ユーザインタフェース

～Sketching Interfaces for Computer Graphics～

- 五十嵐 健夫

Schedule

- 6/6　Design and Evaluation
- 6/13　Information Visualization
- 6/20　Sketching Interfaces for Graphics, 課題出題
- 6/27　End User Programming /
- 　　　Multimodal Interaction
- 7/4　Programming Environments
- 7/11 Human-Robot Interaction,　課題〆切 (24:00)
- 7/18 課題講評

前回の内容

情報視覚化（Information Visualization）
情報検索

- Information Visualizer (Xerox PARC)
- Focus + Context, FishEye
- Zooming UI
- HCIL (Shneiderman)
- Tool Glass and Magic Lenses

今回の内容

Sketching Interfaces for Graphics

- Modeling
- Deformation
- Animation
- Applications

Sketch-Based Interfaces for Interactive Computer Graphics

- Takeo Igarashi
- The University of Tokyo

Outline

- Introduction
- Application Systems (demo and videos)
  - 2D Drawing
  - Shape Modeling
  - Animation Control
  - Special Purpose Editors
- Summary

Introduction

Motivation

- Traditional graphics tools are too complicated.
  - Only accessible for experts
  - Usable only after initial design is complete

Basic Idea

- Sketching can simplify the process.
  - Accessible for novices
 - Useful for initial design process (quick & simple)

Key Issues

- Sketch is simple = provides limited information
- Key issue in designing sketching systems is "How to infer missing information (e.g. depth)"

Key Issues

- Sketch is simple = provides limited information
- Key issue in designing sketching systems is "How to infer missing information (e.g. depth)"

- Algorithm: using domain knowledge
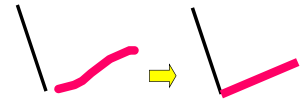- Interface: disambiguation

Outline

- Introduction
- Application Systems (demo and videos)
  - 2D Drawing
  - Shape Modeling
  - Animation Control
  - Special Purpose Editors
- Discussion

2D Drawing

Interactive Beautification   [Igarashi 97]
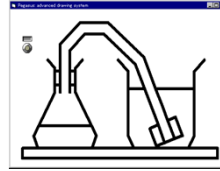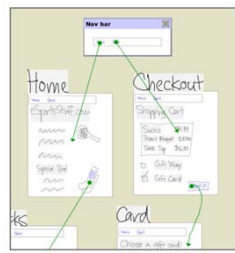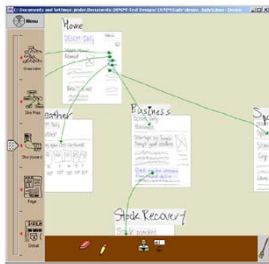
Example   Beautification

- Beautification and prediction in drawing
- Disambiguation by showing multiple candidates
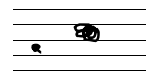
Denim

[Berkley, Lin 2003]

- Web site design
- 手書きのページをブラウジングできる。

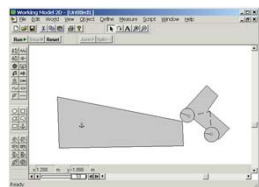E:¥movies¥sketch¥denim_talk.rm

Music Notepad (Brown Univ.)

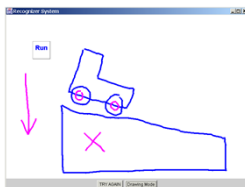- Music score editing based on gestures

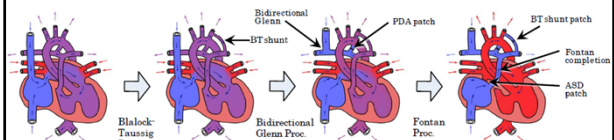E:¥movies¥sketch¥musicnotepad.mpg

ASSIST

(MIT Media Lab.)

絵を描くと、物理シミュレーションが走る。

E:¥movies¥sketch¥assist.wmv

Sketch-based Procedural Illustration of Fluid Systems

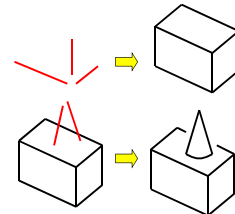B. Zhu, N. Umetani, T. Igarashi,
M. Iwata, R. Haraguchi, K. Nakazawa

Describe complicated flow using fluid simulation.
Mainly designed for infant heart disease.
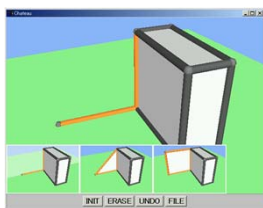
fluid

Shape Modeling

SKETCH
[Zeleznik 96]

- 3D scene construction using gestures.
- "Every object is on top of another object"

Suggestive Interfaces
[Igarashi 01]

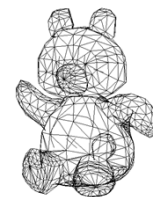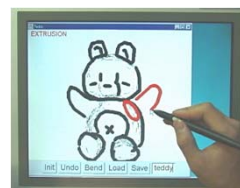

- User provides hints, system shows suggestions
- Disambiguation by showing multiple candidates

Teddy
[Igarashi 99]
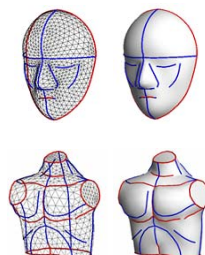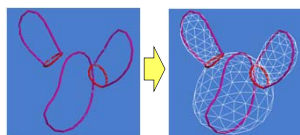

- Freeform models from sketching.
- "Sketches represent some rotund shapes"

FiberMesh
[Nealen et. al. 07]

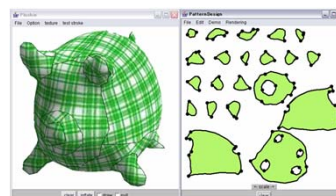- The sketch stays on the surface as control curves.
- The surface is computed via optimization.

Plushie
[Mori and Igarashi 07]

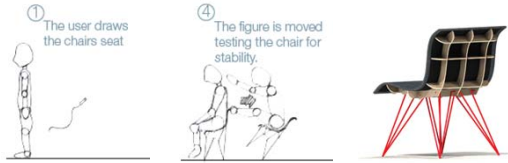- Sketch -> 2D Pattern -> Simulation.
- The user can create physical plush toy.

4

SketchChair

With Greg Saul

- The user draws the outline.
- The system analyzes ergonomics and structure.
- The user constructs the real chair.

chair.mov chair

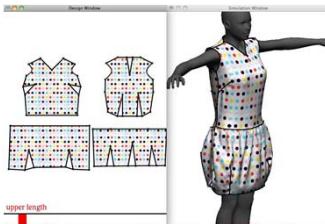## Metallophone Design with FEM

With N. Umetani, K. Takayama, J. Mitani

- The user designs a metallophone
- The system computes the tone in real time.

delfem

Garment Design with Real-time Cloth Simulation

with N. Umetani, E. Grinspun

- 3D simulation results changes as the user edits the 2D pattern.

cloth

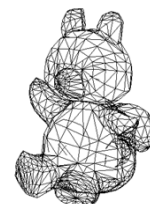# Deformation Techniques

Problem

- How to deform a 3D model by 2D sketching?
  – Sketching skeleton
  – Sketching silhouette

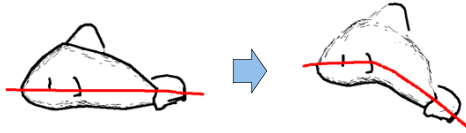## Sketching reference and target (Teddy)

test.html

[Igarashi 99]

T. Igarashi, S. Matsuoka, H. Tanaka, "Teddy: A Sketching Interface for 3D Freeform Design" SIGGRAPH 1999.

Sketching reference and target (Teddy)
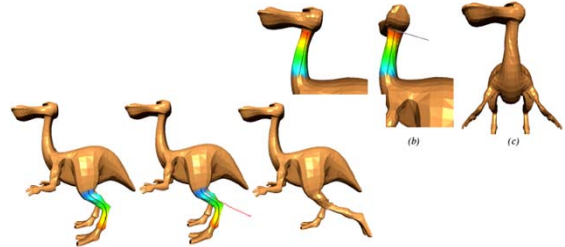
[Igarashi 99]

Original Vertex : Reference stroke.
= Resulting Vertex : Target stroke.

- It moves vertices in 2D using the algorithm used in 2D morphing [Beier and Neely 92]
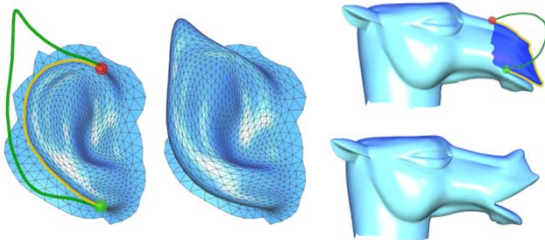
Sketching Skeleton

[Kho 05]

Y. Kho and M. Garland. Sketching mesh deformations.
Interactive 3D Graphics 2005
E:¥movies¥sketchmodeling¥sketching_mesh_deformations.mov

E:¥movies¥sketchmodeling¥sbime.avi
E:¥movies¥sketchmodeling¥silsketch.avi

Silhouette Sketching

[Nealen 05]

A. Nealen, O. Sorkine, M. Alexa and D. Cohen-Or, "A Sketch-Based Interface for Detail-Preserving Mesh Editing", SIGGRAPH 05

RigMesh

rigmesh

[Nealen 05]
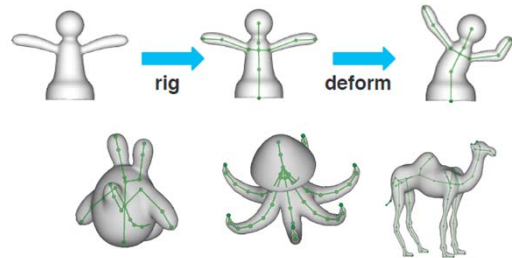
RigMesh: Automatic Rigging for Part-Based Shape Modeling and Deformation
Peter Borosan, Ming Jin, Doug DeCarlo, Yotam Gingold, Andrew Nealen

---

Animation

Articulated Animations

E:¥movies¥sketchmodeling¥Davis03.avi

[Davis 2003]

- The user sketches stick figures.
- Depth disambiguation by selection

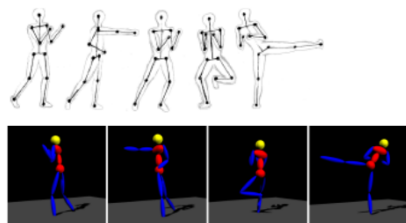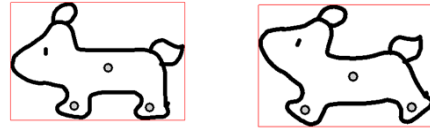## Motion Doodles [Thorne 04]

- The user sketches a desired trajectory.
- "A character walks, runs, or jumps"

Animations by Performance [Igarashi 05]

- Record the user's operation as an animation.
- Use As-rigid-as-possible deformation.

Animations by Performance [Igarashi 05]
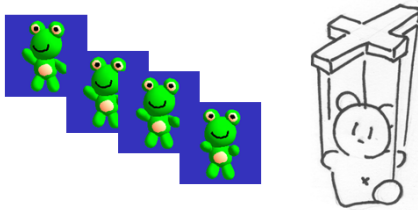
- The user directly performs a motion.
- Blending pre-defined poses

Retrieval and Visualization of Human Motion Data via Stick Figures

Myung Geol Choi, Kyungyong Yang, Takeo Igarashi, Jun Mitani, and Jehee Lee

Special Purpose Editors

Trees Modeling [Okabe 2003]

- The user sketches branches and leaves
- "A tree spreads branches to all directions"

Flower Modeling

[Ijiri 2005]
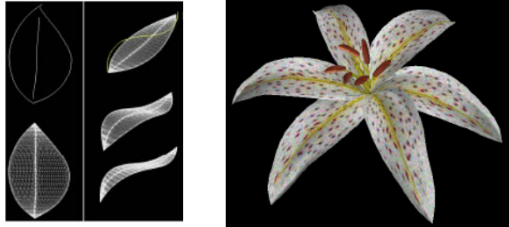
- The user sketches stems, petals, etc.
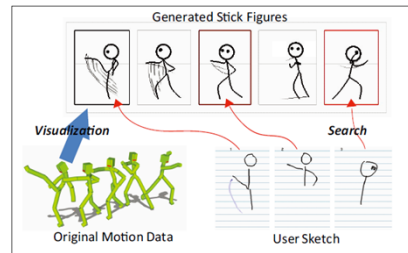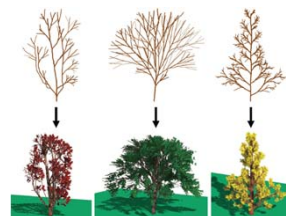- The system provides separate UI for each component.

Garment Design

[Turquin 04]
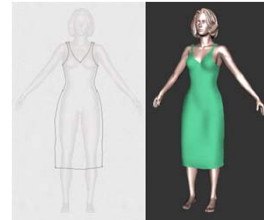
- The user sketches the outline of a garment
- "The garment covers the body surface"

Clothing Manipulation

[Igarashi 03]

- The user sketches marks on the body and clothing
- "The clothing covers the body surface"

Sketching in 3D

3-Draw [Saches 91]

Freeform

[SensAble Tech.]

力学フィードバック付３次元入力デバイスでモデリング

SurfaceDrawing

[Schkolne 2000]

..schkolne.mov

CavePainting

[Keefe 2001]

bucket.avi

..grapes.avi

Sketch Furniture

[FRONT]

sketchfurniture

Situated Modeling: A Shape Stamping Interface with Tangible Primitives

TEI 2011

with M. Lau, M. Hirose, A. Ohgawara, J. Mitani
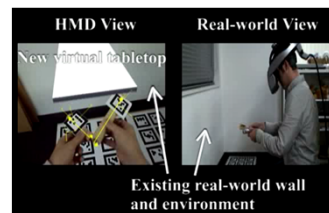
円柱や板の木片をスタンプとして使って家具をモデリングする
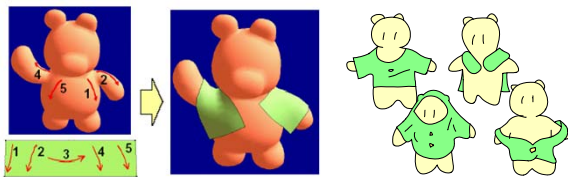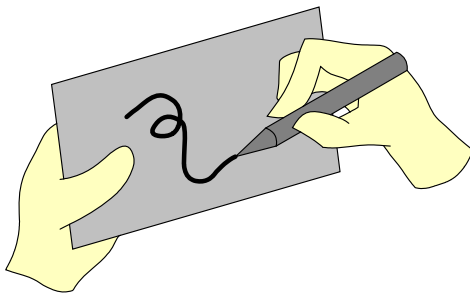
video

DressUp: A 3D Interface for Clothing Design with a Physical Mannequin

TEI 2011

with A Wibowo, D Sakamoto, J Mitani, T Igarashi

実物のマネキンと3次元トラッキング
を利用して服をモデリングする

video

Summary

- Sketching can simplify interfaces.
  - "Accessible tool for novice users"
  - "Quick exploration of various ideas"
- It requires careful consideration.
  - Infer missing information using domain knowledge
  - Provide a disambiguation interface

References

[Igarashi 97] T. Igarashi, S. Matsuoka, S. Kawachiya, H. Tanaka "Interactive Beautification: A Technique for Rapid Geometric Design", UIST '97.

[Zeleznik 96] R.C. Zeleznik, K.P. Herndon, J.F. Hughes. "SKETCH: An interface for sketching 3D scenes" SIGGRAPH '96.

[Igarashi 01] T. Igarashi, J.F. Hughes, "A Suggestive Interface for 3D Drawing", UIST'01.

[Igarashi 99] T. Igarashi, S. Matsuoka, H. Tanaka, "Teddy: A Sketching Interface for 3D Freeform Design" SIGGRAPH '99.

[Owada 03] S. Owada, F. Nielsen, K. Nakazawa, T. Igarashi, "A Sketching Interface for Modeling the Internal Structures of 3D Shapes",Smart Graphics 2003.

[Igarashi 03] T. Igarashi, J.F. Hughes, "Smooth Meshes for Sketch-based Freeform Modeling", I3DG'03.

[Schmidt 05] Schmidt, R., Wyvill, B., Sousa, M.C., Jorge, J.A. "ShapeShop: Sketch-Based Solid Modeling with BlobTrees" Eurographics Workshop on Sketch-Based Interfaces and Modeling 2005.

[Davis 03] J. Davis, M. Agrawala, E. Chuang, Z. Popovic, D. Salesin, "A Sketching Interface for Articulated Figure Animation" SCA 2003.

[Thorne 04] M. Thorne, D. Burke, M. Panne, Motion doodles: an interface for sketching character motion, SIGGRAPH 2004.

[Igarashi 05] T. Igarashi, T. Moscovich, J.F. Hughes, "Spatial Keyframing for Performance-driven Animation", SCA 2005

[Okabe 05] M. Okabe, S. Owada, T. Igarashi, "Interactive Design of Botanical Trees Using Freehand Sketches and Example-based Editing", Eurographics 2005.

[Ijiri 05] T. Ijiri, M. Okabe, S. Owada, T. Igarashi, "Floral diagrams and inflorescences: Interactive flower modeling using botanical structural constraints" SIGGRAPH 2005.

[Turquin 04] E. Turquin, M-P. Cani, J.F Hughes, "Sketching garments for virtual characters", Eurographics Workshop on Sketch-Based Interfaces and Modeling 2004.

[Igarashi 02] T. Igarashi, J.F. Hughes, "Clothing Manipulation", UIST'02.