Procedural Texturing and Shading

Procedural Texturing/Shading

Paradigm for programmability in the graphics pipeline

Allows for a wide variety of surface materials and embellishments

May be facilitated by a custom shading language

- e.g. Pixar's RenderMan, NVIDIA's CG

Potential Advantages of Procedural Textures

Compact representation

No fixed resolution

No fixed area

Parameterized - generates class of related textures

Disadvantages of Procedural Textures

Difficult to build and debug

Surprising results

Slow evaluation

Antialiasing handled manually

Procedural Texture Conventions

Avoid conditionals

- Convert to mathematical functions when possible
- Makes anti-aliasing easier

Parameterize rather than building in constants

- Assign reasonable defaults which may be overridden

Simple Building Blocks

Mix (lerp)

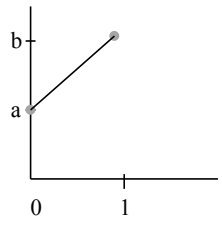
Step, smoothstep, pulse

Min, max, clamp, abs

Sin, cos

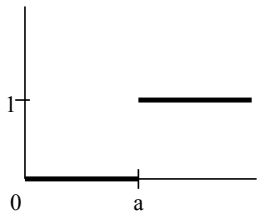
Mod, floor, ceil

Mix



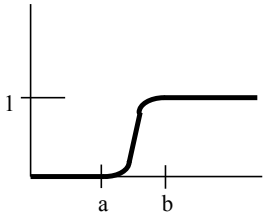
mix(a,b,x)

Step



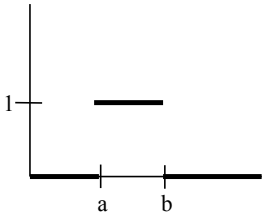
step(a, x)

Smoothstep



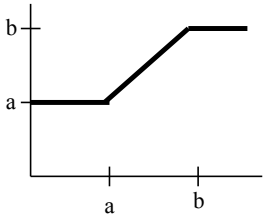
smoothstep(a,b,x)

Pulse



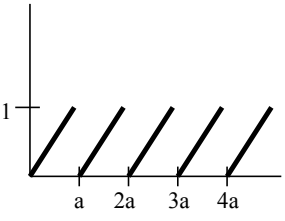
pulse(a,b,x) = step(a,x) - step(b,x)

Clamp



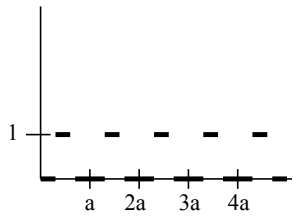
clamp(x,a,b) = min(max(x,a), b)

Mod



mod(x,a) / a

Periodic Pulse



pulse(0.4, 0.6, mod(x,a)/a)

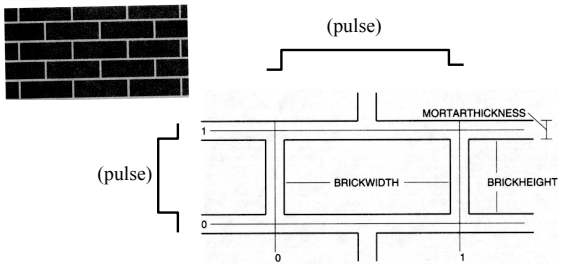
Example 1 - brick (see handout)

Brick is primarily a 2D pulse

Input parameters may include:

- **color of brick and mortar**
- **size of brick**
- **thickness of mortar**
- **mortar bump size**
- **frequency of brick color variation**
- **etc.**

Brick



from Ebert, ed., *Texturing and Modeling: a Procedural Approach, 1994, pages 37-38.*

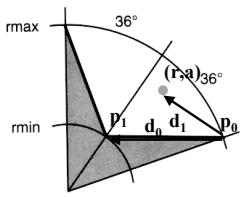
Example 2 - star (see handout)

Exploit symmetry of star geometry

Input parameters may include:

- **Inner and outer star radii**
- **Number of points**
- **Star and background colors**
- **Star bump parameters**
- **Parameters for star distribution**

Star



from Ebert, ed., *Texturing and Modeling: a Procedural Approach, 1994, pages 44-46.*