SIGGRAPH 96 Course

Wavelets in Computer Graphics

Organizers:
Peter Schröder and Wim Sweldens
Morning Schedule

Introduction

Basics
- Time Frequency Analysis
- Building Wavelets at Home

Applications
- Curve Editing, Painting and Image Query
  David Salesin

Afternoon Schedule

Applications:
- Multiresolution Surfaces, Tony DeRose
- Wavelet Radiosity, Peter Schröder
- Spherical Wavelets, Wim Sweldens
- Variational Modeling for Interactive Design and Animation, Michael Cohen
Wavelet Transform

Original

Transform

Wavelet Transform

Erasing coefficients

Reconstruction
Wavelet Transform

Erasing coefficients  Reconstruction

Wavelet Transform

Scaling up wavelet coeffs.  Attenuating wavelet coeffs.
Why?

Dealing with complexity
- large databases
  - many pixels: image manipulation, bandwidth
  - many patches: modeling, rendering
  - many parameters: optimization, animation

Hierarchy
- level-of-detail
- multiresolution

Foundation

Observation
- most interesting data is not random

Exploit
- structure, coherence, correlation, smoothness

Result
- more compact representation
- more efficient computations
What?

**Computational framework**
- easy to implement
- fast: linear time
- wide applicability

**Theoretical framework**
- mathematical foundation
- analysis and error estimates

Wavelets
Where do Wavelets come from?

Many “parents”
- digital signal processing
  - filter banks
  - image compression
  - time frequency localization
- physics
  - coherent states

Where do Wavelets come from?

Many “parents”
- harmonic analysis
  - analysis of integral operators
- numerical analysis
  - fast multigrid solvers for PDEs and integral equations
- geometric modeling
  - subdivision
History

Highlights
- 1911: Haar
- 1930: Littlewood Paley
- 1940: Gabor
- 1960: Calderón-Zygmund

History

Highlights
- 1984: continuous wavelet transform
- 1985: subband coding
- 1985: multiresolution analysis
- 1988: orthogonal wavelets
- 1990: biorthogonal wavelets
- 1994: second generation wavelets
Roadmap

Signals and their frequency contents
- Fourier
- windowed Fourier: Gabor
- Wavelet