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

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Potential Advantages of Procedural Textures

- Compact representation
- No fixed resolution
- No fixed area
- Parameterized - generates class of related textures

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Disadvantages of Procedural Textures

- Difficult to build and debug
- Surprising results
- Slow evaluation
- Antialiasing handled manually

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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

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Simple Building Blocks

- Mix (lerp)
- Step, smoothstep, pulse
- Min, max, clamp, abs
- Sin, cos
- Mod, floor, ceil

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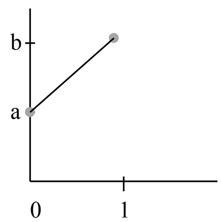
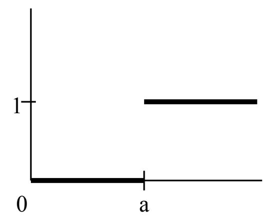
Mix



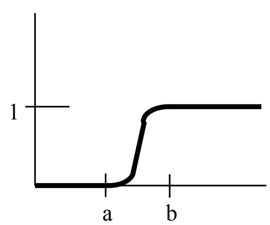
mix(a,b,x)

Step



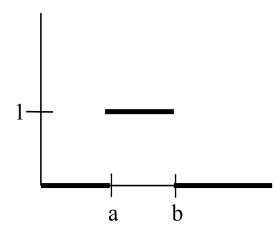
step(a, x)

Smoothstep



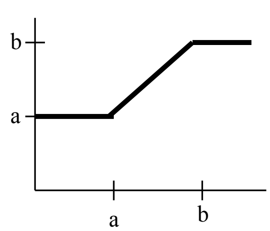
smoothstep(a,b,x)

Pulse



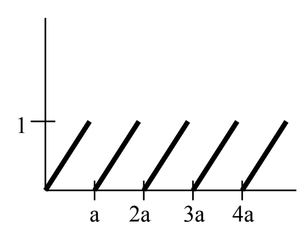
pulse(a,b,x) = step(a,x) - step(b,x)

Clamp



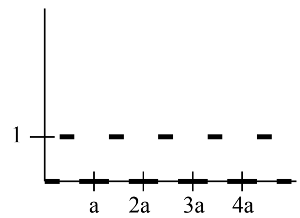
clamp(x,a,b) = min(max(x,a), b)

Mod



mod(x,a) / a

Periodic Pulse



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

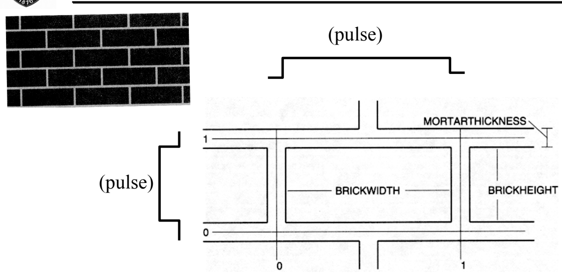
Example 1 - brick (see handout)

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.*

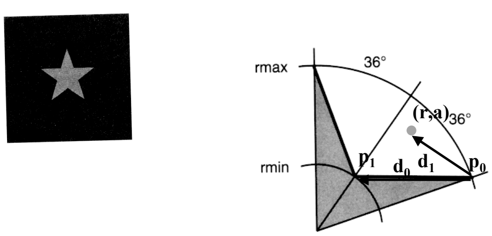
Example 2 - star (see handout)

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.*