Motion Doodles : An Interface for Sketching Character Motion

Matthew Thorne , David Burke , Michiel van de Panne
Overview
Outline

• Introduction
• Contributions
• Algorithm
  – Character Sketching
  – Motion Sketching
• Conclusion
Introduction

• Interactive animation system
• Draw simple character
  – Body, head, arms, legs, feet
• Easy “draw” motion
• Gestures are highly visual in nature
Contribution

• Design a set of continuous gestures for sketching
  – Motions, locations, timing
  – Put onto variety of display device

• Easy to sketch a 2D character and then draw a variety of animated motion
Algorithm – Character Sketching

• Assumptions
  – Draw side view
  – 7 links: head, torso, upper arm, lower arm, upper leg, lower leg, foot
  – Each link is one continuous stroke
  – Draw links in any order, links can intersect
  – Surface detail: thumb, pot-belly, nose
7 sketched links

- Compute major and minor axes
- OBB (Oriented bounding box)
- Compute joint location
- Compute skeleton
Constraints make it simpler:
-- Individual links known to be a link
-- Connectivity of the links is known in advance

1. Wait for seven links to be sketched
2. Fit oriented bounding boxes to all links
3. For each link $i$
4. For each major-axis end-point on link $i$, $P_i^1$ and $P_i^2$:
5. Search all links $j \neq i$, for the closest point, $P_j$
6. If links $i$ and $j$ are not aligned
7. create joint $J_n$ at intersection of major axes of $i$ and $j$
8. else
9. create joint $J_n$ at midpoint of $P_i P_j$
10. Identify and remove all duplicate joints
11. Identify links based on connectivity
12. Create duplicate arm and leg segments.

fail => report to user

如果兩個major axes 在20度之內 => 接近平行

Torso 有三個 joint, head 只有一個 joint 且連結在torso上。
D : original drawing

S : inferred joints and the fitted skeleton

R : reference pose (initial at animation start) => all bones vertical, feet horizontal

Fail :
1. arm downwards parallel to the torso
2. hands are located close to the head, knees, or feet

Currently, user cannot refine the skeletons
A : annotations

P : an animated pose

Decorate character : eyes, ears, hands, hair, a hat, a nose, shoes

Limitation : cannot cross multiple links
Motion Sketching

• Motion sketch needs:
  – Type of Motion
  – Spatial location of Motion
  – Extent of Motion
  – Timing of Motion

• Cursive gesture
Gesture vocabulary design principles

1. Gesture should be cursive => smoothly flow
2. Limited number easy-to-draw gestures
3. Reminiscent, can extend
4. Allow forwards or backwards
5. Similar motion ⇔ similar gesture
6. Allow for the generation of stylistic variations
Sketch Segmentation

• 3 stages
  1. Tokenization stage
     – Produce a corresponding list of token
  2. Parsing stage
     – Identify the set of admissible gestures
  3. Identification stage
     – Identify the specific motions to be generated
Use six token

Tokenization stage
input: time-stamped points

Segmentation on vertical direction (mark at the point of direction changed)

Corner detection

Refine the corner
Specify either straight or curve (line : segment ratio r<1.2)
Merge colinear segments

Identify pauses (add point)

Token assignment
straight(<30 degree) => g, h
straight(>30 degree) => e, f
curve => a, b
example
token
labeling

Parsing stage

Regular Expression !

gesture
identification

ARC
aa, af, ag,
ag, ca, ga

UP LOOP
bb, gb, fb,
ec, bg, bf,
be

DOWN LOOP
b(bb)*b
cf, eg, ee,
gf, gg, gf,
ff, fe, fg

SPIKE
(f|e|g|a|b)hh
e, f, g, h

HAT

LINE
(f|g|e|a|b)
Unique interpretation =>

walk

h > h_{walk}

jump

walk on one leg

walk tip-toe

walk stomp

頂端傾斜的程度

左傾

右傾
Step $< d_{\text{maxstep}}$

Step $> d_{\text{maxstep}}$

Pen remains stationary for more 0.5s $\Rightarrow$ standing posture

Walk before jump $\Rightarrow$ leap
Output Motion Synthesis

• More information
  – Duration, height, rotation

• Parameterized keyframe-based motion synthesis
  – Keyframe database
  – Keyframe interpolator (Catmull-Rom)
  – Inverse-kinematics solver
  – A means to position the center-of-mass at a specify point
keyframe

- Anticipate
- Launch
- Ascent
- Followthrough
- Landing
- Descent

Timing between states:
- Anticipate to Launch
- Launch to Ascent
- Followthrough to Landing
- Landing to Ascent
- Ascent to Descent
- Descent to Ground Contact
Sketching in 3D environments

• Set camera such that it covers the desired workspace
• 3D character modelled in advance
• Find start and end points of each gesture
  – Find the vertical plane embeds the 3D start and end points, process like in 2D
  – Using vertical direction, corner metric
• Limitations
Limitations

• Motions directly towards camera or away
• Ambiguity of gestures
  – In-place stomps v.s. slides
• Direction
  – Forward or backward
Conclusion

• Highly-accessible means for users to create a certain class of character animations
• User rapidly learned the gesture vocabulary and enjoy it
• Add a new motion => create a new gesture that can be identified