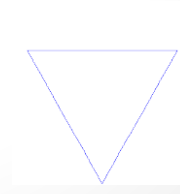
Modelagem em Engenharia C & A

Aula 15- Fractais – A revanche

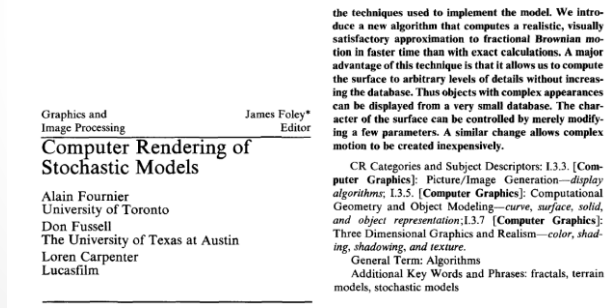
Objetivos

- Modelos Estocásticos
- MidPoint Displacement
- Renderização de superfícies 3D utilizando fractais



Bibliografia

- **Computer Rendering of Stochastic Models**
  - Alain Fournier, University of Toronto; Don Fussell, The University of Texas at Austin; Loren Carpenter, Lucasfilm
  - Communications the ACM Number 6 of Volume 25, June 1982,



Graphics and Image Processing — James Foley* Editor

Computer Rendering of Stochastic Models

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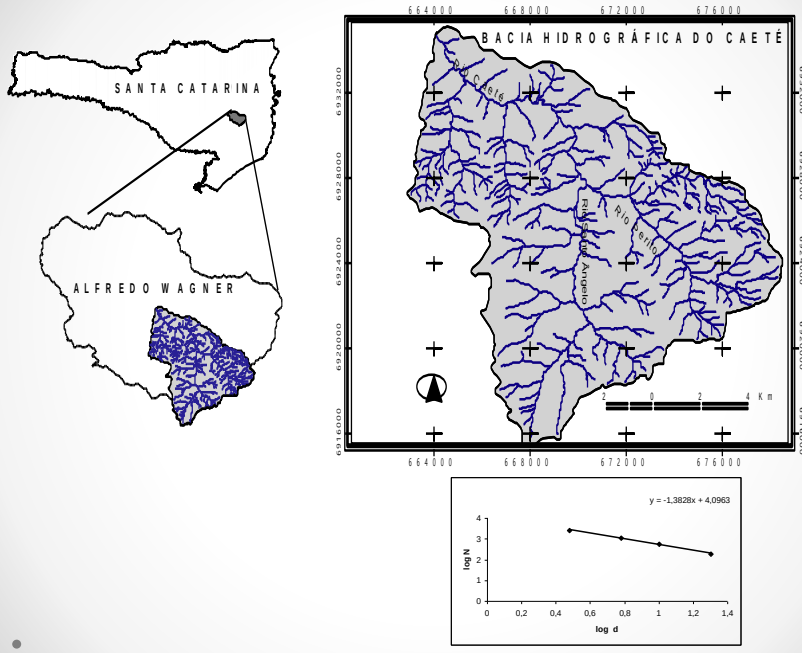
the techniques used to implement the model. We introduce a new algorithm that computes a realistic, visually satisfactory approximation to fractional Brownian motion in faster time than with exact calculations. A major advantage of this technique is that it allows us to compute the surface to arbitrary levels of details without increasing the database. Thus objects with complex appearances can be displayed from a very small database. The character of the surface can be controlled by merely modifying a few parameters. A similar change allows complex motion to be created inexpensively.

CR Categories and Subject Descriptors: I.3.3. [**Computer Graphics**]: Picture/Image Generation—*display algorithms*; I.3.5. [**Computer Graphics**]: Computational Geometry and Object Modeling—*curve, surface, solid, and object representation*;I.3.7 [**Computer Graphics**]: Three Dimensional Graphics and Realism—*color, shading, shadowing, and texture.*
General Term: Algorithms
Additional Key Words and Phrases: fractals, terrain models, stochastic models



Origem do Fractal Randômico

- Movimento Browniano Fractional (FBM)

$$B_H(0, w) = b_0$$

$$B_H(u, w) - B_H(0, w) = [1/\Gamma(H + 0.5)] \left\{ \int_{-\infty}^{u} [(u - s)^{H-0.5} - (-s)^{H-0.5}]\, dB(s, w) + \int_{0}^{u} (u - s)^{H-0.5}\, dB(s, w) \right\}$$

Fig. 1. Ordinary Brownian Motion ($H = 0.5$).

Fig. 2. Fractional Brownian Motion ($H = 0.3$).

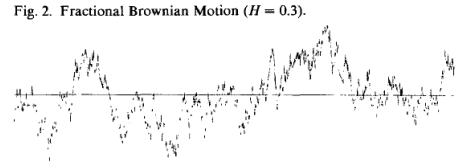
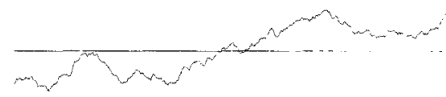
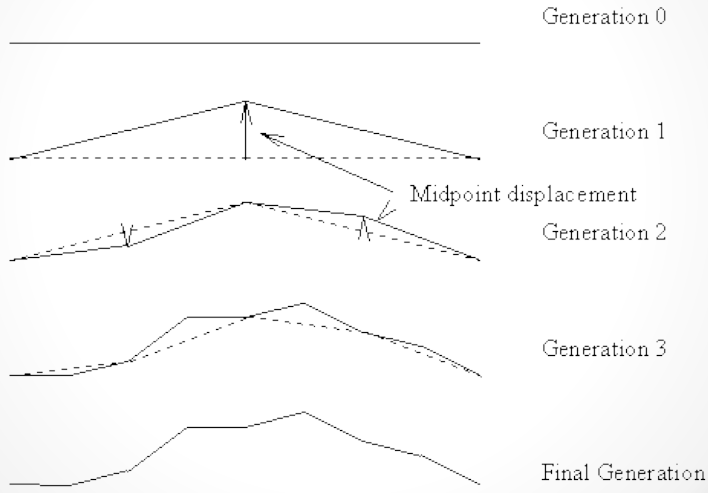


Fig. 3. Fractional Brownian Motion ($H = 0.7$).

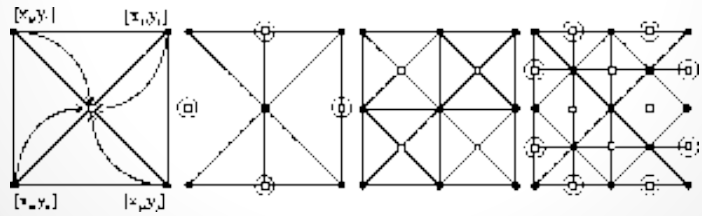


Tecnica da subdivisão recursiva randômica



Método MidPoint Displacement

- Um quadrado inicial é sdubdividido em sucessivos quadrados menores e a cada um é atribuido um deslocamento no eixo z em função do valor das arestas
- 1º passo: adicionar um vértice no meio
  - [x0,y0,f(x0,y0)] [x1,y0,f(x1,y0)] [x0,y1,f(x0,y1)] [x1,y1,f(x1,y1)]
- 2º passo: calcular o deslocamento a partir de uma variação aleatória d com distribuição probabilistica conhecida

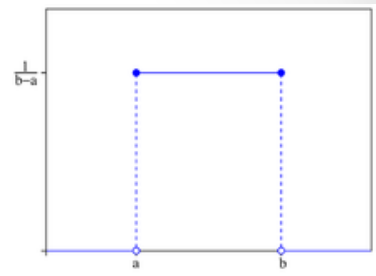


Gerador de Números aleatórios

- Distribuição Prob Uniforme

$$f(x;a,b) = \begin{cases} \frac{1}{b-a} & , \ a \le x \le b, \\ 0 & , \ c.c. \end{cases}$$

$$F(k;a,b) = \frac{\lfloor k \rfloor - a + 1}{b - a + 1}$$

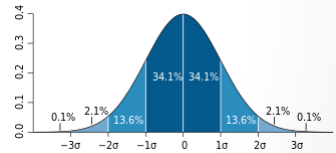


- Função no Excel: ALEATORIO() ou ALEATORIOENTRE ()

Distribuição Normal

$$f(x,\mu,\sigma) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)}, -\infty < x < \infty, \sigma > 0.$$

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{\left(-\frac{x^2}{2}\right)}.$$



Anamorfose Normal x Uniforme

$$Z_1 = \sqrt{-2 \ln U_1} \cos(2\pi U_2)$$

$$Z_2 = \sqrt{-2 \ln U_1} \sin(2\pi U_2).$$

- U_1 e U_2 são dois números aleatórios com distribuição uniforme
- Z_1 e Z_2 resultam dois números com distribuilção normal correspondentes

Uma função para gerar aleatórios normais(???)

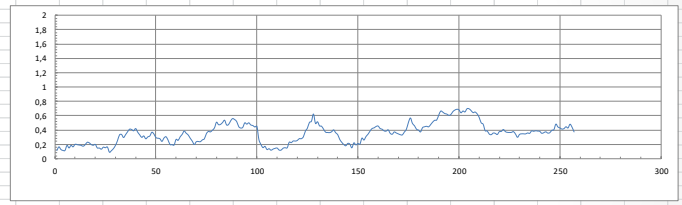
```
'XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX
'XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX
'Função para gerar números aleatórios com distgribuição normal entre - DP e + DP


Function rnorm(mean As Single, std As Single) As Double


    Dim U1 As Double, U2 As Double
    Dim Pi As Double

        Pi = 4 * Atn(1)

        U1 = Rnd
        U2 = Rnd

        rnorm = mean + (Sqr(-2 * (Log(U1))) * Cos(2 * Pi * U2) * std)
End Function
'XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX
```

MID_1D

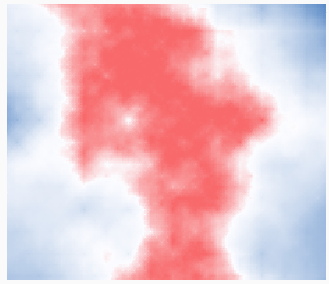
Dimensão	512
Altura	1
Rugosidade	0,6
Deslocamento	1

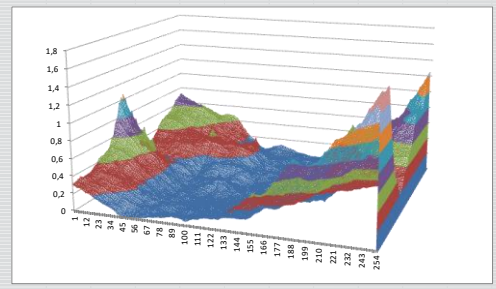
0,07675305
0,1140598
0,164395315
0,127071426
0,114384143
0,113661655
0,18469797
0,148895725
0,184839075
0,164358136
0,20032415
0,194828573
0,190043377

Botão 1



MID_3D





Botão 1

Width	256
Height	1
Roughness	0,4
Displacement	1