Texturing

- Mapping a pattern to a surface
  - To provide realism
  - e.g., brick walls, gravel, carpet, printed patterns, wood grain, etc.
- Goal is to avoid
  - Single colored surfaces
  - Smooth Gouraud interpolations

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Simplistic Approach

- Very finely tessellate the surface
- Determine a color for each patch
- Combined patch effects form a pattern
- Problems:
  - Lots of work
  - May not illuminate well

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Texture/Pattern Mapping

- Describe a grid of color values
  - In texture space (r,s)
- Texture scanning
  - Texture space → object space → pixels
- Pixel-Order scanning
  - Pixels → object space → texture space

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Texture Scanning

- Multi-step process
  1. Generate the texture pattern
  2. Choose how it will be "mixed"
  3. Position relative to the object face/image fragment
  4. Apply to the fragment

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Specifying a Texture

- Typically a rectangular grid of values
  - RGB or RGBA most common
    - Color index has very poor applicability
- Size is restricted
  - Powers of 2 are common
  - Minimum size is reasonable
- Often stored in a file

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"Mixing" a Texture

- How is the texture applied to the surface
  - Replace
    - Texture color replaces surface color
  - Modulate
    - Texture color alters/limits surface color
  - Blend
    - Texture color and surface color mixed
  - Decal
    - Texture has varying levels of transparency

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Positioning a Texture (1)

- Where is the texture placed on the object?
- If texture and object are same size
  - Easy
    - Or is it?

 vs.

  - Orientation matters too

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Positioning a Texture (2)

- Abnormal fragments present challenges

- How do we pick an alignment?
- What if the fragment is too big?
- What if the fragment is too small?
- Should we scale the texture?

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Positioning a Texture (3)

- Repeating
  - Should we tile with copies? Both directions?
  - Do matching edges truly match?
- Clamp/Crop
  - Only display what overlaps

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Positioning a Texture (4)

- Adjacent surface patches
  - How do the borders match?
  - Will it be OK for a "curved" surface?
- Possible solution
  - Small, tiled texture
  - Will this be too "busy"?

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Viewing Distance Effects (1)

- Close range
  - Is the texture detailed enough?
  - Will it look patchy?
- Long range
  - As the texture "shrinks," will it shimmer?

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Viewing Distance Effects (2)

- Variations in pixel and texel size
  - Specify texels, but must draw pixels
- Filtering strategy
  - Nearest – use closest texel to final pixel
  - Linear – weighted average of nearest texels
  - Other – more complex interpolation (bicubic, ...)

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Procedural Texturing

- Specify the texture via function
  - Not by texel map
- Write a function that maps (r,s)
  - To a texture "color"
  - Noise is often included
- Map (r,s) to (x,y) of object or pixel space
  - Account for scale(?), tiling(?), etc.

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