Sketch Based Modeling: A survey

Luke Olsen, Faramarz F. Samavati, Mario Costa Sousa, Joaquim A.

Present by
Amir Badamchi
Multimedia Systems
Amirkabir University of Technology
Contents

• Introduction
• Pipeline
• Applications
Introduction

• SBIM

– Developing methods and techniques to enable users to interact with a computer through sketching
Introduction

• SBIM pipeline
Challenging!

- Ambiguous interpretation
Introduction

• **Reconstruction** is the task of creating a complete description of the 3D geometry of an object based on a 2D representation.

• **Recognition** identifying which class of object an image represents based on shape memory.

• If visual memory can recognize a shape, we can more easily reconstruct it.
Symmetry

- Real
- Skewed
- Generalized
Visual rules

• Some visual rules:
  – Interpret straight lines as straight lines in 3D.
  – Interpret coincident lines as coincident in 3D.
  – Interpret collinear lines as collinear in 3D.
Acquisition

Sketch Based Interface Modeling - Amir Badamchi
Acquisition

Sketch Based Interface Modeling - Amir Badamchi
Sketch Filtering

- Input
- Filter
- Interpret
Sketch Filtering

- User and Device Error
  - Poor skills
  - Digitization Noise
    - Spatial & Temporal quantization
Sketch Filtering

- Resampling can be done on-the-fly by discarding any sample within a threshold distance of earlier samples, and by interpolating between samples separated by more than a threshold.
Sketch Filtering

- Smoothing
  - Local Average Filtering
  - Gaussian Filtering
Sketch Filtering

- Fitting

Resampled input  Polyline approximation  Fit-to-curve  Segmented
Sketch Filtering

• Beautification
Sketch Filtering

• Oversketching
Sketch interpretation

Input → Filter → Interpret
Sketch interpretation

Sketch Based Interface Modeling - Amir Badamchi
Sketch interpretation

• What has the user intended to draw?
• Is the input valid and consistent?
• How can the sketch be mapped to a modeling operation?
Sketch interpretation

• Create fully 3D models automatically from input sketches
• Using input strokes to augment existing models with details
• Deform an existing model
Sketch interpretation

• Model Creation
  – Evocative Systems
    • Sketches compared to template objects
    • Related to visual memory
  – Constructive Systems
    • Sketches used to create freeform object
    • Related to visual rules
Sketch interpretation

• **Evocative Systems**
  1. Extrapolation
  2. Template retrieval
Sketch interpretation

• Evocative Systems
  1. Extrapolation
Sketch interpretation

• Evocative Systems
  1. Extrapolation
  2. Template retrieval
Constructive Systems

Pure reconstruction is a more difficult task than recognize-then-reconstruct, because the latter uses predefined knowledge to define the 3D geometry of a sketch, thereby skirting the ambiguity problem to some extent (ambiguity still exists in the recognition stage).
Constructive Systems

• Rules rather than templates
• 3 main approaches
  1. Mechanical design
  2. Smooth contours
Constructive Systems

• Mechanical objects
  – Computer-Aided Design (CAD)
  – Design of mechanical (mostly planar) objects
  – Precise, perfect surfaces
Constructive Systems

• Engineering design systems
  – Line Labeling
    • For line drawing construction
    • Classify line segment to concave, convex, contour edges
    • Problem
      – Identifying location of vertices, corners and edges.
Contour lines

- Silhouette: separate object from background
- Contour: separate visible from invisible
Why contour lines?

- Found to be meaningful shape indicators
  - Visual rules guide us to see smooth strokes as 3D contours
- Sparse
- Easy to draw for non-artists
Augmentation

- Adding details or features to an existing object
  1. Additive
  2. Surficial
Augmentation

• Additive
  – Only affects the original model near connection point
  – Large-scale addition to existing object
  – Often called extrusion
  – Possibly topology-changing
Augmentation

• Surficial
  – Without changing the underlying surface
  – Displace surface to make features
  – Sketch directly on surface
  – Surface provides 3D reference
Deformation

- Bending
- Twisting
- Free-form deformation (FFD)
- Cutting, tunneling
- Contour oversketching
Applications

• **Computer Aided Design (CAD)**
  – Modeling 3D objects to physical appearance
  – GIDeS, CEGROSS

• **Content Creation**
  – Modeling 3D objects from existing
  – Games, Animation
Applications

• Computer Aided Design (CAD)
  – Modeling 3D objects to physical appearance
  – GIDeS, CEGROSS
Applications

- Computer Aided Design (CAD)
- Content Creation
  - Modeling 3D objects from existing
  - Games, Animation