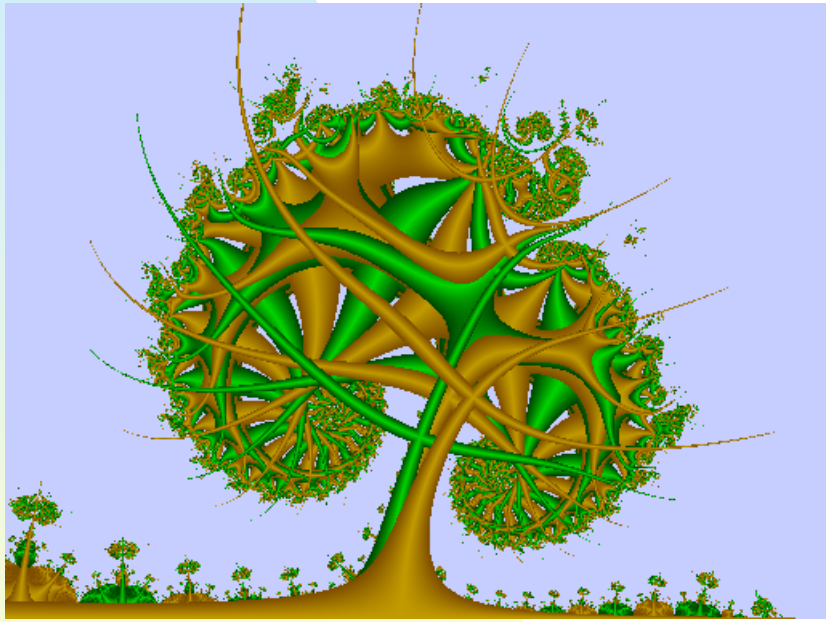
Session overview



- Extending fractional Brownian motion to higher dimensions
- Announcements:
  - Project 4 due Friday
  - Thursday and Friday are project days

Midpoint displacement

- Midpoint displacement methods can work with triangular or square grids of points
- For squares, start with the four corners of the grid as samples of the Gaussian random number generator multiplied by the initial standard deviation

Variance is proportional to distance

- Recall that in one dimension the variance of $X(t_2) - X(t_1)$ is proportional to Δt^{2H}, or $(\Delta t^2)^H$
- This is interpreted as being proportional to the distance between the sample points
- So, in two dimensions, we again want the variance of $X(t_{2x}, t_{2y}) - X(t_{1x}, t_{1y})$ to be proportional to $[(t_{2x}-t_{1x})^2 + (t_{2y}-t_{1y})^2]^H$

Computing the midpoint

- Now compute the midpoint of the grid by averaging the four corners and adding a Gaussian random number with a variance that is $\frac{1}{2}^H$ times the previous variance
- This is because the resolution of the points is now $1/\sqrt{2}$ times the previous resolution
- Realize the grid arrangement is rotated 45º from the previous arrangement

Continuing with the process

- Repeat the process
- At the borders of the 45º grid you only have three points to average
- The interior points have four points available for averaging
- Dimension of the fractal surface is 3-H

Elevation values

- Output of this process is an array of elevation values that need to be displayed somehow
- One method is to use color mapped elevations on a top view
  - This generates respectable looking clouds, for example
  - Find the average elevation
  - Any elevation below this is colored blue
  - Elevations above this are colored via a color ramp from blue to white (linearly interpolated)

Example program

- Matlab program for mountains
- `midpointfBm2D.cpp` has source code that implements the random midpoint displacement method for generating fractional Brownian motion

Please finish quiz

- Please provide helpful feedback