Web-based progressive geometry transmission using subdivision-surface wavelets

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Overview

• Motivation
• Wavelet Construction
• Zerotree Coding
• System Architecture
• Examples

Motivation

Why Multiresolution

• view-dependent rendering
• compression
• progressive transmission
• stable efficient computation
• hierarchical design
Simplification

data

fine resolution

coarse

difference

Refinement

data

fine resolution

coarse

detail

Progressive Meshes

Subdivision Wavelets

0.1 % 1 % 10 %
Compression Schemes

- De-correlation
  - DCT
  - Wavelets
- Quantization (lossy)
- Progressive Coding
  - Arithmetic / Huffman Coding
  - Zerotrees

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What are wavelets?

- sparse basis
  - compression
  - stable, efficient computation
- multiple levels of resolution
  - progressive transmission
  - hierarchical design
- $O(n)$ transform
Reconstruction from 10% of coefficients

Error scaled by 10

Subdivision

Subdivision
Symmetric lifting operations

1D lifting

Surface subdivision
Properties

• symmetry
• smoothness
• vanishing moments
• small compact support

• few local operations for transform
• polynomial precision fitting
Crater Lake (USGS) 1:100 Haar wavelet

1:100 bilinear B-spline unstable fitting (bi quintic)

surface parametrization (isosurface, LLNL)
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Client-Server Architecture

- Server provides
  - coarse model
  - coefficient pyramid
- Client parameters
  - bits/coeff., threshold,
  - max. length of bitstream
  - max. no. polygons, max. levels

Client-Server Architecture

Client Threads

- Receiver
  - coefficient decoder
  - subdivision + expansion of detail
- Visualization
  - subdivide to target resolution
  - user interaction
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Examples

- \( n_q = 8 \) bits per coefficient
- \( t \) : threshold / max. coeff.
- \( b_{ZT} \) : compression for zero tree coding
- \( b_{AC} \) : arithmetic + zero tree coding

<table>
<thead>
<tr>
<th>Example</th>
<th>( t )</th>
<th>( b_{ZT} )</th>
<th>( b_{AC} )</th>
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Future Work

• wavelets for
  – NURBS
  – triangles (Loop subdivision)

• fix bugs