H-Anim Architecture and Motion Capture - NWIPs and WD Outlines and H-Anim Developments Updates

ISO/IEC JTC 1/SC 24 Plenary and WG Meetings

Sydney, Australia

August 26-30, 2013

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Presentation Topics

- NWIPs
  - ISO/IEC 19774 Humanoid Animation – Part 1: Architecture
  - ISO/IEC 19774 Humanoid Animation – Part 2: Motion Capture
- WD Outlines for NWIPs
  - ISO/IEC 19774 Humanoid Animation – Part 1: Architecture
  - ISO/IEC 19774 Humanoid Animation – Part 2: Motion Capture

- H-Anim Developments Updates
  - H-Anim skin representation (Joe Williams and Don Brutzman)
  - H-Anim behavior animation examples of LOA1, LOA2, and LOA3 humanoids (Joe Williams and Don Brutzman)
  - H-Anim character design method using general graphics tools and 10 example characters (Myeong Won Lee)
  - H-Anim motion capture animation, wrl-to-x3d H-Anim converter, H-Anim motion viewer, and H-Anim motion editor with BVH (Myeong Won Lee)

Status of ISO/IEC 19774 Humanoid Animation V1.0: 2006

- Foreword
- Introduction
- 1. Scope
- 2. Normative references
- 3. Terms and definitions
- 4. Concepts
- 5. Abstract data types
- 6. Object interfaces
- 7. Conformance
- Annexes
- A. Nominal body dimensions and levels of articulation
- B. Feature points for the human body
- C. VRML binding
- D. X3D binding
- E. Guidelines for H-Anim in VRML and X3D worlds
- Bibliography

Status of ISO/IEC 19775-1:2008 Extensible 3D (X3D) V3.2 Clause 26 Humanoid Animation (H-Anim) component

- 26.1 Introduction
  - 26.1.1 Name
  - 26.1.2 Overview
- 26.2 Concepts
- 26.3 Node reference
  - 26.3.1 HAnimDisplacer
  - 26.3.2 HAnimHumanoid
  - 26.3.3 HAnimJoint
  - 26.3.4 HAnimSegment
  - 26.3.5 HAnimSite
- 26.4 Support levels

- Table 26.1 – Topics
- Table 26.3 – H-Anim component support levels

NWIP 1: ISO/IEC 19774 Humanoid Animation – Part 1: Architecture

- This work specifies an overall architecture for representing humanoids in a network-enabled 3D graphics and multimedia environment. Each humanoid is an articulated character that can be embedded in different representation systems and animated using the facilities provided by the representation system. This standard specifies the abstract form and structure of humanoids.
- The new work to be addressed is a revision of H-Anim 2 in Extensible 3D (X3D) Part 1: Architecture and base components, 26 Humanoid Animation (H-Anim) component specification and based on ISO/IEC 19774 - Humanoid Animation (H-Anim).

- 1) Definitions
- 2) Concepts
- 3) Humanoid object
- 4) Joint object
- 5) Segment object
- 6) Site object
- 7) Displacer object
- 8) Skeletal humanoid
- 9) Skinned humanoid
- 10) Structure of a humanoid
- 11) 3D medical object for a humanoid
- 12) Abstract data types and object interfaces
- 13) Conformance
- 14) Use cases
- 15) Annexes

NWIP 2: ISO/IEC 19774 Humanoid Animation – Part 2: Motion Capture

- This work defines an exchangeable data model for humanoid animation that can be used in heterogeneous computing environments. It includes the data exchange format of humanoid animation, H-Anim human behavior prototypes, interfaces with various scanning data, and a 3D skinning and recording interface for humanoid animation. It also includes the procedure for modelling H-Anim characters using general graphics tools.
- The new work to be addressed is a revision of H-Anim 2 in the Extensible 3D (X3D) Part 1: Architecture and base components 26 Humanoid Animation (H-Anim) component specification and based on ISO/IEC 19774 - Humanoid Animation (H-Anim).

- 1) Definition of a humanoid character model capable of generating motion from captured motion data
- 2) Definition of a humanoid character model capable of generating motion using 3D scanner data
- 3) Definition of a humanoid character model capable of generating motion using a general motion definition such as keyframe, interpolation, kinematics, and dynamics for human figures
- 4) Definition of motion parameters for transferring or exchanging motion between human character models
- 5) Definition of a motion data interface for including motion data
- 6) Definition of a motion viewer's functionality
- 7) Definition of interoperable human behavior prototypes
- 8) Definition of a 3D skinning interface
- 9) Definition of a recording interface for human motion
- 10) Provision for easier exchange of characters from design systems to H-Anim systems

WD 1: Humanoid Animation-Part 1: Architecture

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5.9 Interoperable human behavior prototypes

5.10 H-Anim modelling and animation for 3D skinning interface

5.11 Recording interface for human motion

5.12 Exchange of characters from design systems to H-Anim systems

6 H-Anim Model definition for motion capture

7 H-Anim Motion definition for motion capture

8 Schema expansion for H-Anim motion definition

9 Use Cases

10 Conformance

Annexes

H-Anim Character Modeling Method

Bibliography

Skin representation (Joe Williams)

- Skin feature points (http://www.hypermultimedia.com/x3d/hanim/JoeH-AnimKick1a.txt)

```
skin [
   Shape {
 # Skin including most Feature Points and Site objects location
    geometry  IndexedFaceSet {
     coord DEF JoeSkinCoord Coordinate { point [
 0.0 1.77 0.0                #0 skull_tip
 0.0 1.665 0.09              #1 sellion
 -0.033 1.62 0.087           #2 r_infraorbitale
 0.033 1.62 0.087            #3 l_infraorbitale
 0.0 1.55 0.097              #4 supramenton
 -0.077 1.64 -0.01           #5 r_tragion
 -0.0527 1.58 0.015          #6 r_gonion
 0.077 1.64 -0.01            #7 l_tragion

....

-0.125 0.0 0.12          #382 add at r_metatarsal bottom
 -0.165 0.0 0.12          #383 add at r_metatarsal outside
 -0.087 0.0 0.122         #384 add at r_metatarsal inside
 -0.090 0.012 0.188       #385 add at r_piggy1_tip
 -0.110 0.011 0.19        #386 add at r_piggy2_tip
 -0.128 0.011 0.185       #387 add at r_piggy3_tip
 -0.142 0.011 0.178       #388 add at r_piggy4_tip
 -0.154 0.010 0.168       #389 add at r_piggy5_tip
 # h-anim2: we need to know the exact order in which
 # deformable skin vertices are defined.
 ]}
```

H-Anim 1 Skin Plan (Joe Williams)

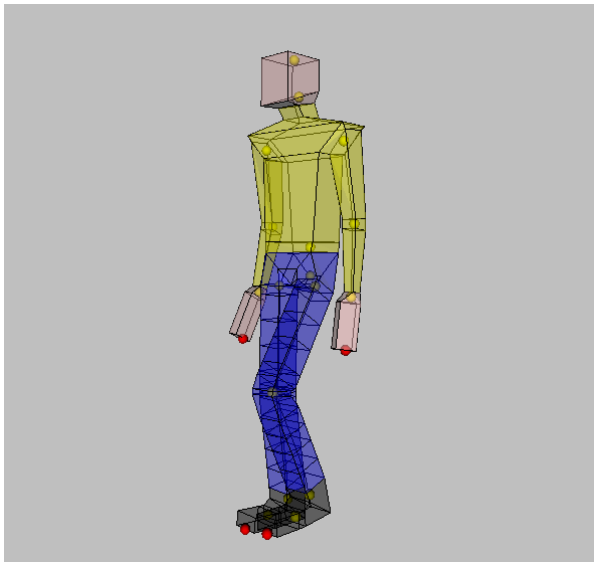
- Extend collection of standard' surface feature points
  - User-friendly names and typical locations
  - Compose 'standard' deformable skin from these feature points
- Document 'standard' Joint and Displacer bindings
  - ‘Standard' skeleton+skin combinations
- Document surface feature point densities
  - Include Medical, Haptic, Physics references
  - Densities according to target skeleton LOA.
- Document default textures
  - Show 'standard' feature points
  - Default texcoords available
- Defines best practices for H-anim 1
  - Sets the stage for H-Anim 2, Interactive and Active
- Current H-Anim ISO FCD candidate
  - Only some tables and examples will change
- H-Anim best skinning practice will emerge
- The complete skeleton and skin model provides needed interfaces for haptic and kinetic simulations

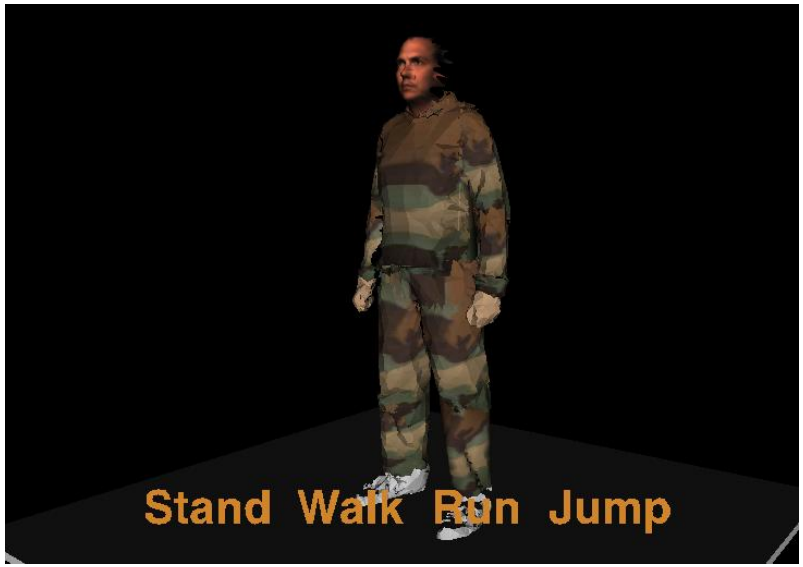
H-Anim 2 Skin Plan (Joe Williams)

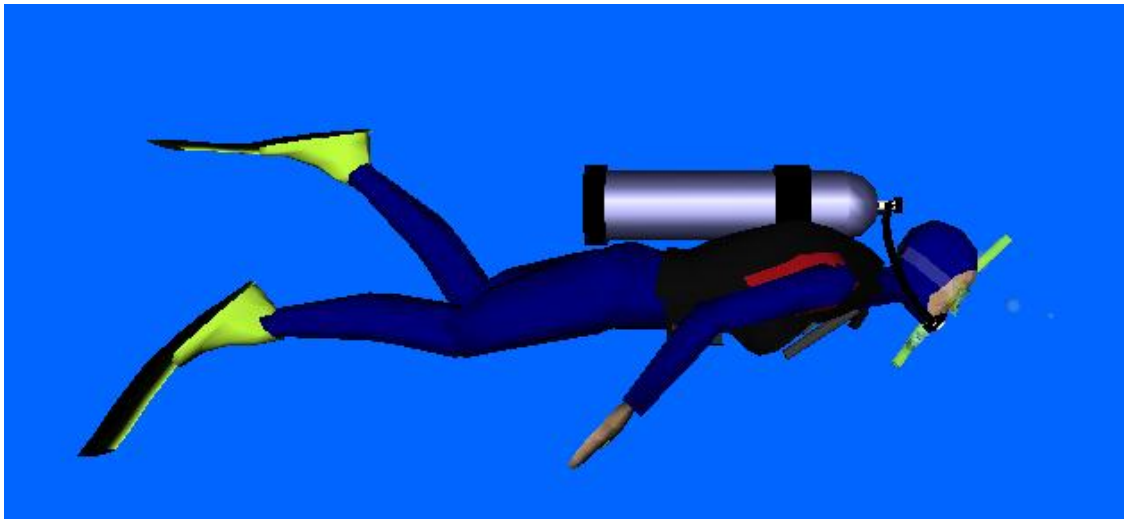
- The H-Anim 1 model can be further improved by incorporating known technical feature upgrades such as specific expected joint behaviors,
- Implementing rigid body physics features specifically for extended kinematics and dynamics.
- Collect best physics, haptics, tactile, sensors, actuators, effectors, muscles, event processing, motion blending/capture/prediction/analysis, quats, tensors, instrumentation, medical component integration/simulation/emulation, dynamic haptic interactions, and kinetic simulations, usable by AI
- Motion modeling/blending/prediction/capture/analysis
- H-Anim Medical Biospatial
- H-Anim 4D Biometrics
- X3D Computational Anatomy
- Best practices skeletons and skins can be moved closer to realistic humanoid realtime spacetime

H-Anim Characters (X3D H-Anim)

http://www.web3d.org/x3d/content/examples/Basic/index.html#HumanoidAnimation







H-Anim Characters (X3D H-Anim)

1.Jin

2.Chul

3.Hyun

4.Young

5.Ju

6.Ga

7.No

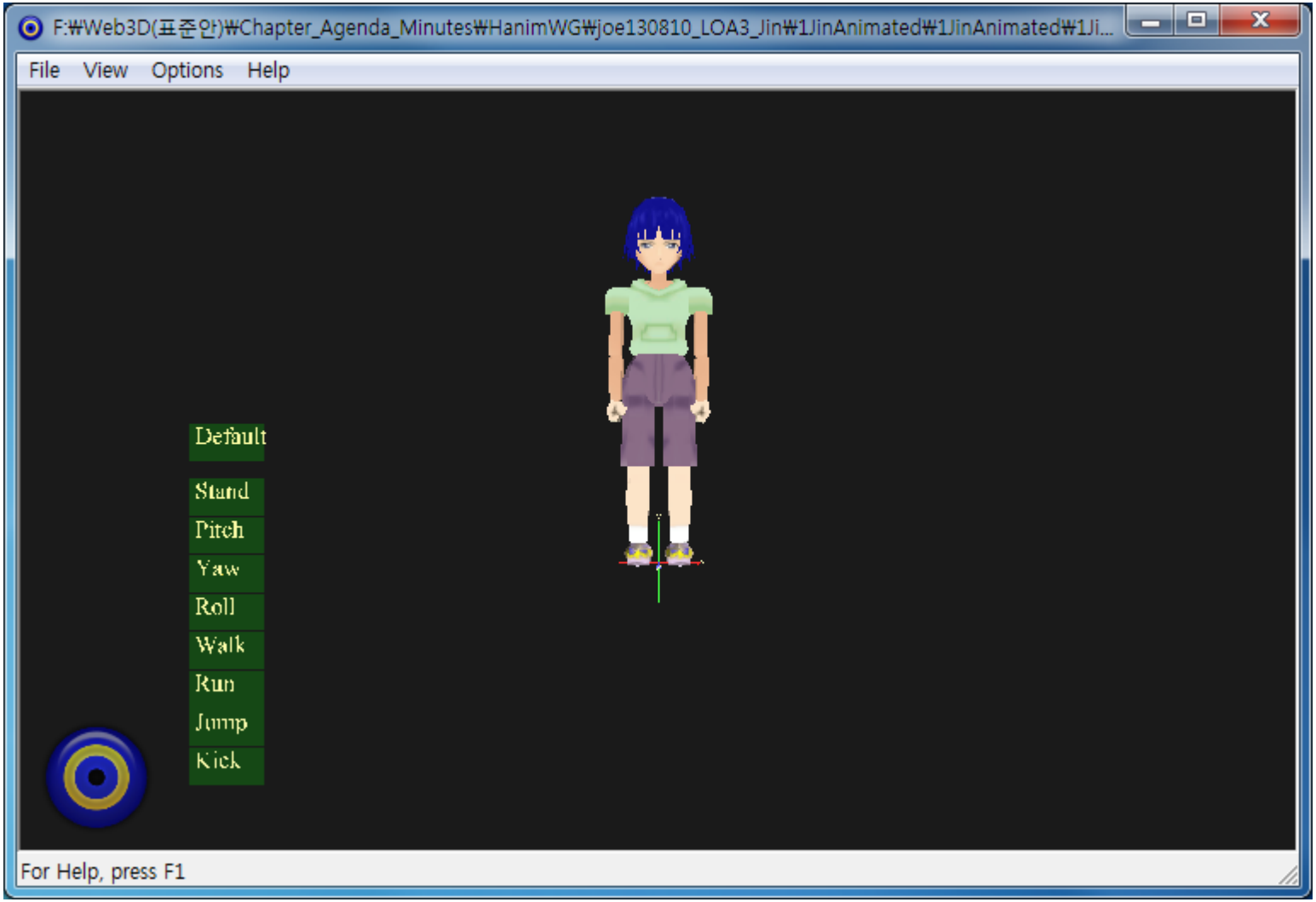
8.Da

9.Ru

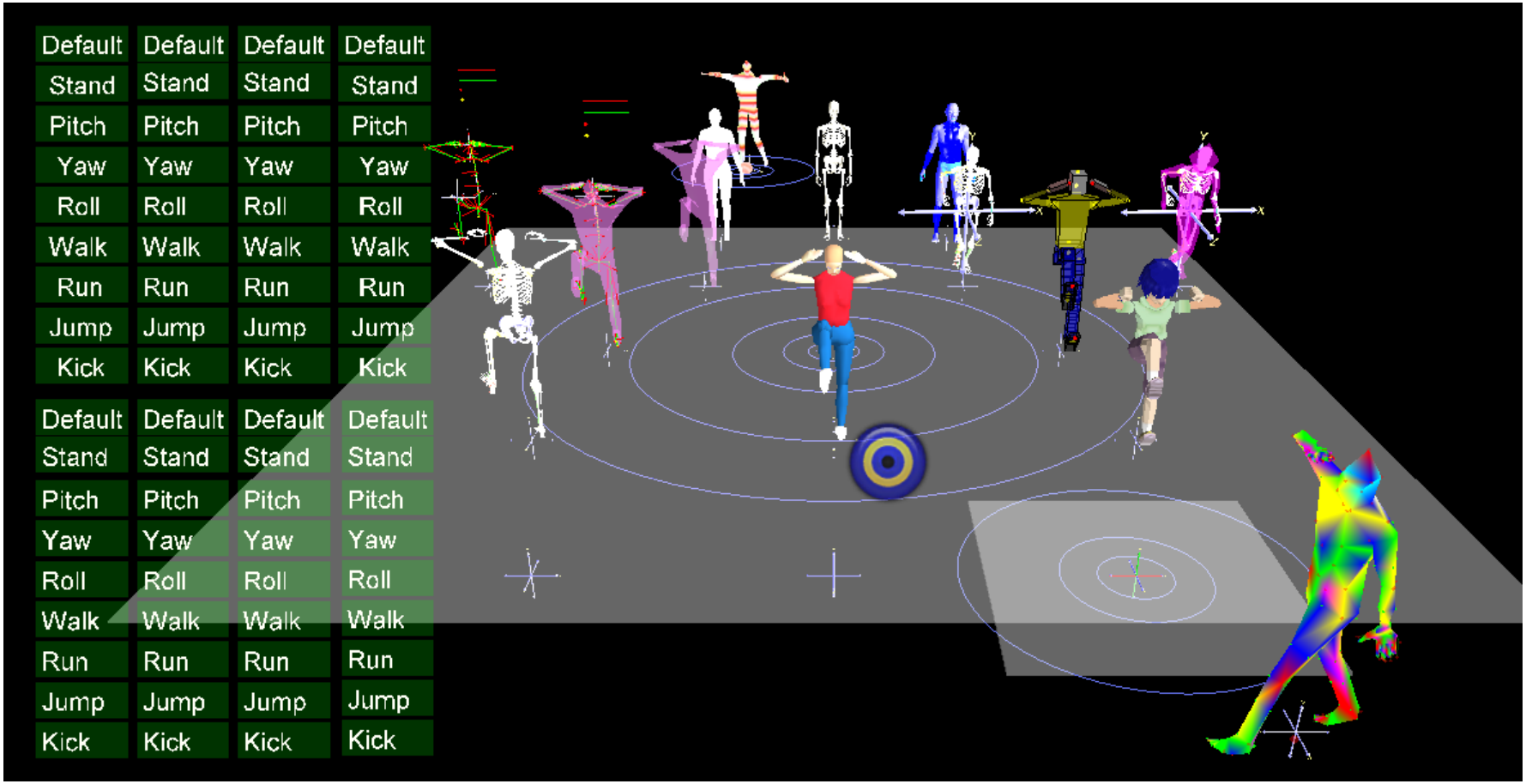
10.Mi

H-Anim Examples (X3D H-Anim)

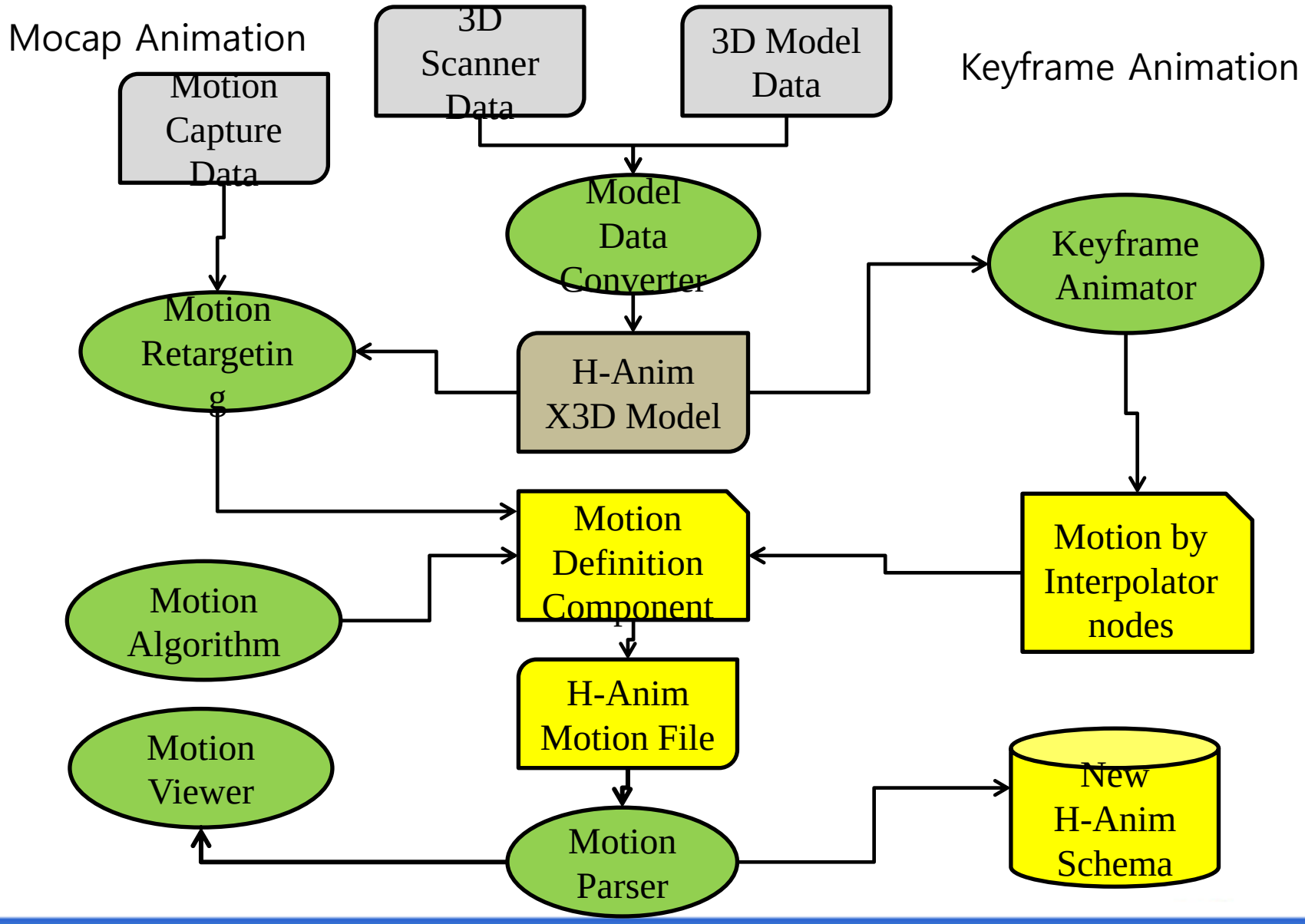
H-Anim Behaviour Animation (Joe Williams and Don Brutzman)



H-Anim Behaviour Animation (Joe Williams and Don Brutzman)



H-Anim Character Animation Generation



Motion Data Definition

- Definition of a Motion Data Component
  - Joint node (update)
    - Define additional fields for motion parameters
  - Motion node
    - Define motion captured data for an H-Anim character model
    - Define the motion node after adjusting the center of each joint to the H-Anim character model

Joint Node Update (1)

```
Interface Joint {
// the same as the existing joint node
float[3] bboxCenter 0 0 0
float[3] bboxSize -1 -1 -1
float[3] center 0 0 0
sequence<Object> children []
sequence<Object> displacers []
sequence<float[3]> llimit []
float[4] limitOrientation 0 0 1 0
string name ""
float[4] rotation 0 0 1 0
float[3] scale 1 1 1
float[4] scaleOrientation 0 0 1 0
float[3] translation 0 0 0
sequence<float[3]> ulimit []

// define additional fields
float[3] Offset
int[2]    ChannelsNumber
sequence<string> Channels
}
```

```
HIERARCHY
ROOT Hips
{
  OFFSET 0.000000 0.000000 0.000000
  CHANNELS 6 Xposition Yposition Zposition Zrotation
  JOINT Chest
  {
    OFFSET 0.000000 5.613096 0.000000
    CHANNELS 3 Zrotation Xrotation Yrotation
    JOINT LeftCollar
    {
      OFFSET 0.003804 10.354579 1.025227
      CHANNELS 3 Zrotation Xrotation Yrotation
      JOINT LeftShoulder
      {
        OFFSET 3.922637 0.000000 0.000000
        CHANNELS 3 Zrotation Xrotation Yrotation
```

- Fields for receiving motion capture data
  - Offset
  - ChannelsNumber
  - Channels

Joint Node Update (2)

- Define additional fields: Offset, Channels, ChannelsNumber (new fields)

```
Interface Joint {
    …
    float[3]              Offset
    int[2]                ChannelsNumber
    sequence<string>      Channels
}
```

  - ChannelsNumber: Number of channels at a joint
  - Channels: Identifiers for channels
  - Offset: The center of a joint

- Example

```
Joint {
…
Offset              [ 1, 3 ]
ChannelsNumber      [ 1, 3 ]
Channels            " Xrotate   Yrotate   Zrotate"
}
```

Motion Node

- Definition of Motion Node (a new node)
  - Define fields: Frames, FrameTime, Transformation Channels

```
Interface Motion {
    int                 Frames
    float               FrameTime
    sequence<float>     Transformation
}
```

  - Frames: Number of frames for an animation sequence
  - FrameTime: Specifies a sampling rate
  - Transformation: Transformation values of a joint for each frame
- Example

```
Motion {
Frames          601
Frametime        0.033333
transformation   [ 11.623, 31.312, 64.121, -0.700, -4.023, ……
                 11.616, 31.313, 64.107, -0.696, -3.954, ……
                 …… ]
}
```

New H-Anim – Modeling Part (1)

```
<Scene>
<NavigationInfo speed="1.5" type="'EXAMINE" "ANY"'/>
<HAnimHumanoid DEF="girl1" name="girl1" version="1.1"/>

<HAnimJoint DEF="hanim_HumanoidRoot" center="0.0 0.0 0.0"
containerField="skeleton" name="HumanoidRoot"/>

<HAnimJoint DEF="hanim_sacroiliac" center="0.0 0.0 0.0" name="sacroiliac"
containerField="children"
Offset="0.000000 0.000000 0.000000“
Channels="6, Xposition, Yposition, Zposition, Zrotation, Xrotation, Yrotation" />

<HAnimSegment DEF="hanim_pelvis" name="pelvis" containerField="children"/>
<Transform translation="0.0 0.0 0.0"  rotation="0 0 0 0"  scale="0.0 0.0 0.0"
scaleOrientation="0 0 0 0">

<Appearance>
<Material diffuseColor="0.537300 0.196100 0.196100"/>
<ImageTexture url="girl1.bmp"/>
</Appearance>
```

New H-Anim – Modeling Part (2)

```
<Shape>
<IndexedFaceSet coordIndex="0, 1, 2, -1, 0, 2, 3, -1, 0, 3, 4, -1, 0, 4, 5, -1, 0, 5, 6, -1,
0, 6, 7, -1, 0, 7, 8, -1, 0, 8, 9, -1, 0, 9, 10, -1, 0, 10, 11, -1, 0, 11, 12, -1, 0, 12, 1, -1,
…"
texCoordIndex="0, 1, 2, -1, 0, 2, 3, -1, 0, 3, 4, -1, 0, 4, 5, -1, 0, 5, 6, -1, 0, 6, 7, -1, 0,
7, 8, -1, 0, 8, 9, -1, 0, 9, 10, -1, 0, 10, 11, -1, 0, 11, 12, -1, 0, 12, 1, -1, 1, 13, 14, -1,  -
1 …">
<Coordinate point="0.0000 105.4000 0.0000, 0.0000 91.2700 -56.9400, -35.2900
91.2700 -49.3200, -61.1200 91.2700 -40.1100, -70.5700 91.2700 0.0000, -61.1200
…"/>
<TextureCoordinate point="0.6211 0.5754,0.7851 0.5720,0.7614 0.5720,0.6907
0.5698,0.6200 0.5698,0.6158 0.5702,0.5451 0.5702,0.4167 0.5698,0.5451
…"/>
</IndexedFaceSet>
</Shape>
</Transform>
</HAnimSegment>
</HAnimJoint>
…
```

New H-Anim – Motion Part

```
…
…
<HAnimMotion>
<FrameInformation frames ="392" frametime = "0.033333">
<SegmentTransform transform = "
196.1625 71.7332 -58.9121 25.9900 9.3900 -76.6700 29.9100 -61.7800 39.3900
0.1500 30.8300 -
…
…
0.3300 -14.2200 -0.2300 2.1900 -4.9100 -21.1400 -5.5400 8.5100 13.4900 -
10.7700 ">
</HAnimMotion>
</Scene>
</X3D>
```

Schema Extension for H-Anim Character Animation (1)

1. Schema definition for Motion data

```
<xs:group name="ChildContentModelHumanoidAnimation">
  <xs:annotation>
    <xs:appinfo>Child-node content model corresponding to X3DChildNode for
HumanoidAnimation component.</xs:appinfo>
            <xs:documentation source="http://www.web3d.org/x3d/specifications/ISO-
IEC-FDIS-19775-1.2-X3D-AbstractSpecification/Part01/components/hanim.html"/>
  </xs:annotation>
  <xs:choice>
            <xs:element ref="HAnimHumanoid"/>
            <xs:element ref="HAnimJoint"/>
            <xs:element ref="HAnimSegment"/>
            <xs:element ref="HAnimSite"/>
<!-- added -->
            <xs:element ref="HAnimMotion"/>
<!-- added -->
  </xs:choice>
</xs:group>
```

Schema Extension for H-Anim Character Animation (2)

2. Schema definition for the updated Joint node

```
<xs:element name="HAnimJoint">
  <xs:annotation>
      <xs:appinfo/>
         <xs:documentation     source="http://www.web3d.org/x3d/specifications/ISO-IEC-
FDIS-19775-1.2-X3D-AbstractSpecification/Part01/components/
hanim.html#HAnimJoint"/>
      </xs:annotation>
      <xs:complexType mixed="false">
      <xs:complexContent mixed="false">
      <xs:extension base="X3DGroupingNode">
                <xs:attribute name="name" type="jointName"/>
                <xs:attribute name="center" type="SFVec3f" default="0 0 0"/>
                <xs:attribute name="rotation" type="SFRotation" default="0 0 1 0"/>
                <xs:attribute name="scale" type="SFVec3f" default="1 1 1"/>
                <xs:attribute name="scaleOrientation" type="SFRotation" default="0 0 1 0"/>
                <xs:attribute name="translation" type="SFVec3f" default="0 0 0"/>
                <xs:attribute name="skinCoordIndex" type="MFInt32"/>
```

Schema Extension for H-Anim Character Animation (3)

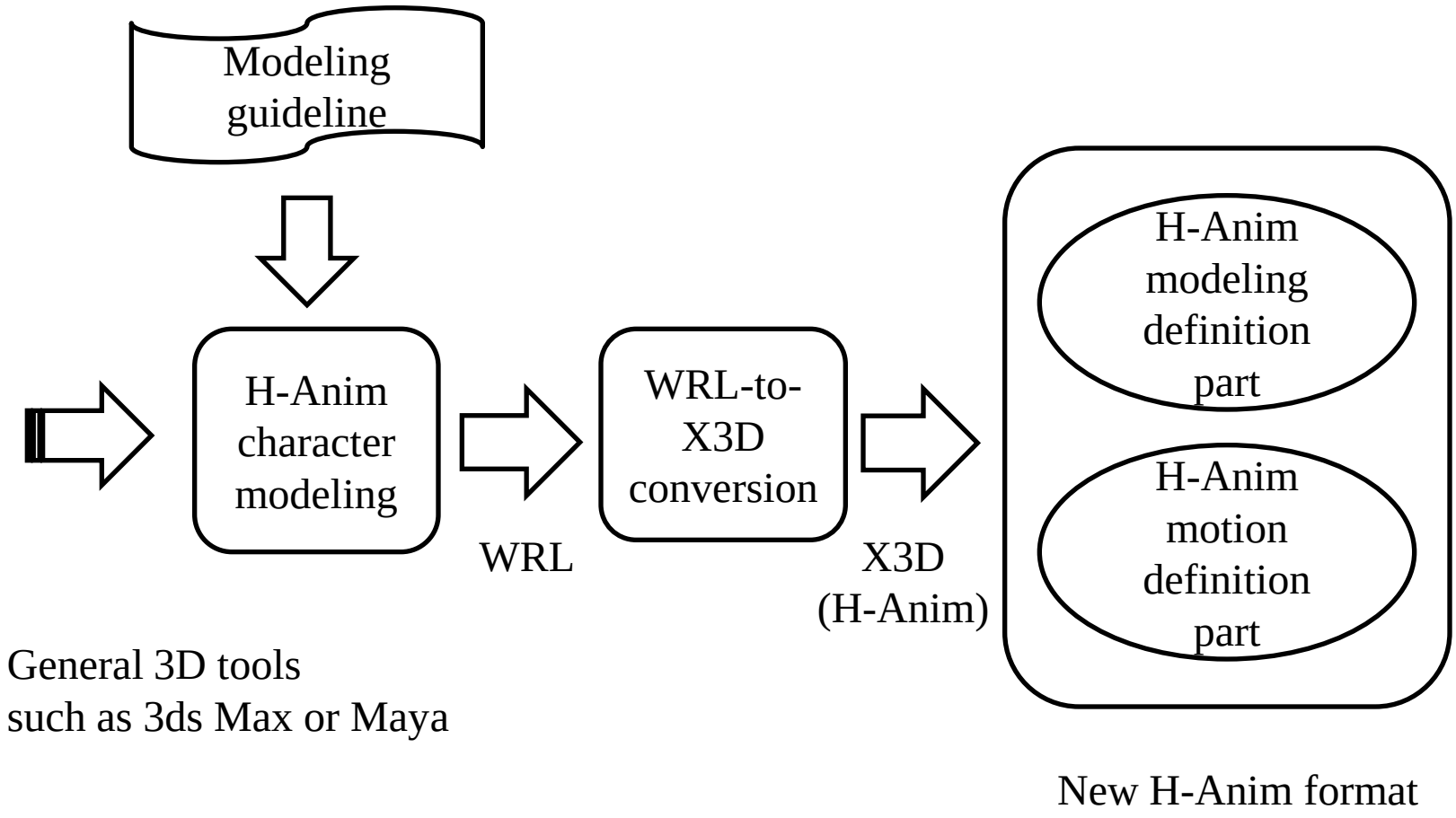
```
            <xs:attribute name="skinCoordWeight" type="MFFloat"/>
            <xs:attribute name="llimit" type="MFFloat"/>
            <xs:attribute name="ulimit" type="MFFloat"/>
            <xs:attribute name="limitOrientation" type="SFRotation" default="0 0 1 0"/>
            <xs:attribute name="stiffness" type="MFFloat" default="0 0 0"/>
<!- added -->
            <xs:attribute name="Offset" type="SFVec3f"/>
            <xs:attribute name="ChannelsNumber" type="MFInt32"/>
            <xs:attribute name="Channels" type="MFString"/>
<!- added -->
        </xs:extension>
      </xs:complexContent>
  </xs:complexType>
</xs:element>
```

Schema Extension for H-Anim Character Animation (4)

3. Schema definition for the Motion node

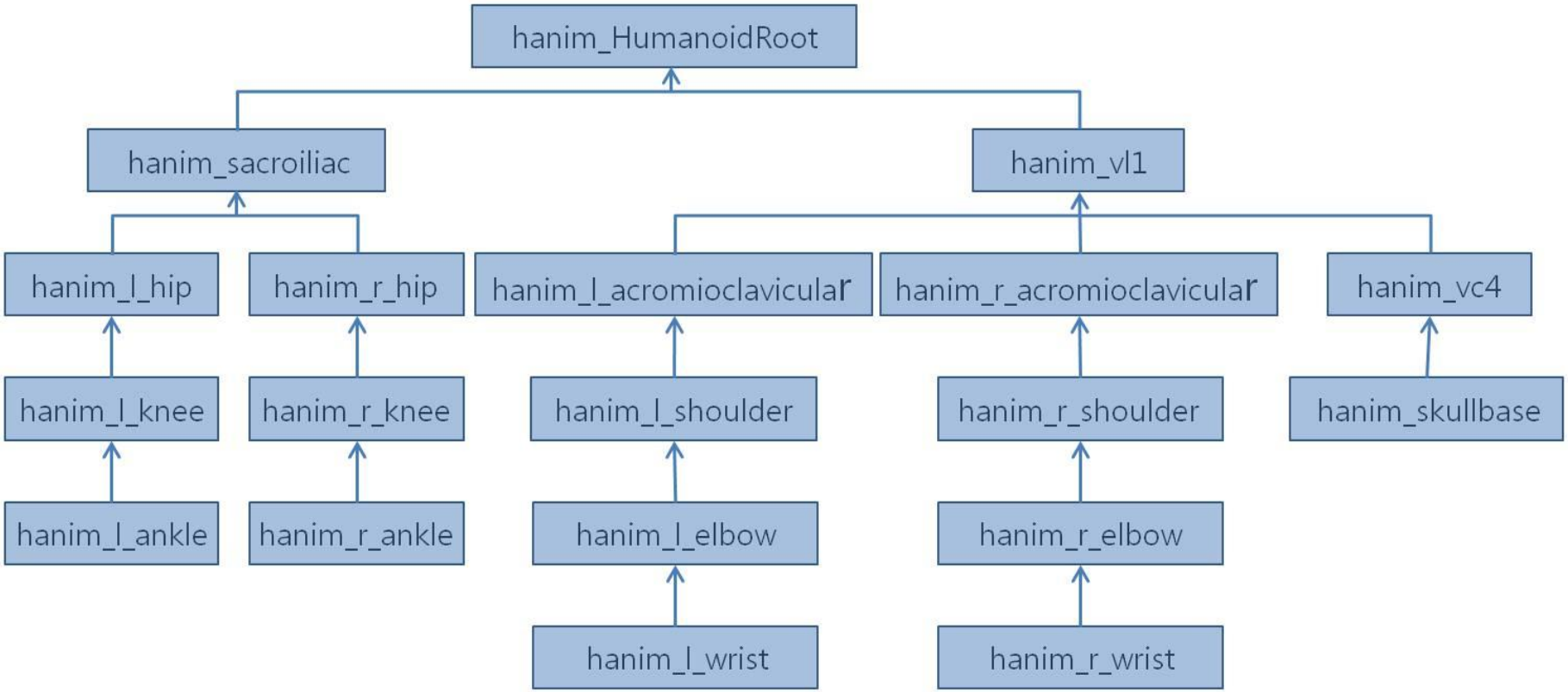
```
<!- added -->
<xs:element name="HAnimMotion">
   <xs:annotation>
       <xs:appinfo/>
            <xs:documentation source="..."/>
   </xs:annotation>
   <xs:complexType>
            <xs:attribute name="DEF" type="xs:ID" use="required"/>
            <xs:attribute name="Frames" type="SFInt32" use="required"/>
            <xs:attribute name="Frametime" type="SFFloat" use="required"/>
            <xs:attribute name="Transformation" type="MFVec3f" use="required"/>
<!--        <xs:attribute name="Transformation" type="MFRotation" use="required"/>-->
    </xs:complexType>
 </xs:element>
```

A Procedure for Modeling an H-Anim Character Using General Graphics Tools



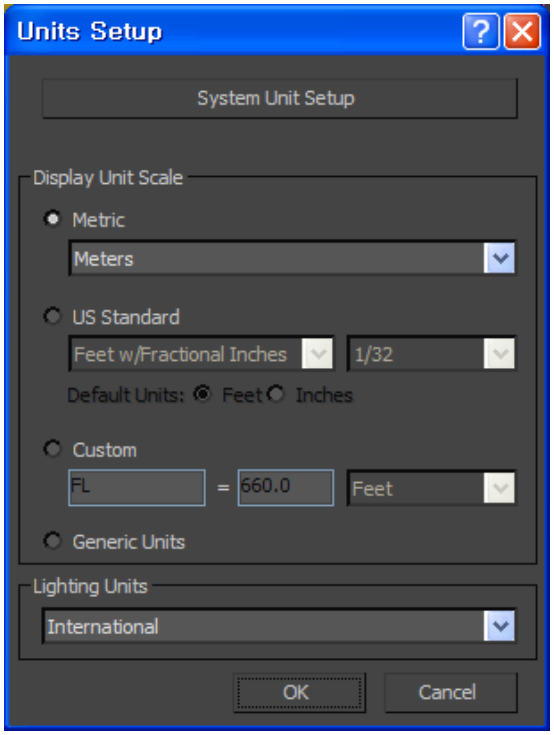
H-Anim Character Modeling Using a General Graphics Tool (1)

All joints of an H-Anim figure must be represented as a tree hierarchy starting with the HumanoidRoot joint. Each joint may or may not have a segment. The figure shows an LOA1 example hierarchy used for the 10 H-Anim characters. 19 joints and 16 segments are used. Three joints (HumanoidRoot, l_acromioclavicular, r_acromioclavicular) have no segments.



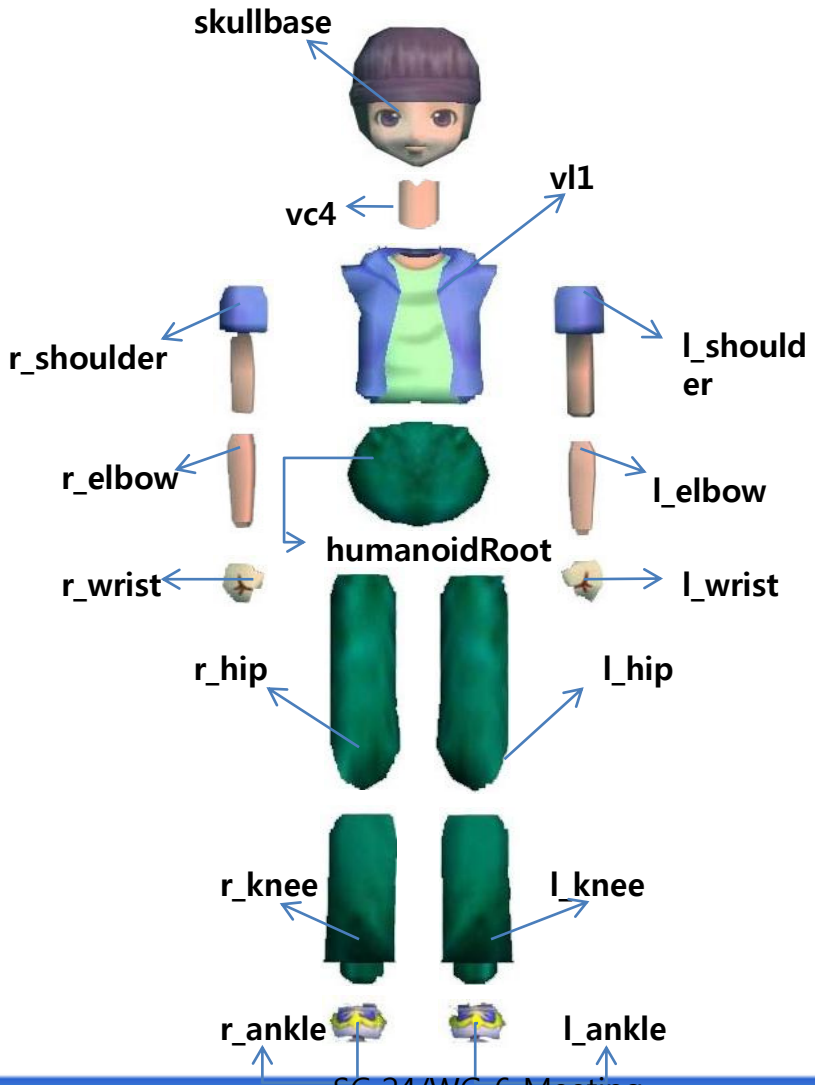
H-Anim Character Modeling Using a General Graphics Tool (2)

Step 1: Units are set up before modeling of the H-Anim character.



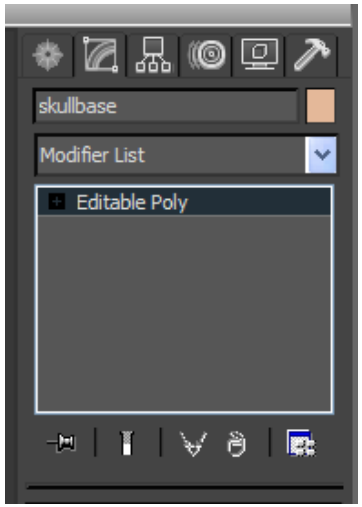
H-Anim Character Modeling Using a General Graphics Tool (3)

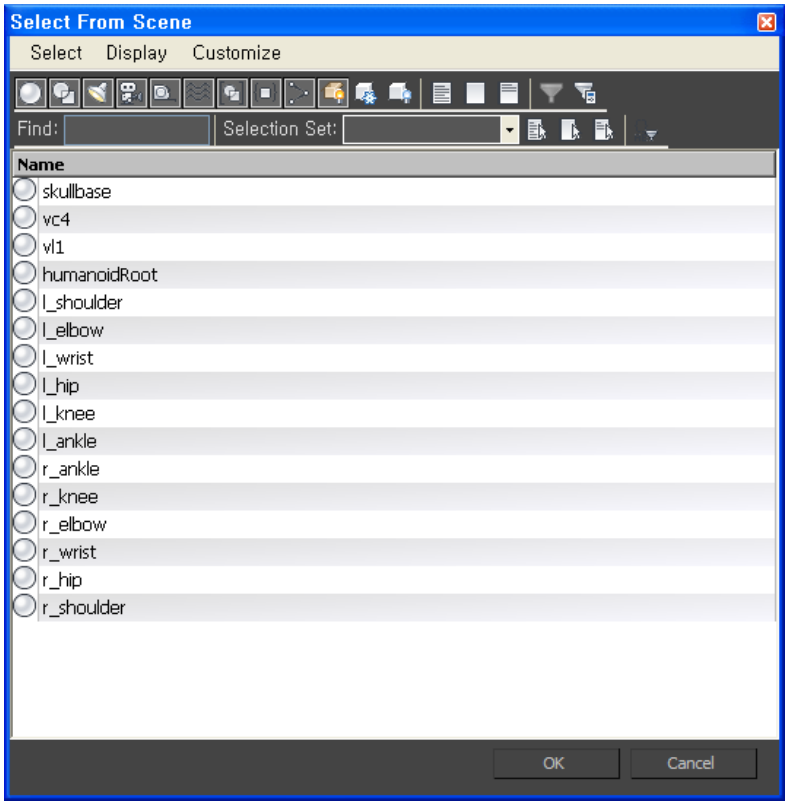
Step 2: Uniquely identify each segment according to the naming scheme of H-Anim.



H-Anim Character Modeling Using a General Graphics Tool (4)

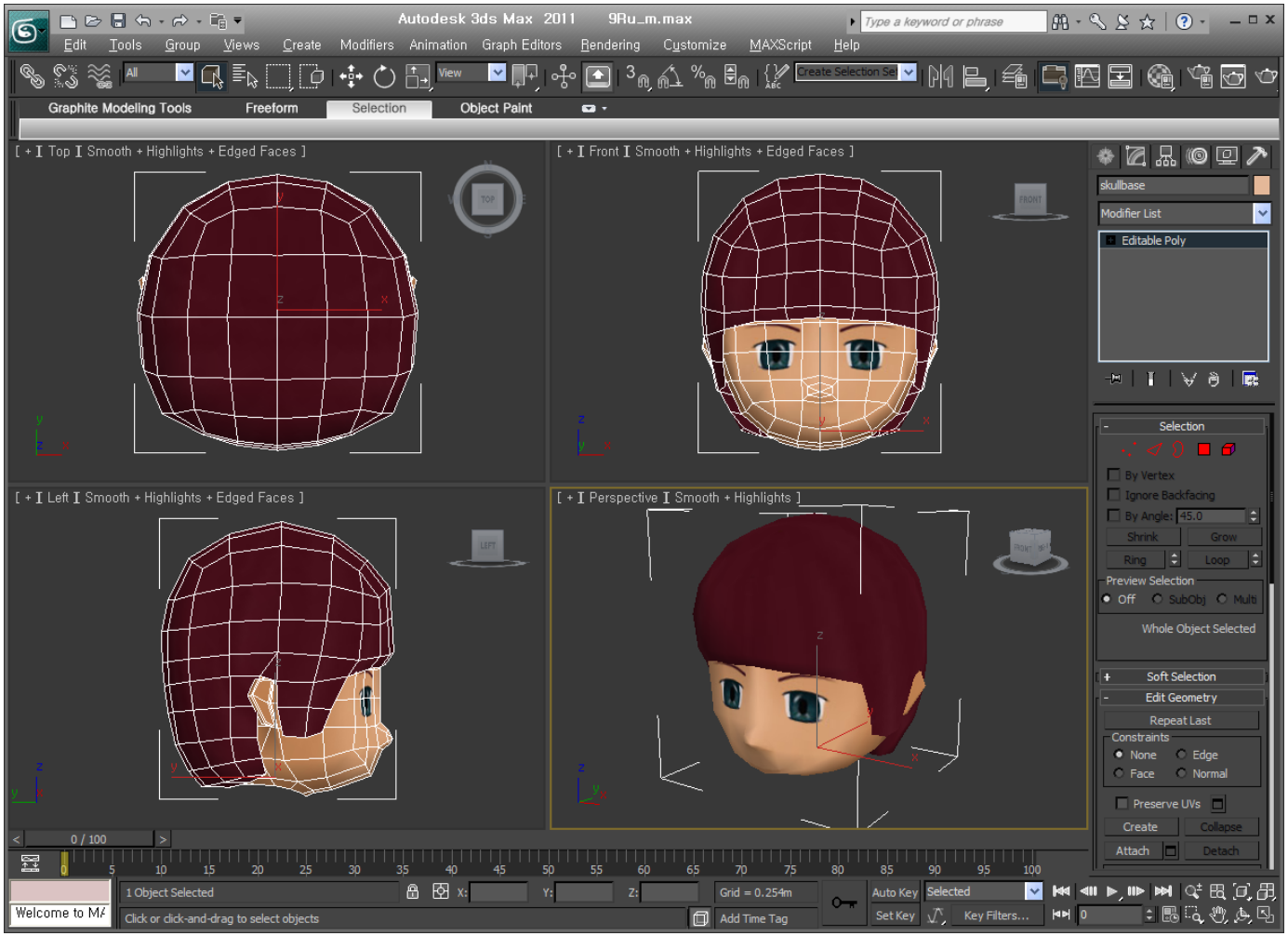
When a segment is designed, its H-Anim joint name must be provided as defined in the hierarchy of an LOA, i.e. LOA1 in this example





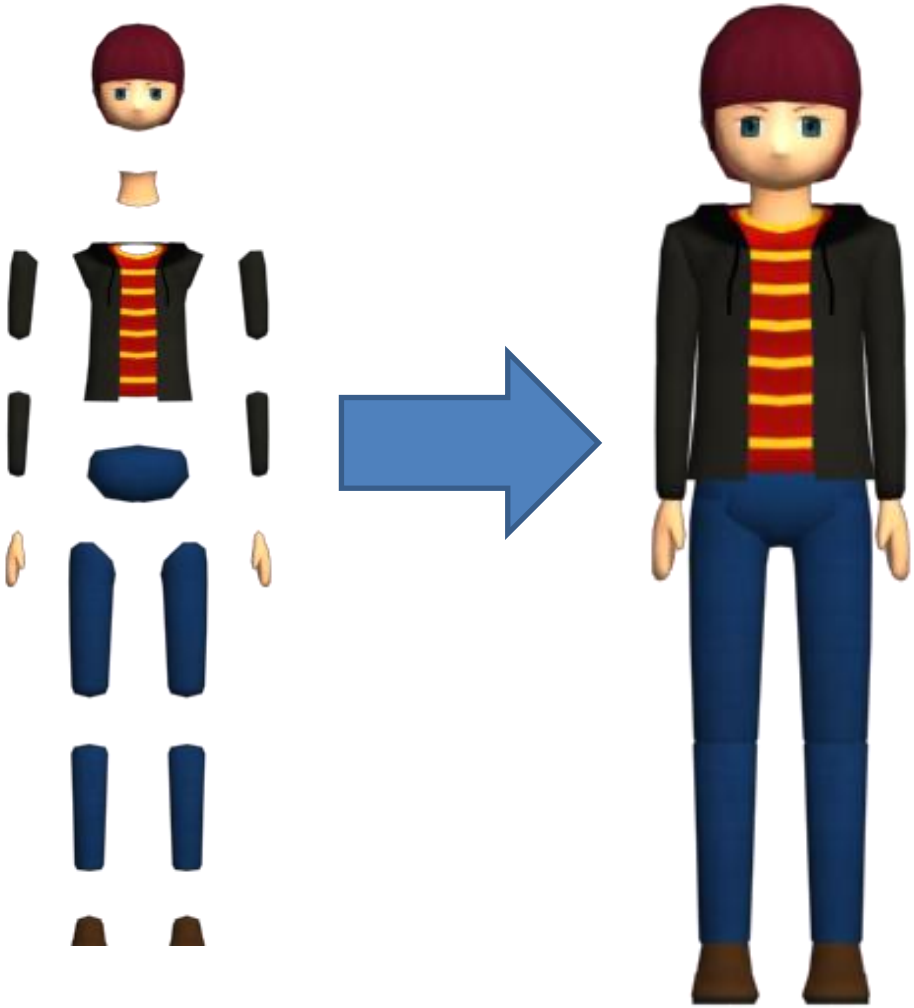
H-Anim Character Modeling Using a General Graphics Tool (5)

Step 3. Each segment with its joint is modelled. The figure shows a segment with an H-Anim skullbase joint. All segments are modelled in this way.



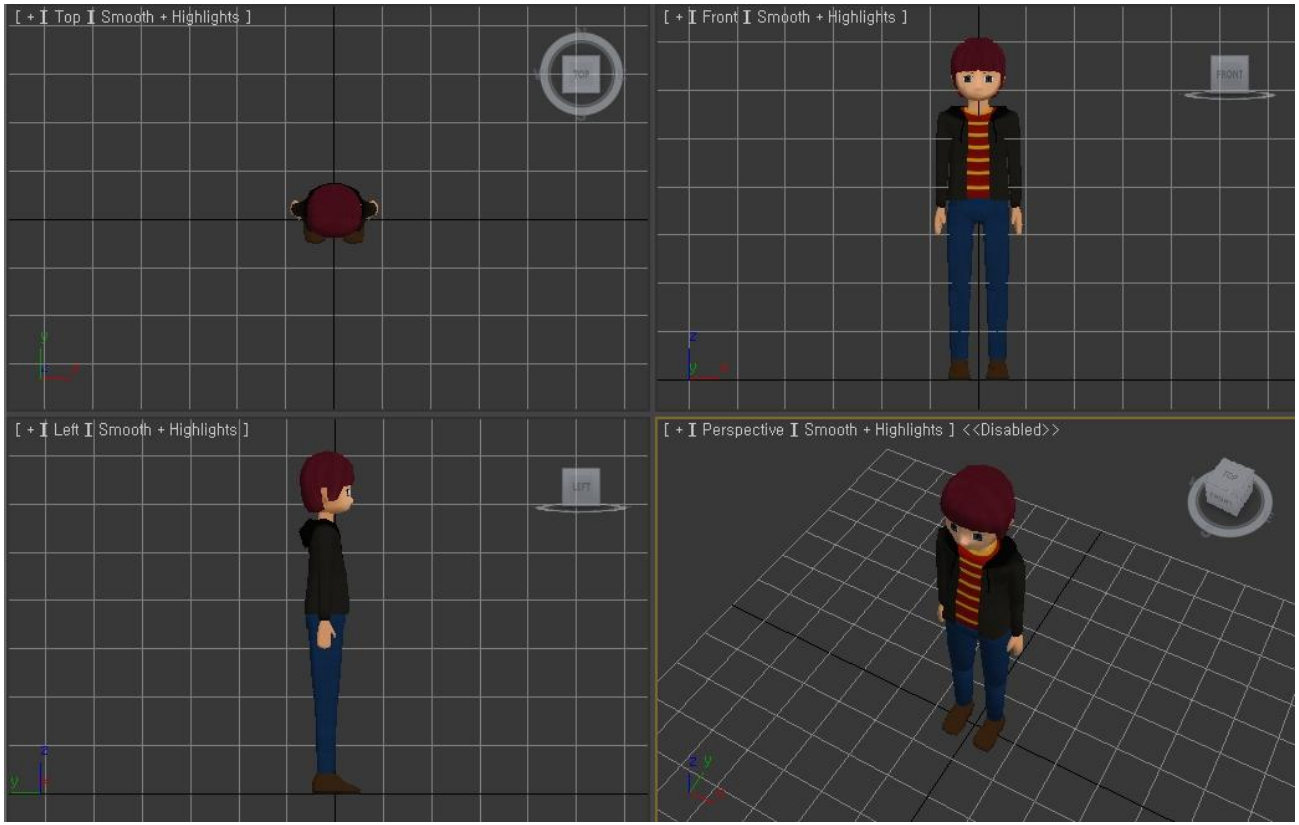
H-Anim Character Modeling Using a General Graphics Tool (6)

Step 4:. Integrate all the segments to form a complete character.



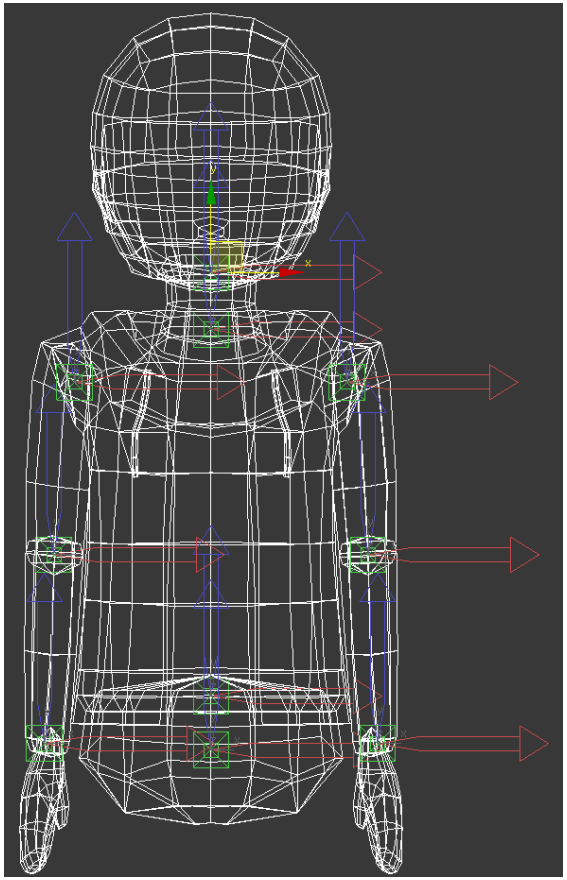
H-Anim Character Modeling Using a General Graphics Tool (7)

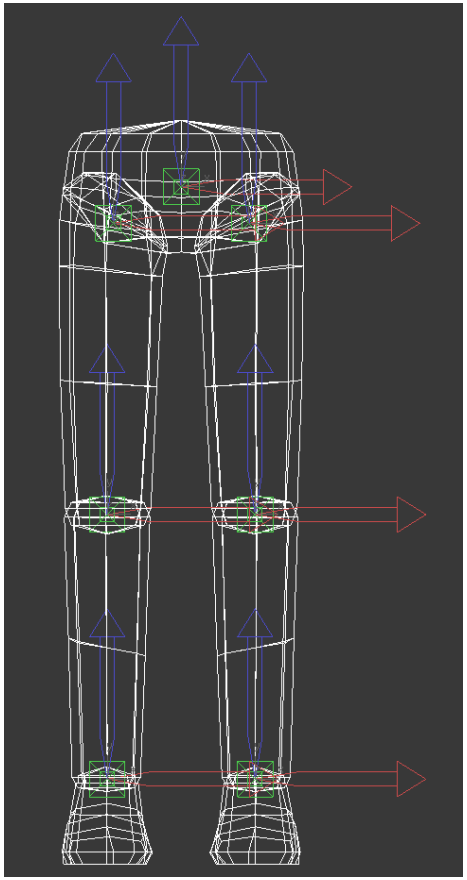
In the front view, the character is looking forward and the origin of the coordinate system is located between the two feet



H-Anim Character Modeling Using a General Graphics Tool (8)

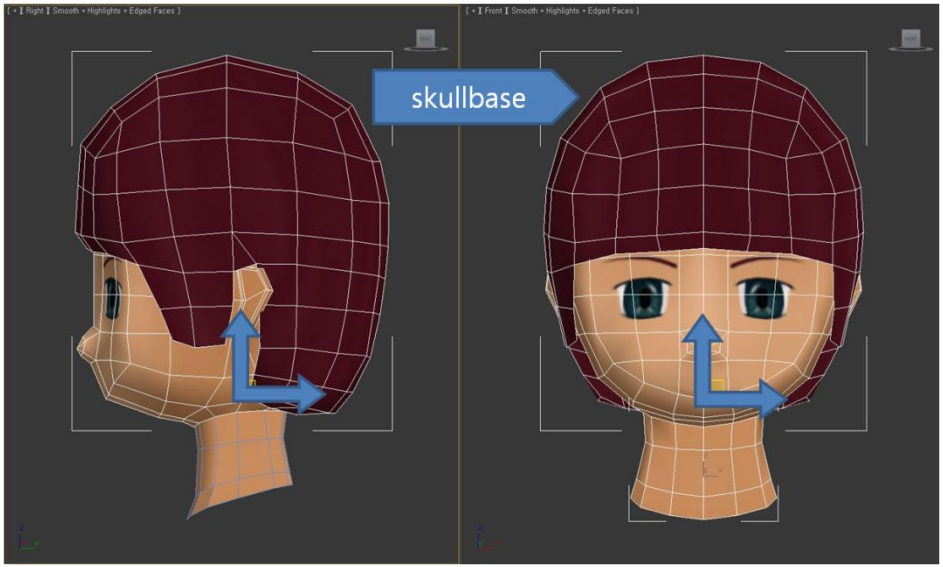
Step 5.: For each segment, a pivot point, which is initially located at the center of an object, must be moved to the H-Anim joint center. The pivot point becomes the center value for each H-Anim joint. In the figure, an arrow denotes each pivot point at a joint.





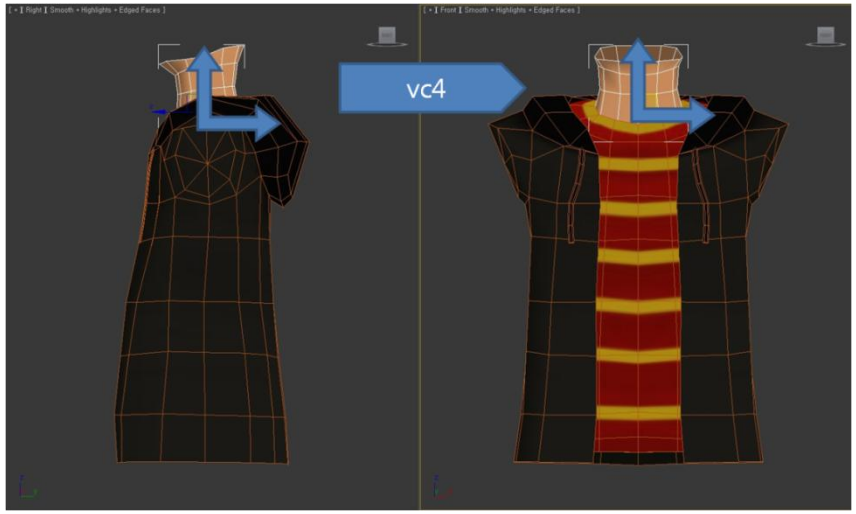
H-Anim Character Modeling Using a General Graphics Tool (9)

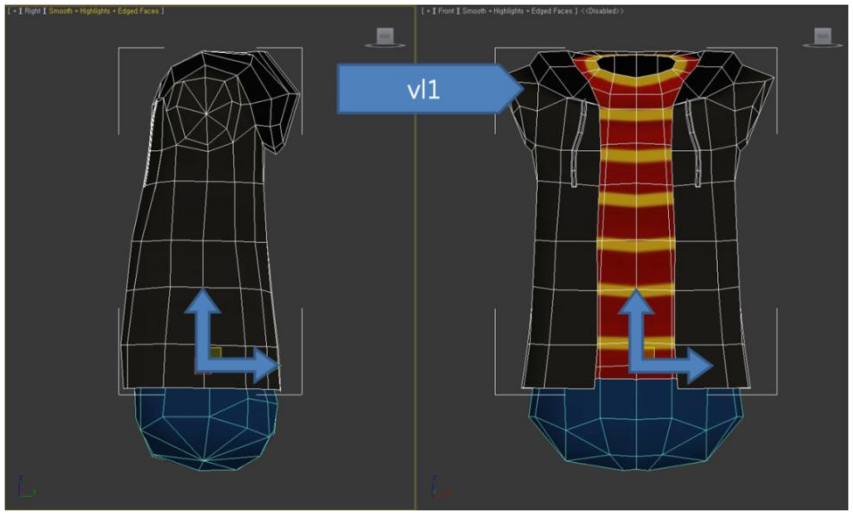
This figure shows the pivot point of the H-Anim skullbase joint



H-Anim Character Modeling Using a General Graphics Tool (10)

The figure shows the pivot points of the H-Anim vc4 and vl1 joints.



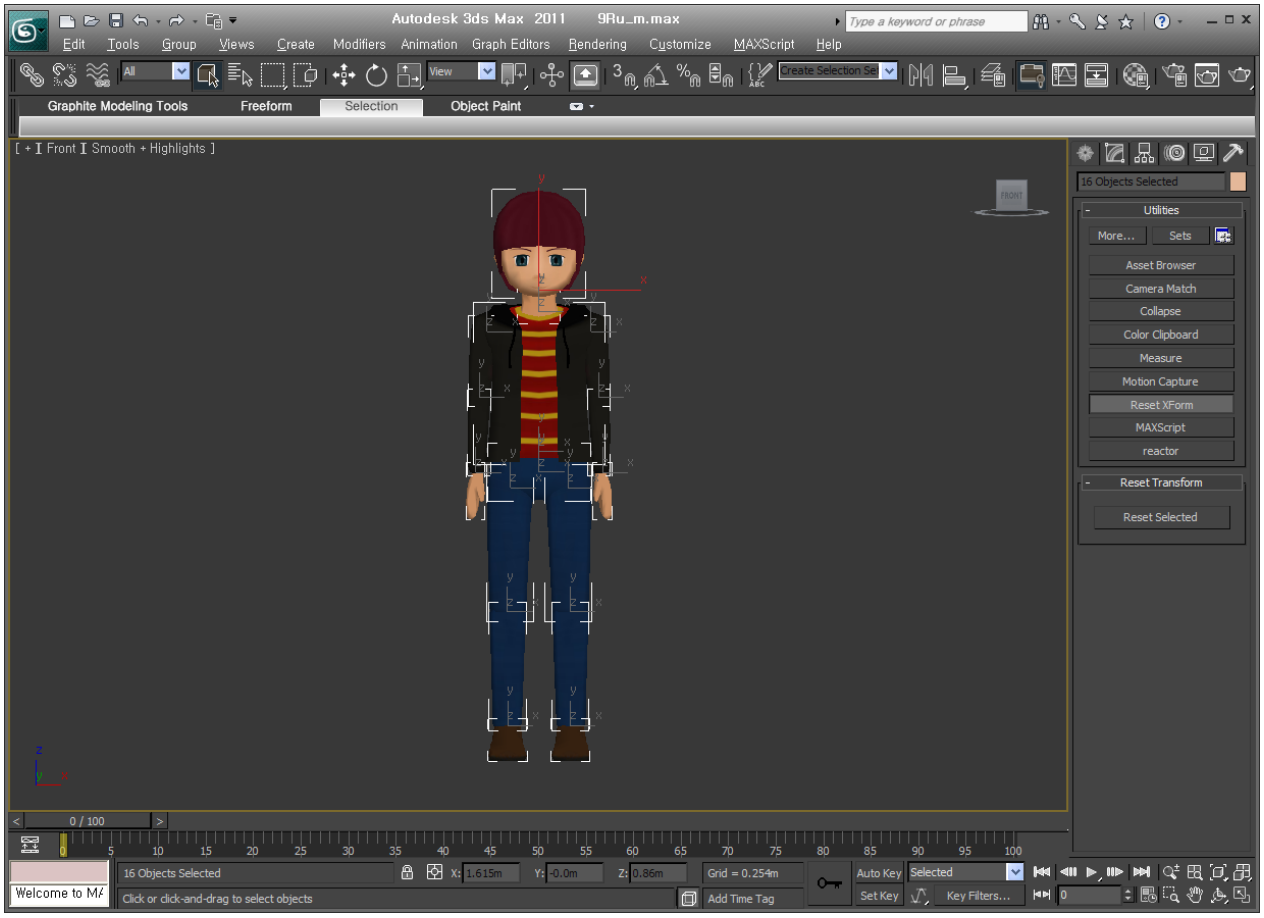


H-Anim Character Modeling Using a General Graphics Tool (11)

Step 6: If necessary, the H-Anim figure can be scaled, at this stage considering real length. Otherwise, the real length of each segment can be taken into consideration at the beginning, when each segment is modelled, if exact length is required. In this example, the character was initially designed considering only the length ratio of each segment then, at this stage, the segments were scaled according to real length (e.g. the height of the character).

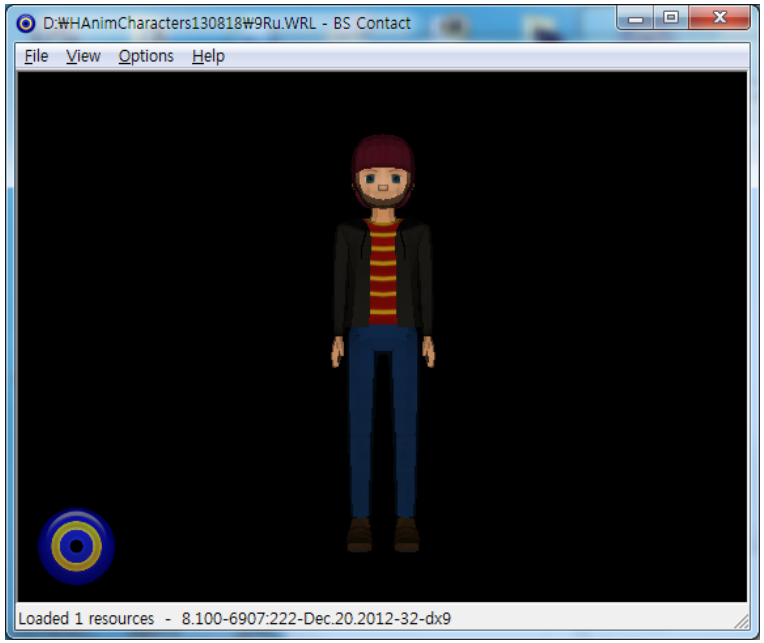
H-Anim Character Modeling Using a General Graphics Tool (12)

Step 7: In the final stage, all Transform nodes are initialized after being applied to all segments. Now, the H-Anim character has final modelling coordinates for his geometry.

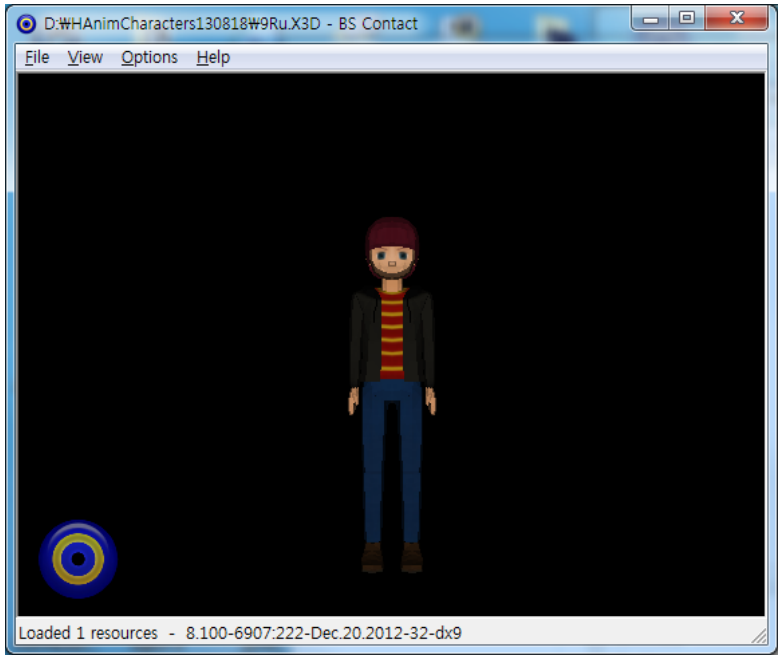


H-Anim Character Modeling Using a General Graphics Tool (13)

Step 8: Store the designed H-Anim character as a wrl file if the general graphics tool has this capability, which is usually the case. The wrl file can be converted to an x3d H-Anim file using a converter program.



WRL



X3D H-Anim

Conversion Program from WRL to X3D H-Anim (1)

WRL File

Definition of H-Anim structure with joint hierarchy, joint center, and segment geometry

X3D H-Anim File

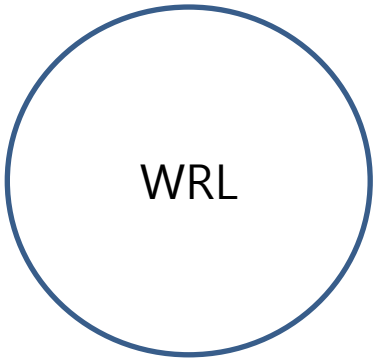
```
DEF skullbase Transform { ...
Shape { ...
}
DEF vc4 Transform { ...
Shape { ...
}
DEF vl1 Transform { ...
Shape { ...
}
DEF humanoidRoot Transform { ...
Shape { ...
}
```

```
<Scene>
...
<HAnimHumanoid DEF="Ru" ...>
<HAnimJoint DEF="Ru_HumanoidRoot" center= ...
<HAnimJoint DEF="Ru_sacroiliac" center=...
<HAnimSegment DEF="Ru_pelvis", ...
<Transform ...>
<Shape>
...
</Shape>
</Transform>
</HAnimSegment>
<HAnimJoint DEF="Ru_l_hip" center=...
```

Conversion Program from WRL to X3D H-Anim (2)

```
DEF skullbase Transform {
  translation 0 58.72 -1.829
  children [
    Shape {
      appearance Appearance {
        material Material {
          diffuseColor 0.588 0.588 0.588
          ambientIntensity 1.0
          specularColor 0 0 0
          shininess 0.145
          transparency 0
        }
        texture ImageTexture {
          url "Ru.bmp"
        }
      }
      geometry DEF skullbase-FACES IndexedFaceSet {
        ccw TRUE
        solid TRUE
        coord DEF skullbase-COORD Coordinate { point [
          1.079 -0.6566 1.833, 5.073 7.007 2.332, 5.209
      5.705 0.1804, ...
        coordIndex [
         56, 57, 19, -1, 19, 8, 56, -1, 7, 6, 18, -1, 18, 16, 7, -
      1, ...
      texCoordIndex [
        1, 2, 3, -1, 3, 0, 1, -1, 4, 5, 6, -1, 6, 7, 4, -1, 8, 9, 6, -
      1, ...
```

```
DEF vc4 Transform {
  translation 0 56 -1.959
  children [
    Shape {
      appearance Appearance {
        material Material {
          diffuseColor 0.588 0.588 0.588
          ambientIntensity 1.0
          specularColor 0 0 0
          shininess 0.145
          transparency 0
        }
        texture ImageTexture {
          url "Ru.bmp"
        }
      }
      geometry DEF vc4-FACES IndexedFaceSet {
```



Conversion Program from WRL to X3D H-Anim (3)

```
<Scene>
...
<HAnimHumanoid DEF="Ru" info="humanoidVersion=2.0" name="Ru" scale="0.0225 0.0225 0.0225" version="2.0">
<HAnimJoint DEF="Ru_HumanoidRoot" center="0.0 0.0 0.0" containerField="skeleton" name="HumanoidRoot">

<HAnimJoint DEF="Ru_sacroiliac" center="0.000000 35.950001 -2.058000" name="sacroiliac" containerField="children">
<HAnimSegment DEF="Ru_pelvis" name="pelvis" containerField="children">
<Transform translation="0.000000 35.950001 -2.058000"  rotation="0.000000 0.000000 0.000000 0.000000"  scale="1.000000 1.000000 1.000000"
        scaleOrientation="0.000000 0.000000 0.000000 0.000000">
<Shape>
<Appearance>
<Material diffuseColor="0.588000 0.588000 0.588000"/>
<ImageTexture url="Ru.bmp"/>
</Appearance>
<IndexedFaceSet coordIndex="18, 0, 6, -1, 6, 8, 18, -1, 30, 31, 10, -1, 10, 12, ...
<Coordinate point="5.1340 1.8530 -2.3070, 5.5760 1.8490 2.3010, 1.8320 1.8550 ...
<TextureCoordinate point="0.9018 0.4063,0.9014 0.4179,0.8749 0.4137,0.8692 ...
</IndexedFaceSet>
</Shape>
</Transform>
</HAnimSegment>

<HAnimJoint DEF="Ru_l_hip" center="3.602000 34.000000 -1.967000" name="l_hip" containerField="children">
<HAnimSegment DEF="Ru_l_thigh" name="l_thigh" containerField="children">
<Transform translation="3.602000 34.000000 -1.967000"  rotation="0.000000 0.000000 0.000000 0.000000"  scale="1.000000 1.000000 1.000000"
        scaleOrientation="0.000000 0.000000 0.000000 0.000000">
<Shape>
<Appearance>
<Material diffuseColor="0.588000 0.588000 0.588000"/>
<ImageTexture url="Ru.bmp"/>
</Appearance>
<IndexedFaceSet coordIndex="47, 16, 2, -1, 2, 48, 47, -1, 1, 18, 15, -1, 15, 0, 1, ...
<Coordinate point="2.8500 0.1840 -0.0877, 2.0230 -0.0169 -2.6250, 0.2938 -
<TextureCoordinate point="0.6973 0.5621,0.6732 0.5606,0.6756 0.5519,0.6995  ...
</IndexedFaceSet>
</Shape>
</Transform>
</HAnimSegment>

<HAnimJoint DEF="Ru_l_knee" center="3.931000 18.500000 -1.935000" name="l_knee" containerField="children">
<HAnimSegment DEF="Ru_l_calf" name="l_calf" containerField="children">
<Transform translation="3.931000 18.500000 -1.935000"  rotation="0.000000 0.000000 0.000000 0.000000"  scale="1.000000 1.000000 1.000000"
        scaleOrientation="0.000000 0.000000 0.000000 0.000000">
```

X3D H-Anim

H-Anim Character Modeling File (X3D H-Anim)

- H-Anim modeling file

```
<Scene>
    <NavigationInfo speed='1.5' type='"EXAMINE" "ANY"'/>
    <Viewpoint centerOfRotation='0 1 0' description='Jin' position='0 1 3'/>
    <HAnimHumanoid DEF='Jin' info='"humanoidVersion=2.0"' name='Jin' scale='0.0225 0.0225
0.0225' version='2.0'>
      <HAnimJoint DEF='Jin_HumanoidRoot' containerField='skeleton' name='HumanoidRoot'>
        <HAnimJoint DEF='Jin_sacroiliac' center='0.000000 35.830002 -0.707600' name='sacroiliac'>
          <HAnimSegment DEF='Jin_pelvis' name='pelvis'>
            <Transform translation='0.000000 35.830002 -0.707600'>
              <Shape>
                <Appearance>
                  <Material diffuseColor='0.588000 0.588000 0.588000'/>
                  <ImageTexture DEF='JinTextureAtlas' url='"images/Jin.bmp" "images/Jin.png"
"http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/Jin.bmp"
"http://www.web3d.org/x3d/content/examples/Basic/HumanoidAnimation/images/Jin.png"'/>
                </Appearance>
                <IndexedFaceSet coordIndex='0 1 2 -1 0 2 3 -1 0 3 4 -1 0 4 5 -1 0 5
                ...
                <Coordinate point='0.0000 5.4970 0.1424 0.0000 4.7610 -2.8250 -2.2830 4.7610 -2.4280
-3.9540 4.7610 -1.9480 -4.5660 4.7610 0.1424 -3.9540
```

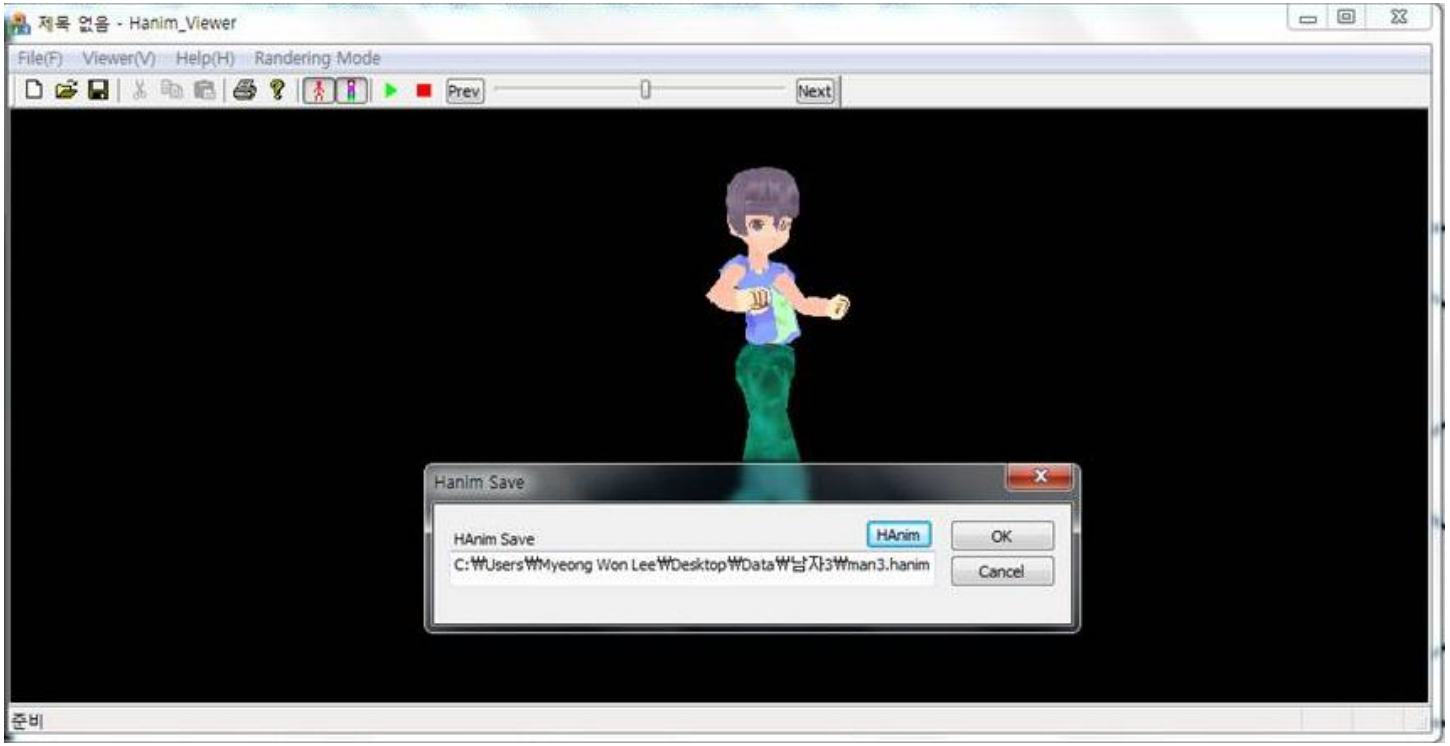
H-Anim Character Animation Using Motion Capture (1)

In our H-Anim motion viewer:

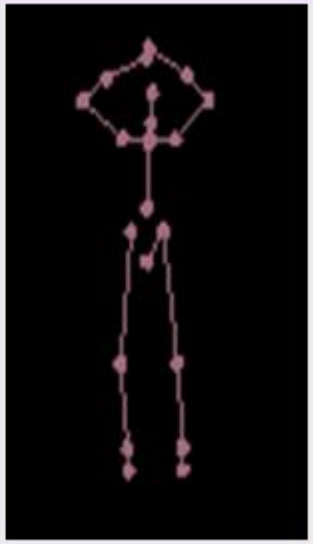
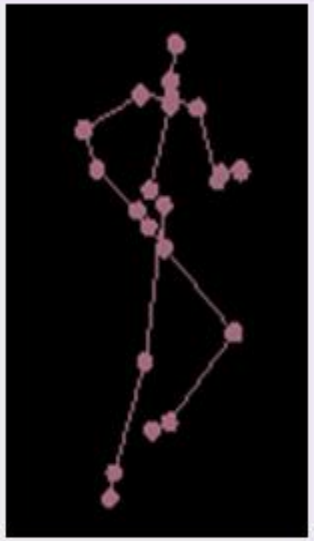
1. Read a motion capture file and apply it to the H-Anim character model. Our H-Anim motion viewer includes the function of motion retargeting which applies the motion of each joint of the motion captured model to the motion of a corresponding joint of the designed H-Anim character model. The motion viewer displays an animation sequence from the H-Anim character model and a motion capture file.

H-Anim Character Animation Using Motion Capture (2)

2. The motion viewer can save the animation sequence as an animation file which has the format of the H-Anim motion data definition. The following figure shows the interface to save an H-Anim animation file after generating an animation sequence.

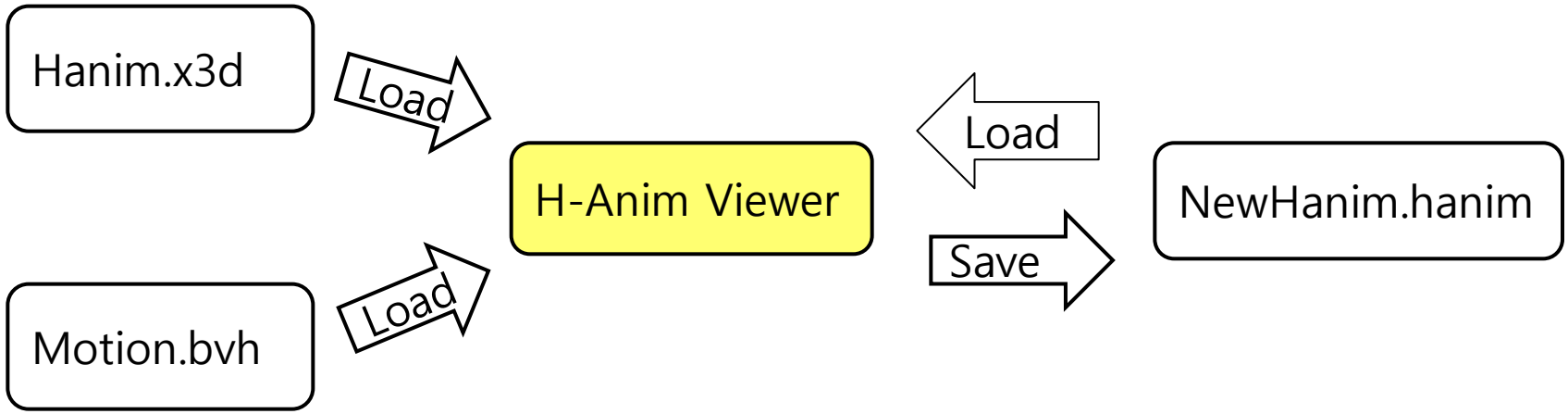


H-Anim Character Animation Using Motion Capture (3)

Motion Capture (BVH)				
H-Anim Animation				

H-Anim Animation File Generation

- H-Anim Motion Viewer
  - Read an H-Anim character model and motion captured data
  - Adjust segment lengths of the mocap character to the H-Anim character
  - Generate and display the motion captured animation for the H-Anim character
  - Generate an H-Anim animation file including the H-Anim character model with the motion captured data



H-Anim Model with Motion Capture (1) : suggestion

```
<Scene>
  <NavigationInfo speed='1.5' type='"EXAMINE" "ANY"'/>
  <Viewpoint centerOfRotation='0 1 0' description='Jin' position='0 1 3'/>
  <HAnimHumanoid DEF='Jin' info='"humanoidVersion=2.0"' name='Jin' scale='0.0225
0.0225 0.0225' version='2.0'>
    <HAnimJoint DEF='Jin_HumanoidRoot' containerField='skeleton'
name='HumanoidRoot'>
      <HAnimJoint DEF='Jin_sacroiliac' center='0.000000 35.830002 -0.707600'
name='sacroiliac'>
        <HAnimSegment DEF='Jin_pelvis' name='pelvis'>
          <Transform translation='0.000000 35.830002 -0.707600'>
```

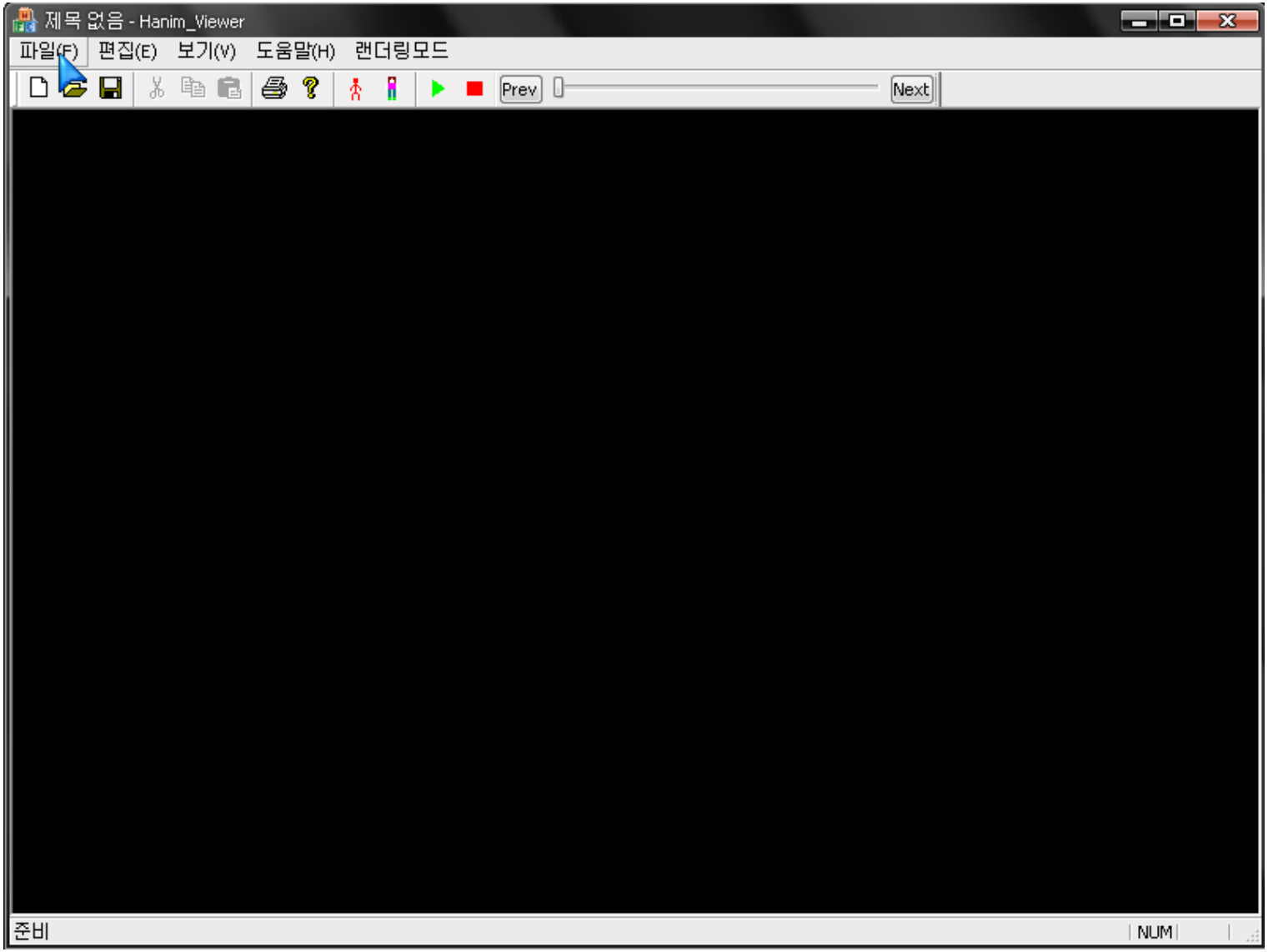
```
<HAnimSegment DEF="hanim_pelvis" name="pelvis" containerField="children"
Offset='0.000000 35.830002 -0.707600'  Channels="6, Xposition, Yposition, Zposition,
Zrotation, Xrotation, Yrotation">
```

```
            <Shape>
              <Appearance>
                <Material diffuseColor='0.588000 0.588000 0.588000'/>
                <ImageTexture DEF='JinTextureAtlas' url='"images/Jin.bmp" "images/Jin.png"
</Appearance>
              <IndexedFaceSet coordIndex='0 1 2 -1 0 2 3 -1 0 3 4 -1 0 4 5 -1 ...
<Coordinate point='0.0000 5.4970 0.1424 0.0000 4.7610 -2.8250 ...
<TextureCoordinate point='0.6211 0.5754 0.7851 0.5720 0.7614 ...
```

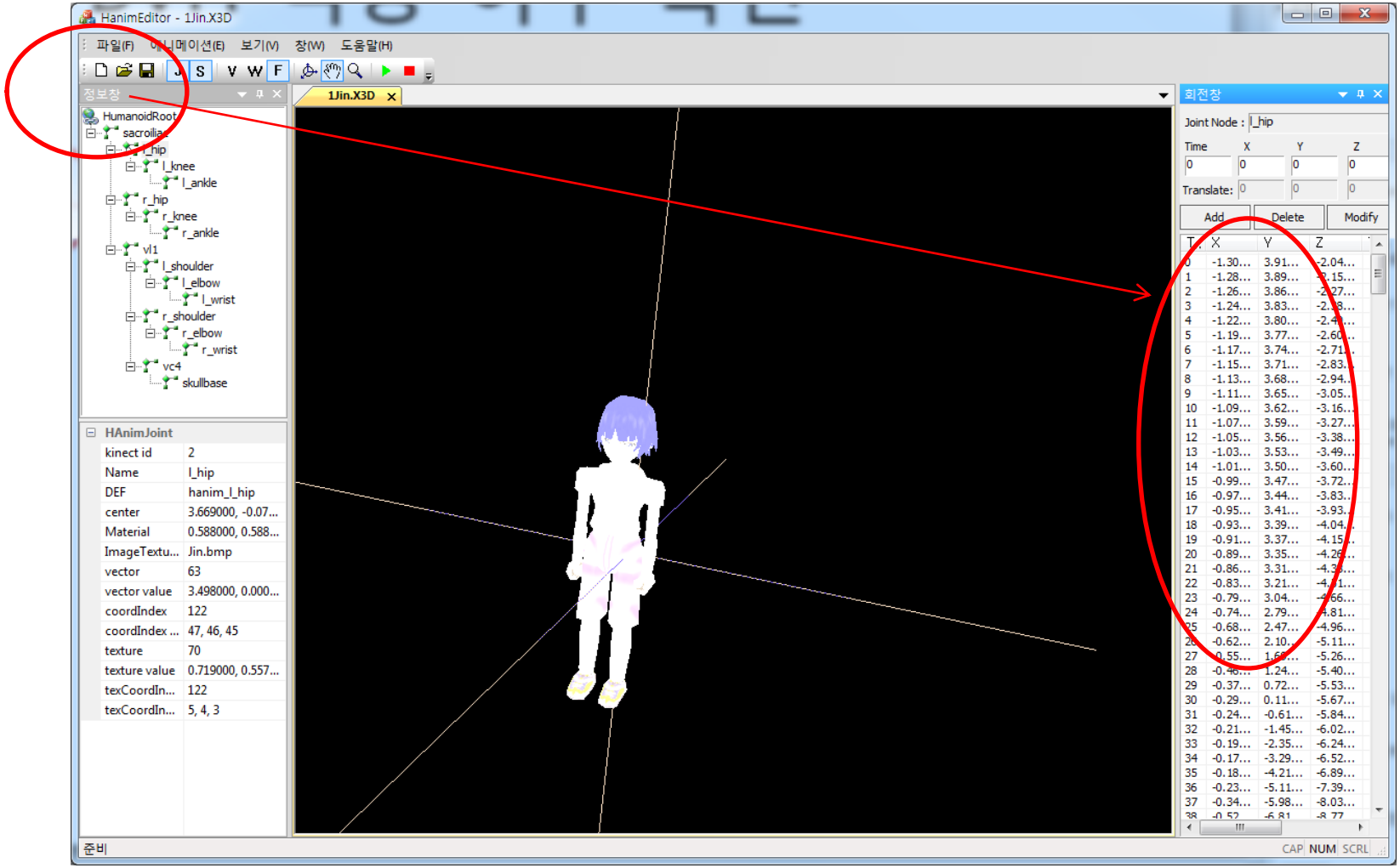
H-Anim Motion with Motion Capture (2) : suggestion

```
0.0221,0.4411 0.0186,0.5487 0.0186,0.4637 0.1714,0.4708 0.0186"/>
</IndexedFaceSet>
</Shape>
</Transform>
</HAnimSegment>
</HAnimJoint>
</HAnimJoint>
</HAnimJoint>
</HAnimJoint>
…
<HAnimMotion>
<FrameInformation frames ="482" frametime = "0.016667"/>
<SegmentTransform transform = "
2.1834 41.2869 79.2237 -1.2490 -4.8590 -3.5820 4.4630 1.3540 0.0750 -13.7320 3.0520
3.9990 95.6770 1.7050 -1.5120 5.5410 -3.4910 0.3390 1.2590 -3.0220 …
…
5.8060 -2.2160 1.0610 9.5740 -0.2270 0.2010 -3.8550 0.3020 -2.8020 7.0420 4.4960 0.4940
6.9090 0.1390 -8.4900 -0.2720 1.8800 "/>
</HAnimMotion>
</Scene>
</X3D>
```

H-Anim Motion Viewer

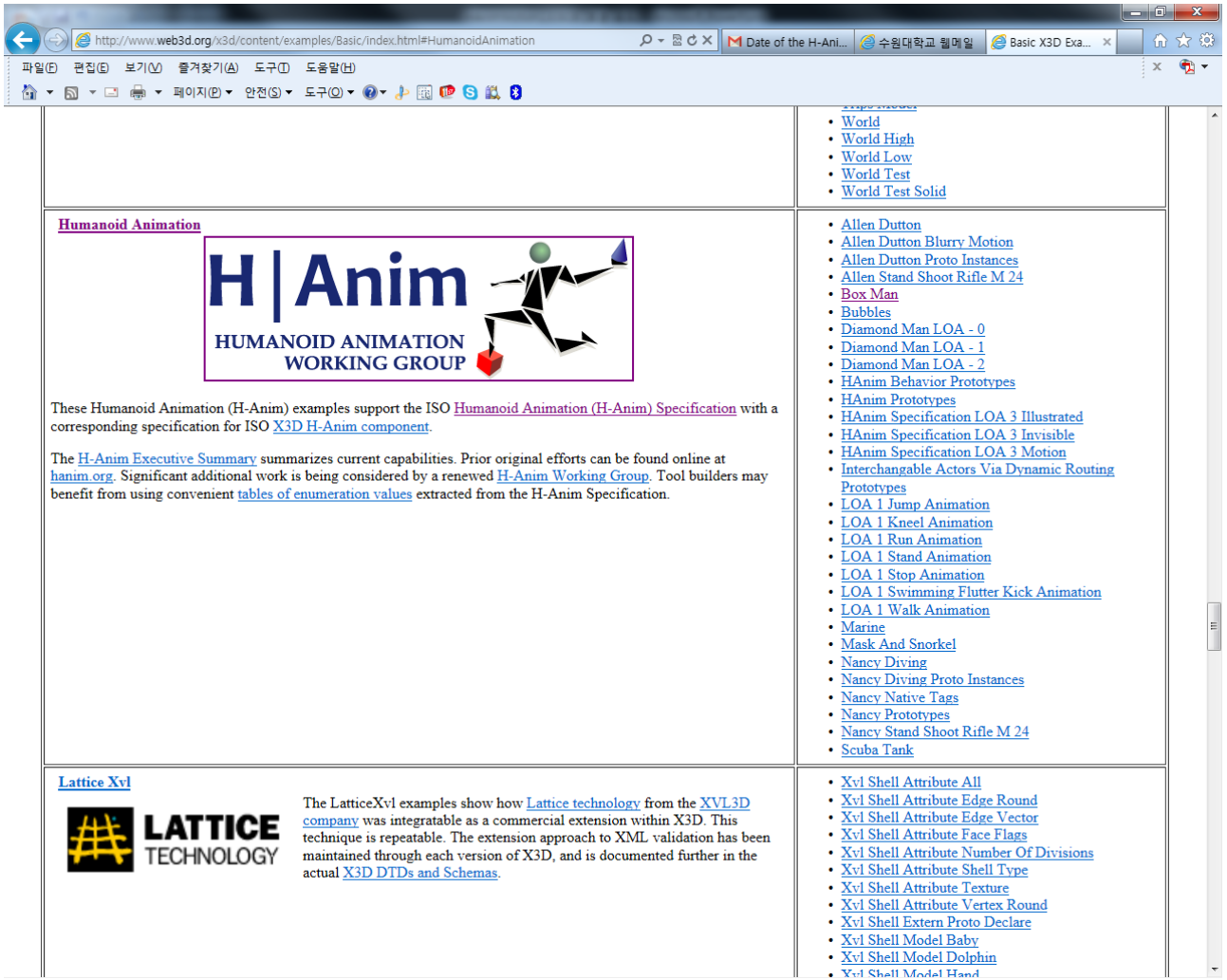


H-Anim Motion Editor



H-Anim Examples

- http://www.web3d.org/x3d/content/examples/Basic/index.html#HumanoidAnimation



H-Anim WG (h-anim@web3d.org)

- Current participants
  - Myeong Won Lee
  - William Glascoe
  - Joe Williams
  - Don Bruzman
  - Richard F. Puk
  - Sandy Ressler
  - Roger Nelson
  - David Bruner
  - Tim Guenzel
  - Kwan Hee Yoo
  - Jung-Ju Choi

Future work

- Anthropometry and landmark
  - CAESAR project (Sandy Ressler)
  - http://www.sae.org/technicalcommittees/caesarhome.htm
- Development of a H-Anim motion editor with motion capture
  - Combining with motion sensors
  - Realtime motion generation for H-Anim characters
- H-Anim behavior animation
  - Classification and definition of human behaviors
- H-Anim skin updates
- Release of the converter program from wrl to x3d hanim
- Release of the H-Anim motion viewer with BVH
- Development of H-Anim characters and their animations
- Definition and implementation of NWIP's content
- Writing and editing WDs for NWIPs