Modeling by Drawing with Shadow Guidance

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3D Modeling

- Fundamental problem
- Many professional modeling systems
- Requiring skills and costing time
- **Too difficult for non-professional users!**
3D Modeling

- Easy-to-use systems

Drawing sketch is a very natural way to express oneself.
Sketch-based Modeling Systems

[Igarashi et al. 1999]

[Rivers et al. 2010]

[Karpenko et al. 2006]

Not easy to draw!
Example-based Modeling System

[Funkhouser et al. 2004]  [Chaudhuri et al. 2011]

[Jain et al. 2012]
Hybrid Systems

Sketch2Scene [Xu et al. 2013]

Sketch-to-Design [Xie et al. 2013]
Guidance

Helpful!
Shadow Guidance

ShadowDraw [Lee et al. 2011]
Shadow Guidance

User study drawings

ShadowDraw [Lee et al. 2011]
Goal: Guided Sketch-based System

• Creating an easy-to-use system.

• Providing guidance.

• Allowing creative variations
Our System
System Pipeline

Database Construction

View-dependent retrieval

Shadow composition

Creative variation

Part conjoining

Online operations

Final model
System Pipeline

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View-dependent retrieval

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Final model

Creative variation

Part conjoining
Database Constructions

• Database
  – Part repository
  – Image repository
Part Repository

Model Categories
Part Repository

• High-level Information
  – Hierarchy information
  – Contact points
  – Symmetry information
Image Repository

- Sample 114 views on the unit view sphere
- Assign camera up-direction for each view position
- Extract line drawing image at each view
Search Engine

• Search engine is based on encoding the patches of all the images in the repository.
• Descriptor: BiCE [Zimmermann et al. 2007]
• Min-hash [Chum 2008]
System Pipeline

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Online Operation
Online Operation
View-dependent Retrieval

Up-direction Alignment

3d voting histogram

retrieved parts
Shadow Composition

• Shadow image \( S^* = W_i \tilde{I}_i \)

• Hierarchy-based shadow image

\[
S^* = \alpha \sum_{i=1}^{N} W_i \tilde{I}_i + S_{sym}^* + S_{adj}^*
\]

- retrieved parts
Shadow Composition
Part Conjoining

- Contact point guided conjoining
- Symmetry information
Creative Modeling

• Global fitting
  – The silhouette of the top candidate is fitted to the drawing strokes.

• Local editing
  – Sketch based local deforming.
RESULTS
Results

Speed: 200%
Results
Results

Bicycle models created by users using our system.
User Study

- Modeling with/without shadow guidance.
Limitation

• Limited variations of the model.

• Part placement.

• Inconsistent segmentation.
Summary

• A sketch-based modeling system
  – provides shadow suggestions to guide the user’s drawing dynamically
  – preserves the high-level geometry structure
  – provides geometric variations

3D models created by users using our system
Thank you for your attention!

Project page:
http://staff.ustc.edu.cn/~lglu/Projects/2013_3DShadowModeling/default.htm

3D models created by users using our system