Fractals

Recapitulation

- Exhibit infinite detail
- Show self-similarity
- Generating approach
  recursive procedure
  deterministic
- Fractal dimension (D)
  roughness & filling-ness
Fractals

Recapitulation

\[ P_1 = F(P_0) \]
\[ P_2 = F(P_1) = F(F(P_0)) \]
\[ P_n = F(P_{n-1}) \]
Random Fractals

Introduction

- Process of Generation: Randomness
- Statistical Self-Similarity
- Different Generating Approaches
Random Fractals

Midpoint Subdivision (curve)
Random Fractals

Midpoint Subdivision (curve)

Issues
Magnitude of MC
Direction of MC
Random Fractals

Midpoint Subdivision (curve)
Random Fractals

Example
Random Fractals

Example
Random Fractals

Subdivision Methods (surface)

Triangle Edge subdivision

Iteration N
Random Fractals

Subdivision Methods

Triangle Edge subdivision

Iteration N+1
Random Fractals

Subdivision Methods

Triangle Edge subdivision
Random Fractals

Subdivision Methods

Triangle Edge subdivision

Issues

Amount of displacement
Direction of displacement
“consistency”
Random Fractals

Subdivision Methods

Triangle Edge subdivision
Random Fractals

Example
Random Fractals

Subdivision Methods

Diamond Square subdivision

Iteration N
Random Fractals

Subdivision Methods

Diamond Square subdivision

Iteration $N+1$
Random Fractals

Subdivision Methods

Square Square subdivision

Iteration N
Random Fractals

Subdivision Methods

Square Square subdivision

Bilinear Interpolation

Iteration N+1
Random Fractals

Applications

- Coast Lines
- Landscapes
- Clouds
- Candies
- Stones
- OTHERS
Algebraic Fractals

Mandelbrot’s Function

\[ z \leftarrow z^2 + c \]

\[ z \text{ and } c \text{ are complex} \]

Algorithm

- \( c \): point in the region \((x + iy)\)
- \( z_0 \): initial value of \( z \)
- \( z_n = z_{n-1}^2 + c \)

Evaluate \( S(z_n) \): if > Tolerance
- assign color \((n)\) to \( c \)

If \( n > \text{Limit} \)
- assign color \((n)\) to \( c \)
Algebraic Fractals

Mandelbrot’s Function
**Algebraic Fractals**

**General Formulation**

If the iteration function is

$$z \rightarrow z^\beta + c ;$$

where

\(\beta\) : integer or real, positive or negative

Then the

number of complete lobe structures

\[ L = \text{floor} \left( \text{abs}(\beta - 1) \right) \]

Fractional part of \(\beta\) is proportional to the size of an emerging baby Lobe.