H-Anim Facial Animation

SIGGRAPH Web3D Meeting

Los Angeles, CA, USA

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The face in H-Anim (4.9.4)

- There are seven “_joint”s rooted at skullbase
  - l_eyeball_joint and r_eyeball_joint: to change eye gaze
  - l_eyebrow_joint and r_eyebrow_joint
  - l_eyelid_joint and r_eyelid_joint: to open/close eyes
  - temporomandibular: to open/close mouth
- These represent the facial animation of a ventriloquist’s figure
  - Facial animation without expression
- Facial animation with expression
  - Implemented by Displacer objects for face vertices
    - Pointed out by Joe Williams in January
    - There may be a Displacer object for each facial expression
      (According to 4.7)
About facial expression

- Facial Action Coding System (FACS)
  - Emotion consists of action units (AUs)
    - Happiness = 6+12, Sadness = 1+4+15, e.g.
    - How many emotions?
      - <Plutchik’s wheel of emotion>, e.g.
    - How many AUs are defined in FACS?
      - 47 main codes, such as “inner brow raiser”, “lip stretcher”, etc.
- AU vs. Displacer
  - Each AU can be defined by a Displacer object, as in 6.6, such as
    ```
    Displacer {
      coordIndex [7, 12, 21, 18]
      displacements [0 0.0025 0, 0 0.005 0, 0 0.0025 0, 0 0.001 0]
      name "l_eyebrow_raiser_action"
    }
    ```
  - A collection of Displacer objects represents a facial expression
About facial expression

• Plutchik’s wheel of emotion
Conveying emotion to H-Anim

• For each emotion, we can define a set of Displacer objects and/or joint angles
  • Joy, e.g.
    • AU1: inner brow raiser
    • AU2: outer brow raiser
    • AU5: upper lid raiser
    • AU12: lip corner puller
    • AU20: lip stretcher
    • AU25: lip parter
    • AU26: jaw drop \(\leftarrow\) by temporomandibular joint angle
    • AU27: mouth stretcher
  • A Displacer object defines which vertices to move
  • An action unit defines which features to move (or morph)
Features in H-Anim

• Only eight facial features in H-Anim

• For all 47 main AUs, more features on a face are probably required

• MPEG4 FPs?
  • 38 facial feature points (FPs) affected by FAPs, excluding tongue and nose
Facial animation to H-Anim

• Facial vertex animation
  • Define the motion of selected vertices using Displacers
    • How many vertices to select?
  • Compute the motion of other vertices

23,728 vertices
Width: 163.035
Height: 214.229
Depth: 128.017
Facial animation to H-Anim

- Adequate to define several thousands of Displacers?
- Grouping vertices into a set of meaningful regions
  - Regions can be obtained from facial features, or we can define the regions as facial features
  - Define a few Displacer objects for each region
  - Parameterize the motion of region boundary from Displacers
    - From existing example animation
  - Reconstruct the position of other vertices from region boundary
Reference model and animation

afraid, angry, disgusted, laughing, sad, surprised, winkLeft, winkRight, lipsLeft, lipsRight

+66,000 vertices
Reference facial animation
Landmark animation
Feature points animation
Facial feature animation
Reconstructed facial animation

Ground truth  Reconstructed
Reconstructed animation
Face regions: trying various configurations

- 165 regions (including 45 landmark positions)
Facial region and landmark representation
Facial regions
Facial regions and meshes
Human Surface Anatomy Labeling System
http://www.anatomymapper.com/#
Facial landmark names: LOE1 (Level of Expression)

<table>
<thead>
<tr>
<th>Right face</th>
<th>Middle face</th>
<th>Left face</th>
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<tbody>
<tr>
<td>Right forehead(1)</td>
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Reference for facial landmark names: http://www.anatomymapper.com/#
Facial landmark names: LOE2

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Reference for facial landmark names:
http://www.anatomymapper.com/#

July 31, 2017
Facial landmark names:
LOE3

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Work in progress (1)

• Facial region LOE (Level of Expression)
  • 122 regions and landmarks → LOE 3
  • 70 regions and landmarks → LOE 2
    • Expression with eye, nose, and mouse
  • 43 regions and landmarks → LOE 1
    • Expression with eye, nose, mouse, cheek, and jaw

• H-Anim representation
  • Specify facial regions
    • LOE 1, LOE 2, LOE 3
  • Specify facial landmarks
  • Specify Skin coordinates for facial regions
  • Determine if Displacer nodes are necessary
Work in progress (2)

• Face and head modelling with LOE
  • Combine face and head in 3D
  • Define all regions for a head
Work in progress (3)

- Region based facial animation
  - LOE3 Facial animation using X3D interpolators
LOE3 Facial Animation using X3D Interpolators
LOE3 Facial Animation using X3D Interpolators
Discussion

• Problems when adding facial models to LOA3 facial joint based modeling
  • Face does not have joints as determined by the medical profession
  • LOA3 defines 7 joints for face

• Suggestion
  • Location of facial models
    • Add the facial region based model to the LOA Skull joint
  • Face region definition
    <Scene>
    <HAnimFace>
      <HAnimFaceRegion DEF='hanim_right_forehead' name='right_forehead' marker = '0 0 0'>
      ...
    </HAnimFace>
    <HAnimJoint>
      <HAnimSegment>
      ...
    </HAnimSegment>
    ...
Work in progress

• WD text preparation
• Development of LOE 1, 2, and 3 facial models
• H-Anim facial expression using LOE 1, 2, and 3 models
  • Define animation interfaces for generating facial expression