAnimJoint with corresponding name from skeletal hierarchy
- Contains Coordinate/CoordinateDouble, HAnimDisplacer, children (other geometry)
- *name* is required, must be unique so that HAnimSegment can be identified at runtime for animation and parent/child checks
- *mass*: total mass of segment, 0 if unavailable.
- *centerOfMass*: relative location within segment
- *momentsOfInertia*: 3x3 inertia matrix

HanimSegment panel X3D-Edit

Edit HAnimSegment

DEF -- containerField

USE children

name

centerOfMass

mass

momentsOfInertia

bboxCenter

bboxSize

HAnimSegment contains each body segment

Visualize

HAnimSegment tooltips

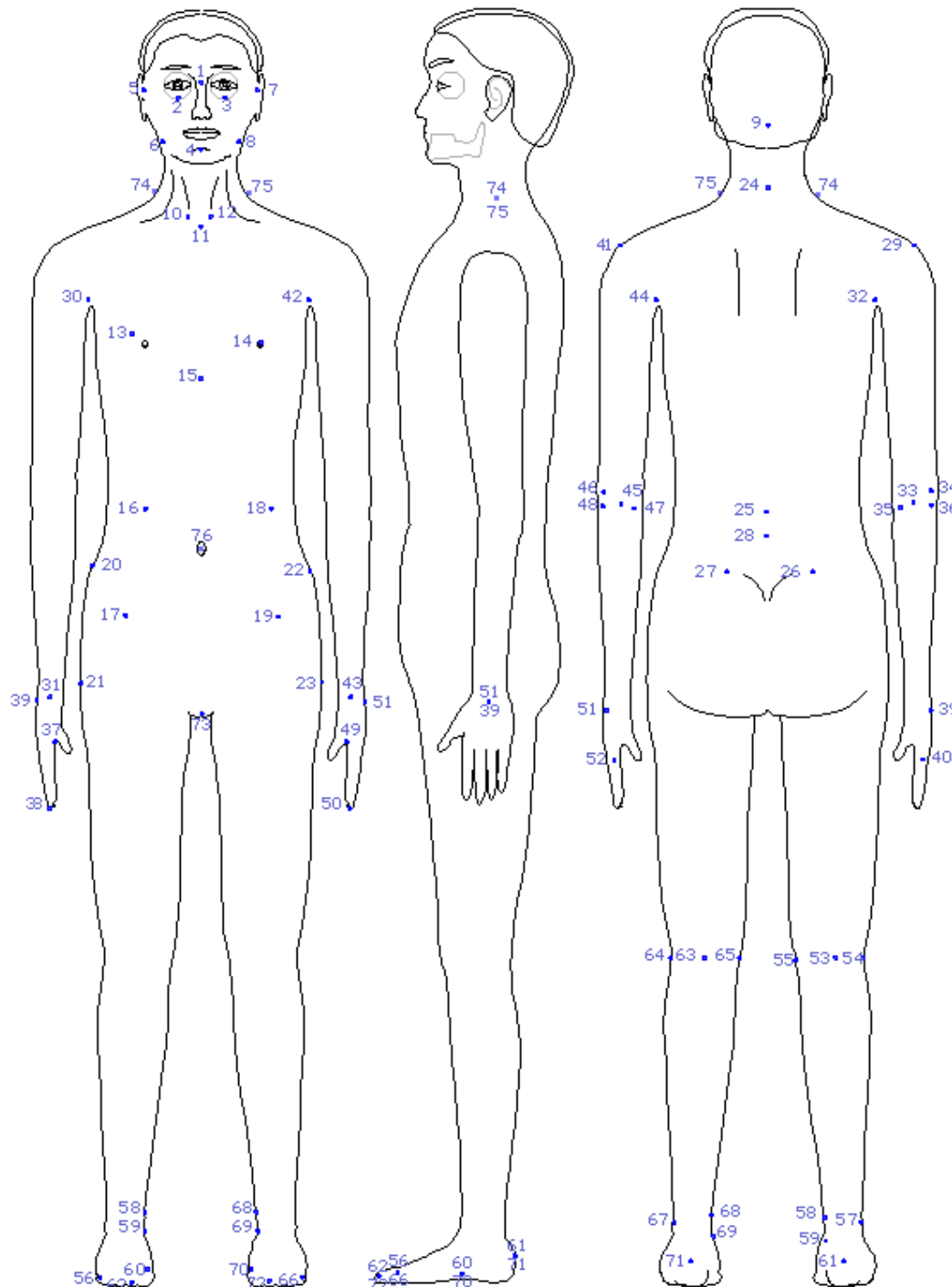
| | | |
|---|--|--|
|  <u>HAnimSegment</u> | <p>Each body segment is stored in an HAnimSegment node. HAnimSegment contains Coordinate/CoordinateDouble, HAnimDisplacer and children nodes.</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Segment</p> <p>Hint: <code>include <component name='H-Anim' level='1'/></code></p> | <p>X3D validation:
Schema, DOCTYPE</p> |
| DEF | <p>[DEF ID #IMPLIED]
DEF defines a unique ID name for this node, referencable by other nodes.</p> <p>Hint: descriptive DEF names improve clarity and help document a model.</p> <p>Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions</p> | |
| USE | <p>[USE IDREF #IMPLIED]
USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).</p> <p>Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.</p> <p>Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.</p> <p>Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| name | <p>[name accessType inputOutput, type SFSstring CDATA #REQUIRED]
Unique name attribute must be defined so that HAnimSegment node can be identified at runtime for animation purposes.</p> <p>Examples: sacrum pelvis l_thigh l_calf etc. listed in H-Anim Specification.</p> <p>Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimSegmentNames19774V1.0.txt</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/concepts.html#Hierarchy</p> | |
| mass | <p>[mass accessType inputOutput, type SFFloat CDATA "0"]
Total mass of the segment, 0 if not available.</p> | |
| centerOfMass | <p>[centerOfMass accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Location within segment of center of mass.</p> | |
| momentsOfInertia | <p>[momentsOfInertia accessType inputOutput, type MFFloat CDATA "0 0 0 0 0 0 0 0"]
3x3 moments of inertia matrix. default: 0 0 0 0 0 0 0 0.</p> | |
| bboxCenter | <p>[bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]
Bounding box center: position offset from origin of local coordinate system.</p> | |
| bboxSize | <p>[bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]
Bounding box size: automatically calculated, can be specified as an optimization or constraint.</p> | |
| containerField | <p>[containerField NMTOKEN "children"]
containerField is the field-label prefix indicating relationship to parent node.</p> <p>Examples: geometry Box, children Group, proxy Shape.</p> <p>Hint: containerField attribute is only supported in XML encoding of X3D scenes.</p> | |
| class | <p>[class CDATA #IMPLIED]
class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes.</p> | |

HAnimSite node

- Contained by HanimSegment
- Can contain Shape or Viewpoint
- HAnimSite node serves three purposes:
 - define an "end effector" location which can be used by an inverse kinematics system,
 - define an attachment point for accessories such as jewelry and clothing, and
 - define a location for a virtual camera in the reference frame of an HAnimSegment (such as a view "through the eyes" of the humanoid)

HAnimSite attributes

- *name* is required, must be unique so that HAnimSite can be identified at runtime for animation and parent/child checks
 - List of names provided by H-Anim specification
 - Authors may define other sites as well
- *translation, rotation, scale, scaleOrientation, bboxCenter, bboxSize*: same as Transform
- *center* is translation offset from origin of the local coordinate system
- *containerField*='children' as regular child node



HanimSite panel X3D-Edit

Edit HAnimSite

DEF hanim_l_middle_distal_tip -- containerField

USE hanim_r_middle_distal_tip children

name l_middle_distal_tip

| | | | | |
|------------------|-------|--------|--------|-------------------------|
| translation | 0.095 | 0.0005 | 0.1924 | Apply scaling factor... |
| center | 0 | 0 | 0 | Apply scaling factor... |
| scale | 1 | 1 | 1 | Insert scale factor... |
| rotation | 0 | 0 | 1 | 0 |
| scaleOrientation | 0 | 0 | 1 | 0 |

normalize rotation and scaleOrientation values

| | | | |
|------------|----|----|----|
| bboxCenter | 0 | 0 | 0 |
| bboxSize | -1 | -1 | -1 |

HAnimSite nodes define an end-effector location for inverse kinematics (IK), an attachment point for accessories such as jewelry and clothing, or a location for a virtual camera.

Visualize

HAnimSite tooltips

| | | |
|------------------------------------|---|---|
| <p>☐ HAnimSite</p> | <p>An HAnimSite node serves three purposes: (a) define an "end effector" location which can be used by an inverse kinematics system, (b) define an attachment point for accessories such as jewelry and clothing, and (c) define a location for a virtual camera in the reference frame of an HAnimSegment (such as a view "through the eyes" of the humanoid for use in multi-user worlds).
 Hint: HAnimSites are stored as children of an HAnimSegment node.
 Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification
 Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Site
 Hint: include <component name='H-Anim' level='1'/></p> | <p>X3D validation:
 Schema, DOCTYPE</p> |
| DEF | <p>[DEF ID #IMPLIED]
 DEF defines a unique ID name for this node, referencable by other nodes.
 Hint: descriptive DEF names improve clarity and help document a model.
 Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions</p> | |
| USE | <p>[USE IDREF #IMPLIED]
 USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).
 Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.
 Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.
 Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| name | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]
 Unique name attribute must be defined so that HAnimSite node can be identified at runtime for animation purposes.
 Examples: cervicale 1_infraorbitale supramenton etc. listed in H-Anim Specification.
 Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimSiteLoa3Names19774V1.0.txt
 Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/BodyDimensionsAndLOAs.html#LOA3DefaultSiteTranslations</p> | |
| translation | <p>[translation accessType inputOutput, type SFVec3f CDATA "0 0 0"]
 Position of children relative to local coordinate system.</p> | |
| rotation | <p>[rotation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
 Orientation of children relative to local coordinate system.</p> | |
| scale | <p>[scale accessType inputOutput, type SFVec3f CDATA "1 1 1"]
 Non-uniform x-y-z scale of child coordinate system, adjusted by center and scaleOrientation.</p> | |
| scaleOrientation | <p>[scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
 Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations).</p> | |
| center | <p>[center accessType inputOutput, type SFVec3f CDATA "0 0 0"]
 Translation offset from origin of local coordinate system.</p> | |
| bboxCenter | <p>[bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]
 Bounding box center: position offset from origin of local coordinate system.</p> | |
| bboxSize | <p>[bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]
 Bounding box size: automatically calculated, can be specified as an optimization or constraint.</p> | |
| containerField | <p>[containerField NMTOKEN "children"]
 containerField is the field-label prefix indicating relationship to parent node.
 Examples: geometry Box, children Group, proxy Shape.
 Hint: containerField attribute is only supported in XML encoding of X3D scenes.</p> | |
| class | <p>[class CDATA #IMPLIED]
 class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes.</p> | |

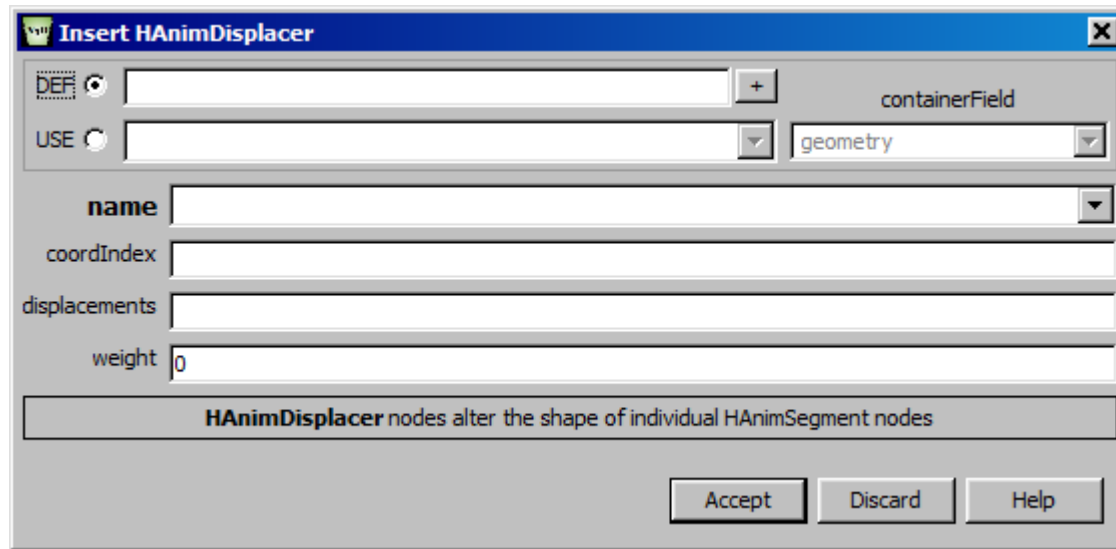
HAnimDisplacer node

- HAnimDisplacer nodes are used to alter the shape of individual segments. Three uses:
 - Identify vertices corresponding to a particular feature on the HAnimSegment,
 - Represent a particular muscular action displacing vertices in various directions (linearly or radially),
 - Represent a complete configuration of the vertices in an HAnimSegment. For example, there might be an HAnimDisplacer for each facial expression.
- Multiple HAnimDisplacer nodes must appear consecutively inside parent HAnimSegment

HAnimDisplacer attributes

- *name* is required, must be unique so that HAnimDisplacer can be identified at runtime for animation and parent/child checks
 - *name* suffixes include *_feature*, *_action* and *_config*
- *name* matches Surface feature points
 - Provided in text table of values
 - Provided in Annex B of H-Anim Specification
- *displacements*: array of 3D values added to neutral or resting position of HAnimSegment vertex sets referenced by *coordIndex* field
- *coordIndex*: defines how coordinate array of HAnimSegment vertices is affected

HanimDisplacer panel X3D-Edit



HAnimDisplacer tooltips

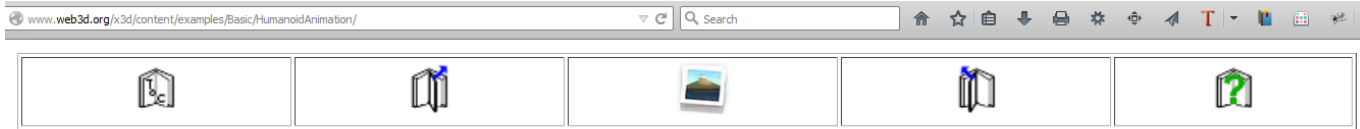
| | | |
|---|---|--|
|  <u>HAnimDisplacer</u> | <p>HAnimDisplacer nodes are used to alter the shape of individual segments. HAnimDisplacer can be used in three different ways: (a) identify vertices corresponding to a particular feature on the HAnimSegment, (b) represent a particular muscular action displacing vertices in various directions (linearly or radially), and (c) represent a complete configuration of the vertices in an HAnimSegment. For example, in the case of a face, there might be an HAnimDisplacer for each facial expression.</p> <p>Hint: name suffixes include <code>_feature</code>, <code>_action</code> and <code>_config</code>. Multiple HAnimDisplacer nodes must appear consecutively inside HAnimSegment.</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Displacer</p> <p>Hint: include <code><component name='H-Anim' level='1'/></code></p> | <p>X3D validation:
Schema, DOCTYPE</p> |
| DEF | <p>[DEF ID #IMPLIED]
DEF defines a unique ID name for this node, referencable by other nodes</p> | |
| USE | <p>[USE IDREF #IMPLIED]
USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).</p> <p>Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.</p> <p>Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.</p> <p>Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| name | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]
Unique name attribute must be defined so that HAnimDisplacer node can be identified at runtime for animation purposes.</p> <p>Examples: sellion r_infraorbitale etc. listed in H-Anim Specification.</p> <p>Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimFeaturePoints19774V1.0.txt</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/FeaturePoints.html</p> | |
| coordIndex | <p>[coordIndex accessType inputOutput, type MFInt32 CDATA #IMPLIED]
Defines coordinate array of HAnimSegment vertices affected by HAnimDisplacer indices provide order in which coordinates are applied order starts at index 0, commas are optional between sets use -1 to separate indices for each feature</p> | |
| displacements | <p>[displacements accessType inputOutput, type MFVec3f CDATA #IMPLIED]
Set of 3D values added to neutral or resting position of each set of HAnimSegment vertices referenced by coordIndex field</p> | |
| weight | <p>[weight accessType inputOutput, type SFFloat CDATA 0.0]
Scale displacements using weight value before adding them to neutral vertex positions.</p> | |
| containerField | <p>[containerField NMTOKEN "displacers"]
containerField is the field-label prefix indicating relationship to parent node.</p> <p>Examples: geometry Box, children Group, proxy Shape.</p> <p>Hint: containerField attribute is only supported in XML encoding of X3D scenes.</p> | |
| class | <p>[class CDATA #IMPLIED]
class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes.</p> | |

Support

The following tables of information are related to the H-Anim specification and corresponding X3D H-Anim component. They are provided for developer use.

| | Plain Text Data Tables | Specification Descriptions |
|------|---|--|
| 1 | HAnimHierarchyWeb3d-19774-V1.0.txt | Text-based node hierarchy from approved ISO standard: H-Anim Specification, 4.9.5 Hierarchy. |
| 3 | HAnimHierarchyWithSites.txt | Hierarchy of joints, segments with corresponding surface-feature sites (based on skeletal proximity) |
| 4 | HAnimJointNames19774V1.0.txt | List of approved HAnimJoint names. <ul style="list-style-type: none"> • Table 4.2 - Body Joint object names • Table 4.3 - Hand Joint object names • Table 4.4 - Face Joint object names |
| 5 | HAnimSegmentNames19774V1.0.txt | Approved HAnimSegment names, excerpted from H-Anim Specification, 4.9.5 Hierarchy. |
| 6..9 | HAnimJointLoa0Names19774V1.0.txt
HAnimSiteLoa0Names19774V1.0.txt | List of approved HAnimSite names, LOA 0 to 3. |
| 10 | HAnimSurfaceFeaturePoints19774V1.0.txt | Surface feature points, used by HAnimDisplacer nodes. |
| 11 | SiteNameComparisonsByLOA.xlsx | Site names comparison by LOA, constructed from preceding text tables. |

Examples



X3D Example Archives: Basic, Humanoid Animation



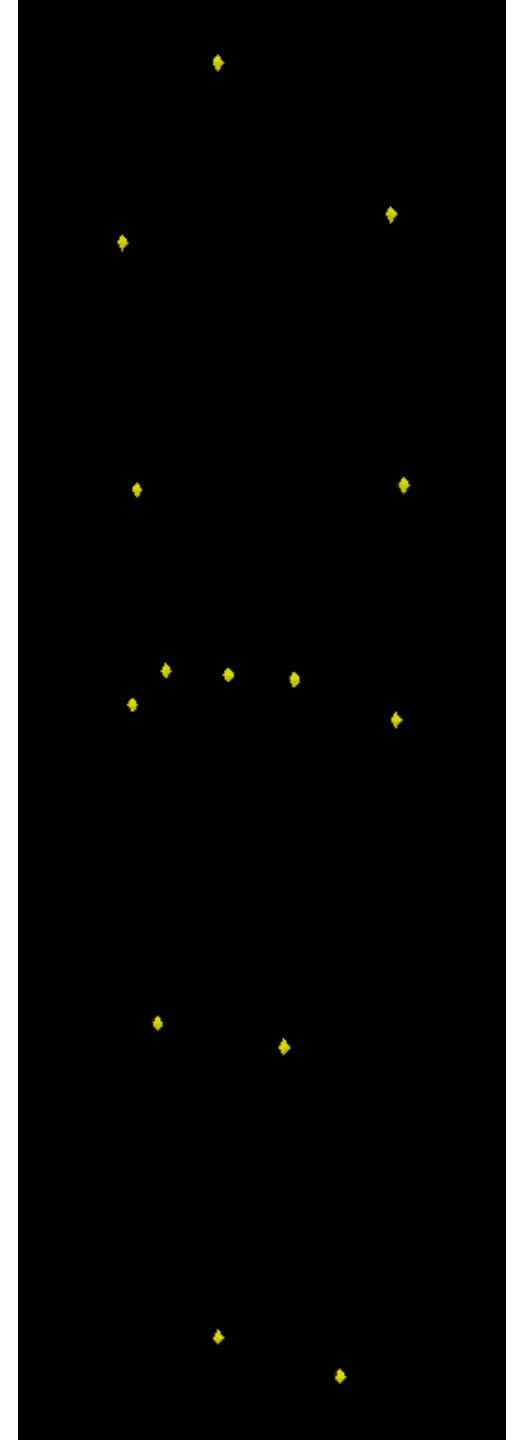
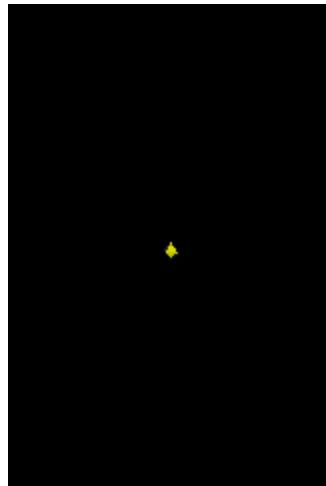
These Humanoid Animation (H-Anim) examples support the ISO [Humanoid Animation \(H-Anim\) Specification](#) with a corresponding specification for ISO [X3D Abstract Specification H-Anim component](#).

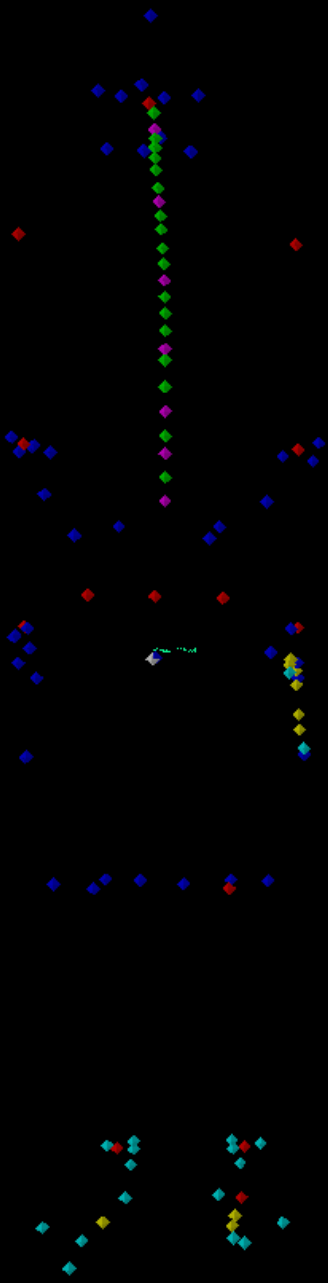
The [H-Anim Working Group Executive Summary](#) summarizes current capabilities. Prior original efforts can be found online at hanim.org. Significant additional work is being considered by renewed efforts documented on the [H-Anim Working Group Wiki](#). Tool builders may benefit from using convenient [tables of enumeration values](#) extracted from the H-Anim Specification. Related work appears in the [Medical](#) examples.

| X3D Scenes | Descriptions |
|--|--|
| Allen Dutton | Articulated human model developed from laser-scan data in x3d Native Tags. |
| Allen Dutton Blurry Motion | Articulated human model developed from laser-scan data in x3d Native Tags. Motions of the avatar are blurry. |

Diamond Man

- DiamondManLOA-0.x3d
- DiamondManLOA-1.x3d
- DiamondManLOA-2.x3d
(includes visual key)





Diamond Man Key

- Minimal Humanoid Joints
- Humanoid Joints
- Recommended Spinal Joints
- Spinal Joints
- Hand & Feet Joints
- Humanoid Sites

Interchangable Actors Via Dynamic Routing Prototypes

X3D Example Archives: Basic, Humanoid Animation, Interchangable Actors Via Dynamic Routing Prototypes

This example demonstrates interchangeability of avatars (Nancy, Allen, Boxman) and animation behaviors (Stand, Run, Jump, Walk) via dynamic routing.

- [.x3d model](#)
- [.xhtml](#)
- [.wrl VRML97](#)
- [.x3dv](#)
- [.html listing](#)
- [.x3dom .xhtml](#)
- [.json encoding](#)
- [.x3db](#)
- [.xml view](#)

VOICE PANEL
VOICE INPUT
Initiate Actors

WHAT TO SAY?

- Nancy
- Allen
- Box Man
- Switch To Nancy
- Switch To Allen
- Switch To Box Man
- Display Nancy
- Display Allen
- Display Box Man
- Tura Into Nancy
- Tura Into Allen
- Tura Into Box Man
- Jump
- Run
- Walk
- Kneel
- Stand
- Why Don't You Jump
- Why Don't You Run
- Why Don't You Walk
- Why Don't You Kneel
- Why Don't You Stand
- Could You Jump
- Could You Run
- Could You Walk
- Could You Kneel
- Could You Stand
- Please Run
- Please Jump
- Please Walk
- Please Kneel
- Please Stand
- Good bye
- So long

ALLEN
NANCY
BOXMAN

Stand Walk Run Jump Kneel

Korean Characters

- 12 characters at LOA 1 and 2
- Authored in 3DS Max and Maya
- Testing MOCAP conversions
- Confirming best practices and tool support
- Work continues, reported on h-anim mail list

LOA1 H-Anim Characters (X3D H-Anim)



1.Jin



2.Chul



3.Hyun



4.Young



5.Ju



6.Ga



7.No



8.Da



9.Ru



10.Mi



11.Min

LOA2 H-Anim Characters (X3D H-Anim)



1.Jin



11.Min

LOA-4 Models Hands and Feet

Four initial models to test improvements

- HanimModelHandLeft.x3d HanimModelHandRight.x3d
- HanimModelFootLeft.x3d HanimModelFootRight.x3d
- Checked into Basic HumanoidAnimation Examples under SourceForge version control

Next steps, work in progress:

- Incremental improvements, checked in
- X3D v3.4 DOCTYPE and XML Schema validation
- X3D Schematron rules validation
- MOCAP animation and model integration

Integrating Hanim Models, Animation

HAnimHumanoid can only have single root Joint

- Typically "Root"

How to best add portions of models? Should work since various LOAs are designed for composition.

- Root
 - HandsLeft
 - HandsRight
- Animation
 - Body interpolator
 - Left hand mocap interpolators
 - Right hand mocap interpolators

Additional Resources

Additional Resources

- Numerous...
- X3D Resources
- H-Anim working group page
- H-Anim working group wiki

Chapter Summary

Chapter Summary

H-Anim Humanoid Animation is an ISO Standard co-evolving with (and supported by) X3D.

H-Anim is designed to be implementable by a variety of different 3D graphics technologies.

H-Anim models have regular patterns of Joints and Segments to create a movable skeleton. Sites and Displacers support feature animation.

Current work includes improved support for skin, face/hands/feet, motion capture (mocap) conversions for full-fidelity animation, including usability for medically accurate records.

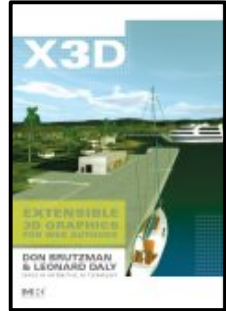
Suggested exercises

- Explore the examples both basic bodies and also behavior switching
- Animate a humanoid around a scene
- Add visualization geometry to an empty skeleton, examine the changes that occur
- List possible use cases that might take advantage of body/behavior libraries
- Investigate current technology developments in motion capture (mocap) and direct scanning of human bodies

References

References 1

X3D: Extensible 3D Graphics for Web Authors
by Don Brutzman and Leonard Daly, Morgan
Kaufmann Publishers, April 2007, 468 pages.



- Chapter 3, Grouping Nodes
- <http://x3dGraphics.com>
- <http://x3dgraphics.com/examples/X3dForWebAuthors>

X3D Resources

- <http://www.web3d.org/x3d/content/examples/X3dResources.html>

References 2

X3D-Edit Authoring Tool

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

X3D Scene Authoring Hints

- <http://x3dgraphics.com/examples/X3dSceneAuthoringHints.html>

X3D Graphics Specification

- <http://www.web3d.org/x3d/specifications>
- Also available as help pages within X3D-Edit

References 3

Basic Examples Archive, HumanoidAnimation

- <http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation>

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Monterey California 93943-5000 USA

1.831.656.2149 voice

CGEMS, SIGGRAPH, Eurographics

The Computer Graphics Educational Materials Source(CGEMS) site is designed for educators

- to provide a source of refereed high-quality content
- as a service to the Computer Graphics community
- freely available, directly prepared for classroom use
- <http://cgems.inesc.pt>

X3D for Web Authors recognized by CGEMS! 😊

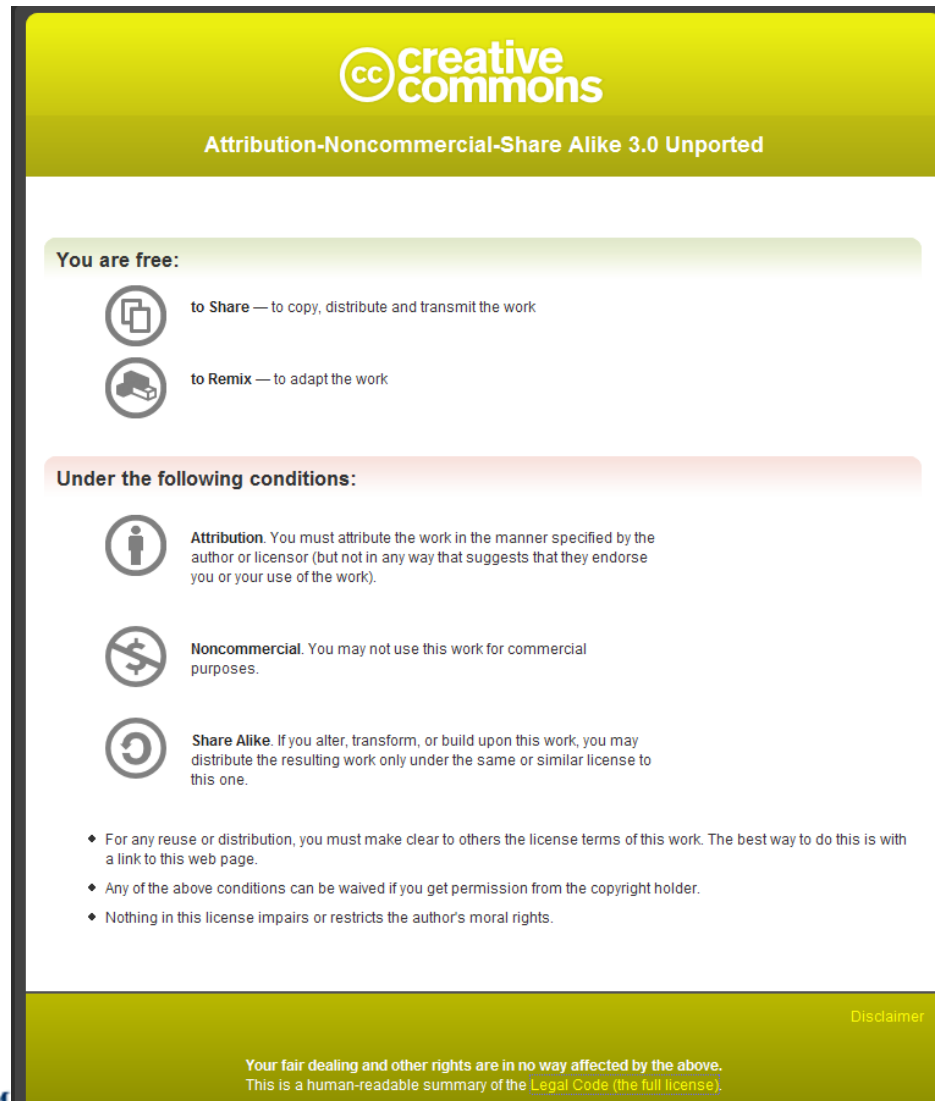
- Book materials: X3D-Edit tool, examples, slidesets
- Received jury award for Best Submission 2008

CGEMS supported by SIGGRAPH, Eurographics



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X3D Graphics for Advanced Modeling

Humanoid Animation (H-Anim)

*"Our bodies are our gardens,
to the which our wills are gardeners."*
William Shakespeare, *Othello*, Act I, Scene 3

Contents

Chapter Overview and Concepts

X3D Nodes and Examples

Additional Resources

Chapter Summary and Suggested Exercises

References



Chapter Overview



Overview

H-Anim Humanoid Animation is an ISO Standard co-evolving with (and supported by) X3D.

H-Anim is designed to be implementable by a variety of different 3D graphics technologies.

H-Anim models have regular patterns of Joints and Segments to create a movable skeleton.

Sites and Displacers support feature animation.

Current work includes improved support for skin, face/hands/feet, motion capture (mocap) conversions for full-fidelity animation, including usability for medically accurate records.

Skin, sites and displacers are also modeled.

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Concepts

Motivation

- The H-Anim International Standard is an abstract representation for modeling the skeleton and skin of 3D human figures.
- H-Anim describes a standard representation of humanoids that allows creation of human figures that can be interoperably animated, using behavior scripts or motion capture data created by a variety of modeling tools.
- Current work includes mocap plus hand, feet and face models for full human anatomy.

Relevant Specifications

- Humanoid animation (H-Anim) specification ISO/IEC 19774:2006 version 2.0 describes full semantics of H-Anim models
 - Usable in multiple languages: X3D, VRML97, etc.
- X3D Abstract Specification bindings are in Humanoid animation (H-Anim) component
- VRML97 support is provided by Prototype declarations which give full functionality

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Web3D Recommended Standards

<http://www.web3d.org/standards>

ISO/IEC 19774 Humanoid animation (H-Anim) specification

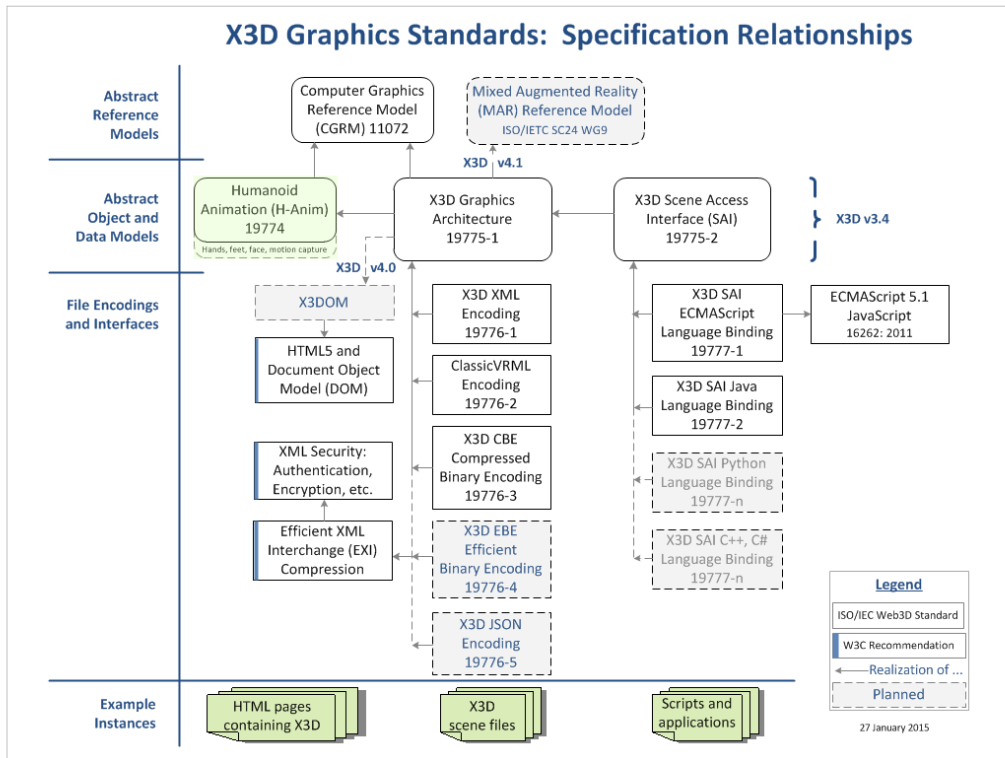
<http://www.web3d.org/documents/specifications/19774/V1.0/HAnim/HAnim.html>

X3D Humanoid Animation (H-Anim) component

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/components/hanim.html>

H-Anim Prototypes

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimPrototypes.x3d>



X3D Graphics Standards: Specification Relationships

<http://www.web3d.org/specifications/X3dSpecificationRelationships.png>

<http://www.web3d.org/specifications/X3dSpecificationRelationships.pdf>

<http://www.web3d.org/specifications/X3dSpecificationRelationships.vsd>

Original design objectives

ISO/IEC 19774:2005, H-Anim version 1.0

Compatibility

- The features of an H-Anim human figure shall be implementable in any compliant browser.

Flexibility

- No assumptions shall be made about the types of applications that will use an H-Anim human figure.

Simplicity

- When in doubt, leave it out. The human figure specification can always be extended later.

H-Anim Specification versions

ISO approval of the current H-Anim International Standard is dated 2006-02-16

- ISO/IEC 19774:2006 stable
- Section 6.2 Humanoid states version='2.0'

Partial work completed in 2009: PDAM

- Proposed Draft Amendment 1 to H-Anim,
- ISO/IEC 19774:2006/PDAM1:200x.
- Also states version 2.0 but some **version 2.1** models produced... Consistent correctness is important...

Future Hanim 2015 likely version='2.2'

experimental



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http://web3d.org/mailman/private/h-anim_web3d.org/2015-January/000641.html

The current ISO approved HAnim standard says

- ISO approval of the current H-Anim International Standard was 2006-02-16

<http://www.web3d.org/standards/all>

- Document label on the cover page is "This document is ISO/IEC 19774:2005, Humanoid animation (H-Anim)."

<http://www.web3d.org/documents/specifications/19774/V1.0/HAnim/HAnim.html>

(Dick, wondering, isn't this an editorial erratum we should fix so that the document is internally consistent?)

- The frame header says "ISO/IEC 19774:2006"

<http://www.web3d.org/documents/specifications/19774/V1.0/index.html>

- Humanoid "version 2.0" in section 6.2 Humanoid

<http://www.web3d.org/documents/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Humanoid>

H-Anim v2.2 design objectives

Skeleton

- New Level of Articulation (LOA) for hands and feet

Skin

- More examples to confirm skin functionality works
- Add facial animation model

Motion Capture (mocap)

- Dynamically interoperable mocap data conversion

Anatomical correctness

- Enable modeling of human body with full fidelity for medical records and simulation applications

Anatomically correct humans

H-Anim specification design put high premium on generality for any animated figure

- However most cartoon/game character physical models vary widely and are completely ad hoc
- Offered a capability but apparently didn't fill a need

Strong interest in enabling anatomically valid, medically correct humans in full detail

- Perhaps lead to standards for 3D medical records
- Shared challenge with X3D Medical Working Group
- Alternate humanoid characters also allowed

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Current limitations in H-Anim

- Few skin examples have been produced, further verification of correctness needed
- It is difficult to compose and sequence multiple animation behaviors at run time
- Need library of reusable skeleton/skin bodies and composable motion-capture animations
- Future work: mocap streaming mechanisms need to operate compatibly with forthcoming continuous level of detail (CLOD) design for streamable X3D compression

H-Anim Working Group

- H-Anim Humanoid Animation Working Group
- The H-Anim Working group develops and demonstrates the ISO Humanoid Animation (H-Anim) standard.
- H-Anim supports a wide variety of articulated figures, including anatomically correct human models, incorporating haptic and kinematic interfaces in order to enable sharable skeletons, bodies and animations.
- <http://www.web3d.org/working-groups/humanoid-animation-h-anim>



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Web3D Working Groups

<http://www.web3d.org/working-groups>

H-Anim Working Group

<http://www.web3d.org/working-groups/humanoid-animation-h-anim>

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Levels of Articulation (LOAs)

Levels of Articulation (LOAs) 1

Level of articulation (LOA), refers to the number of articulations (or joints) that are defined for a humanoid figure.

- A humanoid figure with fourteen joints is said to have a “low level of articulation”, whereas a humanoid figure with 72 joints might be said to have a “high level of articulation”.
- A skeletal hierarchy containing only a HumanoidRoot Joint object is the lowest level of articulation that is allowed for an H-Anim figure.

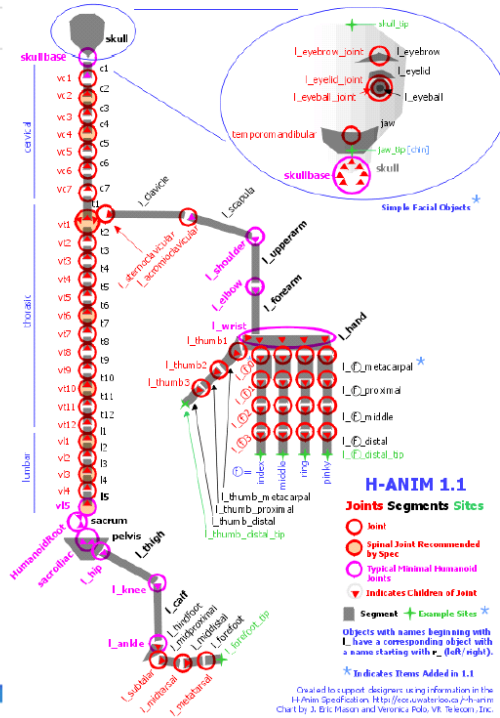
LOAs are composable, not strictly progressive

Levels of Articulation (LOAs) 2

Each LOA provides increased skeletal fidelity

| LOA | Plain Text Data Tables | Specification Descriptions |
|-----|------------------------------------|--|
| 0 | HAnimHierarchyWeb3d-19774-V1.0.txt | Text-based node hierarchy from approved ISO standard: H-Anim Specification, 4.9.5 Hierarchy. |
| 1 | HAnimHierarchyWithSites.txt | Hierarchy of joints, segments with corresponding surface-feature sites (based on skeletal proximity) |
| 2 | HAnimJointNames19774V1.0.txt | List of approved HAnimJoint names. <ul style="list-style-type: none">• Table 4.2 - Body Joint object names• Table 4.3 - Hand Joint object names• Table 4.4 - Face Joint object names |
| 3 | HAnimSegmentNames19774V1.0.txt | Approved HAnimSegment names, excerpted from H-Anim Specification, 4.9.5 Hierarchy. |
| 4 | TODO, work in progress | |

H-Anim Hierarchy



2014-7-24

4

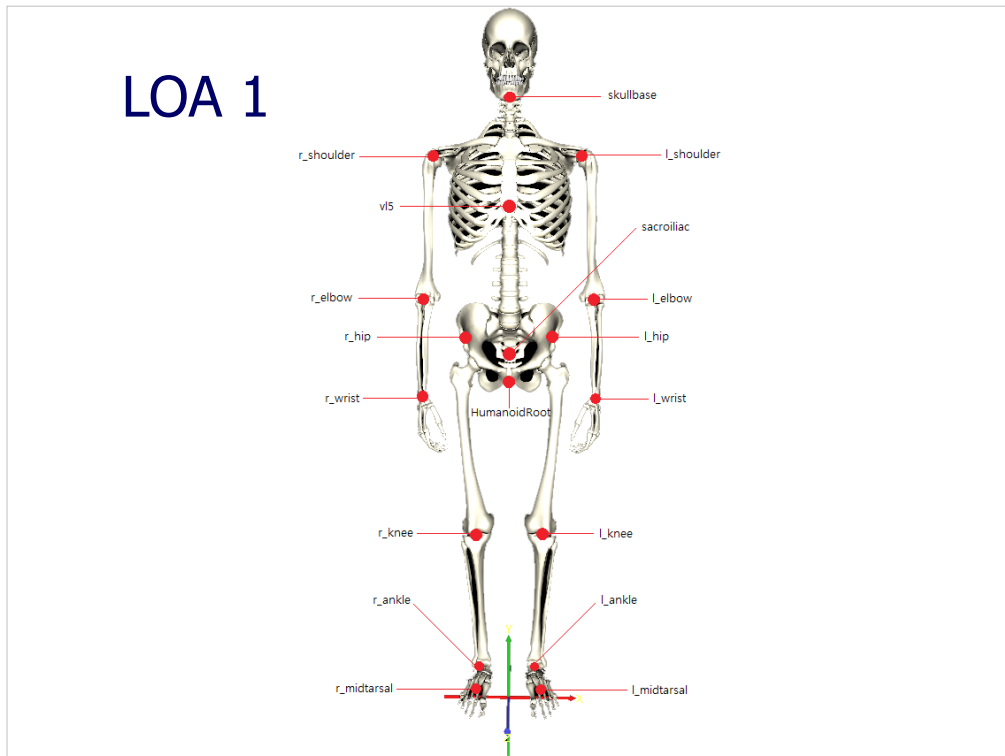
LOA 0

Single joint: HumanoidRoot

Very important: positions, orients virtual body anywhere in the virtual (or augmented) world

- Example: receives translation/rotation values from PositionInterpolator/OrientationInterpolator streams

TODO confirm: an LOA-0 scene can Inline additional parts of a body, without needing fully contiguous skeleton joints



LOA Joint Diagrams created by Dr. Myeong Won LEE and students, Suwon University

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA1.png>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA2.png>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA3.png>

Original model and skeleton snapshots

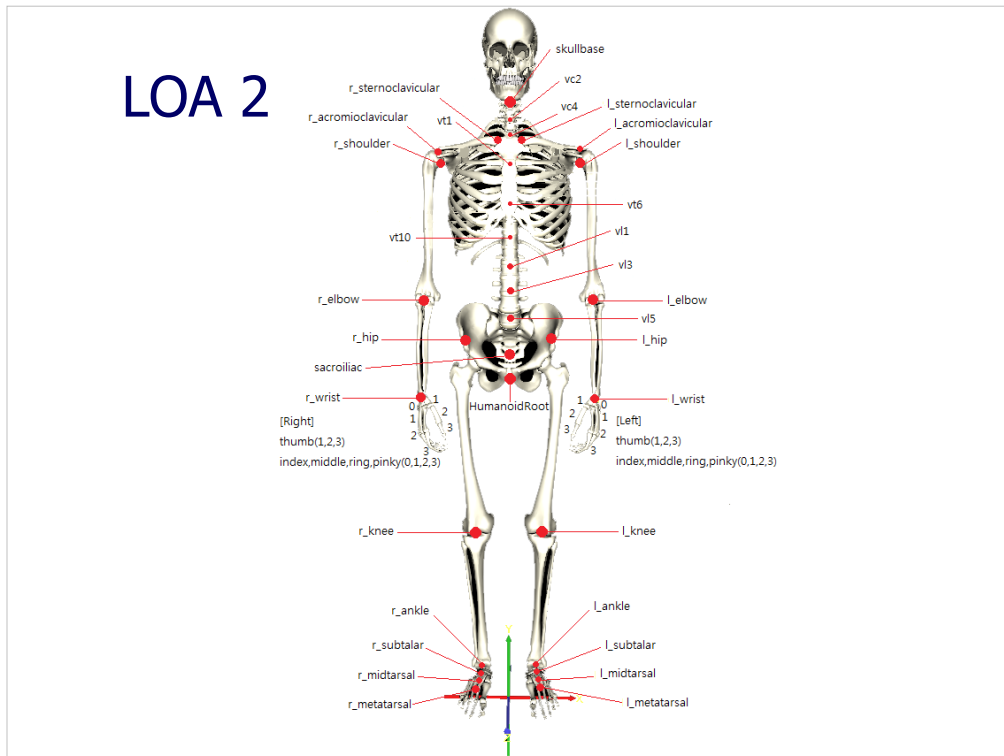
<http://www.web3d.org/x3d/content/examples/Basic/Medical/BonesAllSkeleton.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonFrontView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonLeftSideView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonRearView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonRightSideView.png>



LOA Joint Diagrams created by Dr. Myeong Won LEE and students, Suwon University

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA1.png>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA2.png>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA3.png>

Original model and skeleton snapshots

<http://www.web3d.org/x3d/content/examples/Basic/Medical/BonesAllSkeleton.x3d>

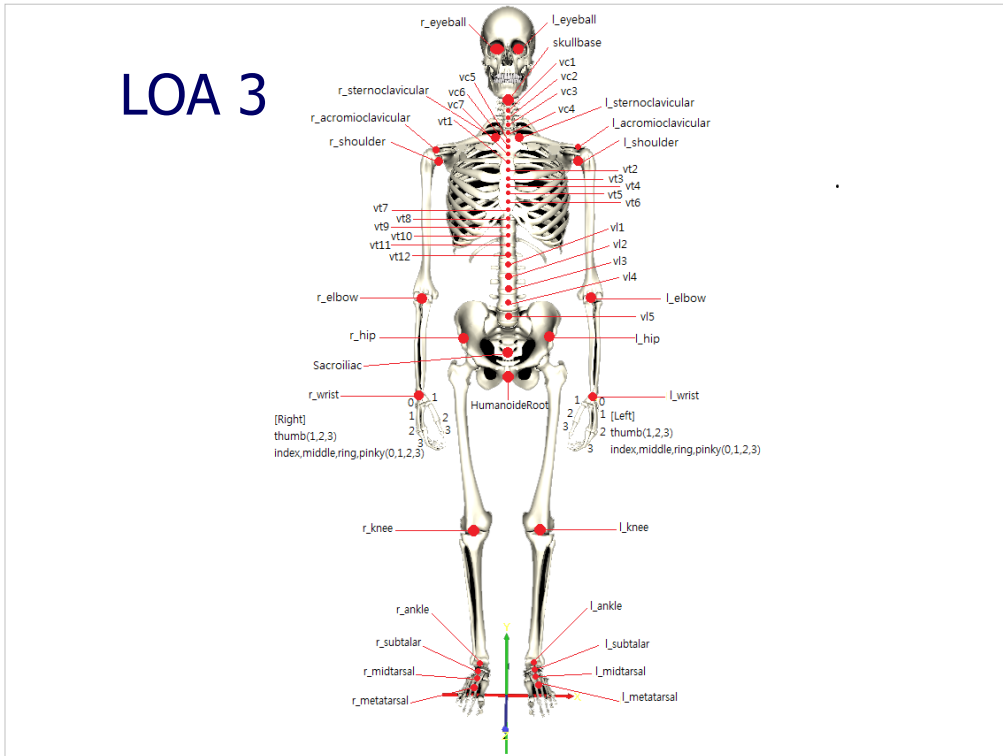
<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonFrontView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonLeftSideView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonRearView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonRightSideView.png>

LOA 3



LOA Joint Diagrams created by Dr. Myeong Won LEE and students, Suwon University

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA1.png>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA2.png>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/BonesAllSkeletonFrontViewLOA3.png>

Original model and skeleton snapshots

<http://www.web3d.org/x3d/content/examples/Basic/Medical/BonesAllSkeleton.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonFrontView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonLeftSideView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonRearView.png>

<http://www.web3d.org/x3d/content/examples/Basic/Medical/images/BonesAllSkeletonRightSideView.png>

H-Anim LOA-3 Examples

X3D Example Archives: Basic, Humanoid Animation



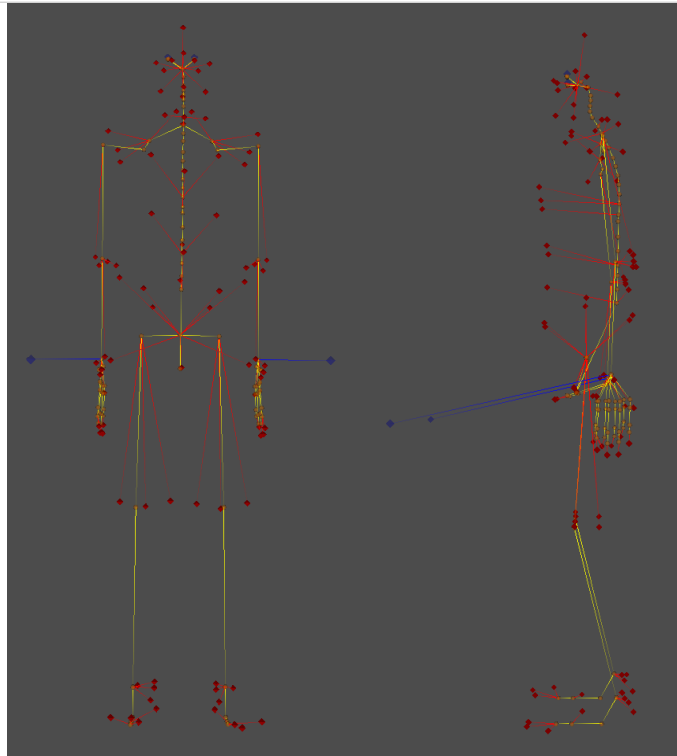
These Humanoid Animation (H-Anim) examples support the ISO [Humanoid Animation \(H-Anim\) Specification](#) with a corresponding specification for ISO [X3D Abstract Specification H-Anim component](#).

The [H-Anim Working Group Executive Summary](#) summarizes current capabilities. Prior original efforts can be found online at [hanim.org](#). Significant additional work is being considered by renewed efforts documented on the [H-Anim Working Group Wiki](#). Tool builders may benefit from using convenient [tables of enumeration values](#) extracted from the H-Anim Specification. Related work appears in the [Medical](#) examples.

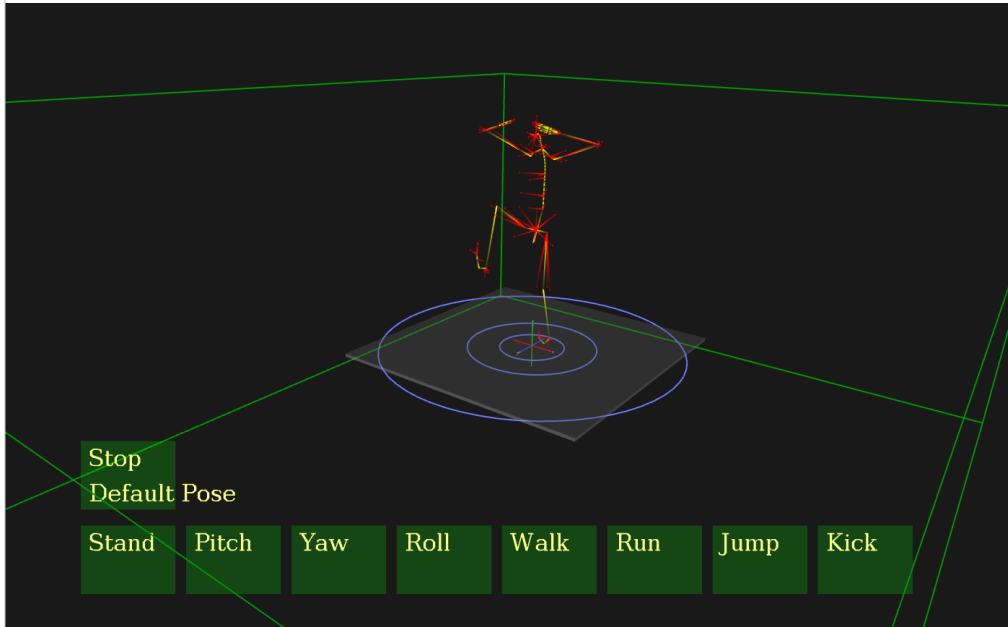
- [HanimSpecificationLOA3Invisible.x3d](#)
- [HanimSpecificationLOA3Illustrated.x3d](#)
- [HAnimSpecificationLOA3Motion.x3d](#)

Hanim
Specification
LOA3
Illustrated
.x3d

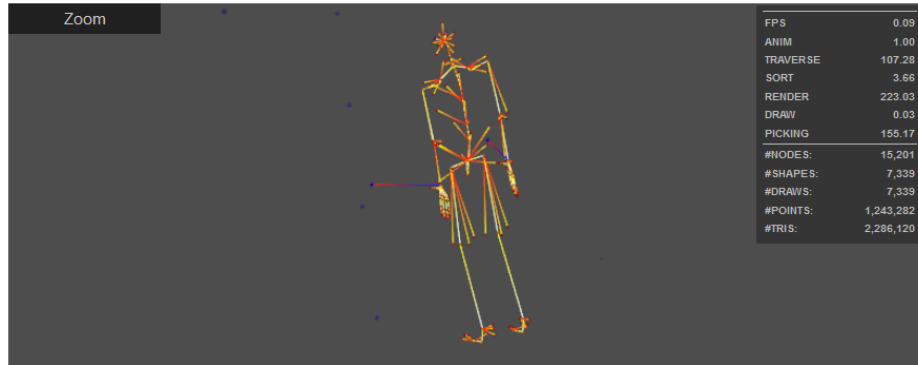
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HAnimSpecificationLOA3Motion.x3d

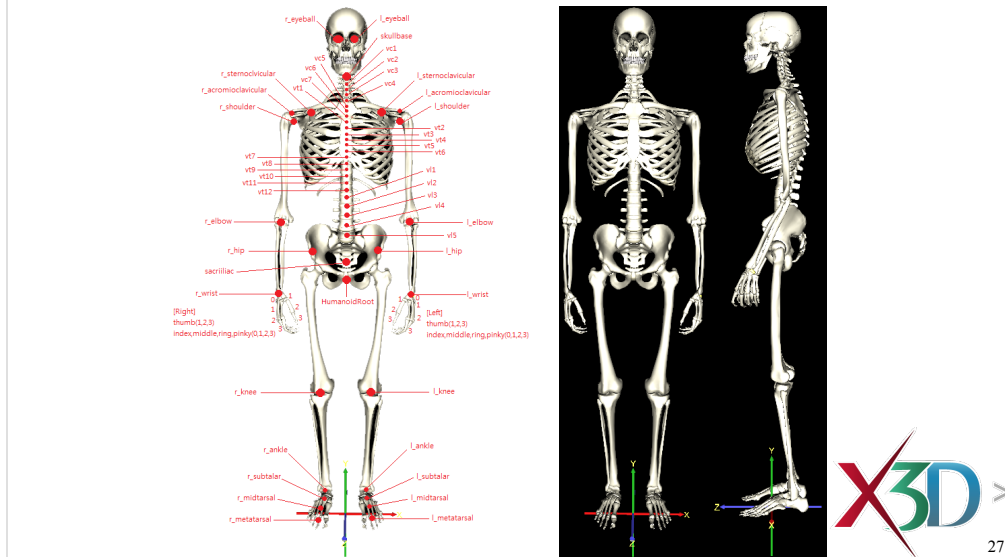


H-Anim support by X3DOM



H-Anim skeleton available

<http://www.web3d.org/x3d-resources/content/examples/Basic/Medical>



The X3D skeleton on the right was changed to a white background, then used to create the image on the left that was then annotated to show joints.

TODO: provide capability to add bones to an Hanim Joint/Segment skeleton as individual Inline X3D bone models.

LOA 4 (proposed)

Hands

- Finer detail of interior bones
- Directed Acyclic Graph (DAG) for complex joints
- More formal names for joints and segments

Feet

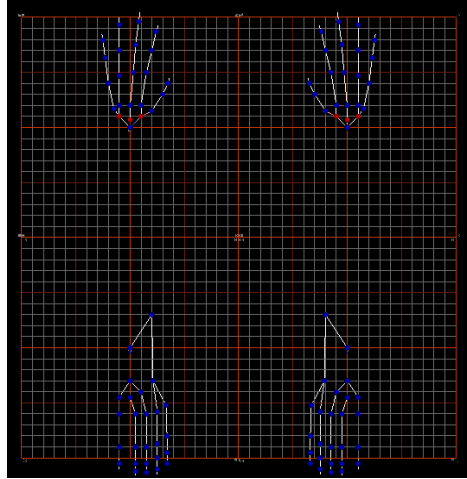
- Finer detail of interior bones
- Directed Acyclic Graph (DAG), avoid complex group

Face

- Control points for expressive skin animation

Hands

- TODO Hand model example work in progress



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Hands examples by Dr. Kwan Hee YOO, Chungbuk University

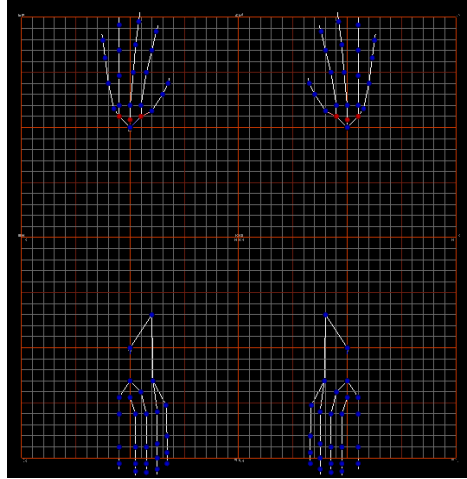
<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimModelHandLeft.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimModelHandRight.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimModelsHandsFeet.x3d>

Feet

- TODO Foot model example work in progress



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Feet examples by Dr. Kwan Hee YOO, Chungbuk University

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimModelFootLeft.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimModelFootRight.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/HAnimModelsHandsFeet.x3d>

Face

- TODO initial face exemplar produced, further work in progress to create X3D exemplars

Progress report: Jung-Ju Choi, Ajou University H-Anim meetings of the Web3D Korea Chapter in Seoul 25 January 2015. 12MB, includes video.

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/presentations/H-AnimFacialAnimation2015January25.pdf>

Higher LOAs? Different bodies?

Current + planned LOAs are thorough

- LOAs 0..4 can represent all externally visible human motion across fidelity range from simple animation to high-precision accuracy, compatibly increasing
- Also matches current capabilities for motion capture

Future H-Anim work might examine

- Non-visible or “floating” bones in human anatomy
- Conventions for other animals
- Conventions for cartoon characters

BVH mocap data format

History: popular mocap data format

- Biovision Hierarchy
- company now defunct, so little fear of lawsuits

Widely used and supported

- by many mocap tools and animation libraries

Informally defined

- Many ad hoc references, none appear authoritative

Add the full BVH mocap format description to H-Anim specification as informative annex?

- Precision important for what H-Anim does



Biovision Hierarchy file format

https://en.wikipedia.org/wiki/Biovision_Hierarchy

BVH to X3D MOCAP conversion

Lengthy 2014 work, H-Anim Working Group
Algorithm documented on H-Anim wiki

- <http://www.web3d.org/wiki/index.php/Techniques>
- Paper by Myeong Won Lee et al.

Currently implemented in Suwon University C++
H-Anim Model and Mocap Editor

- TODO add matching Java source to X3D-Edit

NIST: BVH to H-ANIM motion capture process

- <http://ovrt.nist.gov/projects/wear/mocap>



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X3D v3.4 proposed changes

H-Anim 2.x Specification functional changes

- Few (if any) major changes, better guidance
- H-Anim component level 2 adds hands, feet, face?
- Change, formalize name enumerations for hands
- Motion capture (mocap): possible new nodes?

Specification and validation

- X3D v3.4 DOCTYPE, Schema, Schematron available
- Continue to improve authoring tool support
- Hanim component level 2 needed in X3D spec?



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TODO determine if X3D v3.4 DOCTYPE, Schema can load previous version or else are standalone. Probably standalone.

X3D v4.0 potential changes

Integration with HTML5, X3DOM

- Already implemented in X3DOM
- Are any other specification changes expected?

X3D v4.1 potential changes

Integration with Mixed and Augmented Reality (MAR) Reference Model extensions for X3D

- Multiple aspects of MAR relate to H-Anim, including Part 3, Live Actor and Entity Representation in MAR
- Are any other specification changes for H-Anim in X3D expected?

Application Support

Players

- X3DOM, BSContact, Instant Reality, H3DViewer, OctagaVS, view3dscene, Xj3D

Authoring Tools

- Suwon University H-Anim Mocap Editor
- X3D-Edit
- BS Content Studio

Validation, Stylesheets

- X3D DTD, Schema, Schematron, X3D Validator
- X3D Tidy, X3dToXhtml.xslt



Web3D Recommended Standards

<http://www.web3d.org/standards>

ISO/IEC 19774

<http://www.web3d.org/documents/specifications/19774/V1.0/HAnim/HAnim.html>

H-Anim implementations progress

- Reference examples found in X3D Basic archives for HumanoidAnimation
- Detailed X3D Quality Assurance (QA) tests using X3D Schematron, multiple other tests for in-depth validation of joints/segments
- X3dToXhtml.xslt stylesheet can provide automatic definition of visualization lines and shapes for illustrating H-Anim skeletons, available in X3D-Edit
- X3D Tidy conversions, visualization, cleanup

Validating H-Anim scenes

- H-Anim scenes can be quite length, complex
- Visual inspection can be insufficient – too hard!
- Use the X3D Validator to find, fix problems
- Clear all warnings to gain high confidence in results
- X3D-Edit can test correctness in all players

X3D Validator
This Web application checks X3D scene validity.

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Open Standards for Real Time 3D Communication

Choose a local .x3d scene:
Browse... No file selected.

Enter an online .x3d url:

TODO fix snapshot once BS Contact is fixed

Quality Assurance (QA) Tests

X3D Header checks

- Confirm correct X3D DTD and Schema incantations

X3D DTD: element and attribute structure

- Requires approved names for joints, segments, sites

X3D Schema: strong typing value checks

- Requires approved names for joints, segments, sites

X3D Schematron

- Must have name field, DEFs meet name conventions
- Uniqueness, cross-referencing
- Matching hierarchies: Joints Segments Sites



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X3D Quality Assurance (QA)

<http://www.web3d.org/x3d/content/examples/X3dResources.html#QualityAssurance>

X3D Specifications: XML Schema and DOCTYPE Validation

<http://www.web3d.org/specifications>

X3D Schematron

<http://www.web3d.org/x3d/tools/schematron/X3dSchematron.html>

X3D Validator

<https://savage.nps.edu/X3dValidator>

X3D Tidy

<http://www.web3d.org/x3d/stylesheets/X3dTidy.html>

X3dToXhtml.xslt

Pretty-print stylesheets for converting .x3d model source to .xhtml documentation

- AnyScene.x3d to AnyScene.xhtml

Includes feature for H-Anim that shows how to add geometry to visualize a skeleton

- Visualization report for HAnimHumanoid model
- HanimSpecificationLOA3Invisible.html was augmented and converted to become HAnimSpecificationLOA3Illustrated.x3d

HanimSpecificationLOA3Invisible.x3d annotations using X3dToXhtml.xslt pretty-print stylesheet

Visualization report for HAnimHumanoid model [hanim_humanoid](#)

Key to author-assist additions:

- **HAnimJoint** Suggested Shape geometry additions are provided to illustrate each HAnimJoint
- **HAnimSegment** Suggested IndexedLineSegment connections illustrate each HAnimSegment
- **HAnimSite** Suggested IndexedLineSegment and Shape geometry additions illustrate each HAnimSite
- **Viewpoint** Suggested Shape geometry additions illustrate each HAnimSite/Viewpoint combinations

```
<HAnimHumanoid DEF='hanim_humanoid' name='humanoid' version='2.0'
  info=' "authorName=Matthew T. Beitler Joe D. Williams Don Brutzman"
        "authorEmail=h-anim@web3d.org"
        "copyright=none"
        "creationDate=12 May 1999"
        "usageRestrictions=none"
        "humanoidVersion=2.0"
        "height=1.7504"
        >
  • <HAnimJoint DEF='hanim_HumanoidRoot' name='HumanoidRoot' center='0 0.824 0.0277' containerField='skeleton'>
    o <HAnimSegment DEF='hanim_sacrum' name='sacrum'>
      ■ <!-- <HAnimJoint name='HumanoidRoot' /> visualization sphere within <HAnimSegment name='sacrum' /> -->
      ■ <TouchSensor description='HAnimJoint HumanoidRoot, HAnimSegment sacrum' />
      ■ <Transform translation='0 0.824 0.0277'> <Shape DEF='HanimJointShape'> <Sphere radius='0.006' /> <Appearance DEF='HanimJointAppearance'> <
      </Transform>
      ■ <!-- HAnimSegment visualization line segment from parent <HAnimJoint name='HumanoidRoot' /> to <HAnimJoint name='sacroiliac' /> -->
      ■ <Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.824 0.0277, 0 0.9149 0.0016' /> <ColorRGBA DEF='HanimSegmentLineColorRGBA' color='
      ■ <!-- HAnimSegment visualization line segment from parent <HAnimJoint name='HumanoidRoot' /> to <HAnimJoint name='v15' /> -->
      ■ <Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.824 0.0277, 0.0028 1.0568 -0.0776' /> <ColorRGBA USE='HanimSegmentLineColorRGBA' /
    </HAnimSegment>
    o <HAnimJoint DEF='hanim_sacroiliac' name='sacroiliac' center='0 0.9149 0.0016'>
      ■ <HAnimSegment DEF='hanim_pelvis' name='pelvis'>
        ■ <!-- <HAnimJoint name='sacroiliac' /> visualization sphere within <HAnimSegment name='pelvis' /> -->
        ■ <TouchSensor description='HAnimJoint sacroiliac, HAnimSegment pelvis' />
        ■ <Transform translation='0 0.9149 0.0016'> <Shape USE='HanimJointShape' /> </Transform>
        ■ <!-- HAnimSegment visualization line segment from parent <HAnimJoint name='sacroiliac' /> to <HAnimJoint name='l_hip' /> -->
        ■ <Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.9149 0.0016, 0.0961 0.9124 -0.0001' /> <ColorRGBA USE='HanimSegmentLineColor'
        ■ <!-- HAnimSegment visualization line segment from parent <HAnimJoint name='sacroiliac' /> to <HAnimJoint name='r_hip' /> -->
        ■ <Shape> <LineSet vertexCount='2'> <Coordinate point='0 0.9149 0.0016, -0.0961 0.9124 -0.0001' /> <ColorRGBA USE='HanimSegmentLineColor'
      </HAnimSegment>
    </HAnimJoint>
  </HAnimHumanoid>
```

X3D-Tidy 1

X3D Tidy is an XSLT stylesheet that checks for simple errors in X3D scenes and fixes them

- <http://www.web3d.org/x3d/stylesheets/X3dTidy.html>

Usage

- Selection parameters control filtering, additions
- Embedded in X3D-Edit

H-Anim functionality:

- Illustrating or cleaning HAnimHumanoid skeletons of HAnimJoint/HAnimSegement/HAnimSite nodes



Cleaning or illustrating Humanoid Animation (H-Anim) skeletons, showing **default values**:

```
<!-- Default parameter values can be overridden when invoking this stylesheet -->
<xsl:param name="HAnimSkeletonIllustrate" ><xsl:text>false</xsl:text></xsl:param>
<xsl:param name="HAnimSiteIllustrate" ><xsl:text>false</xsl:text></xsl:param>
<xsl:param name="HAnimViewpointIllustrate" ><xsl:text>false</xsl:text></xsl:param>
```

TODO:

```
<xsl:param name="HAnimGeometryRemove" ><xsl:text>false</xsl:text></xsl:param>
<xsl:param name="HAnimAddBoneSegments" ><xsl:text>false</xsl:text></xsl:param>

<xsl:param name="jointColor" ><xsl:text>1 0.5 0</xsl:text></xsl:param>
<xsl:param name="segmentColor" ><xsl:text>1 1 0</xsl:text></xsl:param>
<xsl:param name="segmentColorRGBA" ><xsl:text>1 1 0 1, 1 1 0 0.1</xsl:text></xsl:param>
<xsl:param name="siteColor" ><xsl:text>1 0 0</xsl:text></xsl:param>
<xsl:param name="siteColorRGBA" ><xsl:text>1 0 0 1, 1 0 0 0.1</xsl:text></xsl:param>
<xsl:param name="siteViewpointColor" ><xsl:text>0 0 1</xsl:text></xsl:param>
<xsl:param name="siteViewpointColorRGBA" ><xsl:text>0 0 1 1, 0 0 1 0.1</xsl:text></xsl:param>
```

X3D-Tidy 2

- Authors can use X3D Tidy to fix minor errors and apply best practices for X3D scene authoring.
- X3D Tidy provides an additional degree of Quality Assurance (QA) that helps achieve intended results in X3D scenes and metadata.
- X3D Tidy takes an .x3d scene (written using the X3D XML encoding) as input, and returns a modified .x3d scene as output. Any corrections are applied in place without changing the overall formatting or layout of the original X3D scene.
- X3D Tidy does not attempt to make scene corrections which might change intended scene content or require an authoring decision.

X3D Tidy for H-Anim

Special features for H-Anim

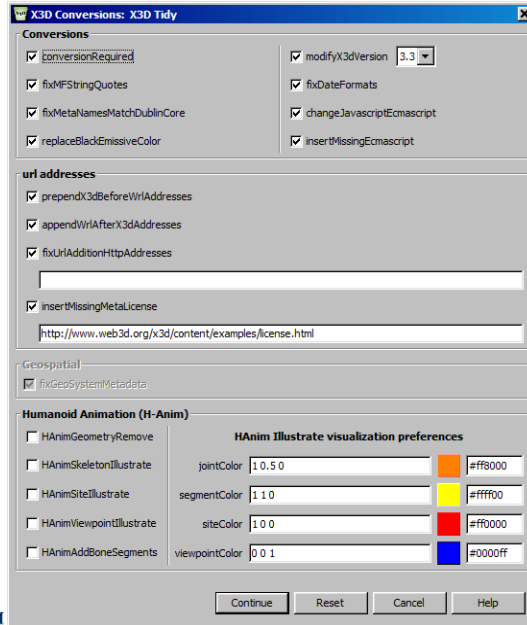
- Can automatically remove Shape geometry while leaving HAnimHumanoid joint/segment/site/viewpoint nodes (i.e. the skeleton) intact
- Can add visualization geometry to HAnim skeleton
- Thus automates pretty-print stylesheet capability

- TODO option to insert bone geometry for segments in HAnim skeleton

X3D Tidy

<http://www.web3d.org/x3d/stylesheet/X3dTidy.html>

X3D Tidy launch panel in X3D-Edit



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X3D Nodes and Examples



Naming rules

Hanim nodes contain both *name*, DEF fields

- Match by adding humanoid's name as prefix to DEF
- Thus allows including multiple HanimHumanoids in a single scene without ambiguity
- Parent/child node relationships are strict for paired HanimJoint, corresponding HanimSegment nodes (preventing foot segment in mouth joint, etc.)
- X3D Schematron warns if names mismatch, helpful for validating full complexity of human models
- Can ignore name validation if non-human humanoid

HAnimHumanoid node 1

The HAnimHumanoid node is used to

- store references to the joints, segments, sites, skin and viewpoints,
- serve as a container for the entire humanoid,
- provide convenient way of moving the entire humanoid through its environment, and
- store human-readable data such as author and copyright information.

HAnimHumanoid top-level children can contain:

- HAnimJoint, HAnimSegment, HanimSite, Viewpoint, Coordinate/CoordinateDouble, Normal nodes



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X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimHumanoid>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Humanoid>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimHumanoid>

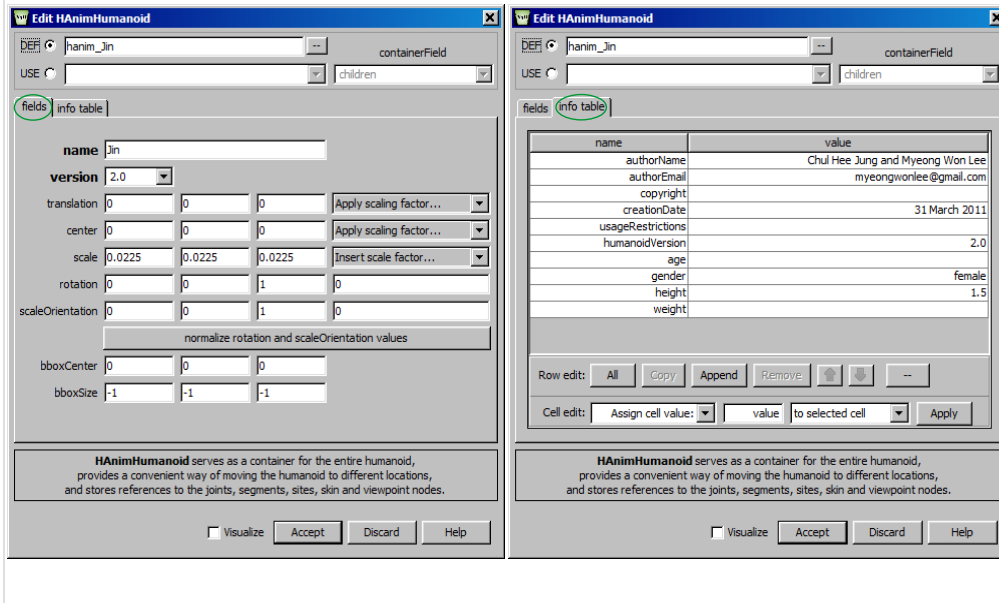
HAnimHumanoid node 2

- First child is HanimHumanoidRoot
- Viewpoint nodes DEfined outside of skeleton can follow body without relative motion

USE nodes follow skeleton

- Provide easy references for H-Anim tool support
- Provide hooks for Inverse Kinematics (IK) engines

HAnimHumanoid panel X3D-Edit



Example scene:

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/KoreanCharacter01Jin.x3d>

HAnimHumanoid attributes

- *name* is required, must be unique so that HAnimHumanoid can be identified at runtime for animation purposes
- *version* is required
 - *version*='2.0' for approved H-Anim ISO 19774,
 - *version*='2.2' for current experimentation
- *translation, rotation, scale, scaleOrientation, bboxCenter, bboxSize*: same as Transform
- *center* is translation offset from origin of the local coordinate system
- *containerField*='children' as regular child node

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimHumanoid>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Humanoid>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimHumanoid>

HAnimHumanoid *info* attribute

- *info* contains array of metadata settings expressed as MFString key=value pairs
- approved keyword terms: humanoidVersion
authorName authorEmail copyright
creationDate usageRestrictions age gender
height and weight
- Example: *info*=' "authorName=Chul Hee Jung and Myeong Won Lee"
"authorEmail=myeongwonlee@gmail.com"
"creationDate=31 March 2011"
"humanoidVersion=2.0" "gender=female"
"height=1.5" '

Example shown:

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/KoreanCharacter02Chul.x3d>

Note MFString syntax for array of quoted SFString values. Preferred form is shown where the overall *info* attribute value is surrounded by single quotes (apostrophes) while the individual key=value pairs are each surrounded by double quotes (quotation marks).

Another example:

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/NancyNativeTags.x3d>

```
info=' "humanoidVersion=Nancy V1.2b" "authorEmail=cindy@ballreich.net" "authorName=Cindy Ballreich" "copyright=1997 3Name3D / Yglesias Wallock Divekar Inc. all rights reserved." "creationDate=Tue Dec 30 08:30:08 PST 1997" "gender=female" "usageRestrictions=Noncommercial usage is ok if 3Name3D name and logo http://www.ballreich.net/vrml/h-anim/small_logo.gif is present and proper credit is given." '
```

TODO proposed change for .x3d XML encoding: alternate form that uses regular attribute notation for key=value pairs.

HAnimHumanoid tooltips

| | | |
|--------------------------------|--|--|
| <p>✦ HAnimHumanoid</p> | <p>The HAnimHumanoid node is used to: (a) store references to the joints, segments, sites, skin and viewpoints, (b) serve as a container for the entire humanoid, (c) provide a convenient way of moving the humanoid through its environment, and (d) store human-readable data such as author and copyright information. HAnimHumanoid contains HAnimJoint, HAnimSegment, HAnimSite, Coordinate/CoordinateDouble, Normal, and Viewpoint nodes.</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Humanoid</p> <p>Hint: <code><component name="H-Anim" level="1"></code></p> | <p>X3D validation:
Schema, DOCTYPE</p> |
| <p>DEF</p> | <p>[DEF ID #IMPLIED]
DEF defines a unique ID name for this node, referencable by other nodes.
Hint: descriptive DEF names improve clarity and help document a model.
Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions</p> | |
| <p>USE</p> | <p>[USE IDREF #IMPLIED]
USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).
Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.
Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.
Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| <p>name</p> | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]
Unique name attribute must be defined so that HAnimHumanoid nodes can be identified at runtime for animation purposes.</p> | |
| <p>version</p> | <p>[version accessType inputOutput, type SFString CDATA (2.0) #REQUIRED]
HAnimHumanoid version, where standardized ISO 19774 value is 2.0.
Warning: prior versions of HAnim nodes might not validate correctly.</p> | |
| <p>info</p> | <p>[info accessType inputOutput, type MFString CDATA #IMPLIED]
Metadata keyword-value pairs, where approved keyword terms are humanoidVersion authorName authorEmail copyright creationDate usageRestrictions age gender height and weight.</p> | |
| <p>translation</p> | <p>[translation accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Position of children relative to local coordinate system.</p> | |
| <p>rotation</p> | <p>[rotation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
Orientation of children relative to local coordinate system.</p> | |
| <p>scale</p> | <p>[scale accessType inputOutput, type SFVec3f CDATA "1 1 1"]
Non-uniform x-y-z scale of child coordinate system, adjusted by center and scaleOrientation.</p> | |
| <p>scaleOrientation</p> | <p>[scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations).</p> | |
| <p>center</p> | <p>[center accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Translation offset from origin of local coordinate system.</p> | |
| <p>bboxCenter</p> | <p>[bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]
Bounding box center: position offset from origin of local coordinate system.</p> | |
| <p>bboxSize</p> | <p>[bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]
Bounding box size: automatically calculated, can be specified as an optimization or constraint.</p> | |
| <p>containerField</p> | <p>[containerField NMTOKEN "children"]
containerField is the field-label prefix indicating relationship to parent node.
Examples: geometry Box, children Group, proxy Shape.
Hint: containerField attribute is only supported in XML encoding of X3D scenes.</p> | |

X3D Tooltips

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimHumanoid>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Humanoid>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimHumanoid>

HAnimJoint node, attributes

- Contained by HAnimHumanoid, HAnimJoint
- Contains HAnimSegment or HanimJoint with corresponding name from skeletal hierarchy
- *name* is required, must be unique so that HAnimJoint can be identified at runtime for animation and parent/child checks
- *translation, rotation, scale, scaleOrientation bboxCenter, bboxSize*: same as Transform
- *center* is translation offset from origin of the local coordinate system
- *containerField*='children' as regular child node

HAnimJoint attributes 2

- *ulimit, llimit*: upper, lower limits for maximum joint rotation in radians. Always contains 3 values, one for each local axis.
- *limitOrientation*: orientation of upper/lower rotation limits, relative to HAnimJoint center.
- *skinCoordIndex*: coordinate index values referencing vertices influenced by the joint.
- *skinCoordWeight*: weight deformation values for corresponding *skinCoordIndex* values.
- *stiffness*: axial willingness of joint to move, larger values means greater resistance

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimJoint>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Joint>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimJoint>

TODO: *ulimit*, *llimit*, *stiffness* each need to have type SFVec3f instead of MFVec3f

HAnimJoint panel X3D-Edit

Edit HAnimJoint

DEF containerField

USE skeleton

name

limit

limitOrientation

skinCoordIndex

skinCoordWeight

stiffness

translation

center

scale

rotation

scaleOrientation

bboxCenter

bboxSize

HAnimJoint is used to represent each joint in the body.
Parent node must be another **HAnimJoint** or else the HAnimHumanoid node.
HAnimJoint can only contain HAnimSegment or HAnimJoint as children nodes.

HAnimJoint tooltips 1

| | | |
|--|--|---|
| <p>J HAnimJoint</p> | <p>Each joint in the body is represented by an HAnimJoint node.
 Hint: HAnimJoint may only be a child of another HAnimJoint node, or skeleton field for the HAnimHumanoid.
 Hint: HAnimJoint can only contain HAnimSegment or HAnimJoint as children nodes.
 Warning: an HAnimJoint may not be a child of an HAnimSegment.
 Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification
 Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Joint
 Hint: include <component name="H-Anim" level="1"></p> | <p>X3D validation:
 Schema, DOCTYPE</p> |
| <p>DEF</p> | <p>[DEF ID #IMPLIED]
 DEF defines a unique ID name for this node, referenceable by other nodes.
 Hint: descriptive DEF names improve clarity and help document a model.
 Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions</p> | |
| <p>USE</p> | <p>[USE IDREF #IMPLIED]
 USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).
 Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.
 Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.
 Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| <p>name</p> | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]
 Unique name attribute must be defined so that HAnimJoint node can be identified at runtime for animation purposes.
 Examples: HumanoidRoot sacroiliac l_hip l_knee l_ankle etc. listed in H-Anim Specification.
 Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimJointNames19774V1.0.txt
 Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/concepts.html#Hierarchy</p> | |
| <p>center</p> | <p>[center accessType inputOutput, type SFVec3f CDATA "0 0 0"]
 Translation offset from origin of local coordinate system.
 Hint: usually HAnimJoint position is controlled by the center field, not the translation field.</p> | |
| <p>translation</p> | <p>[translation accessType inputOutput, type SFVec3f CDATA "0 0 0"]
 Position of children relative to local coordinate system.
 Warning: usually HAnimJoint position is controlled by the center field, not the translation field.</p> | |
| <p>rotation</p> | <p>[rotation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
 Orientation of children relative to local coordinate system.</p> | |
| <p>scale</p> | <p>[scale accessType inputOutput, type SFVec3f CDATA "1 1 1"]
 Non-uniform x-y-z scale of child coordinate system, adjusted by center and scaleOrientation.</p> | |
| <p>scaleOrientation</p> | <p>[scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
 Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations).</p> | |

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimJoint>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Joint>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimJoint>

HAnimJoint tooltips 2

| | |
|-------------------------------|---|
| <code>scaleOrientation</code> | <code>[scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]</code>
Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations). |
| <code>ulimit</code> | <code>[ulimit accessType inputOutput, type MFFloat CDATA #IMPLIED]</code>
Upper limit for maximum joint rotation in radians.
Hint: always contains 3 values, one for each local axis. |
| <code>llimit</code> | <code>[llimit accessType inputOutput, type MFFloat CDATA #IMPLIED]</code>
Lower limit for minimum joint rotation in radians.
Hint: always contains 3 values, one for each local axis. |
| <code>limitOrientation</code> | <code>[limitOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]</code>
Orientation of upper/lower rotation limits, relative to HAnimJoint center. |
| <code>skinCoordIndex</code> | <code>[skinCoordIndex accessType inputOutput, type MFInt32 CDATA #IMPLIED]</code>
Coordinate index values referencing which vertices are influenced by the joint. |
| <code>skinCoordWeight</code> | <code>[skinCoordWeight accessType inputOutput, type MFFloat CDATA #IMPLIED]</code>
Weight deformation values for the corresponding values in the skinCoordIndex field. |
| <code>stiffness</code> | <code>[stiffness accessType inputOutput, type MFFloat CDATA "0 0 0" (0,1)]</code>
value (0,1) indicating willingness of joint to move larger stiffness values means greater resistance (about local X, Y, Z axes).
Hint: used by inverse kinematics systems. |
| <code>bboxCenter</code> | <code>[bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]</code>
Bounding box center: position offset from origin of local coordinate system. |
| <code>bboxSize</code> | <code>[bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]</code>
Bounding box size: automatically calculated, can be specified as an optimization or constraint. |
| <code>containerField</code> | <code>[containerField NMTOKEN "children"]</code>
containerField is the field-label prefix indicating relationship to parent node.
Examples: geometry Box, children Group, proxy Shape.
Hint: containerField attribute is only supported in XML encoding of X3D scenes. |
| <code>class</code> | <code>[class CDATA #IMPLIED]</code>
class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes. |

X3D Tooltips

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimJoint>

HAnimSegment node, attributes

- Body segments are stored by HAnimSegment
- Contained by HAnimJoint with corresponding name from skeletal hierarchy
- Contains Coordinate/CoordinateDouble, HAnimDisplacer, children (other geometry)
- *name* is required, must be unique so that HAnimSegment can be identified at runtime for animation and parent/child checks
- *mass*: total mass of segment, 0 if unavailable.
- *centerOfMass*: relative location within segment
- *momentsOfInertia*: 3x3 inertia matrix

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimSegment>

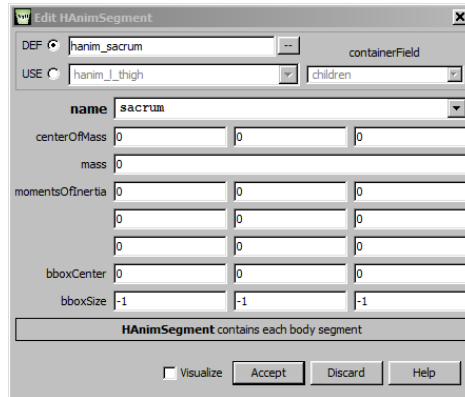
HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Segment>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimSegment>

HanimSegment panel X3D-Edit



HAnimSegment tooltips

| | | |
|---|--|------------------------------------|
|  HAnimSegment | Each body segment is stored in an HAnimSegment node. HAnimSegment contains Coordinate/CoordinateDouble, HAnimDisplacer and children nodes.
Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification
Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Segment
Hint: include <component name='H-Anim' level='1'/> | X3D validation:
Schema, DOCTYPE |
| DEF | [DEF ID #IMPLIED]
DEF defines a unique ID name for this node, referenceable by other nodes.
Hint: descriptive DEF names improve clarity and help document a model.
Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions | |
| USE | [USE IDREF #IMPLIED]
USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).
Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.
Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.
Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene. | |
| name | [name accessType inputOutput, type SFString CDATA #REQUIRED]
Unique name attribute must be defined so that HAnimSegment node can be identified at runtime for animation purposes.
Examples: sacrum pelvis l thigh l calf etc. listed in H-Anim Specification.
Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimSegmentNames19774V1.0.txt
Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/concepts.html#Hierarchy | |
| mass | [mass accessType inputOutput, type SFFloat CDATA "0"]
Total mass of the segment, 0 if not available. | |
| centerOfMass | [centerOfMass accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Location within segment of center of mass. | |
| momentsOfInertia | [momentsOfInertia accessType inputOutput, type MFFloat CDATA "0 0 0 0 0 0 0"]
3x3 moments of inertia matrix. default: 0 0 0 0 0 0 0. | |
| bboxCenter | [bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]
Bounding box center, position offset from origin of local coordinate system. | |
| bboxSize | [bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]
Bounding box size; automatically calculated, can be specified as an optimization or constraint. | |
| containerField | [containerField NMTOKEN "children"]
containerField is the field-label prefix indicating relationship to parent node.
Examples: geometry Box, children Group, proxy Shape.
Hint: containerField attribute is only supported in XML encoding of X3D scenes. | |
| class | [class CDATA #IMPLIED]
class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes. | |

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimSegment>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Segment>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimSegment>

HAnimSite node

- Contained by HanimSegment
- Can contain Shape or Viewpoint
- HAnimSite node serves three purposes:
 - define an "end effector" location which can be used by an inverse kinematics system,
 - define an attachment point for accessories such as jewelry and clothing, and
 - define a location for a virtual camera in the reference frame of an HAnimSegment (such as a view "through the eyes" of the humanoid)

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimSite>

HAnim specification:

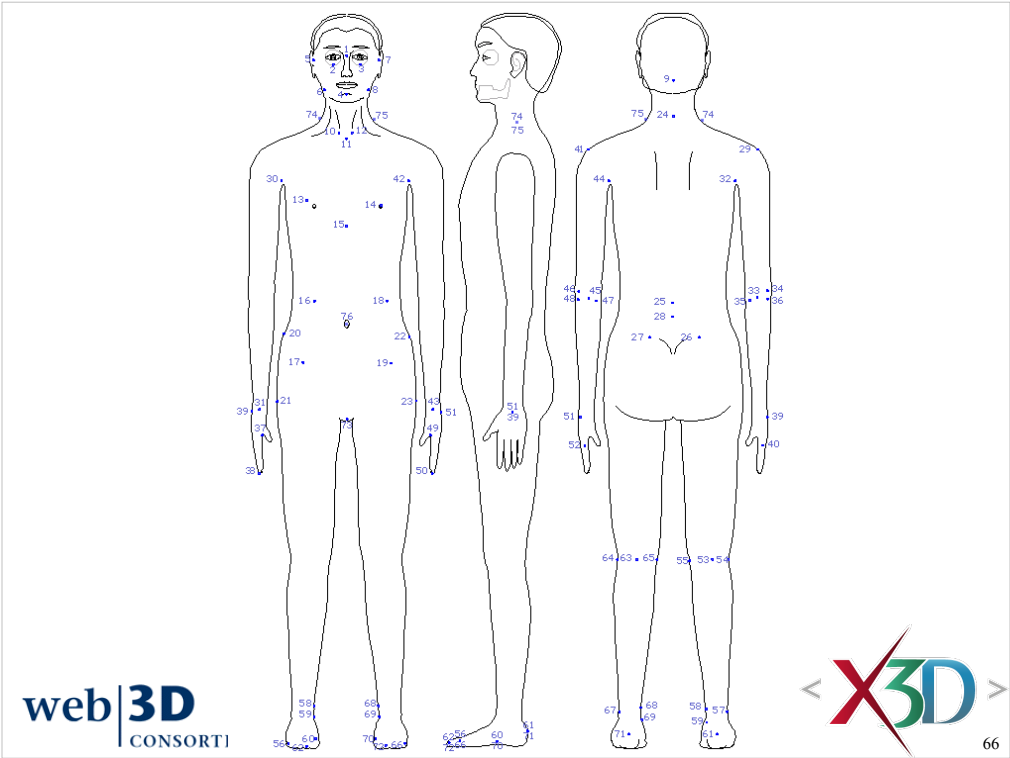
<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Site>

X3D specification:

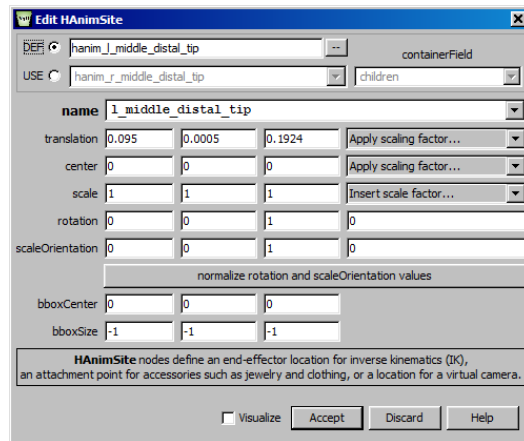
<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimSite>

HAnimSite attributes

- *name* is required, must be unique so that HAnimSite can be identified at runtime for animation and parent/child checks
- List of names provided by H-Anim specification
- Authors may define other sites as well
- *translation, rotation, scale, scaleOrientation bboxCenter, bboxSize*: same as Transform
- *center* is translation offset from origin of the local coordinate system
- *containerField*='children' as regular child node



HanimSite panel X3D-Edit



Example:

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/BoxMan.x3d>

HAnimSite tooltips

| | | |
|-------------------------|---|---|
| HAnimSite | An HAnimSite node serves three purposes: (a) define an "end effector" location which can be used by an inverse kinematics system, (b) define an attachment point for accessories such as jewelry and clothing, and (c) define a location for a virtual camera in the reference frame of an HAnimSegment (such as a view "through the eyes" of the humanoid for use in multi-user worlds).
Hint: HAnimSites are stored as children of an HAnimSegment node.
Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification
Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Site
Hint: include <component name="H-Anim" level="1"> | X3D validation:
Schema , DOCTYPE |
| DEF | [DEF ID #IMPLIED]
DEF defines a unique ID name for this node, referencable by other nodes.
Hint: descriptive DEF names improve clarity and help document a model.
Hint: http://www.web3d.org/x3d/content/examples/X3dSceneAuthoringHints.html#NamingConventions | |
| USE | [USE IDREF #IMPLIED]
USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value).
Hint: USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.
Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.
Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene. | |
| name | [name accessType inputOutput, type SFString CDATA #REQUIRED]
Unique name attribute must be defined so that HAnimSite node can be identified at runtime for animation purposes.
Examples: cervicale 1, infraorbitale supramenton etc. listed in H-Anim Specification.
Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimSiteLoa3Names19774V1.0.txt
Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/BodyDimensionsAndLOAs.html#LOA3DefaultSiteTranslations | |
| translation | [translation accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Position of children relative to local coordinate system. | |
| rotation | [rotation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
Orientation of children relative to local coordinate system. | |
| scale | [scale accessType inputOutput, type SFVec3f CDATA "1 1 1"]
Non-uniform x-y-z scale of child coordinate system, adjusted by center and scaleOrientation. | |
| scaleOrientation | [scaleOrientation accessType inputOutput, type SFRotation CDATA "0 0 1 0"]
Preliminary rotation of coordinate system before scaling (to allow scaling around arbitrary orientations). | |
| center | [center accessType inputOutput, type SFVec3f CDATA "0 0 0"]
Translation offset from origin of local coordinate system. | |
| bboxCenter | [bboxCenter accessType initializeOnly, type SFVec3f CDATA "0 0 0"]
Bounding box center: position offset from origin of local coordinate system. | |
| bboxSize | [bboxSize accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]
Bounding box size: automatically calculated, can be specified as an optimization or constraint. | |
| containerField | [containerField NMTOKEN "children"]
containerField is the field-label prefix indicating relationship to parent node.
Examples: geometry Box, children Group, proxy Shape.
Hint: containerField attribute is only supported in XML encoding of X3D scenes. | |
| class | [class CDATA #IMPLIED]
class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes. | |

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimSite>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Site>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimSite>

HAnimDisplacer node

- HAnimDisplacer nodes are used to alter the shape of individual segments. Three uses:
 - Identify vertices corresponding to a particular feature on the HAnimSegment,
 - Represent a particular muscular action displacing vertices in various directions (linearly or radially),
 - Represent a complete configuration of the vertices in an HAnimSegment. For example, there might be an HAnimDisplacer for each facial expression.
- Multiple HAnimDisplacer nodes must appear consecutively inside parent HAnimSegment

HAnimDisplacer attributes

- *name* is required, must be unique so that HAnimDisplacer can be identified at runtime for animation and parent/child checks
 - *name* suffixes include *_feature*, *_action* and *_config*
- *name* matches Surface feature points
 - Provided in text table of values
 - Provided in Annex B of H-Anim Specification
- *displacements*: array of 3D values added to neutral or resting position of HAnimSegment vertex sets referenced by *coordIndex* field
- *coordIndex*: defines how coordinate array of HAnimSegment vertices is affected

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimDisplacer>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Displacer>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimDisplacer>

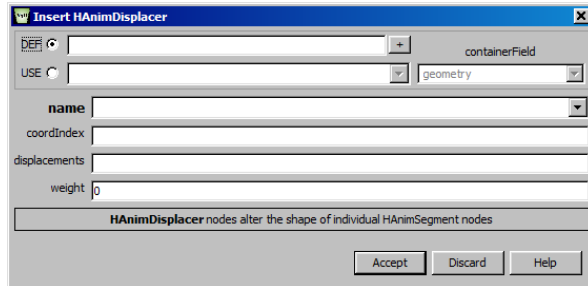
Feature point table

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimSurfaceFeaturePoints19774V1.0.txt>

H-Anim Specification Annex B, Feature points for the human body

<http://www.web3d.org/documents/specifications/19774/V1.0/HAnim/FeaturePoints.html>

HanimDisplacer panel X3D-Edit



TODO: need example scene

HAnimDisplacer tooltips

| | | |
|--------------------------------|---|---|
| HAnimDisplacer | <p>HAnimDisplacer nodes are used to alter the shape of individual segments. HAnimDisplacer can be used in three different ways: (a) identify vertices corresponding to a particular feature on the HAnimSegment, (b) represent a particular muscular action displacing vertices in various directions (linearly or radially), and (c) represent a complete configuration of the vertices in an HAnimSegment. For example, in the case of a face, there might be an HAnimDisplacer for each facial expression.</p> <p>Hint: name suffixes include <code>_feature</code>, <code>_action</code> and <code>_config</code>. Multiple HAnimDisplacer nodes must appear consecutively inside HAnimSegment.</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/HAnim.html H-Anim Specification</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Displacer</p> <p>Hint: include <code><component name="H-Anim" level="1"/></code></p> | <p>X3D validation:
 Schema, DOCTYPE</p> |
| DEF | <p>[DEF ID #IMPLIED]</p> <p>DEF defines a unique ID name for this node, referencable by other nodes</p> | |
| USE | <p>[USE IDREF #IMPLIED]</p> <p>USE means reuse an already DEF-ed node ID, excluding all child nodes and all other attributes (except for containerField, which can have a different value). USE references to previously defined DEF geometry (instead of duplicating nodes) can improve performance.</p> <p>Warning: do NOT include any child nodes, a DEF attribute, or any other attribute values (except for containerField) when defining a USE attribute.</p> <p>Warning: each USE value must match a corresponding DEF value that is defined earlier in the scene.</p> | |
| name | <p>[name accessType inputOutput, type SFString CDATA #REQUIRED]</p> <p>Unique name attribute must be defined so that HAnimDisplacer node can be identified at runtime for animation purposes.</p> <p>Examples: <code>sellion_r_infraorbitale</code> etc. listed in H-Anim Specification.</p> <p>Hint: http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/HAnimFeaturePoints19774V1.0.txt</p> <p>Hint: http://www.web3d.org/files/specifications/19774/V1.0/HAnim/FeaturePoints.html</p> | |
| coordIndex | <p>[coordIndex accessType inputOutput, type MFInt32 CDATA #IMPLIED]</p> <p>Defines coordinate array of HAnimSegment vertices affected by HAnimDisplacer indices provide order in which coordinates are applied order starts at index 0, commas are optional between sets use -1 to separate indices for each feature</p> | |
| displacements | <p>[displacements accessType inputOutput, type MFVec3f CDATA #IMPLIED]</p> <p>Set of 3D values added to neutral or resting position of each set of HAnimSegment vertices referenced by coordIndex field</p> | |
| weight | <p>[weight accessType inputOutput, type SFFloat CDATA 0.0]</p> <p>Scale displacements using weight value before adding them to neutral vertex positions.</p> | |
| containerField | <p>[containerField NMTOKEN "displacers"]</p> <p>containerField is the field-label prefix indicating relationship to parent node.</p> <p>Examples: <code>geometry Box</code>, <code>children Group</code>, <code>proxy Shape</code></p> <p>Hint: containerField attribute is only supported in XML encoding of X3D scenes.</p> | |
| class | <p>[class CDATA #IMPLIED]</p> <p>class is a space-separated list of classes, reserved for use by XML stylesheets. The class attribute is only supported in XML encoding of X3D scenes.</p> | |

X3D Tooltips:

<http://www.web3d.org/x3d/tooltips/X3dTooltips.html#HAnimDisplacer>

HAnim specification:

<http://www.web3d.org/files/specifications/19774/V1.0/HAnim/ObjectInterfaces.html#Displacer>

X3D specification:

<http://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/versionContent.html#HAnimDisplacer>

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Support



The following tables of information are related to the H-Anim specification and corresponding X3D H-Anim component. They are provided for developer use.

| | Plain Text Data Tables | Specification Descriptions |
|------|---|--|
| 1 | HAnimHierarchyWeb3d-19774-V1.0.txt | Text-based node hierarchy from approved ISO standard: H-Anim Specification, 4.9.5 Hierarchy. |
| 3 | HAnimHierarchyWithSites.txt | Hierarchy of joints, segments with corresponding surface-feature sites (based on skeletal proximity) |
| 4 | HAnimJointNames19774V1.0.txt | List of approved HAnimJoint names. <ul style="list-style-type: none"> • Table 4.2 - Body Joint object names • Table 4.3 - Hand Joint object names • Table 4.4 - Face Joint object names |
| 5 | HAnimSegmentNames19774V1.0.txt | Approved HAnimSegment names, excerpted from H-Anim Specification, 4.9.5 Hierarchy. |
| 6..9 | HAnimJointLoa0Names19774V1.0.txt
HAnimSiteLoa0Names19774V1.0.txt | List of approved HAnimSite names, LOA 0 to 3. |
| 10 | HAnimSurfaceFeaturePoints19774V1.0.txt | Surface feature points, used by HAnimDisplacer nodes. |
| 11 | SiteNameComparisonsByLOA.xlsx | Site names comparison by LOA, constructed from preceding text tables. |

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/tables.html>

Table of H-Anim Tables of Names and Features

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/tables.html>

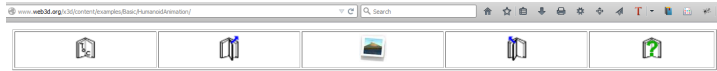
SiteNameComparisonsByLOA.xlsx

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/tables/SiteNameComparisonsByLOA.xlsx>

These various text tables are used to populate correct lists of relevant attribute values in validation checkers, authoring-tool menus, etc.

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Examples



X3D Example Archives: Basic, Humanoid Animation



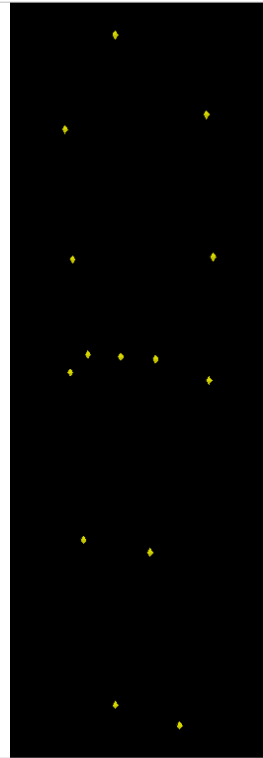
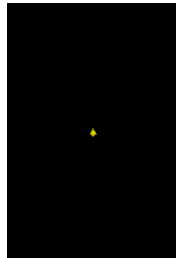
These Humanoid Animation (H-Anim) examples support the ISO [Humanoid Animation \(H-Anim\) Specification](#) with a corresponding specification for ISO [X3D Abstract Specification H-Anim component](#).

The [H-Anim Working Group Executive Summary](#) summarizes current capabilities. Prior original efforts can be found online at [hanim.org](#). Significant additional work is being considered by renewed efforts documented on the [H-Anim Working Group Wiki](#). Tool builders may benefit from using convenient [tables of enumeration values](#) extracted from the H-Anim Specification. Related work appears in the [Medical](#) examples.

| X3D Scenes | Descriptions |
|--|--|
| Allen Dutton | Articulated human model developed from laser-scan data in x3d Native Tags. |
| Allen Dutton Blurry Motion | Articulated human model developed from laser-scan data in x3d Native Tags. Motions of the avatar are blurry. |

Diamond Man

- DiamondManLOA-0.x3d
- DiamondManLOA-1.x3d
- DiamondManLOA-2.x3d
(includes visual key)

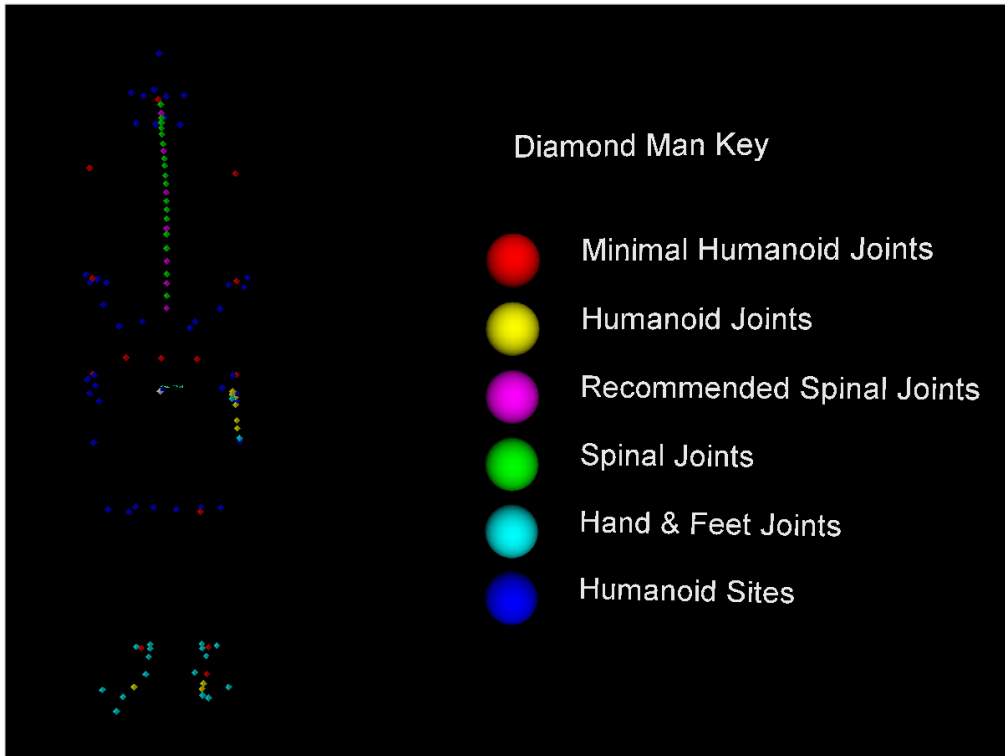


DiamondMan models

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/DiamondManLOA-0.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/DiamondManLOA-1.x3d>

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/DiamondManLOA-2.x3d>



DiamondManLOA-3.x3d

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/DiamondManLOA-3.x3d>

Interchangable Actors Via Dynamic Routing Prototypes

X3D Example Archives: Basic, Humanoid Animation, Interchangable Actors Via Dynamic Routing Prototypes

This example demonstrates interchangeability of avatars (Nancy, Allen, Boxman) and animation behaviors (Stand, Run, Jump, Walk) via dynamic routing.

ALLEN
NANCY
BOXMAN

Stand Walk Run Jump Kneel

ALLEN
NANCY
BOXMAN

Stand Walk Run Jump Kneel

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Korean Characters

- 12 characters at LOA 1 and 2
- Authored in 3DS Max and Maya
- Testing MOCAP conversions
- Confirming best practices and tool support

- Work continues, reported on h-anim mail list

LOA1 H-Anim Characters (X3D H-Anim)



1.Jin



2.Chul



3.Hyun



4.Young



5.Ju



6.Ga



7.No



8.Da



9.Ru



10.Mi



11.Min

August 18-22, 2014 SC24 Plenary & WG Meetings

LOA2 H-Anim Characters (X3D H-Anim)



1.Jin



11.Min

LOA-4 Models Hands and Feet

Four initial models to test improvements

- HanimModelHandLeft.x3d HanimModelHandRight.x3d
- HanimModelFootLeft.x3d HanimModelFootRight.x3d
- Checked into Basic HumanoidAnimation Examples under SourceForge version control

Next steps, work in progress:

- Incremental improvements, checked in
- X3D v3.4 DOCTYPE and XML Schema validation
- X3D Schematron rules validation
- MOCAP animation and model integration



Basic HumanoidAnimation Examples

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation>

SourceForge version control

<http://sourceforge.net/p/x3d/code/HEAD/tree/www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation>

Additional links for X3D Examples

<http://www.web3d.org/x3d/content/examples/X3dResources.html#Basic>

Integrating Hanim Models, Animation

HAnimHumanoid can only have single root Joint

- Typically "Root"

How to best add portions of models? Should work since various LOAs are designed for composition.

- Root
 - HandsLeft
 - HandsRight
- Animation
 - Body interpolator
 - Left hand mocap interpolators
 - Right hand mocap interpolators



Basic HumanoidAnimation Examples

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation>

SourceForge version control

<http://sourceforge.net/p/x3d/code/HEAD/tree/www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation>

Additional links for X3D Examples

<http://www.web3d.org/x3d/content/examples/X3dResources.html#Basic>

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Additional Resources



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Additional Resources

- Numerous...
- X3D Resources
- H-Anim working group page
- H-Anim working group wiki

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Chapter Summary



Chapter Summary

H-Anim Humanoid Animation is an ISO Standard co-evolving with (and supported by) X3D.

H-Anim is designed to be implementable by a variety of different 3D graphics technologies.

H-Anim models have regular patterns of Joints and Segments to create a movable skeleton.

Sites and Displacers support feature animation.

Current work includes improved support for skin, face/hands/feet, motion capture (mocap) conversions for full-fidelity animation, including usability for medically accurate records.

Suggested exercises

- Explore the examples both basic bodies and also behavior switching
- Animate a humanoid around a scene
- Add visualization geometry to an empty skeleton, examine the changes that occur
- List possible use cases that might take advantage of body/behavior libraries
- Investigate current technology developments in motion capture (mocap) and direct scanning of human bodies

[back to Table of Contents](#)

References

References 1

X3D: Extensible 3D Graphics for Web Authors
by Don Brutzman and Leonard Daly, Morgan
Kaufmann Publishers, April 2007, 468 pages.

- Chapter 3, Grouping Nodes
- <http://x3dGraphics.com>
- <http://x3dgraphics.com/examples/X3dForWebAuthors>

X3D Resources

- <http://www.web3d.org/x3d/content/examples/X3dResources.html>



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References 2

X3D-Edit Authoring Tool

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

X3D Scene Authoring Hints

- <http://x3dgraphics.com/examples/X3dSceneAuthoringHints.html>

X3D Graphics Specification

- <http://www.web3d.org/x3d/specifications>
- Also available as help pages within X3D-Edit

References 3

Basic Examples Archive, HumanoidAnimation

- <http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation>



Basic Examples Archive, HumanoidAnimation

<http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/>

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X3D for Web Authors recognized by CGEMS! ☺

- Book materials: X3D-Edit tool, examples, slidesets
- Received jury award for Best Submission 2008

CGEMS supported by SIGGRAPH, Eurographics



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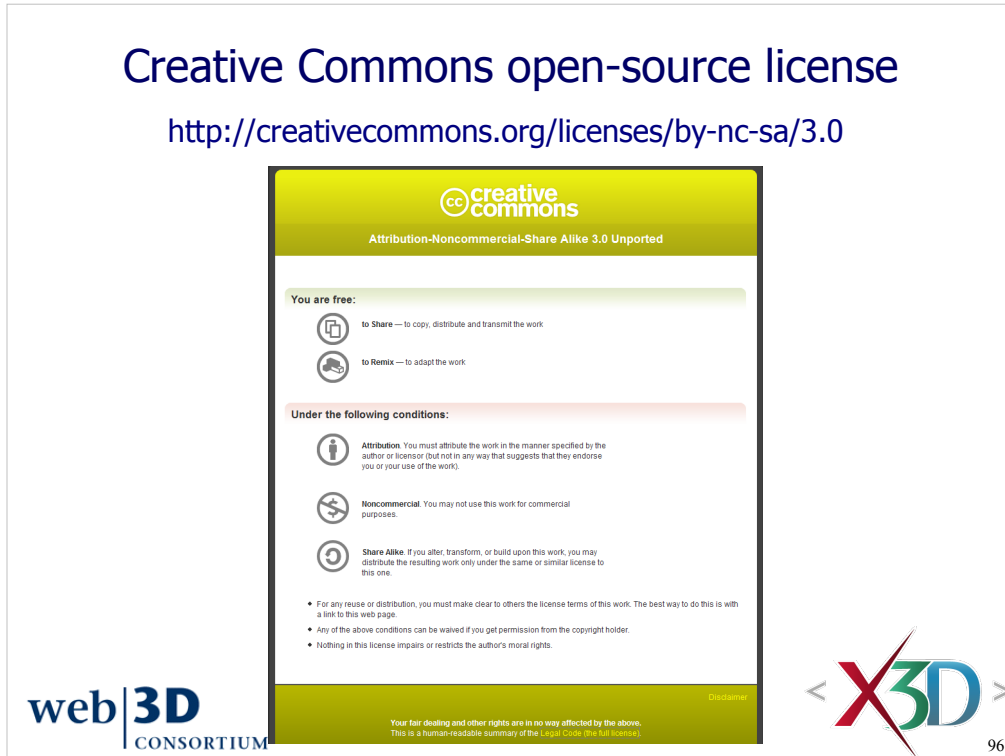


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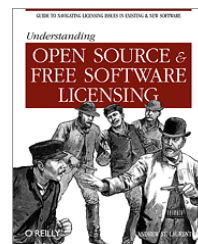
License available at

<http://www.web3d.org/x3d/content/examples/license.txt>

<http://www.web3d.org/x3d/content/examples/license.html>

Good references on open source:

Andrew M. St. Laurent, *Understanding Open Source and Free Software Licensing*, O'Reilly Publishing, Sebastopol California, August 2004. <http://oreilly.com/catalog/9780596005818/index.html>



Herz, J. C., Mark Lucas, John Scott, *Open Technology Development: Roadmap Plan*, Deputy Under Secretary of Defense for Advanced Systems and Concepts, Washington DC, April 2006. <http://handle.dtic.mil/100.2/ADA450769>



