H|Anim
HUMANOID ANIMATION
WORKING GROUP

Humanoid Animation

ISO/IEC JTC 1/SC 24 WG 9 & Web3D Meetings

January 15-18, 2018

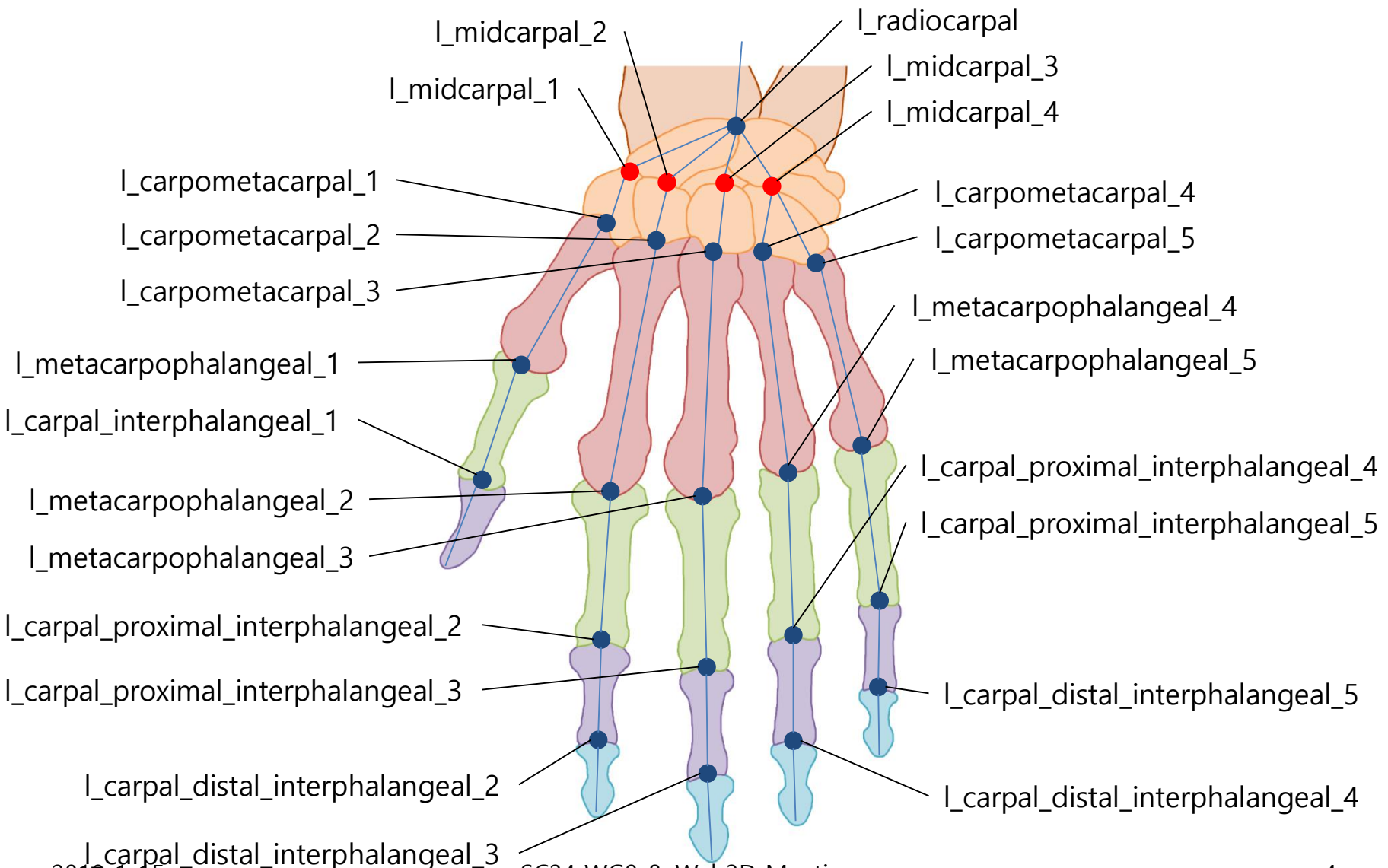
Myeong Won Lee

ISO/IEC 19774-1 CD2 and 19774-2 CD2 revision

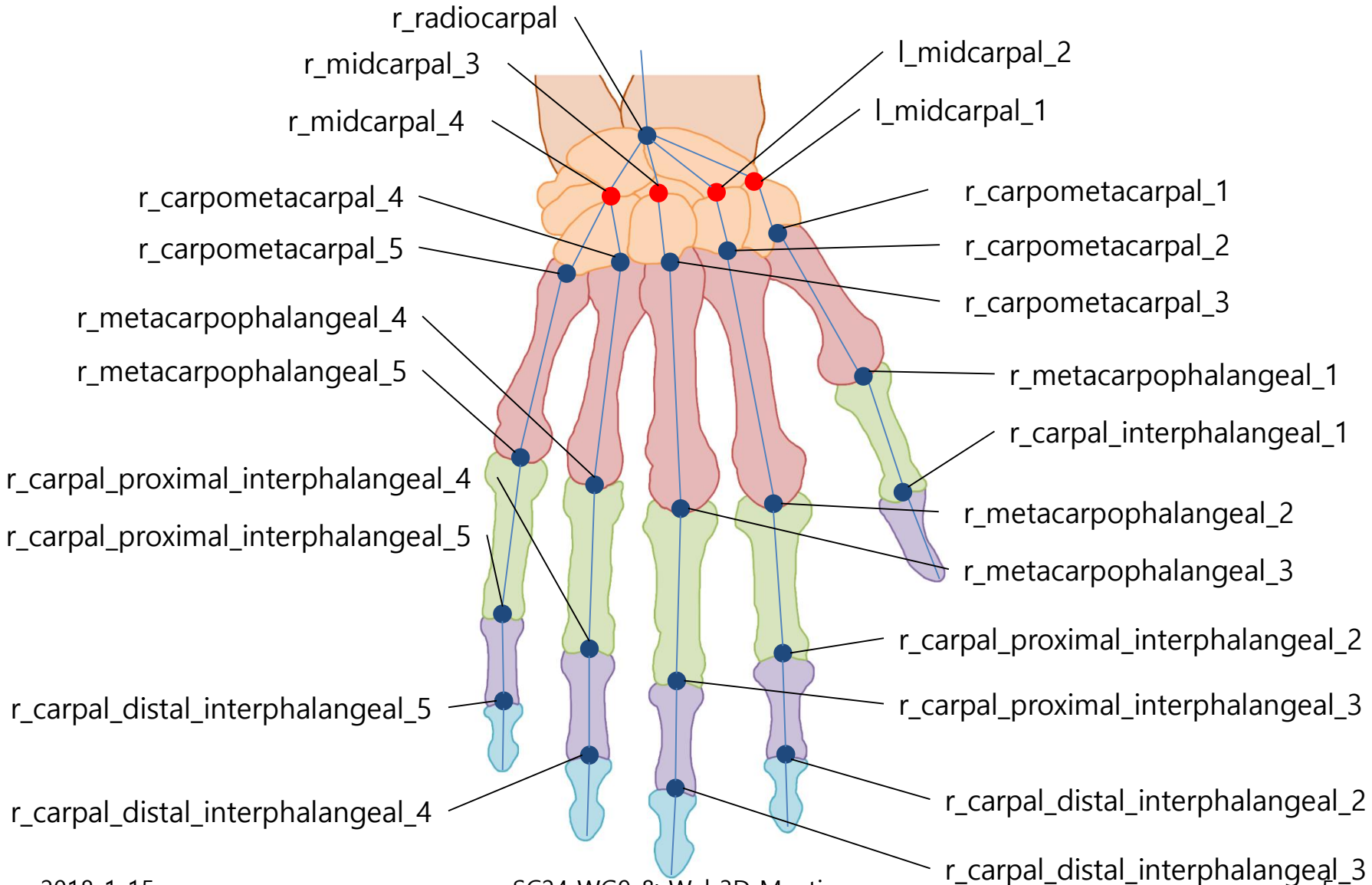
H-Anim CD2 Checklist

- Hand joints
  - midcarpal joint problems
- Size of hand images
  - Left hand and right hand images were corrected
  - Original materials PPT files were uploaded to the Web3D GitHub
- Part 1
  - Table 4.4 LOA4 hand Joint object names
  - Figure 4.6 LOA-4 Joints
  - Figure 4.11 Basic set of Joint:Segment hierarchy for LOA4
- Part 1
  - Table 4.temp - Joint:Segment naming consistency check ??
  - VRML is necessary here ??
- Part 2
  - Figure 4.1 – Procedure of humanoid animation
- Review of collated disposition comments about CD2

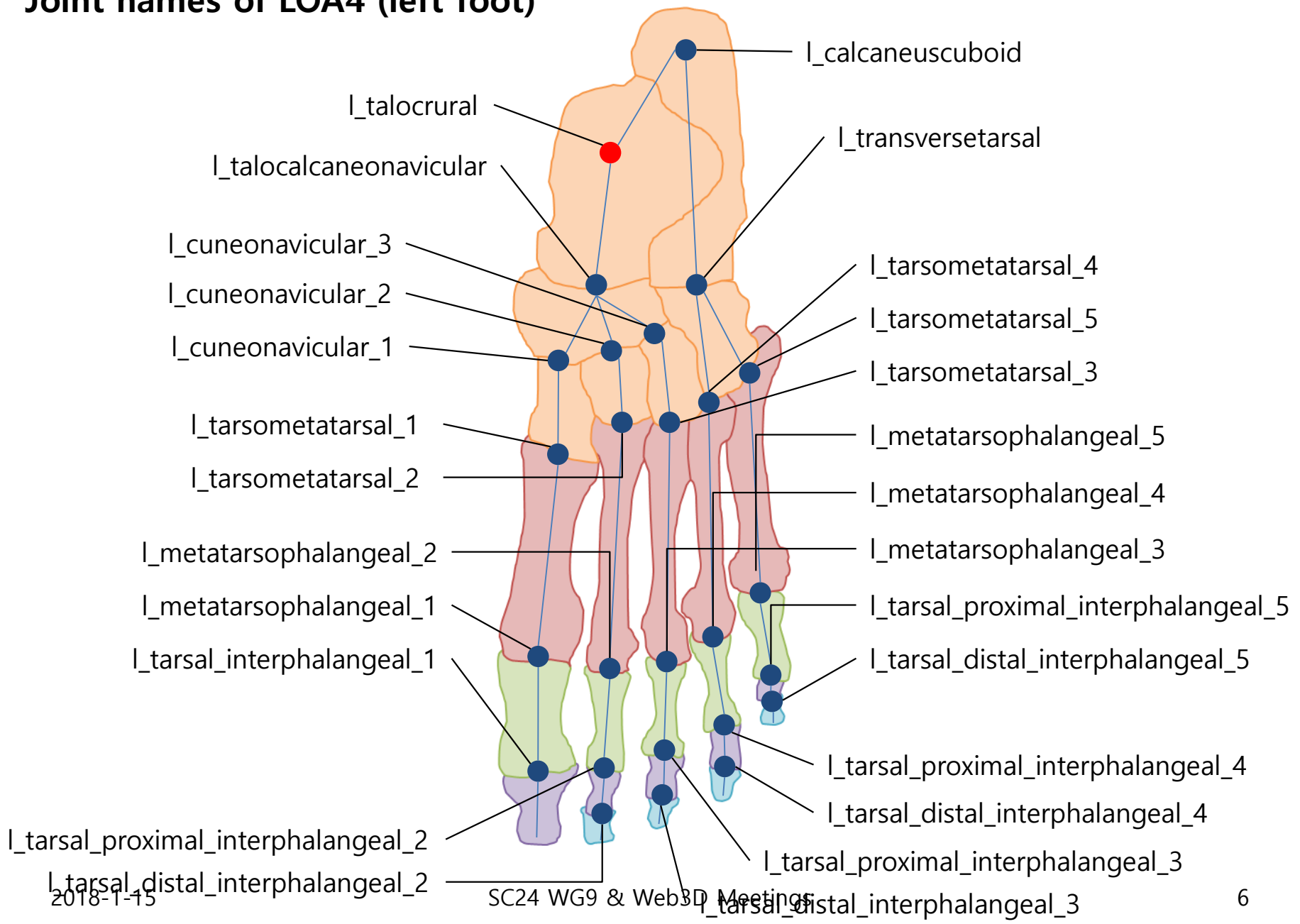
Joint names of LOA4 (left hand)



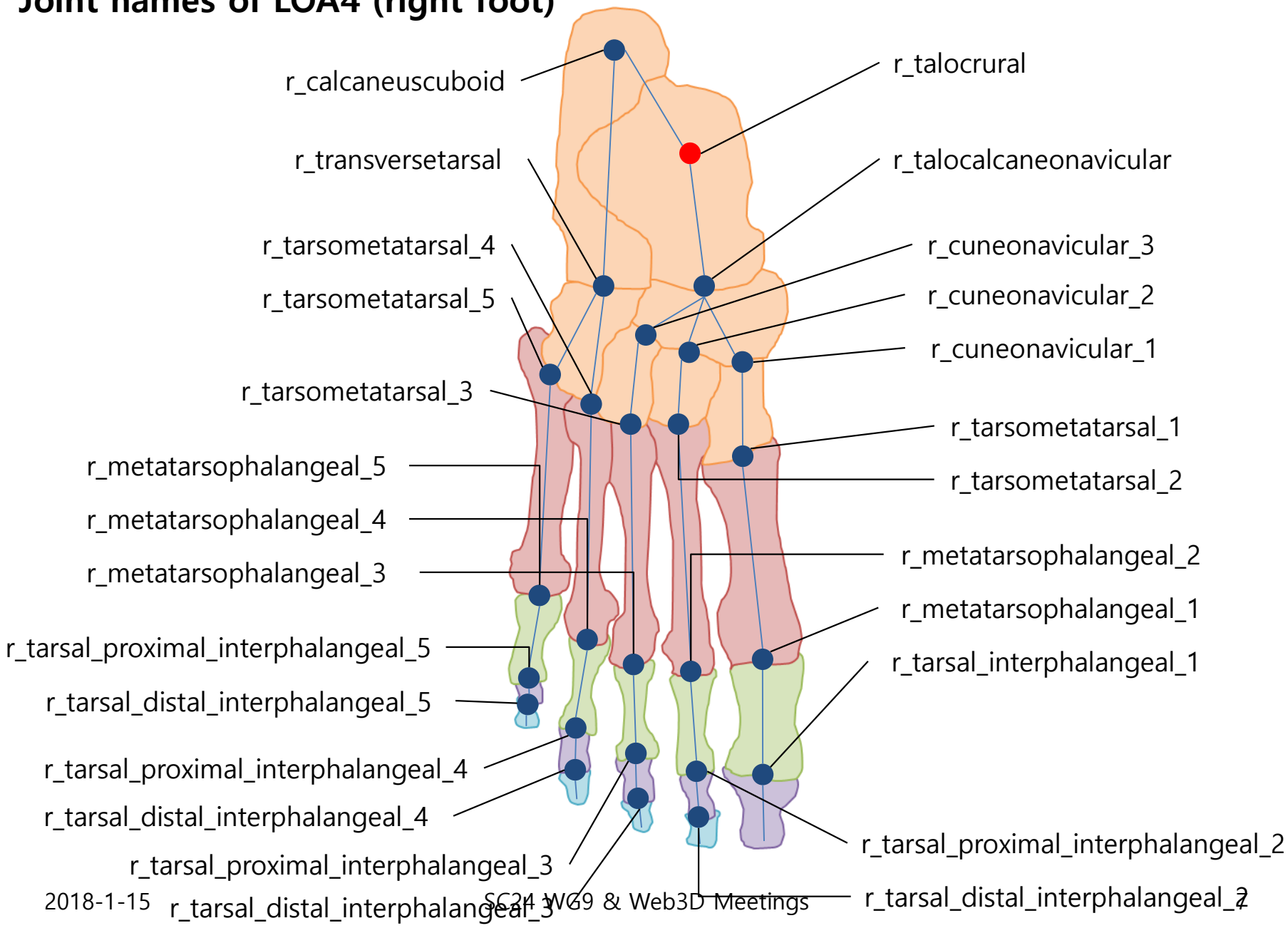
Joint names of LOA4 (right hand)



Joint names of LOA4 (left foot)



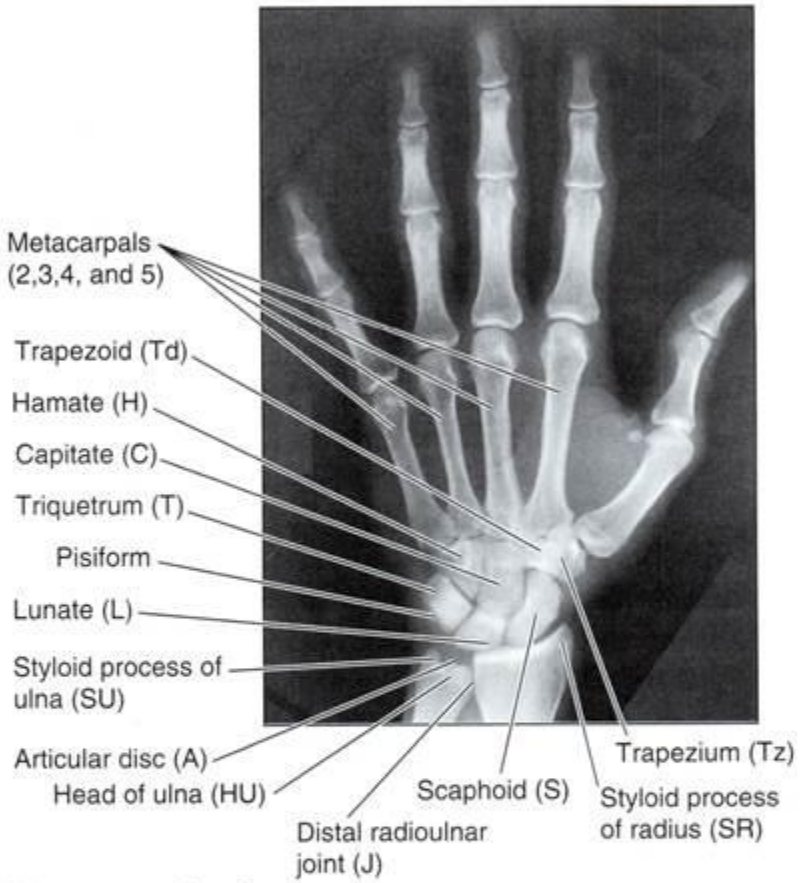
Joint names of LOA4 (right foot)



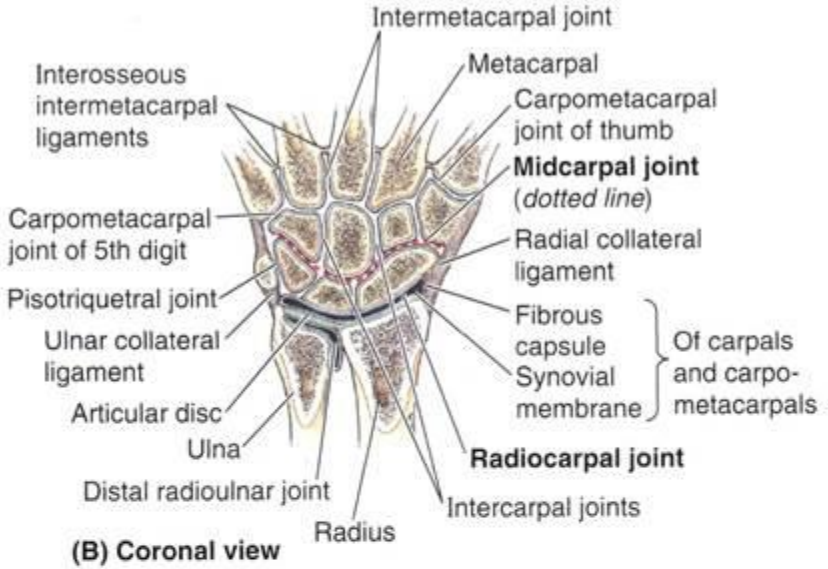
Medical notice

- l_midcarpal_1 : l_trapezium
- l_midcarpal_2 : l_trapezoid
- l_midcarpal_3 : l_capitate
- l_midcarpal_4 : l_hamate

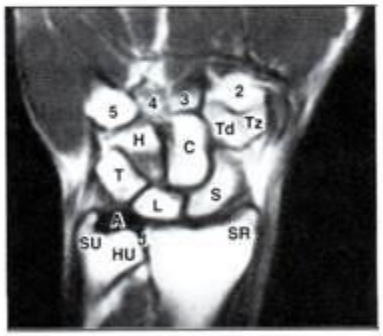
Note: In medical terminology, midcarpal_1, midcarpal_2, midcarpal_3, and midcarpal_4 are not joints, but rather are bone connection points



(A) Anteroposterior view

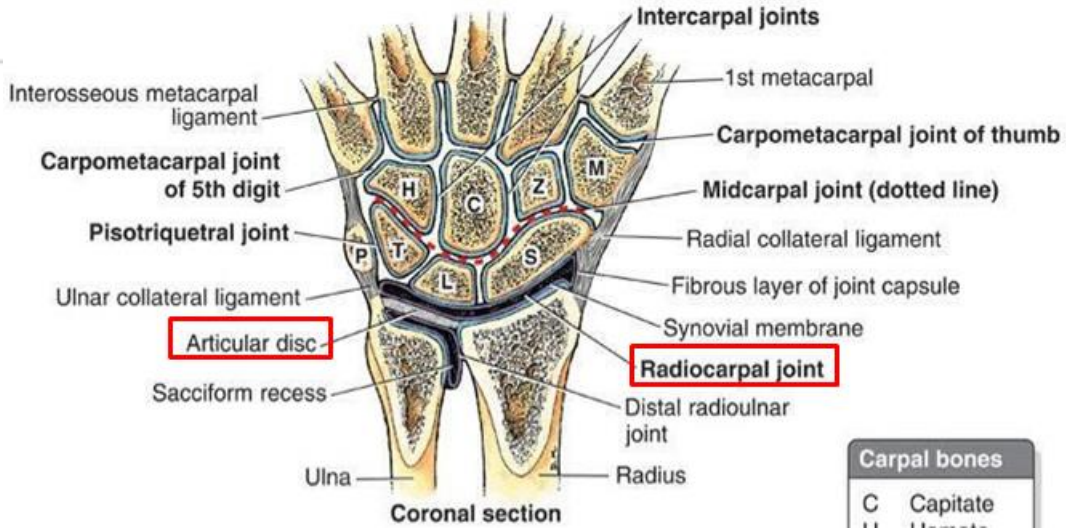


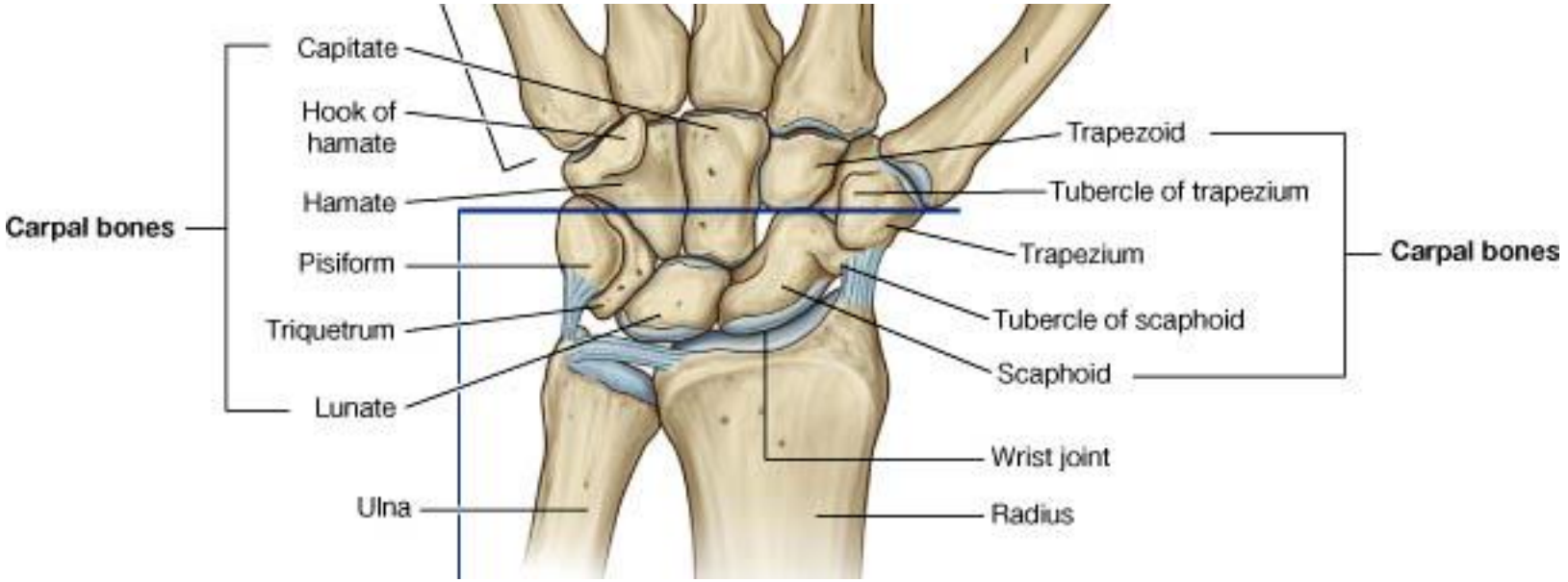
(B) Coronal view



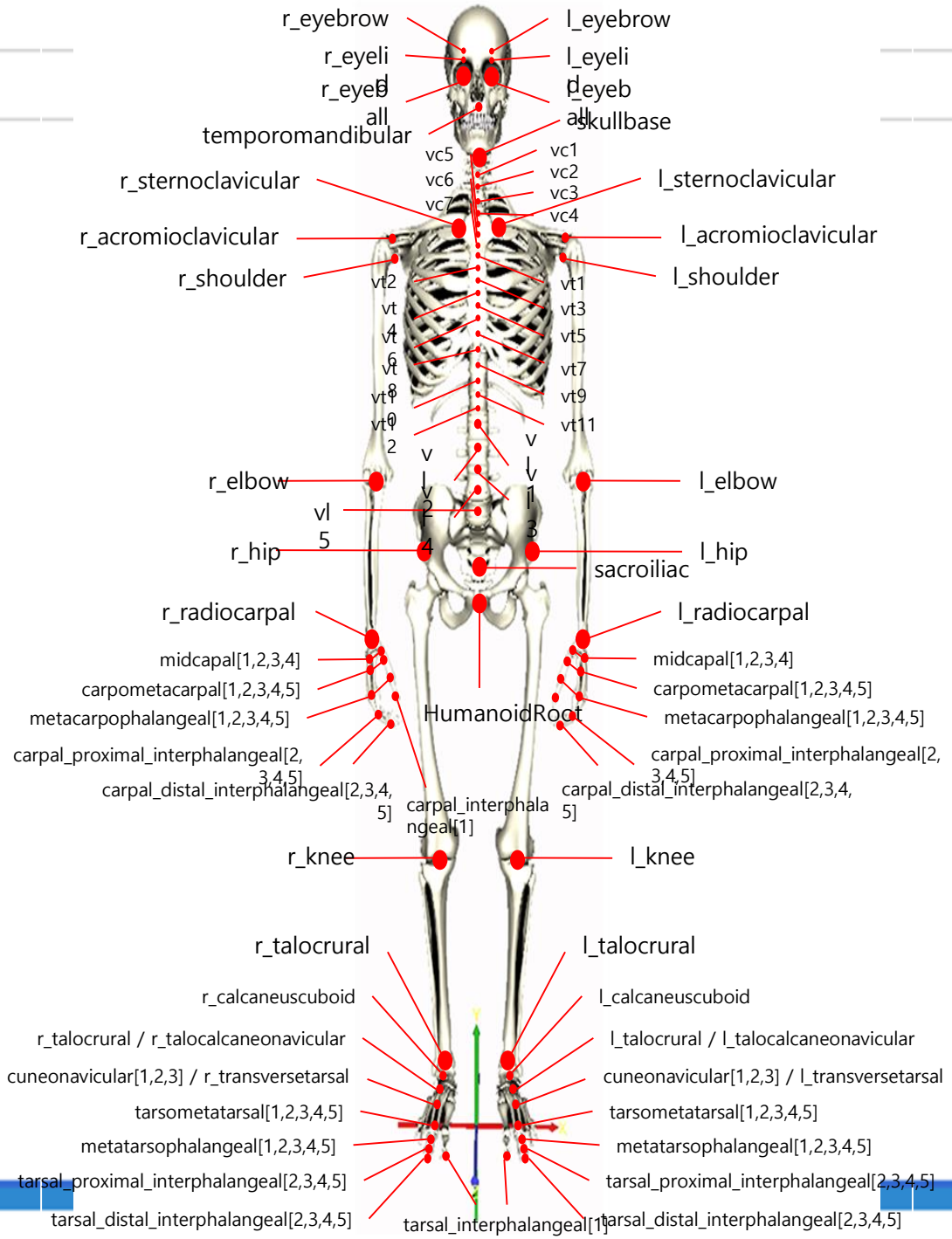
(C) Coronal view

Figure 6.71. Bones of wrist and hand. A. In radiographs of the wrist and hand the "joint space" at the distal end of the ulna appears wide because of the radiolucent articular disc. (Courtesy of Dr. E. L. Lansdown, Professor of Medical Imaging, University of Toronto, Toronto, Ontario, Canada.) **B.** This coronal section of the right hand demonstrates the distal radioulnar, wrist, intercarpal, carpometacarpal, and intermetacarpal joints. Although they appear to be continuous when viewed radiographically in parts **A** and **C,** the articular cavities of the distal radioulnar and wrist joints are separated by the articular disc of the distal radioulnar joint. **C.** This coronal MRI shows the wrist. Structures are identified in part **A.** (Courtesy of Dr. W. Kucharczyk, Chair of Medical Imaging and Clinical Director of Tri-Hospital Magnetic Resonance Centre, Toronto, Ontario, Canada.)


Intercarpal joints
1st metacarpal
Interosseous metacarpal ligament
Carpometacarpal joint of thumb
Carpometacarpal joint of 5th digit
Midcarpal joint (dotted line)
Pisotriquetral joint
Radial collateral ligament
Fibrous layer of joint capsule
Ulnar collateral ligament
Synovial membrane
Articular disc
Radiocarpal joint
Sacciform recess
Distal radioulnar joint
Ulna
Radius
Coronal section
H
C
Z
M
P
T
S
L
Carpal bones
C Capitate


Capitate
Hook of hamate
Hamate
Pisiform
Triquetrum
Lunate
Carpal bones
Trapezoid
Tubercle of trapezium
Trapezium
Tubercle of scaphoid
Scaphoid
Carpal bones
Wrist joint
Ulna
Radius

LOA4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vc2
vc3
vc4
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l_sternoclavicular
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l_acromioclavicular
r_shoulder
l_shoulder
vt2
vt4
vt6
vt8
vt10
vt12
vt1
vt3
vt5
vt7
vt9
vt11
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sacroiliac
HumanoidRoot
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l_radiocarpal
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l_knee
r_talocrural
l_talocrural
r_calcaneuscuboid
l_calcaneuscuboid
r_talocrural / r_talocalcaneonavicular
l_talocrural / l_talocalcaneonavicular
cuneonavicular[1,2,3] / r_transversetarsal
cuneonavicular[1,2,3] / l_transversetarsal
tarsometatarsal[1,2,3,4,5]
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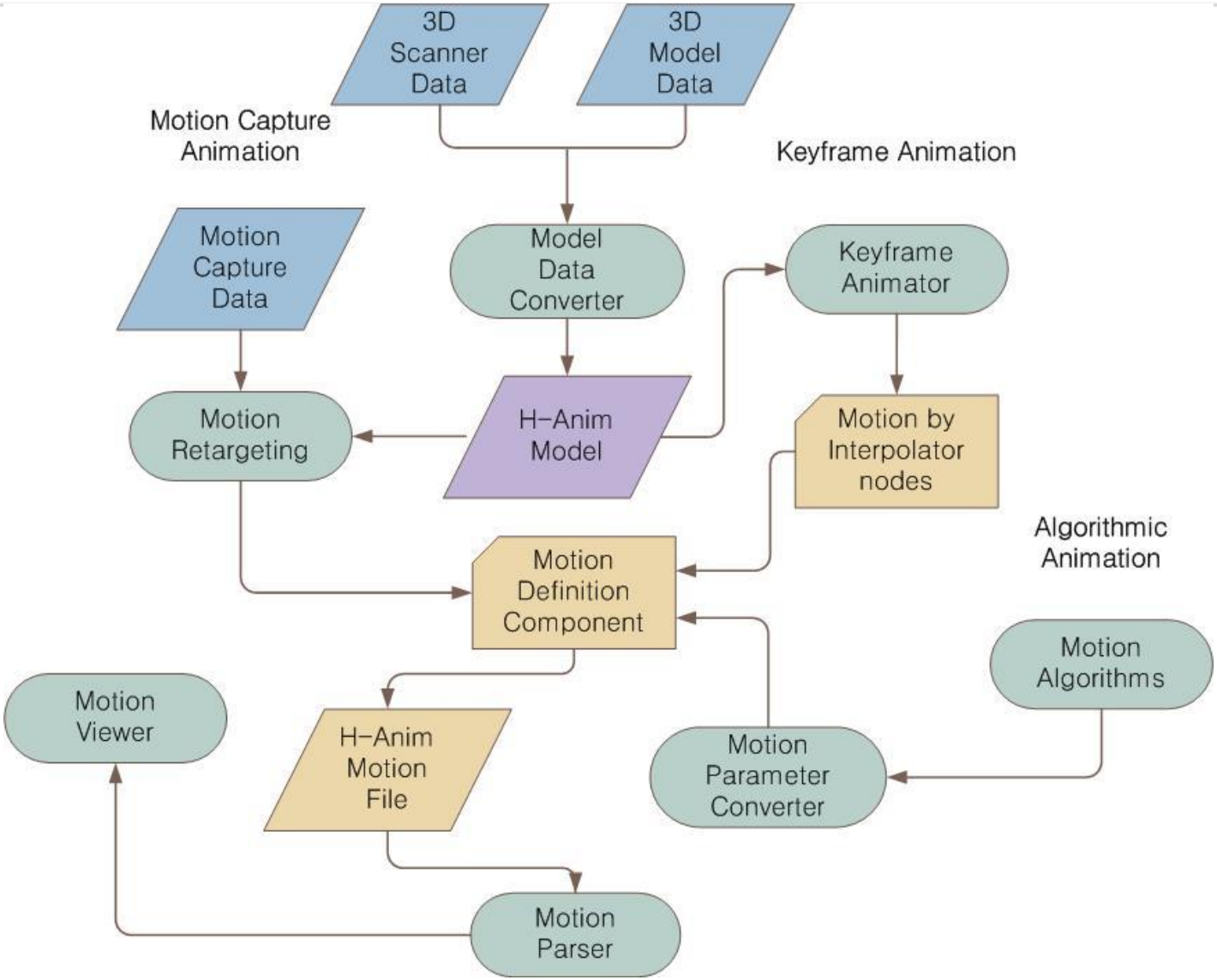
Part 2:
Figure 4.1 – Procedure of humanoid animation



The followings are slides previously presented at the Arlington SC24 Plenary in 2017

H-Anim Standardization Status

Status of H-Anim Revision

- CD 2
  - ISO/IEC 19774 Humanoid Animation – Part 1: Architecture
  - ISO/IEC 19774 Humanoid Animation – Part 2: **Motion Data Animation**

- Implementation software and examples for H-Anim modeling and motion capture animation
  - H-Anim modeling
    - H-Anim modeling guidelines for general graphics tools
    - Wrl-to-x3d H-Anim model converter for **LOA-0, LOA-1, LOA-2, LOA-3 and LOA-4 H-Anim models**
  - H-Anim motion capture animation
    - Mocap parameters to X3D interpolators converter
    - H-Anim motion viewer for **LOA-0, LOA-1, LOA-2, LOA-3 and LOA-4 H-Anim models**
    - H-Anim motion editor with **LOA-0, LOA-1, LOA-2, LOA-3 and LOA-4** H-Anim models and motion capture animation

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

ISO/IEC 19775-1:2013 X3D Architecture and base components V3
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

Humanoid Animation V1.0 - Part 1: Architecture

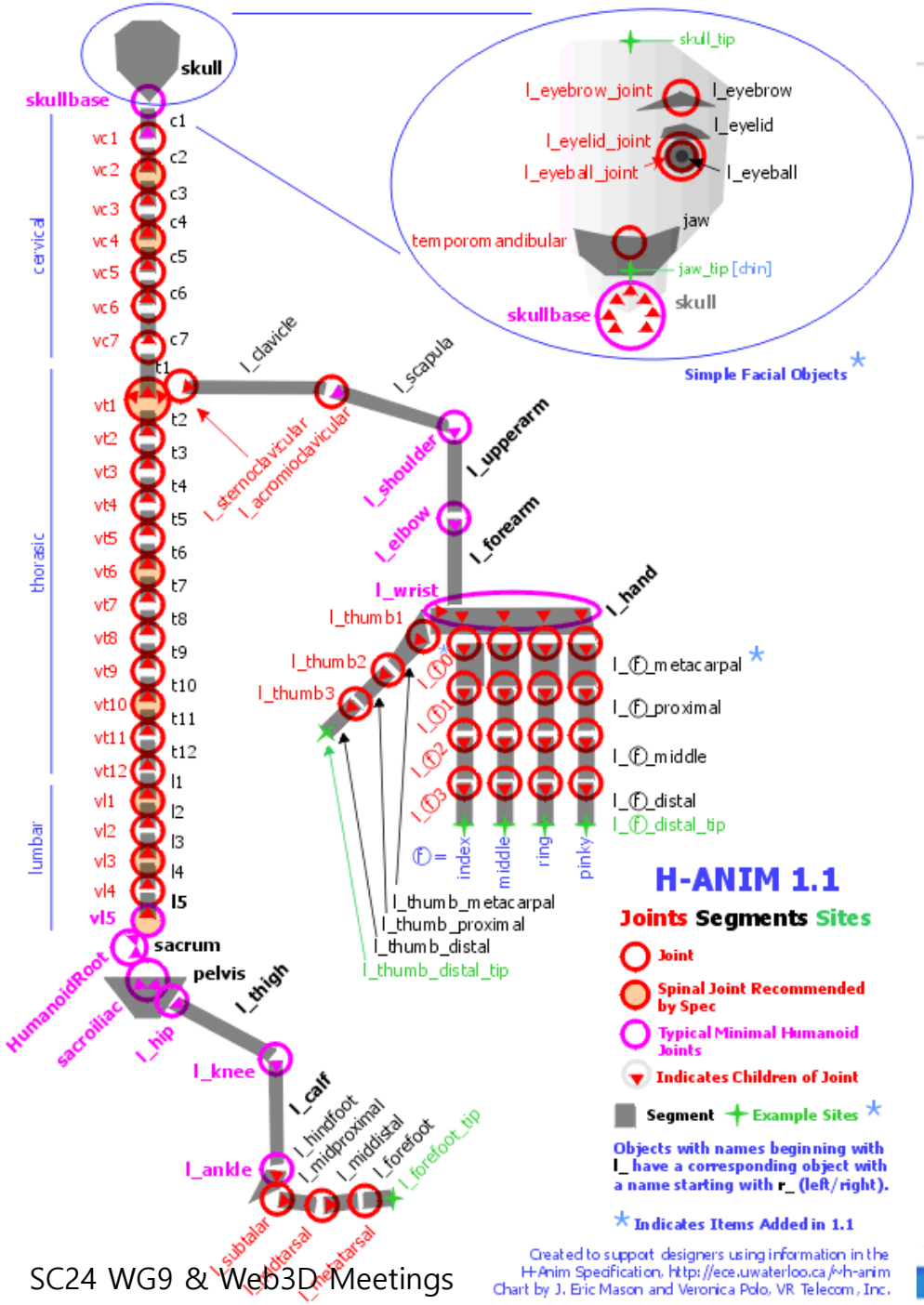
- Foreword
- Introduction
- 1. Scope
- 2. Normative references
- 3. Terms, definitions, symbols, and abbreviations
- 4. Concepts
- 5. Abstract data types
- 6. Object interfaces
- 7. Conformance
- Annexes
- A. Nominal body dimensions and levels of articulation
- B. Feature points for the human body
-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

Humanoid Animation-Part 2: Motion Data Animation

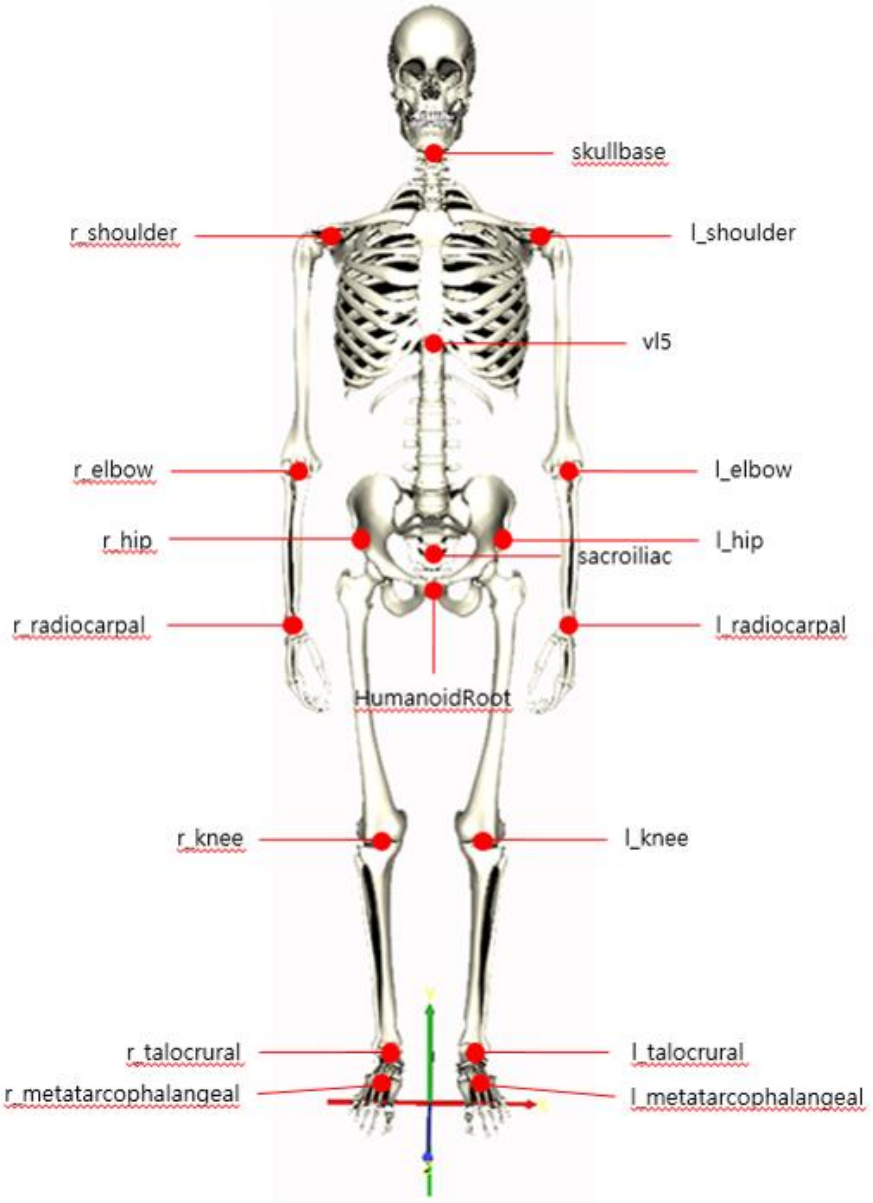
H-Anim Part 1: Architectire

H-Anim Hierarchy

ISO/IEC 19774
Humanoid Animation



LOA 1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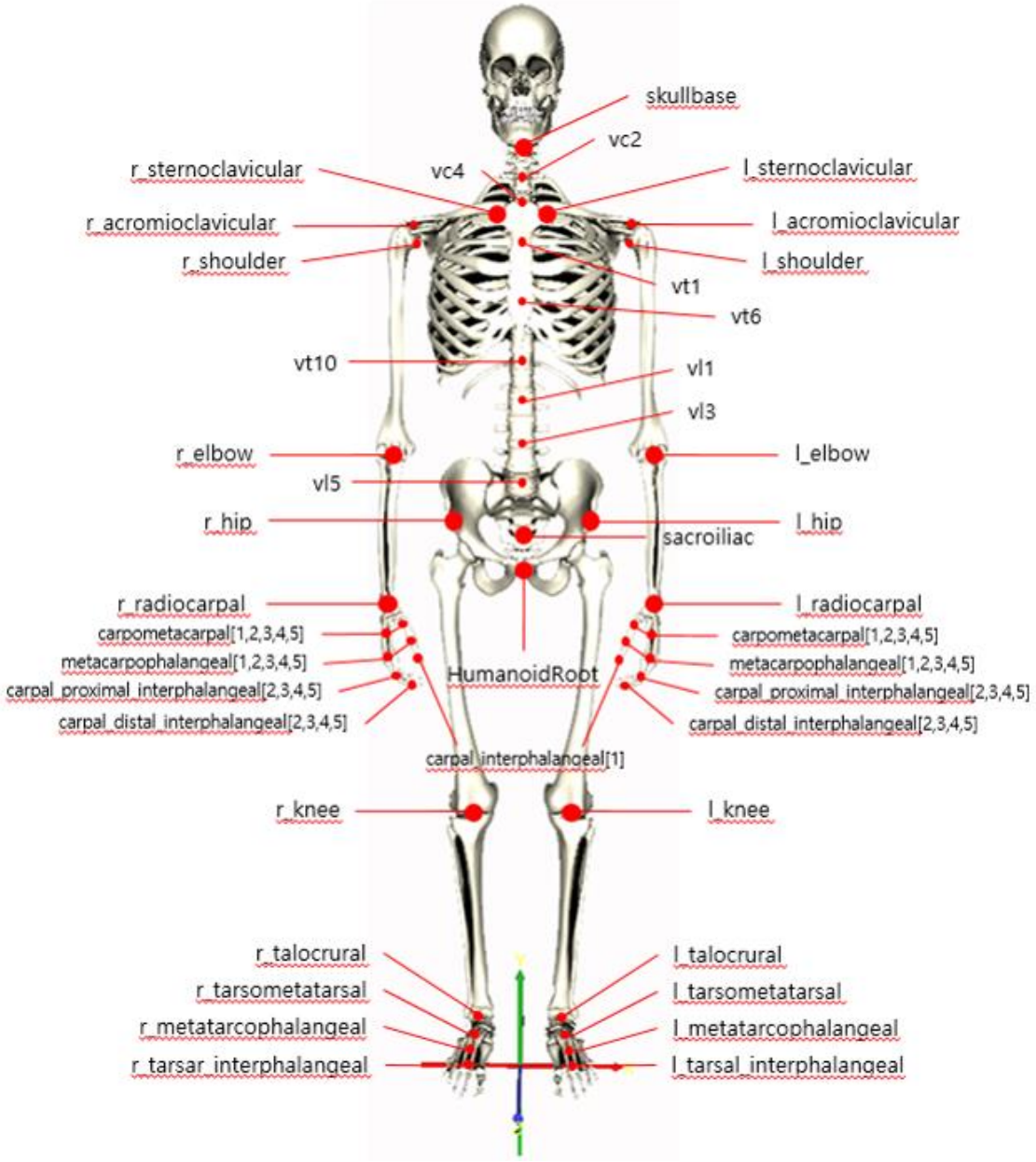
LOA 2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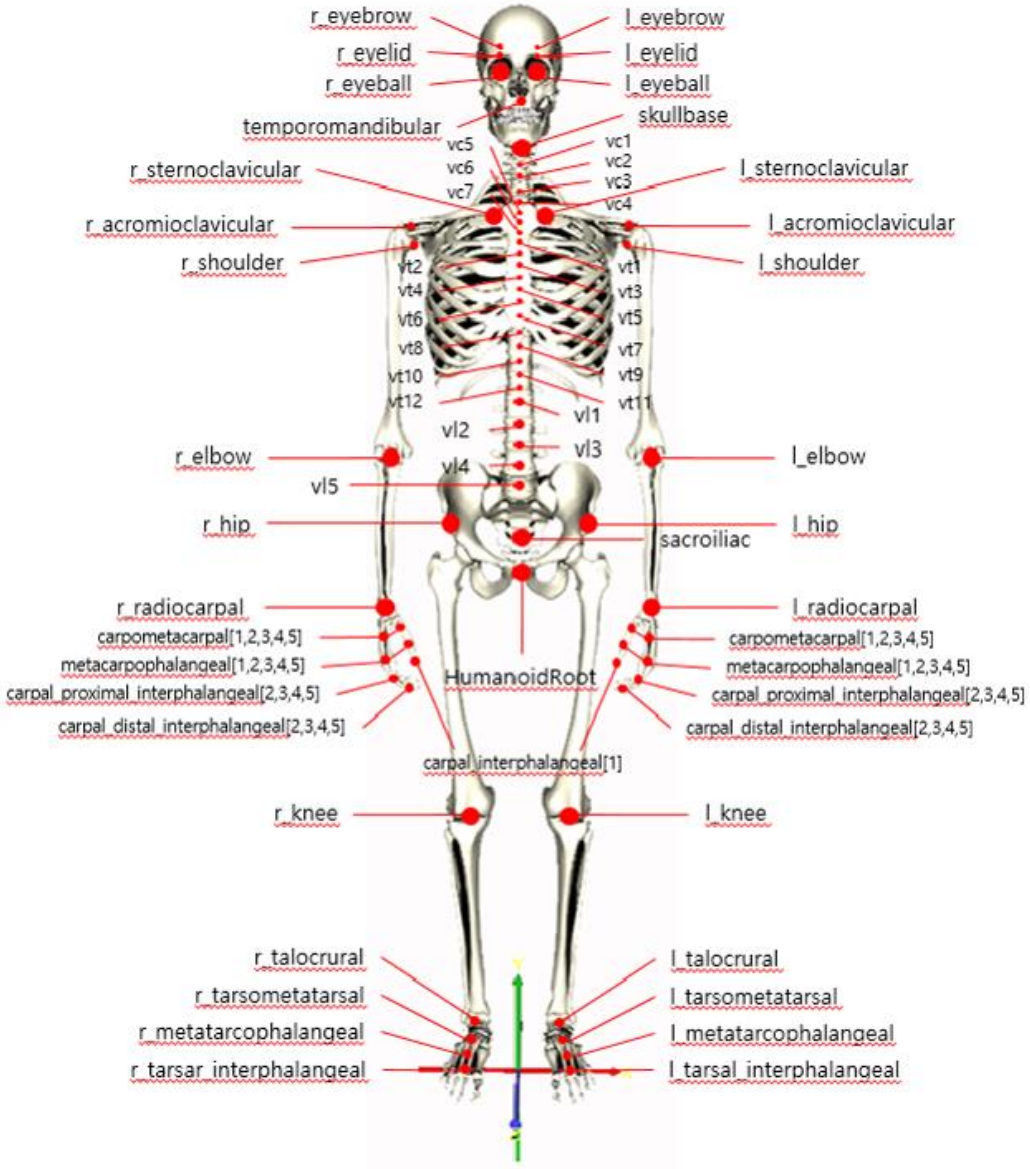
LOA 3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l_tarsometatarsal
r_metatarcophalangeal
l_metatarcophalangeal
r_tarsar_interphalangeal
l_tarsal_interphalangeal

LOA 4 Hand

Elbow

Radiocarpal_joint (wrist): hand

midcarpal_Joint_12 : **trapezoid**

carpometacarpal_Joint_1 : **metacarpal1**

metacarpophalangeal_Joint_1 : **proximal_phalanges1**

interphalangeal_Joint_1 : **distal_phalanges1**

carpometacarpal_Joint_2 : **metacarpal2**

metacarpophalangeal_Joint_2 : **proximal_phalanges2**

proximal_Interphalangeal_Joint_2 : **middle_phalanges2**

distal_Interphalangeal_Joint_2 : **distal_phalanges2**

midcarpal_Joint_3 : **capitate**

carpometacarpal_Joint_3 : **metacarpal3**

metacarpophalangeal_Joint_3 : **proximal_phalanges3**

proximal_Interphalangeal_Joint_3 **: middle_phalanges3**

distal_Interphalangeal_Joint_3 : **distal_phalanx3**

midcarpal_Joint_45 : **hamate**

carpometacarpal_Joint_4 : **metacarpal4**

metacarpophalangeal_Joint_4 : **proximal_phalanges4**

proximal_Interphalangeal_Joint_4 : **middle_phalanges4**

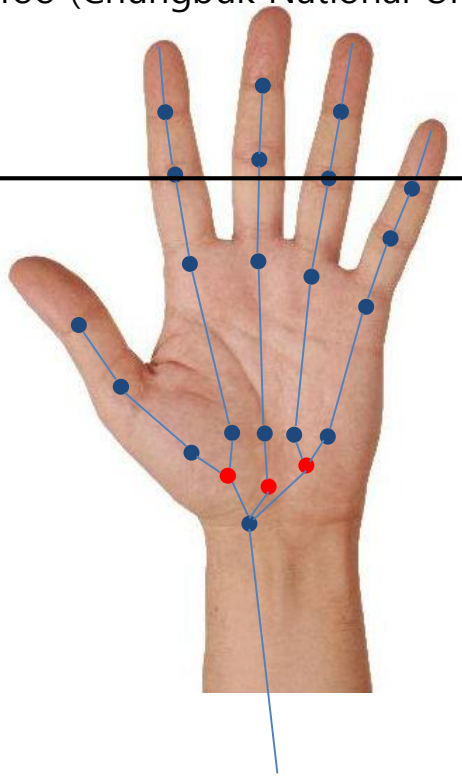
distal_Interphalangeal_Joint_4 : **distal_phalanx4**

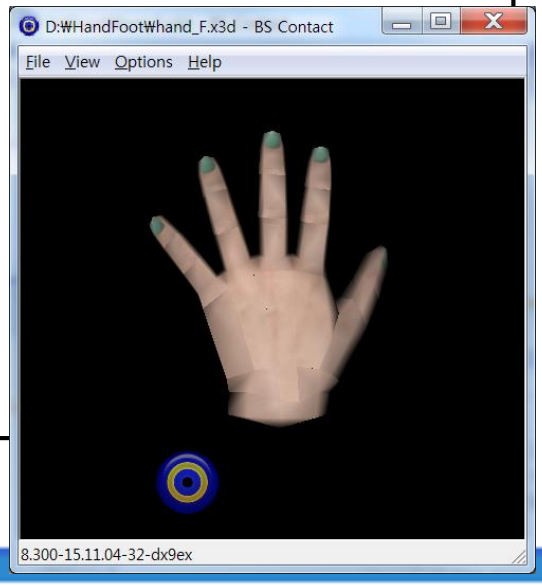
carpometacarpal_Joint_5 : **metacarpal4**

metacarpophalangeal_Joint_5 : **proximal_phalanges5**

proximal_Interphalangeal_Joint_5 : **middle_phalanges5**

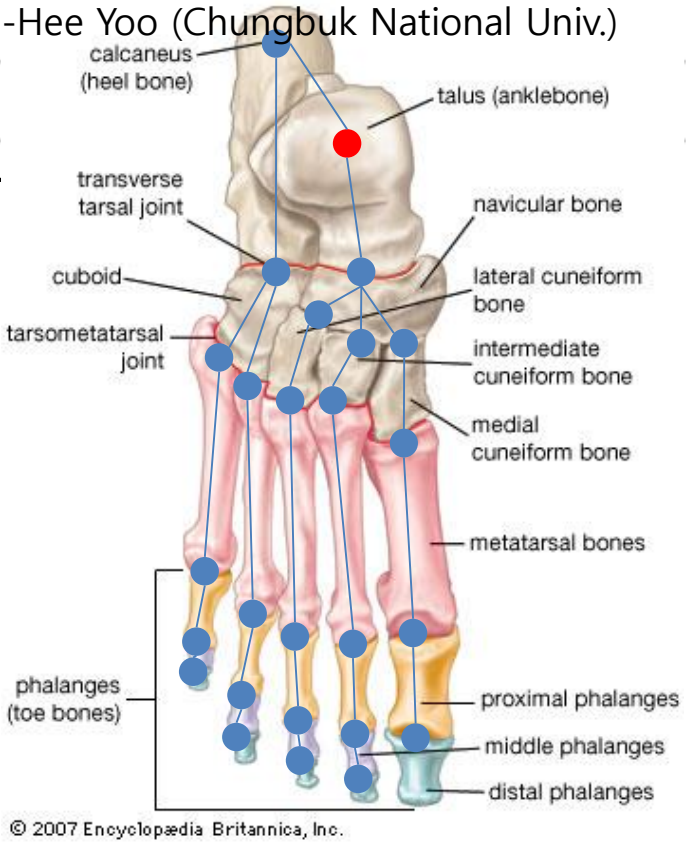
distal_Interphalangeal_Joint_5 : **distal_phalanx5**

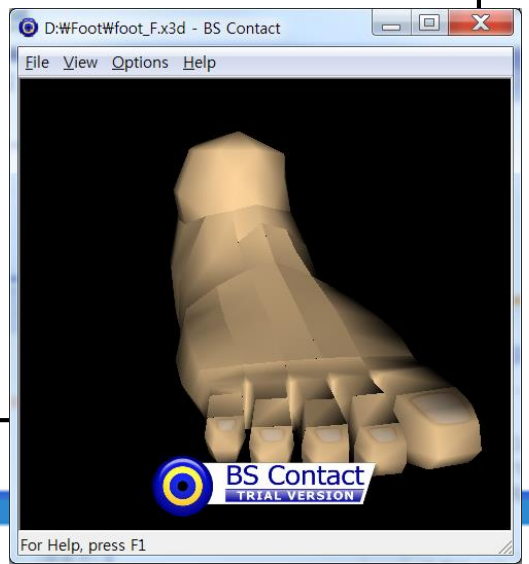




LOA 4 Foot

Tibia
- **Talocrural Joint : talus (hindfoot)**
  - **Talocalcaneonavicular Joint : navicular**
    - **Cuneonavicular Joint 1 :cuneiform1**
      - Tarsometatarsal Joint 1 :**metatarsal1**
        - Metatarsophalangeal 1 : **proximal_phalanges1**
          - f_ Interphalangeal Joint : **distal_phalanges1**
    - **Cuneonavicular Joint 2 : cuneiform2**
      - Tarsometatarsal Joint 2 : **metatarsal2**
        - Metatarsophalangeal Joint 2 : **proximal_phalanges2**
          - f_Proximal Interphalangeal Joint 2 : **middle_phalanges2**
            - f_Distal Interphalangeal Joint 2 : **distal_phalanges2**
    - **Cuneonavicular Joint 3 : cuneiform3**
      - Tarsometatarsal Joint 3 : **metatarsal2**
        - Metatarsophalangeal Joint 3 : **proximal_phalanges3**
          - f_Proximal Interphalangeal Joint 3 : **middle_phalanges3**
            - f_Distal Interphalangeal Joint 3 : **distal_phalanges3**
  - **Calcaneuscuboid Joint : calcaneus**
    - **Transversetarsal Joint : cuboid**
      - Tarsometatarsal Joint 4 : **metatarsal4**
        - Metatarsophalangeal Joint 4 : **proximal_phalanges4**
          - f_Proximal Interphalangeal Joint 4 : **middle_phalanges4**
            - f_Distal Interphalangeal Joint 4 : **distal_phalanges4**
      - Tarsometatarsal Joint 5 : **metatarsal5**
        - Metatarsophalangeal Joint 5 : **proximal_phalanges5**
          - f_Proximal Interphalangeal Joint 5 : **middle_phalanges5**
            - f_Distal Interphalangeal Joint 5 : **distal_phalanges5**





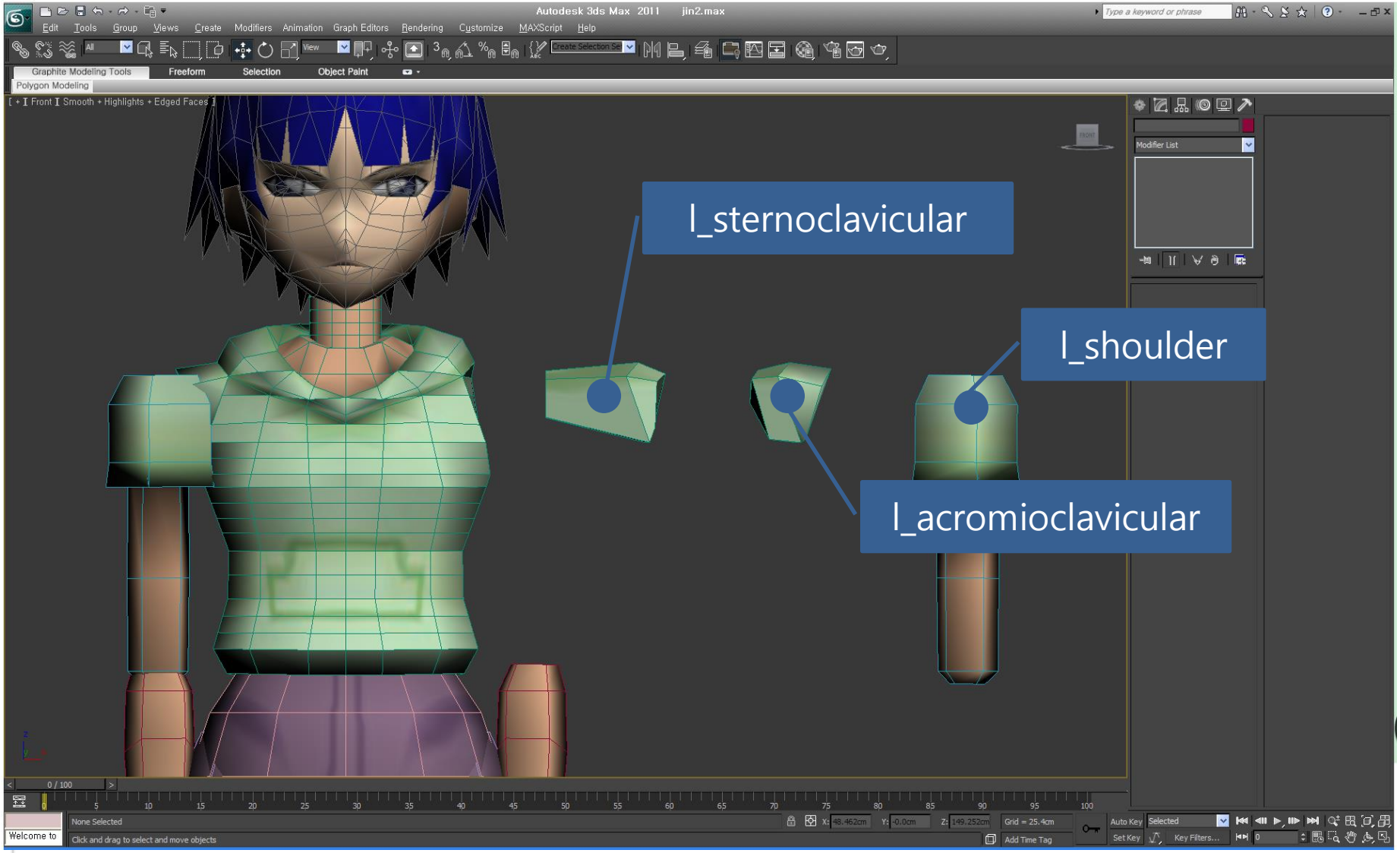
LOA Comparison

	LOA 1	LOA 2	LOA 3	LOA 4
No. of joints	18	71	94	144
No. of segments	18	71	94	144
Representation details	Basic joint hierarchy	More backbone joints compared to LOA1, addition of finger joints	More backbone joints compared to LOA2, 7 eye joints in face	More hands and feet joints compared to LOA3
Motion capture devices	MS Kinect	Subset of LOA2 joints available depending on mocap devices (between LOA1 and LOA2)	None (possible using increased motion sensors)	None (possible using increased motion sensors)
Animation levels	Simple humanoid animation	More detailed animation such as finger animation (e.g. for piano and guitar) compared to LOA1	Detailed animation upgraded with facial animation (such as eyeball and other eye joint animation), more natural animation compared to LOA2	Detailed animation upgraded with anatomical hands and feet joints

Joints composition for each LOA (No. of joints)

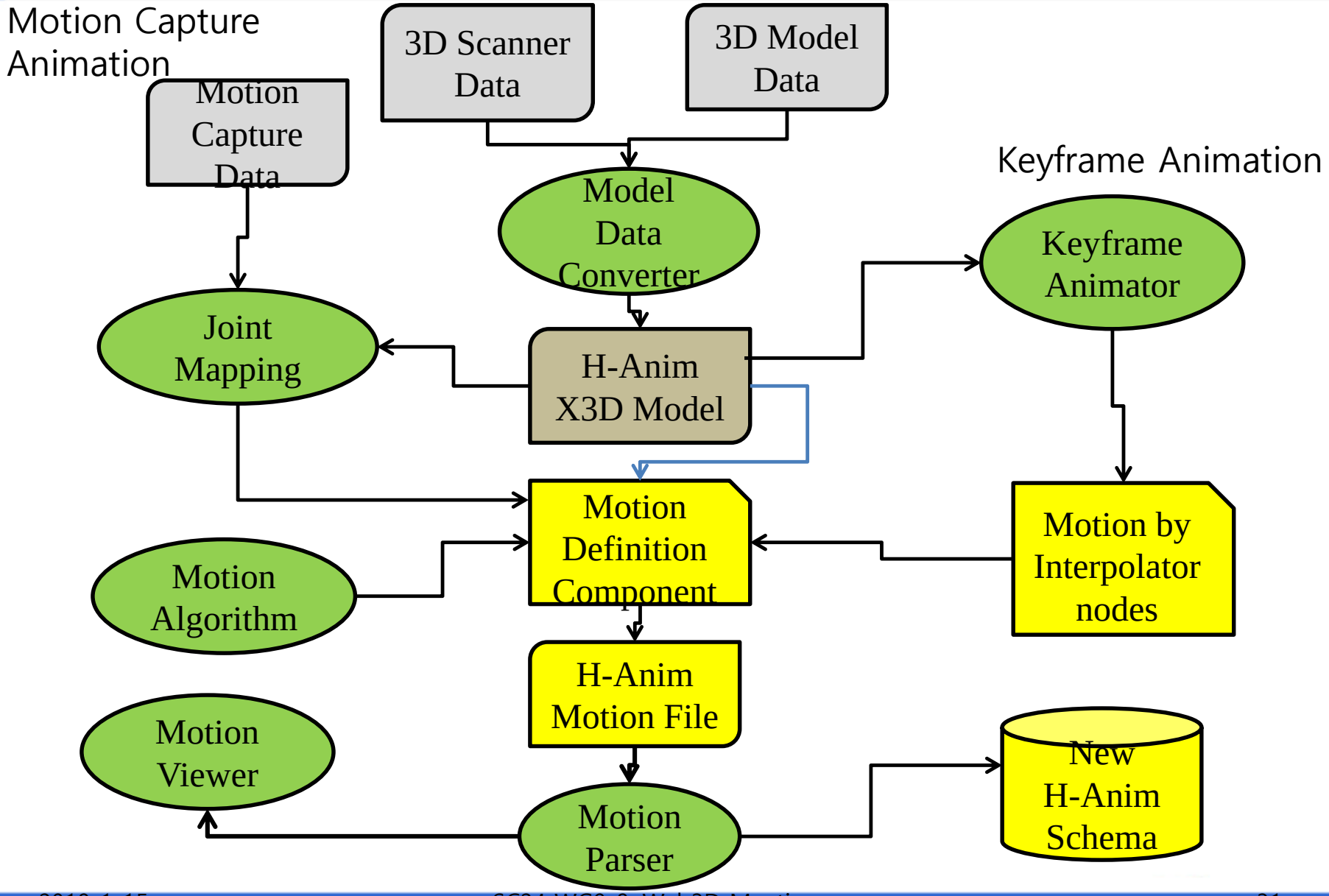
	LOA 1	LOA 2	LOA 3	LOA 4
Head	1	1	8	8
Waist	2	2	2	2
Backbone	1	8	24	24
Arm	6	8	8	8
Leg	4	4	4	4
Hands	2	40	40	46
Feet	2	8	8	52
Total	18	71	94	144

LOA 1 Modeling example



H-Anim Part 2: Motion Capture

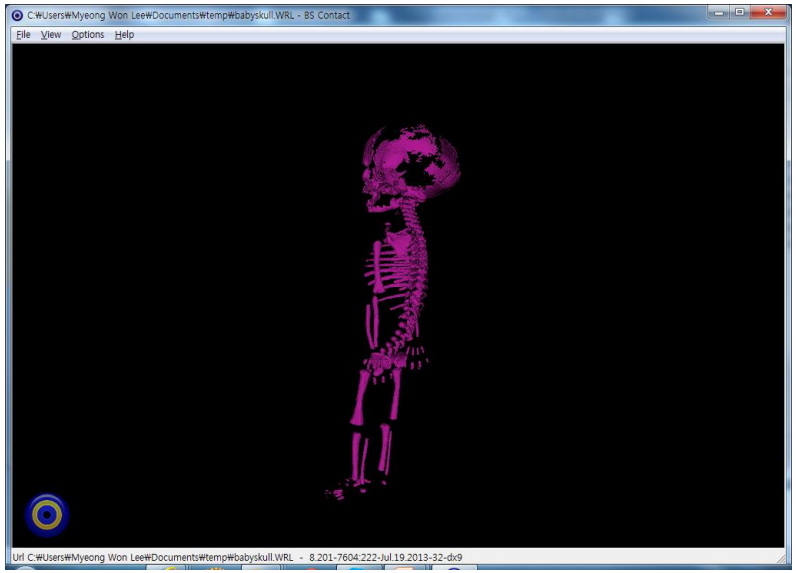
Humanoid Animation Generation Using H-Anim



Modeling an H-Anim Character

- Design using general tools (e.g. 3ds Max)
  - Model a segment with H-Anim joint name, define center of each joint, integrate segments, and complete an H-Anim hunan figure

- Design using 3D scanner data
  - Obtain scanner data , divide each segment data, provide each segment with an H-Anim segment name, provide each joint with a center point, and integrate segments, and complete an H-Anim human figure



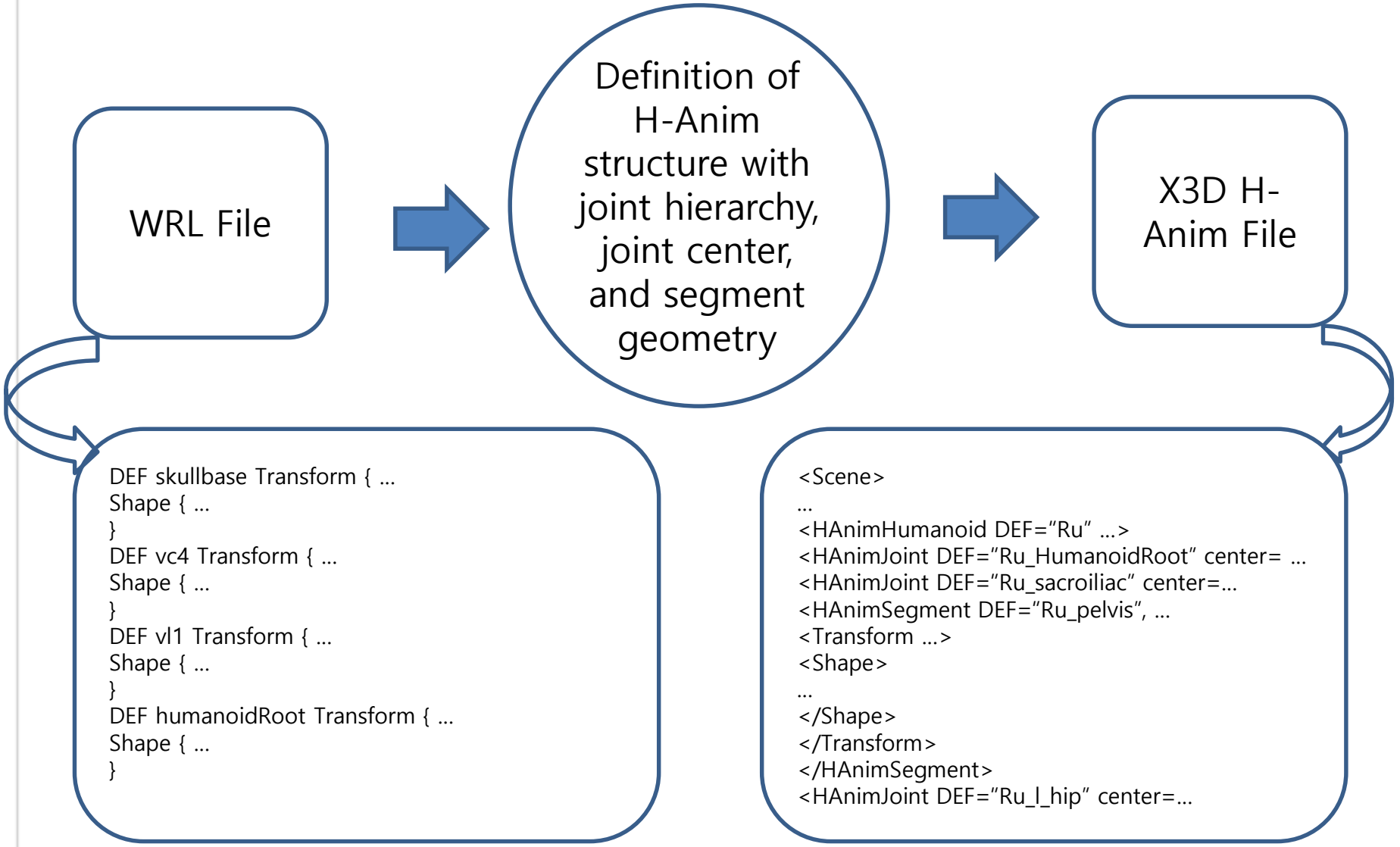
Mocap and H-Anim LOA1 Joint

Mocap (BVH) Joint Name	H-Anim Joint Name (19774:2006 v1.0)
Hips	HumanoidRoot
LeftHip	l_hip
LeftKnee	l_knee
LeftAnkle	l_ankle
RightHip	r_midtarsal
RightKnee	r_hip
RightAnkle	r_knee
Chest	r_ankle
LeftCollar	vl5
LeftShoulder	l_shoulder
LeftElbow	l_elbow
LeftWrist	l_wrist
RightCollar	l_midtarsal
RightShoulder	r_shoulder
RightElbow	r_elbow
RightWrist	r_wrist
Neck	sacroiliac
Head	Skullbase

Motion Definition Using Motion Capture Data

- Definition using X3D Interpolator (1)
  - Conversion of motion capture data (e.g. bvh) to X3D Interpolator
  - Bvh to X3D interpolator conversion
    - Requires conversion between motion capture rotation angles such as euler angles and SFRotation angles
    - Requires conversion between the orders of parameter values
- Definition of Motion Object (2)
  - Motion object
    - Define motion capture animation for an H-Anim character model
    - Define an H-Anim model, joint mapping, motion capture data
      - An H-Anim model is specified.
      - For joint mapping, joints array for joint mapping of a motion capture figure to the H-Anim model, and channels array for specifying the number of channels and channel types corresponding to the motion capture data are specified.
      - Motion capture data are specified.

Converter Program: WRL to X3D H-Anim (1)



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
```

LOA1 H-Anim Characters (X3D H-Anim) - 18 joints

1.Jin

2.Chul

3.Hyun

4.Young

5.Ju

6.Ga

7.No

8.Da

9.Ru

10.Mi

11.Min

12.Sun

LOA2 H-Anim Characters (X3D H-Anim) - 71 joints

1.Jin

2.Chul

4.Young

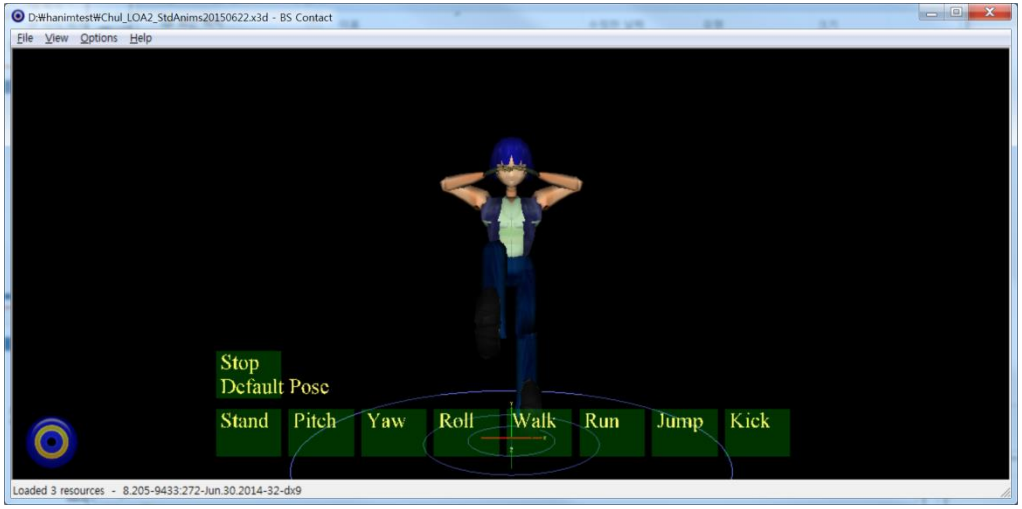
11.Min

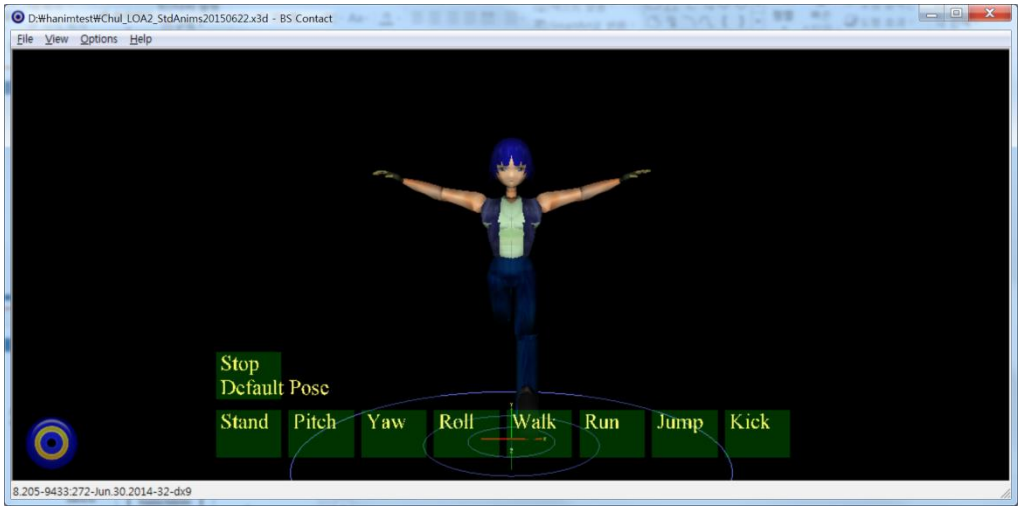
LOA3 H-Anim Characters (X3D H-Anim) - 94 joints

1.Jin

H-Anim Behavior Animation Using X3D Interpolators

LOA 2 character (Chul)

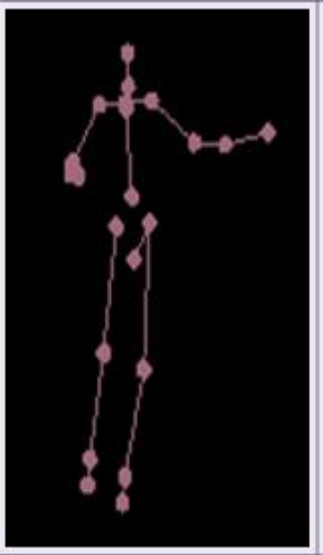
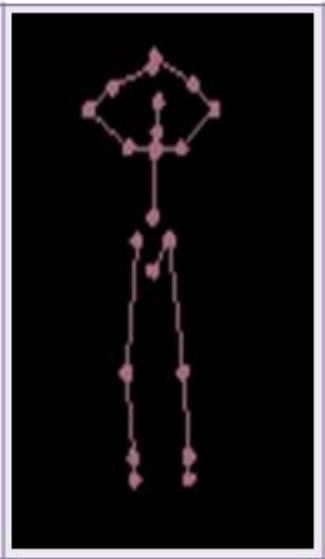




H-Anim Motion Capture using X3D Interpolators

BVH Converter

H-Anim Character Animation Using Motion Capture

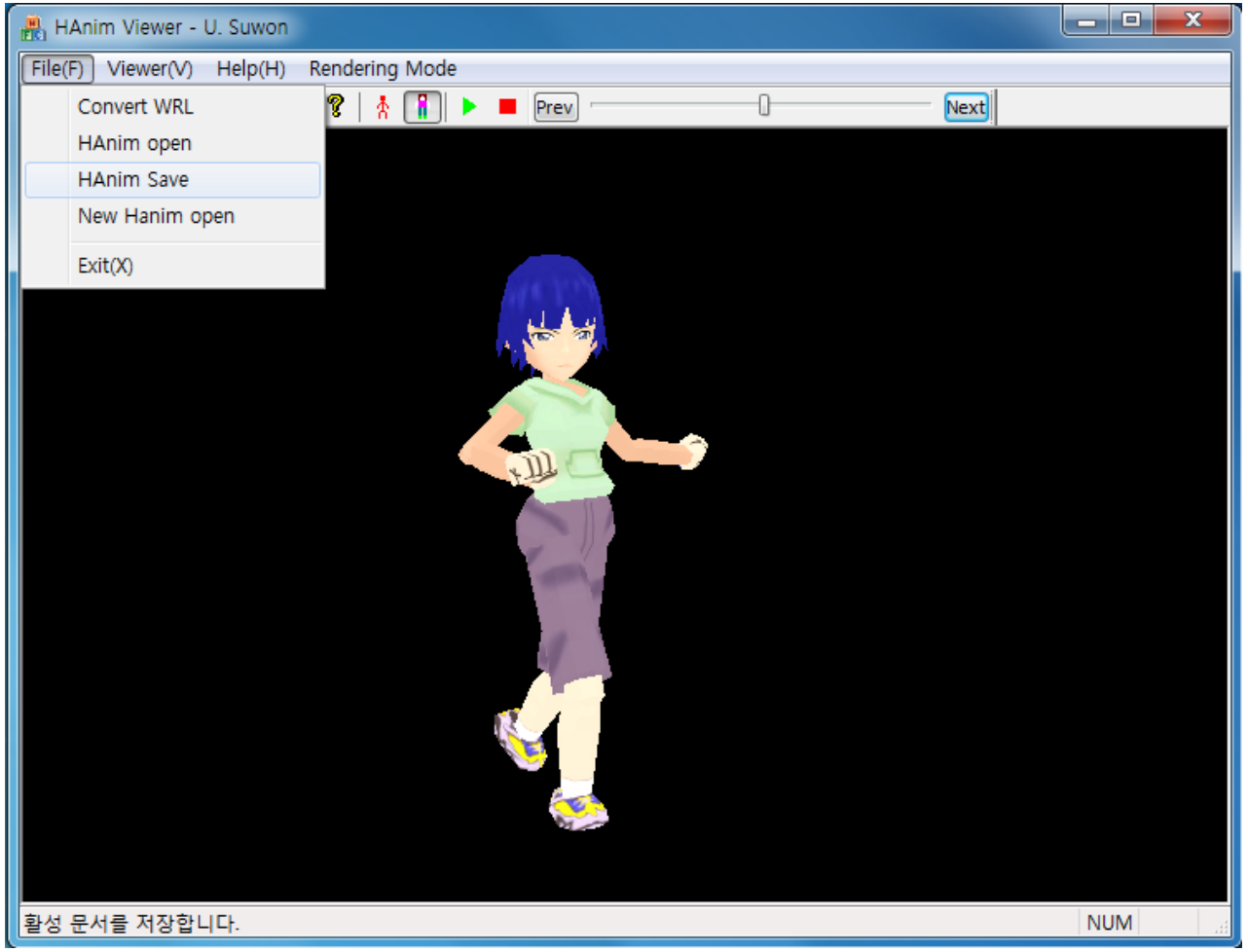
Motion Capture (BVH)				
H-Anim Animation				

LOA 1 and LOA 2 H-Anim Motion Capture Animation

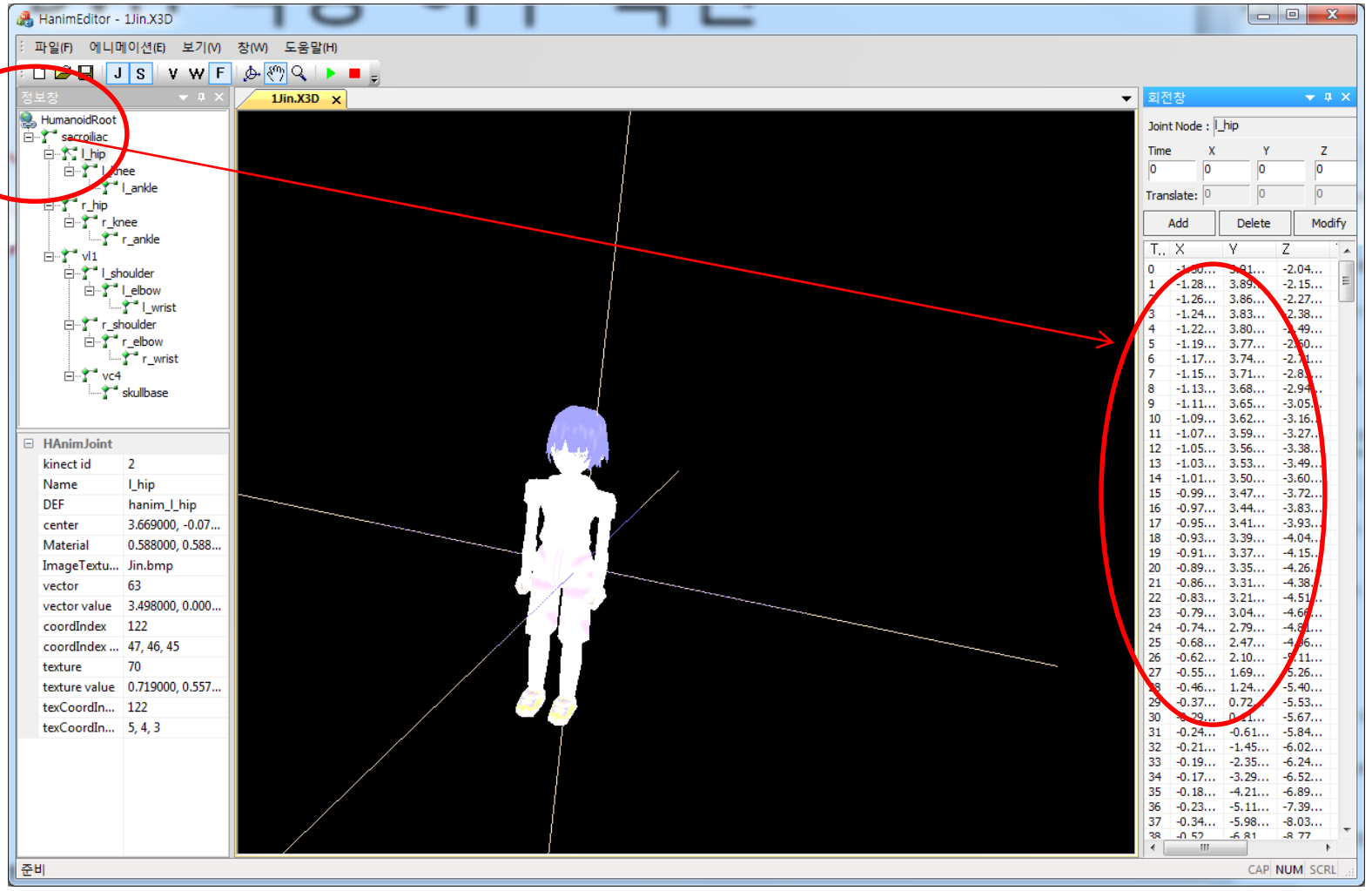
LOA 1

LOA 2

H-Anim Motion Viewer



H-Anim Motion Editor



H-Anim Editor

- Objectives
  - Generate H-Anim human animation using motion capture data
  - Edit motion capture animation
  - Edit model hierarchy
  - Edit joint
  - Edit segment

H-Anim character animation & music 3D

- http://www.youtube.com/watch?v=hFz3WU3JIU0
- H-Anim Music 3D Animation - Sundays

- http://www.youtube.com/watch?v=0gsRNN9gfSM
- H-Anim Music 3D Animation - Sundays

- http://www.youtube.com/watch?v=TiUskQ0DTqY
- H-Anim Music 3D Animation - Travels

- http://www.youtube.com/watch?v=MlGwSHI8aGA
- H-Anim Music 3D Animation - The Present

- http://www.youtube.com/watch?v=R_uYm-pyJxU
- H-Anim LOA2 Music 3D Animation - Travels

Work in progress

- Tools and examples
  - LOA0, LOA 1, LOA 2, LOA 3, LOA 4 model converter: wrl-to-x3d hanim
  - LOA0, LOA 1, LOA 2, LOA 3, LOA4 H-Anim motion viewer
  - LOA0, LOA 1, LOA 2, LOA 3, LOA4 H-Anim motion editor
  - LOA 4 H-Anim hands and feet
  - LOE1, LOE2, LOE3 H-Anim facial animation

- ISO standards development
  - ISO/IEC 19774 Humanoid Animation Part 1: Architecture (CD)
  - ISO/IEC 19774 Humanoid Animation Part 2: Motion Capture (CD)
  - ISO/IEC 19774 Humanoid Animation Part 3: Facial Animation (NWIP)

H-Anim 3D Music Video Competition

2016 & 2017

ISO H-Anim 3D Animated Music Video Competition (1)

- 3D H-Anim character animation and music composition
- Online international contest
- LOA1, LOA2, LOA3, LOA4 H-Anim character modelling and animation
- LOE1, LOE2, LOE3 H-Anim facial expression animation

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

ISO H-Anim 3D Animated Music Video Competition (2)

- Background and history
  - Proposal: H-Anim WG Meeting, January 2015
  - Web3D loadmap by Web3D Consortium: Web3D Conference, June 2015
  - 2016 the first competition
    - Organized by Web3D Consortium & Web3D Korea
    - Supported by KSA (Korean Standards Association), SSA (Society for Standards and Standardization) and Web3D Consortium
  - 2017 the second competition (planned)
    - Organized by Web3D Consortium & Web3D Korea
    - Supported by KSA (Korean Standards Association), SSA (Society for Standards and Standardization) and Web3D Consortium

ISO H-Anim 3D Animated Music Video Competition (3)

- Process for 2016 competition
  - Announcement: October 2015 via Web3D mailing list
  - Submission deadline: June 30 2016
  - Submission files and format: character and virtual stage x3d files, avi (or mp3)
  - Judging: July 1-20, 2016
  - Announcement of winners: July 24, 2016 at Web3D Conference or via mail and email
  - Winners submissions demo: Web3D Conference and H-Anim BoF at SIGGRAPH 2016
- Process for 2017 competition (tentative)
  - Announcement: October 2016 via Web3D mailing list
  - Submission deadline: June 30 2017
  - Submission files and format: character and virtual stage x3d files, avi (or mp3)
  - Judging: July 1-20, 2017
  - Announce prizes: H-Anim BoF at SIGGRAPH 2017
  - Winners submissions demo: H-Anim BoF at SIGGRAPH 2017

ISO H-Anim 3D Animated Music Video Competition (4)

- Competition entry submission requirements:
  - An X3D virtual stage (x3d file required, media files optional)
  - An H-Anim character (H-Anim x3d files required)
  - License free music (mp3 or avi file required with proof of license free status)
  - A 90 to 120 second video (avi file), along with the associated X3D files and media files
  - A completed contest entry summarizing your submission. Details include title, author, a summary about the character (maximum three lines), and 1-2 representative screen shots from the video.

- Competition details are maintained on the Web3D mailing lists and the Web3D Consortium website

ISO H-Anim 3D Animated Music Video Competition (5)

- Contest Judging Criteria:

  Each entry will be judged on the following:

  - creativity of 3D character animation,
  - use of the ISO/IEC 19774 specification (LOA1, LOA2, LOA3) for character models,
  - creativity of the virtual stage,
  - use of the ISO/IEC 19775-1 X3D specification.

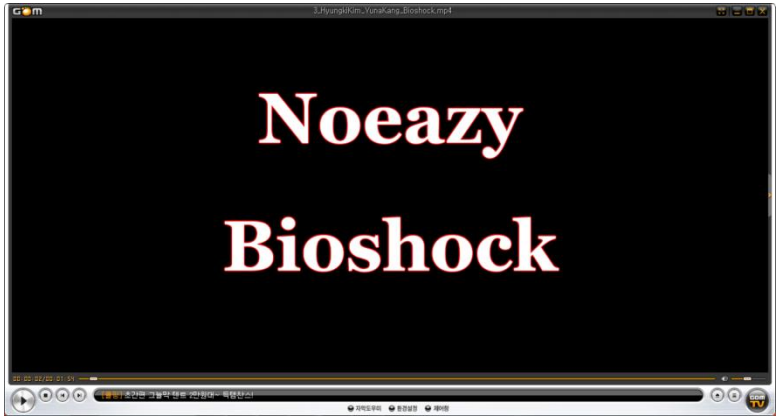
H-Anim 3D Music Video Demo

2017 Winners

2016 Winner's Video

Minjoo Lee

Wooju Sim

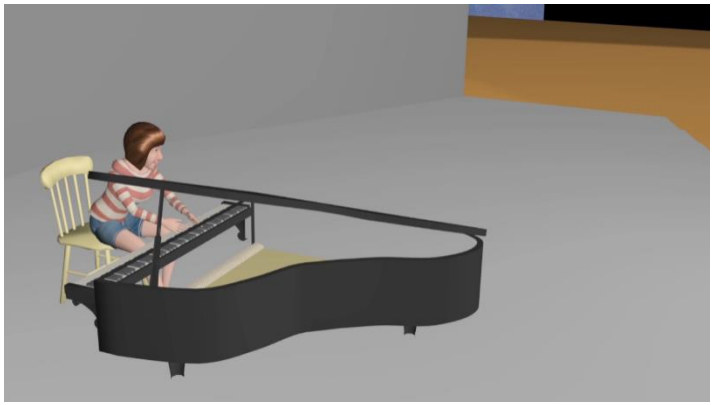


Hyungki Kim and Yuna Kang

2017 Winner's Video

Hwakyoung You

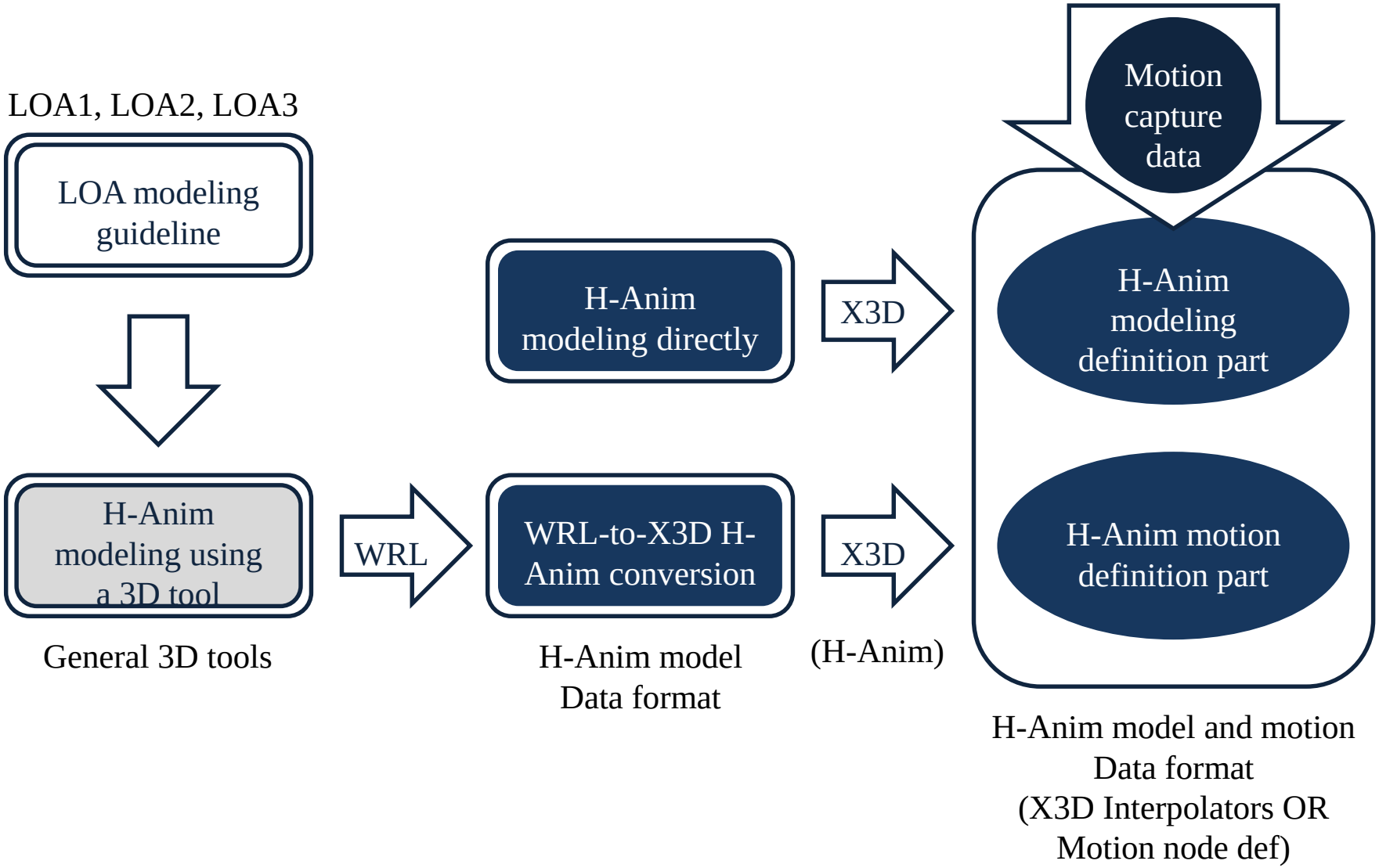
Minjoo Lee



Soonho Lee

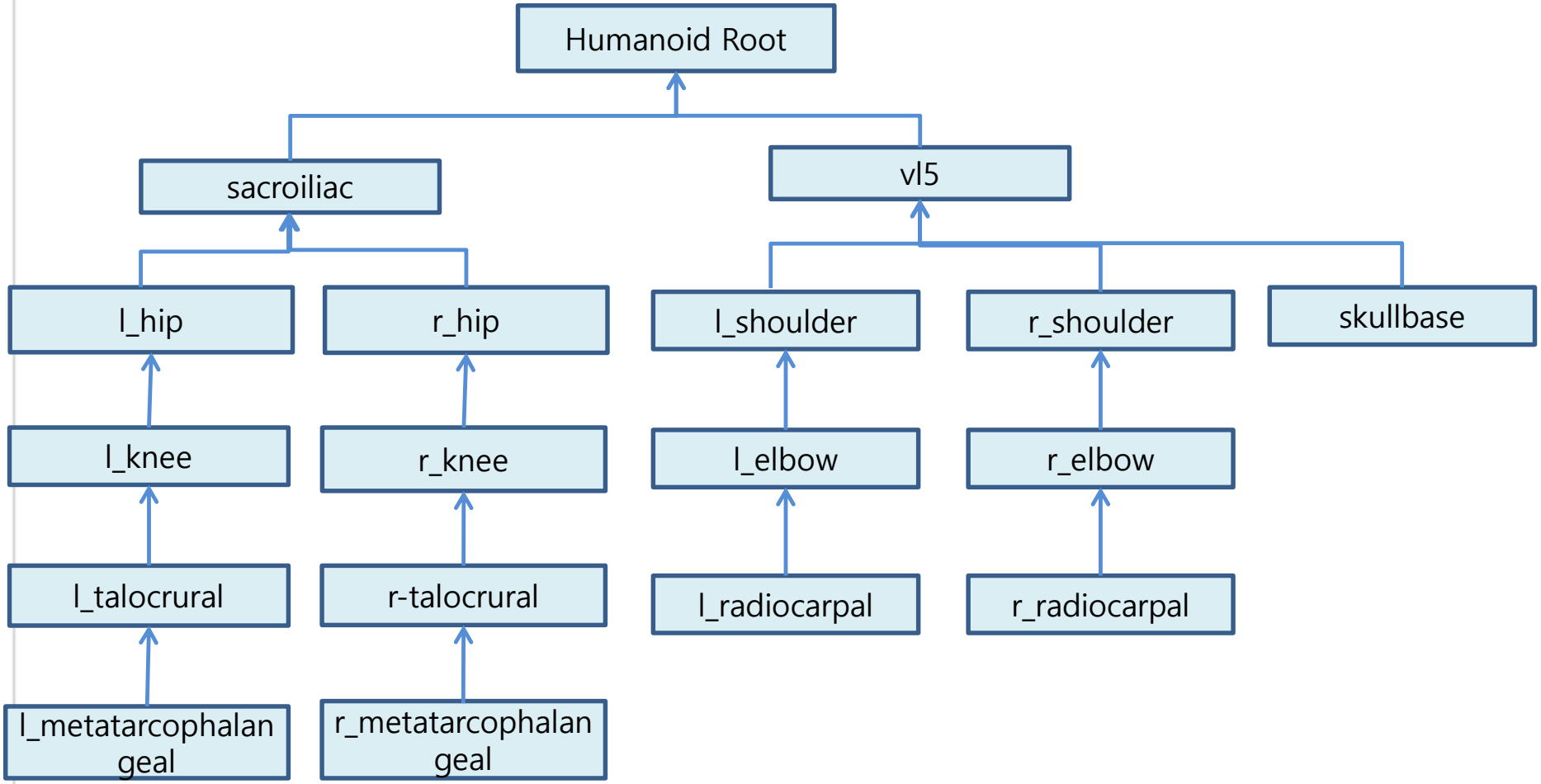
Design guidelines for H-Anim 3D characters

H-Anim Character Animation Using a General Graphics Tool



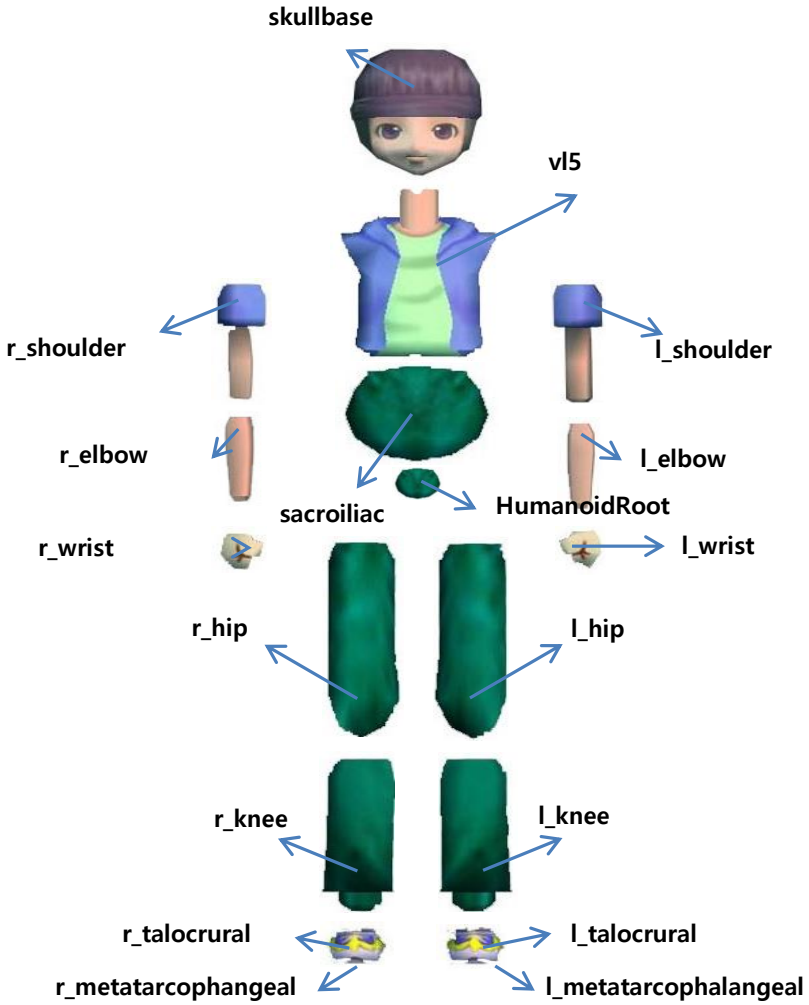
H-Anim Character Modeling Using a General Graphics Tool (1)

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 an H-Anim character. 18 joints and 18 segments are specified.



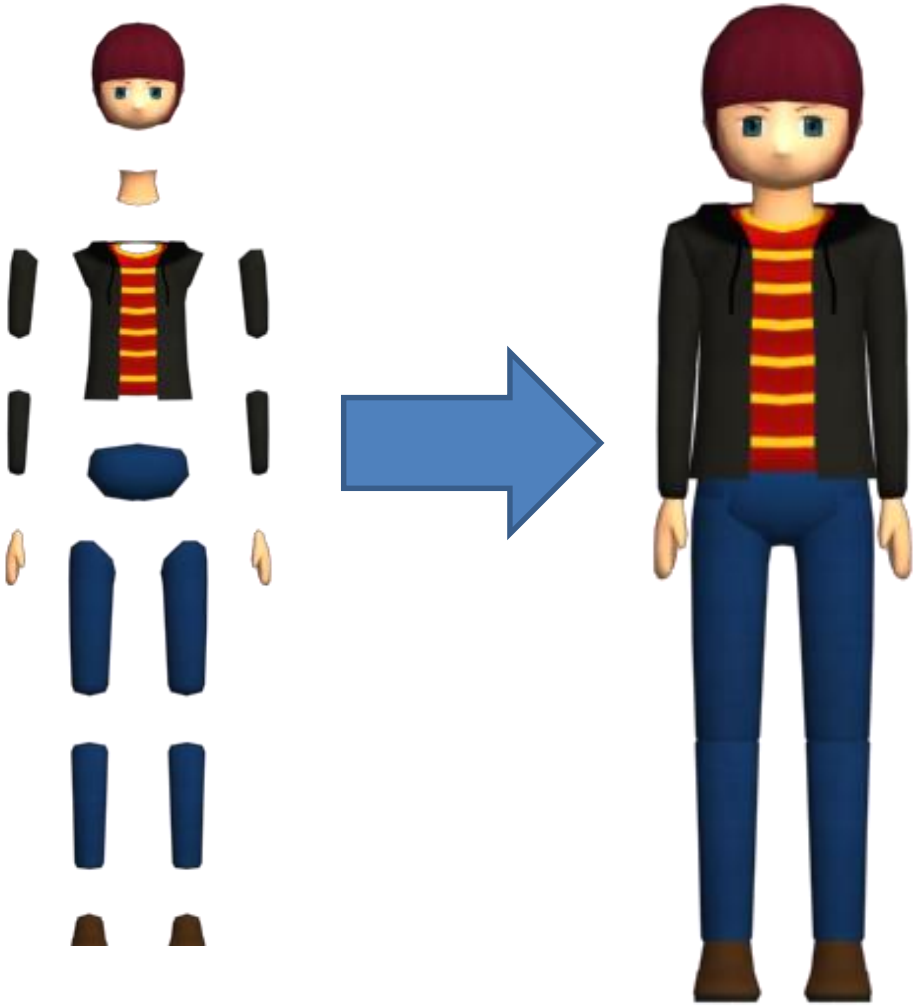
H-Anim Character Modeling Using a General Graphics Tool (2)

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



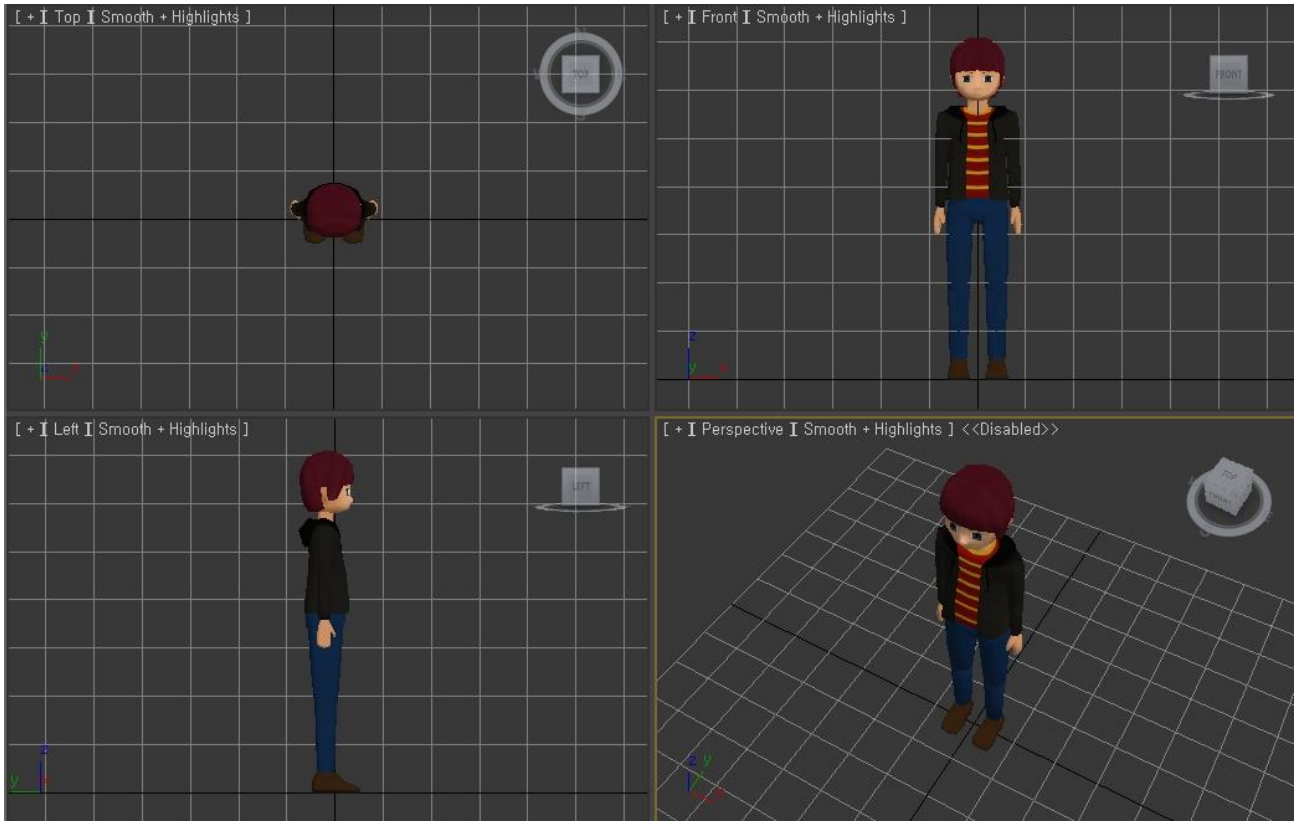
H-Anim Character Modeling Using a General Graphics Tool (3)

Integrate all the segments to form a complete character.



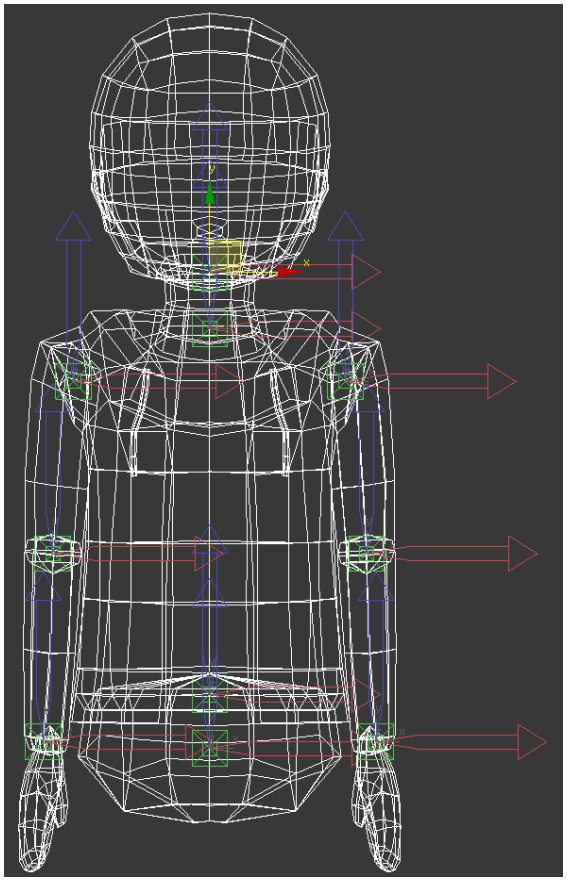
H-Anim Character Modeling Using a General Graphics Tool (4)

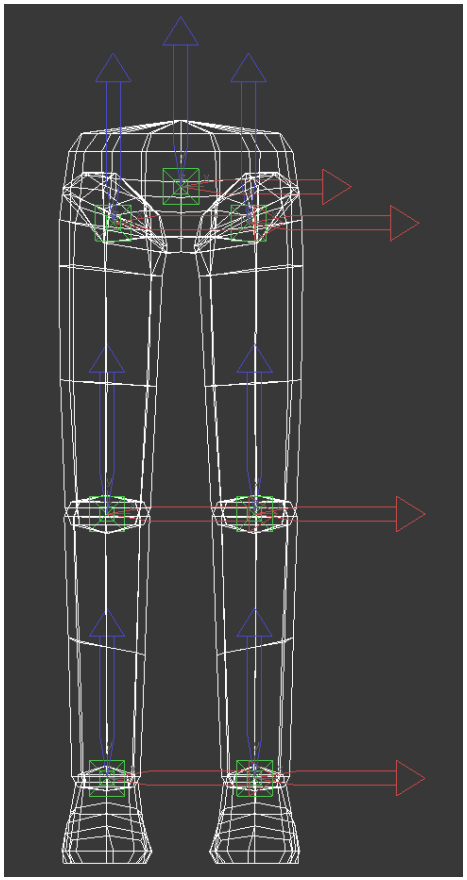
In the front view, the character is looking forward and the origin of the coordinate system is located between the two feet



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

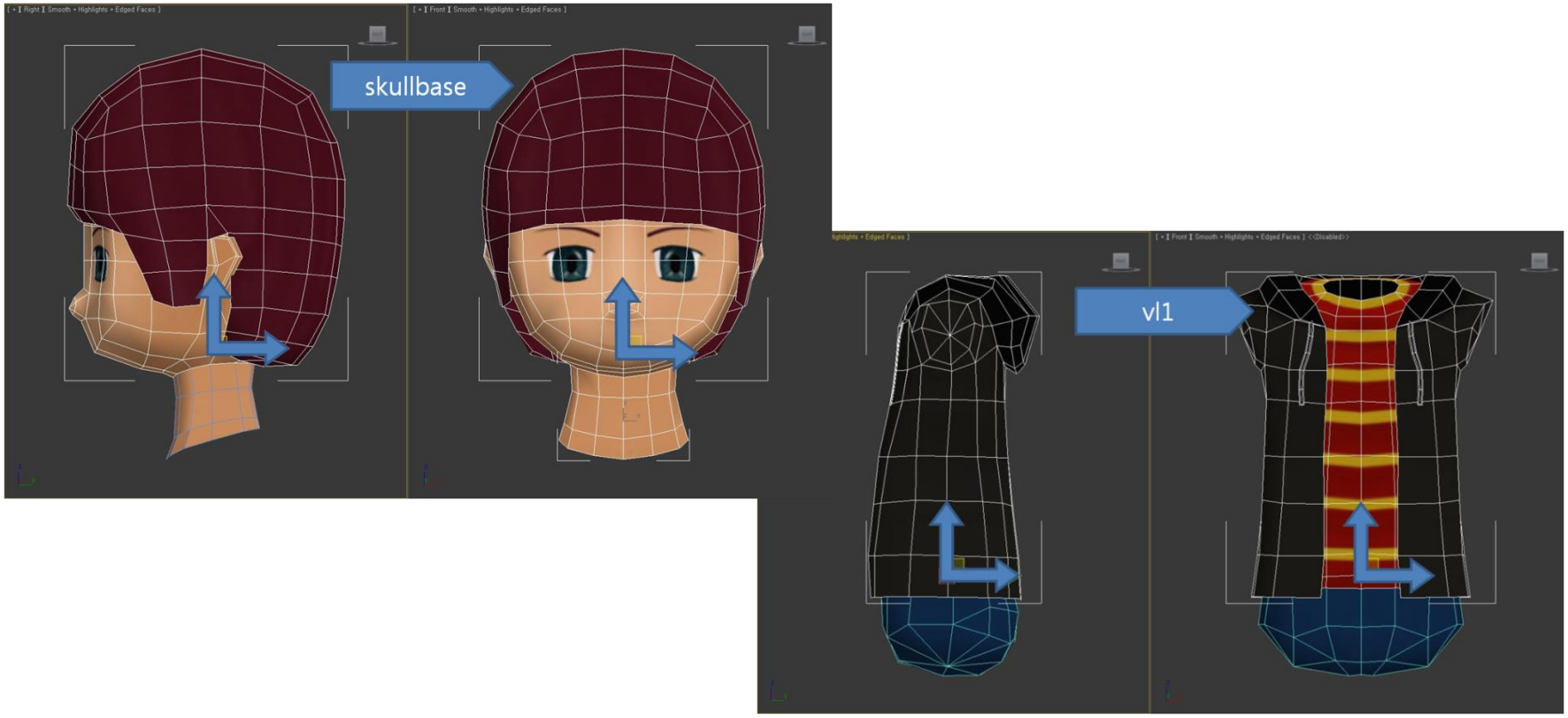
For each segment, a pivot point, which is initially located at the center of an object, must be moved to the H-Anim joint center. The pivot point becomes the center value for each H-Anim joint. In the figure, an arrow denotes each pivot point at a joint.





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

This figure shows the pivot points of the H-Anim skullbase and vl1 joints.

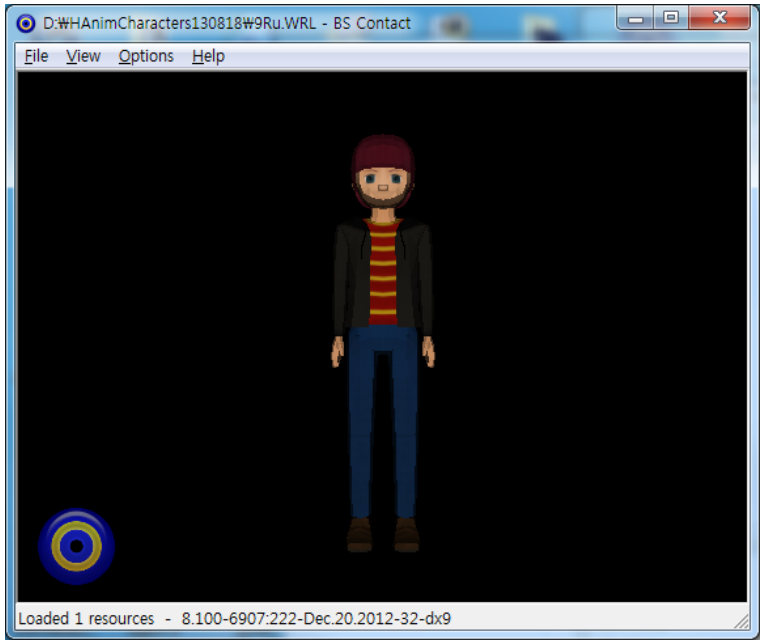


H-Anim Character Modeling Using a General Graphics Tool (7)

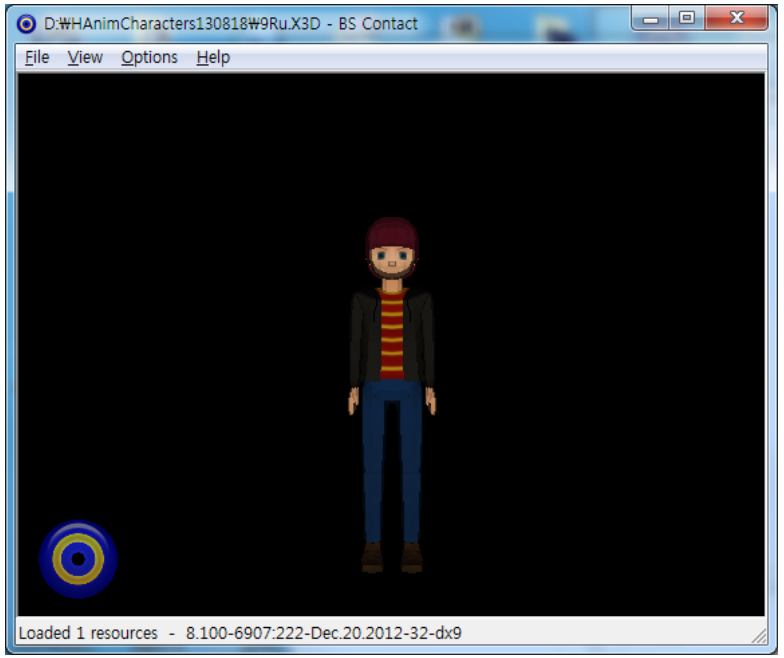
If necessary, the H-Anim figure can be scaled, at this stage considering real length. Otherwise, the real length of each segment can be taken into consideration at the beginning, when each segment is modelled, if exact length is required. In this example, the character was initially designed considering 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 (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

Design Guidelines Demo (Key Points)