Virtual Reality in Architecture

Jiri Vondra
vondra@matfyz.cz
Faculty of Mathematics and Physics
Charles University, Prague

Motivation

- Guide through the city
- Gallery visiting
- Projected building walkthroughs

Specific features

- Lot of objects in the model
- Small number of visible objects
- Extensive use of textures

Urban LOD

- Farer objects require lower LOD
  - Outlined
  - Outlined with small textures
  - Full textured face

Approach

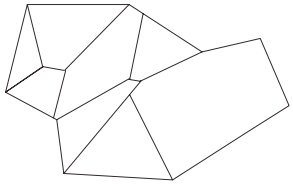
- Capturing of model data
  - building
  - city
- Preprocessing
- Real-time presentation

Aspect

- two different view directions have the same aspect if the corresponding structure graphs are isomorphic

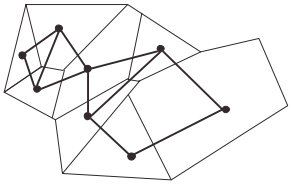
Aspect Graph

- Visibility Space Partition (VSP)
  - partition the space into maximal connected regions with the same aspect



Aspect Graph (Cont.)

- A vertex for each region of the VSP
- An edge connecting adjacent regions



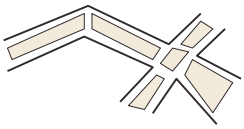
Aspect Graph: Generation

- Generating of the Aspect Graph is more time and space consuming
- Algoritms generate the Aspect Graph approximatly
- Aproximation by cells and gates (portals)
- Potentional Visible Set (PVS) in cells

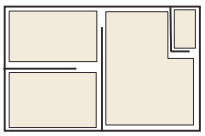
Preprocessing: Structering

- Regular grid
- General cells

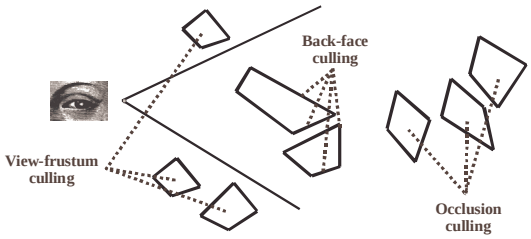
City



Flat

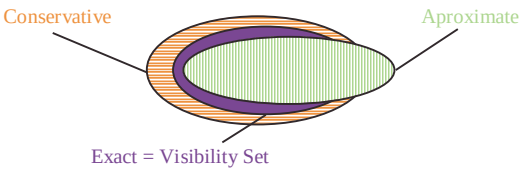


Preprocessing: Culling



Taxonomy

- Exact vs. Aproximate vs. Conservative Visibility

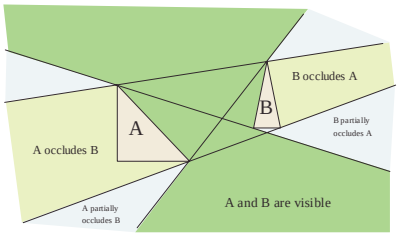


Taxonomy

- Online vs. Precomputed
  - most algorithms precompute the data for better performance in the rendering
- Image space vs. Object space
  - space for determination of visibility
- Point vs. Region Visibility

Coorg & Teller

- Based on the aspect graph for two meshes



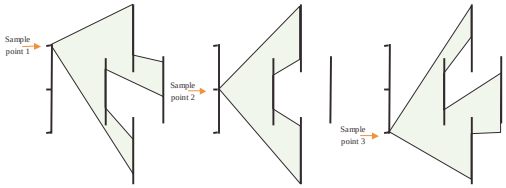
Coorg & Teller

Summary:

- Object space algorithm
- Conservative visibility
- Most suitable for large occluders in a scene like a city
- Point & Region visibility

Occluder Fusion for Urban Walkthroughs

- Discrete point conservative approximation
- Points' distance = shrinking value for occluder



Occluder Fusion for Urban Walkthrougs

Summary:

- Object space algorithm
- Conservative visibility
- Most suitable for large occluders
- Region visibility

Hierachical Occlusion Map

- Hierarchy of occlusion maps
  - higher map is created by halving resolution
  - map stores opacity of the point

Hierarchical Occlusion Map

Summary:

- Image space algorithm
- ”Exact” visibility
- Aproximated algorithm can be done by setting threshold of opacity
- Point visibility

Links

- SIGGRAPH - Course Notes
- Virtual Old Prague
  http://www.ms.mff.cuni.cz/vsp
- Capturing Data (from GIS)
  http://www.vrvis.at/ar2/city_model/index.html
- Virtual Toronto
  http://www.intoronto.com