SIGGRAPH 96 Course

Wavelets in Computer Graphics

Organizers:

Peter Schröder and Wim Sweldens

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

3

Afternoon Schedule

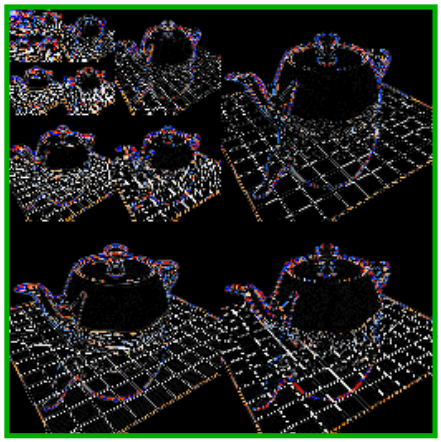
Applications:

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

4

Wavelet Transform

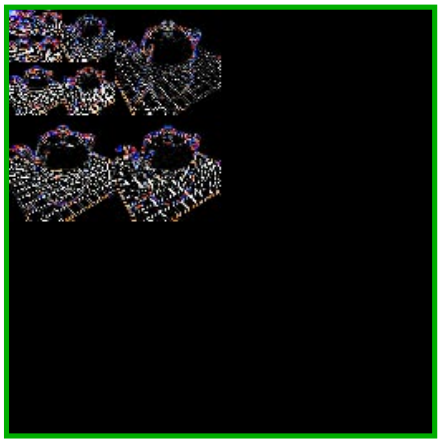
Original



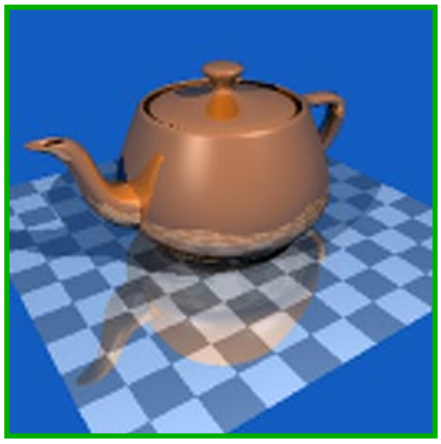
Transform

5

Wavelet Transform



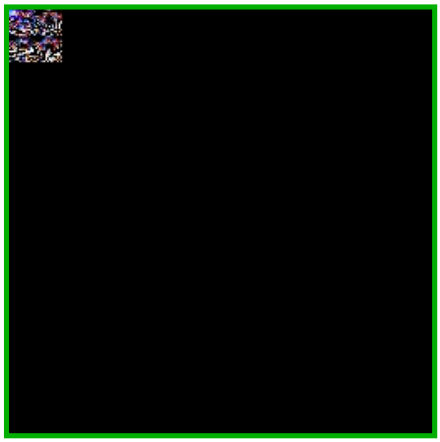
Erasing coefficients



Reconstruction

6

Wavelet Transform



Erasing coefficients

Reconstruction

7

Wavelet Transform

Scaling up wavelet coeffs.

Attenuating wavelet coeffs.

8

Why?

Dealing with complexity

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

Hierarchy

- level-of-detail
- multiresolution

9

Foundation

Observation

- most interesting data is not random

Exploit

- structure, coherence, correlation, smoothness

Result

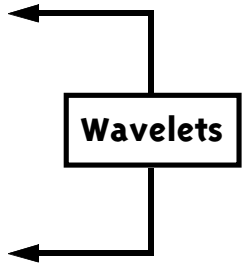
- more compact representation
- more efficient computations

10

What?

Computational framework

- easy to implement
- fast: linear time
- wide applicability



Theoretical framework

- mathematical foundation
- analysis and error estimates

Where do Wavelets come from?

Many "parents"

- digital signal processing
  - filter banks
  - image compression
  - time frequency localization
- physics
  - coherent states

13

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

14

History

Highlights

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

15

History

Highlights

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

16

Roadmap

Signals and their frequency contents

- Fourier
- windowed Fourier: Gabor
- Wavelet

17

18