3D Object Recognition and 2-Simplex Meshes

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Overview

- Some popular 3D object recognition techniques
  - Appearance-based matching
  - Feature matching
  - Regular mesh tessellation
- 2-Simplex Meshes
- Spherical Attribute Images
- For further reading
Popular Recognition Techniques:
Appearance-Based Matching

Basic steps
1. Sample a view-sphere
2. Record feature measurements as observable from a camera at each view-sphere sample point (create templates)
3. Compare observed data with each template from each model
4. Choose the model and orientation that provides the best match

Requires sufficiently fine sampling of the view sphere
Popular Recognition Techniques:

Feature Matching

- Ravi’s work, Rick’s local features
- Basic steps
  1. Find features invariant to rotation and translation
  2. Build an attributed graph
     - Nodes: features
     - Arcs: spatial arrangement
  3. Choose the model whose graph is most similar
Popular Recognition Techniques:

**Regular Mesh Tessellation**

- “Regularly” sample the mesh
  - Square grid
  - Triangularization
  - 2-Simplex
- Measure feature values at mesh vertices
- Vertex-by-vertex comparison

Image from [3]
2-Simplex Meshes

- Dual of triangularization
  - Triangle face $\rightarrow$ simplex vertex

- Triangle vertex $\rightarrow$ simplex face
2-Simplex Meshes:

Two Examples
2-Simplex Meshes:

Topological & Geometric Modifications

Edge Swap

Edge Removal
2-Simplex Meshes:

Edge Removal Example
Spherical Attribute Images

2D Contour
1-Simplex Mesh

SAI: Point size $\propto$
vertex curvature
Spherical Attribute Images:

2D SAI Examples
Spherical Attribute Images:
Recognition

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3D Vehicle Recognition
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Further Reading


   - Extended Gaussian Image (EGI) and its variants
   - Spherical Attribute Image (SAI)

   - Mathematics of simplex meshes
   - Regularization and optimization of 2-simplex meshes