Fundamentals and Applications of Sketch Processing

Setups & Motivations

Misha & Chenxi
Creation Process

Tracking Samples → 2D Sketches → 3D Sketches → Stroke Construction & Drawing Interface
Digital Drawing Devices

2D Drawing Tablets

- Sutherland’s Sketchpad (1963)
- Various drawing tablets (photo taken in 2012)
- Pen and touch display (photo taken in 2019)

3D Drawing Systems

- HTC Vive Pro 2 (2021)
- Sutherland’s HMD (1968)
- Apple Vision Pro (2024)
Tracking Samples

2D sample sequence
- (x, y)
- Timestamp
- Pressure
- Tilt

3D sample sequence
- (x, y, z)
- Timestamp
- Orientation
Stroke Representations

2D stroke representations
- Polylines
- Parametric curves
- Splines
- etc.

3D stroke representations
- Tubes
- Calligraphic curves (ribbons)
- etc.
Tracking Samples → 2D Sketches → Raster Samples → Vectorization

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https://www.youtube.com/watch?v=t54FRtdmDC8
Non-Sequential 2D Samples: Pixels

Digital drawings

Digital scans

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Non-Sequential 2D Samples: Pixels

Digital drawings

Digital scans

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Raster Sketch Cleanup

Raster rough sketch

Raster clean sketch

Good for preprocessing
Sketch Vectorization

Raster sketch ➔ Vector sketch
Sketch Vectorization

[Li et al. 2020], DiffSVG
Sketch Vectorization

Clean sketch

Overdrawn sketch
Tracking Samples

Raster Samples

Creation Process

2D Sketches

Sketch Cleanup & Flat Colorization
Typical Sketches
Typical Sketches
Sketch Topology: Cleanup/Simplification/Consolidation

Chenxi Liu

© NARI ANIMATION.
https://www.youtube.com/watch?v=KxUBFAuE3aU
Typical Sketches
Sketch Topology: Flat Colorization/Junction Reconstruction

Chenxi Liu

© BaM Animation
https://www.youtube.com/watch?v=MKtcsFSiUF0
Projection Ambiguity in Single Sketch

[Lifting]

[Sinha et al. 1993]
Projection Ambiguity in Single Sketch

[Sinha et al. 1993]
Projection Ambiguity in Single Sketch

Lifting

ill-conditioned

[Sinha et al. 1993]
Creation Process

Tracking Samples -> 2D Sketches -> Raster Samples -> 3D Sketches

Models & Animations

Sketch Surfacing

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3D Sketches

Samples
- No connectivity
- Inconsistently oriented normals

Ribbons
- With connectivity
- Inconsistently oriented normals
- Hidden parts

Tubes
- With connectivity
- No normals
- Can be lifted sketches
3D Sketches

Samples
- No connectivity
- Inconsistently oriented normals

Ribbons
- With connectivity
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Tubes
- With connectivity
- No normals
- Can be lifted sketches
Creation Process

Tracking Samples → 2D Sketches → Models & Animations

Sketch-Based Modeling & Animation
3D Modeling and Animation is Time-Consuming

- **Cartoony Building**
  - Modeling: 10 Days
  - Texture, UV map: 4 Days
  - Lighting, Shading: 2 Days

- **Stylized Character**
  - Modeling: 10 Days
  - Sculpting: 6 Days
  - Texture, UV map: 3 Days
  - Lighting, Shading: 1 Day

- **Realistic Character**
  - Modeling: 14 Days
  - Sculpting: 9 Days
  - Texture, UV map: 4 Days
  - Lighting, Shading: 2 Days

https://pixune.com/blog/how-long-does-it-take-to-create-a-3d-model/

https://madebythings.com/the-anatomy-of-an-animation-project/
3D Modeling and Animation are Time-Consuming

Sketch-Based Approaches
- Intuitive and expressive
- Novice friendly
- Easy to communicate
Creation Process

2D Sketches

3D Sketches

Tracking Samples

Raster Samples

Models & Animations

Sketch-Related Vision Tasks

Data for Learning