AUTODESK UNIVERSITY 2014

Shading and Texturing Workflow

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VI4947

In this intermediary class I will discuss the theory behind my workflow for shading and texturing environments, props, and characters. These techniques can be used to texture any high-resolution object, whether for visual effects, animated films, video game cinematics, or even architectural work. We will discuss shaders, as well as available methods for applying textures to your models. We will also cover pattern creation methods, from procedurals to hand-painted textures to photo manipulation. We will focus on how to efficiently shade thousands of individual objects without having to spend a lot of time UV shading everything (although we will touch on UV shading). Many of the examples will use 3ds Max software, Mudbox software, Chaos Group's V-Ray rendering engine, and Adobe Photoshop—but you can apply the principals discussed to the 3D app, paint application, and renderer of your choice.

Learning Objectives

At the end of this class, you will be able to:

- Understand a process / workflow by which you can effectively shade / texture almost any object.
- Understand all of the different methods for placing patterns on a surface
- Understand all of the different methods for creating those patterns.
- Understand all of the different methods for storing these patterns.
- How to use these patterns inside Shaders to create your final materials.

About the Speaker

Neil Blevins began his career in traditional painting and drawing before getting into 3D graphics while living in his home country of Canada. After getting a BFA in design art, Neil moved to Los Angeles where he worked for Blur Studio, creating graphics for video games, commercials, and television, as well as for feature and ride films. For the last 12 years Neil has worked as a digital artist for Pixar Animation Studios in San Francisco. In his spare time he makes science-fiction 3D/2D hybrid artwork, he authors tools, and he writes art-related lessons and tutorials for his website.

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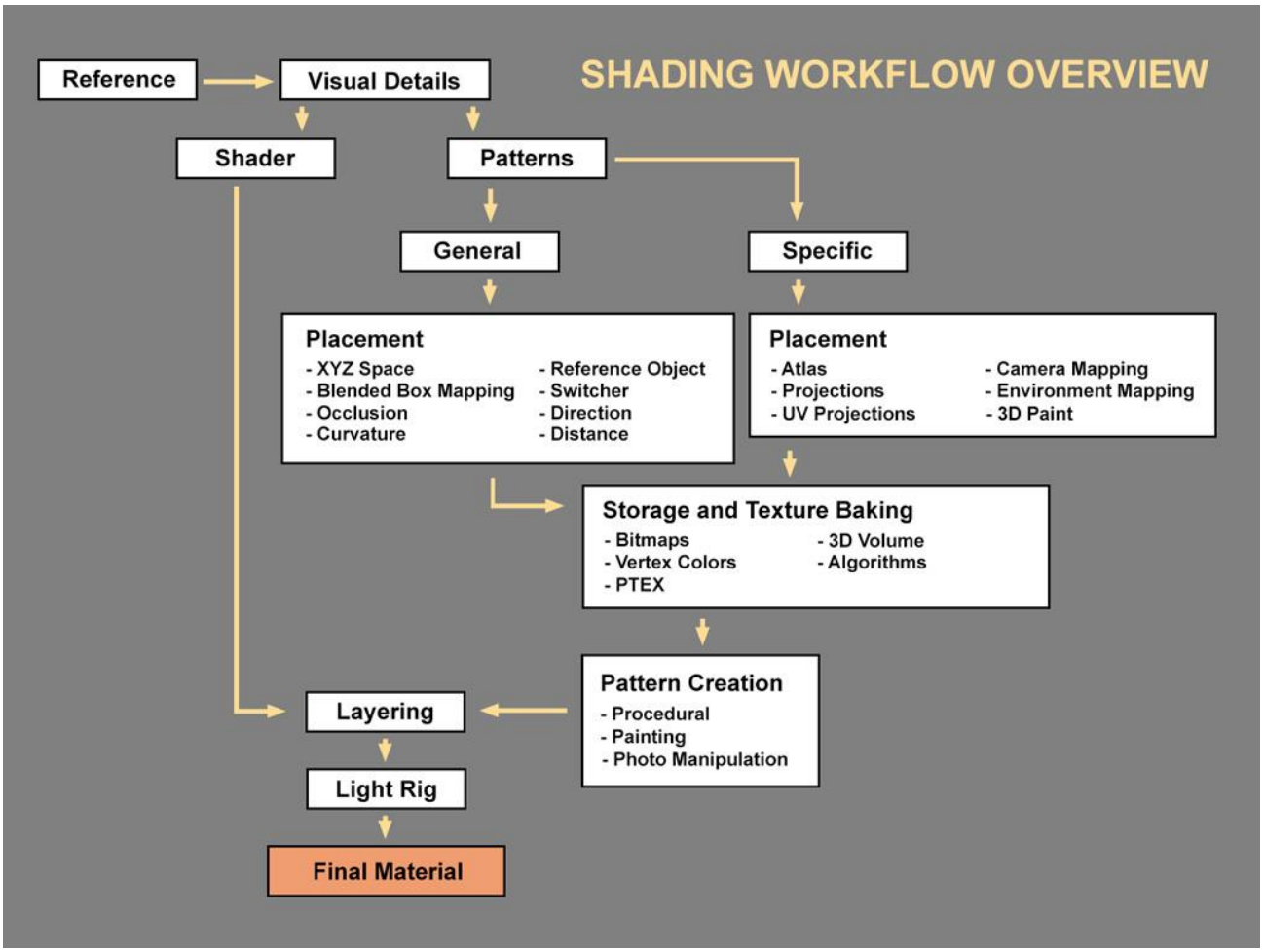
Shading and Texturing Workflow

So this lesson discusses my workflow for shading / texturing models. This topic is of course huge, so consider this an overview. I've added links to specific tutorials on specific techniques, and check the Shading / Texturing section of my CG Education page for further lessons on materials and shading. But this lesson is a good place to start.

If you'd like a video version of this lesson, please consider buying my Hard Surface Shading And Texturing Gnomon DVD, the first part of the DVD is me going over in greater detail a slightly older version of the same material below.

This workflow is the process I go through when shading any sort of object, regardless of whether its a character, vehicle, set, or prop, hard surface or organic, maya, max, xsi, this workflow is pretty much the same no matter what software you choose (I use 3dsmax as my main example software in this lesson, but all the theory applies to maya and every other 3d app and renderer out there).

Most of us when texturing are doing something similar to this workflow instinctively, but the nice thing about laying it all out is it may help you make more informed decisions on which techniques to use for what objects. There are many, many ways to go about texturing cg models, and rather than choosing one technique and trying to use it for every situation, there is value in using a number of different techniques, ones that are better suited for the specific situation. At many companies, they have decided to UV and then paint everything. Which is fine, but they're missing out on a lot of time saving methods like Blended Box Maps, Procedurals and Projections. This article hopes to show that there are lots of methods for shading, and using many instead of few has a lot of advantages.



Here are the basic steps of my shading / texturing workflow...

1. Reference
2. Visual Details List
3. Splitting Details Into Shaders And Patterns
4. Shaders
5. Patterns
6. Splitting Patterns Into General and Specific Patterns
7. General Patterns
8. Specific Patterns
9. General Pattern Placement
10. Specific Pattern Placement
11. Pattern Storage And Texture Baking
12. Pattern Creation
13. Layering
14. Light Rig
15. Final Material

1) Gathering Reference

Probably the most important thing you can do to make your project successful, even for objects that don't exist in real life. Sometimes we get so excited making an object in 3d that we don't stop to first think about and observe the thing we are going to make. Spend the time to get good reference! Use original sources (real photos, observation) more than processed sources (other people's paintings, images, films).

Here's some places to get Reference:

- Take your own photos (get a camera, even a cheap camera, iphone is fine most of the time)
- Client
- Get photos from library, books, web
- Films
- Other artists work
- Create an Archive (Morgue) of reference photos (Mine is 92,000 files / 41 Gig)

2) Identifying Visual Details

Pick the 5 to 10 things that make this object look the way it looks and write them down.

Example, Rock:

- Rough surface (Not Shiny)
- Cracks
- Large crinkly bump
- Smaller grainy bump
- Grey/yellow color
- Spotty color pattern

Example, Fire Hydrant:

- Three color of paint (Yellow, Grey, Green)
- Paint has a slight bump
- Paint is slightly reflective
- Paint chips off to reveal metal base
- Metal base is dull, dark grey
- Rust

3) Splitting Visual Details Into Shaders And Patterns

A Surface Shader is a set of equations used to determine the appearance of a surface and how it responds to light. A Shader is combined with Maps (Patterns) to form a Material. Sometimes your material is refereed to as a "shader", but for clarity sake, I will only refer to the Illumination portion of your material as a shader.

Now lets look at your Visual Detail List, what on the list is part of the shader?

Example, Hydrant (3 shaders):

- Paint Shader
- Metal Shader

- Rust Shader

Look at your Visual Detail List, what on the list are patterns?

Example, Hydrant (8 patterns):

- Paint requires several colors, has a paintbrush bump pattern, a pattern to change how reflective the surface is, and the paint is worn off to reveal the metal in a specific pattern (4 patterns).
- Metal has some slight blemishes in color (1 pattern)
- Rust has a specific color, specific bump, and then is placed on the surface of the hydrant in a specific pattern (3 patterns).

4) Shaders

Common Shaders in the CG World:

- Lambert (Simple Diffuse)
- Phong (Highlight)
- Blinn (Highlight, less distortion at glancing angles)
- Oren Nayar (Diffuse for Rough Surfaces)
- Ward Anisotropic (Anisotropic Highlights)
- Cook-Torrance (Metals)
- GGX

Now lets choose the most appropriate shaders...

Example, Hydrant:

- Paint could be a Lambert with a Blinn shader for shininess
- Metal could use a Cook-Torrance shader, or a Lambert/Blinn made to look metallic
- Rust could use a lambert, or Oren Nayar since it's very rough, and doesn't need a specular Highlight

Here's a few lessons on shaders...

- Reflections and Highlights
- Anisotropic Reflections In The Real World
- Anisotropic Reflections In CG Software
- Energy Conservation In Shaders
- Translucency and Sub-Surface Scattering

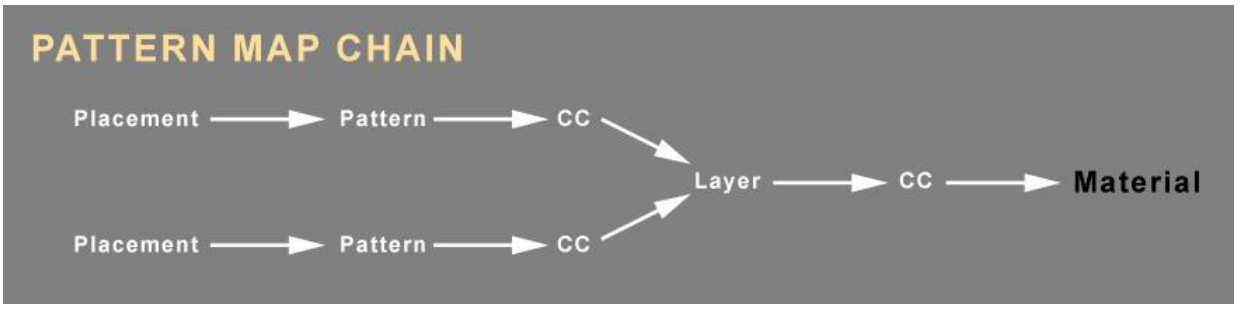
5) Patterns

Now we look at our list of patterns. To make a successful material, you generally want at least 3 patterns per material...

- Color
- Bump / Displacement (Disp)
- Specular Amount (Spec)

Although some specialty shaders require more patterns like a Translucency amount, subsurface color, etc.

Patterns tend to be chains of nodes (maps) that are layered together and then plugged into a particular channel of a material. Like in this example, a Placement node places a Pattern, that Pattern is Color Corrected (CC), then these Color Corrected Patterns are layered together using a Layer node, the result of that is Color Corrected, and then plugged into your material as a color, a bump, a specular amount etc. At its most basic level, pretty much all Pattern Map Chains you do for any material take on a form like this...



6) Splitting Patterns Into General And Specific Patterns

- General Patterns: General Patterns are non-specific, stuff that pretty much covers your entire object. In the Fire Hydrant example, a General Pattern would be the brush strokes in the paint. They don't need to be anywhere specific to read as paint.
- Specific Patterns: Specific patterns are patterns that appear in only very specific spots. In the Fire Hydrant example, a Specific Pattern would be the spots that show rust, since that appears only in very specific places on the hydrant (such as where two objects intersect).

Think of this with a traditional painters metaphor. Many painters start by blocking in the basic colors over the entire canvas, then they add details on top. So your basic color would be the General Patterns, and your details would be the Specific Patterns.

Also, some companies have a specific "Shader" job and a specific "Painter" job, usually the Shader handles the Materials and General Patterns, Painters handles Specific Patterns. Or in some companies you have Shader Writers and Painters, in which case the Shader Writer codes the shader, and almost everything else is handled by the Painter. Some companies, one person does both the shader, specific and general patterns.

7) General Patterns

In our Fire Hydrant Example, these are the General Patterns:

- Paint Color
- Paint Bump
- Paint Specularity
- Metal Color
- Rust Color
- Rust Bump

8) Specific Patterns

In our Fire Hydrant Example, these are the Specific Patterns:

- Worn Off Paint Placement
- Rust Placement

9) General Pattern Placement

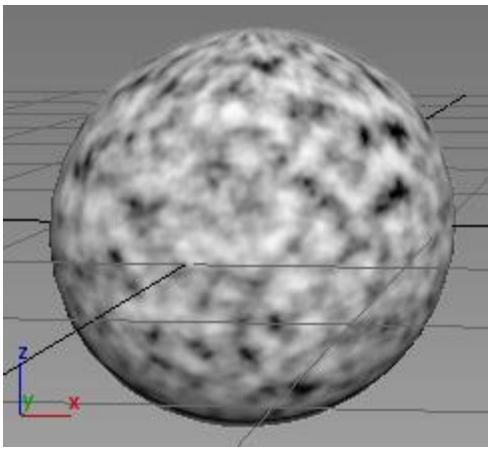
Patterns can be thought of as having three components, how you place that pattern on your object, how the pattern is stored, and creating the pattern itself. These three components are tied together, but for the purpose of choosing techniques, lets keep them conceptually separate for the moment.

No one pattern placement method works in all cases, generally a material will need to use several different pattern placement methods. All pattern placement methods can be used for General and Specific Patterns, but for the most part a placement method tends to work best for one or the other. So lets look at the 8 General Pattern Placement methods, and then you can decide which ones work best for the General Patterns in your material:

1. XYZ Space
2. Blended Box Mapping
3. Occlusion
4. Curvature
5. Reference Object
6. Switcher
7. Direction
8. Distance

9.1) XYZ Space

The pattern exists in a 3 dimensional space. This is generally used by Procedurals. XYZ Space can be in world space or object space. For example, if you rotate your object, the object space changes, but the world space will not.



Examples In Software:

- 3dsMax Base Package: Most procedurals (Noise, Smoke, Dent, etc.)
- Maya Base Package: Most Procedurals (Cloud, Marble, Stucco, etc.)
- Darktree (Darksim)

Advantages:

- Very quick to assign to your object.

Disadvantages:

- You're limited by the types of available procedural patterns.

9.2) Blended Box Mapping

Like a regular box map, a bitmap is projected from 6 different directions, but the edges are blended, so you don't see any seams.

Here's a lesson on Blended Box Maps...

- Blended Box Mapping

Examples In Software:

- 3dsMax Base Package: doesn't exist
- 3dsMax Scripts: The SoulburnScripts have an ugly hack that tries to mimic this feature (blendedBoxMapMaker).
- 3dsMax Plugins: InstantUV did this, but the plugin was discontinued in 2000.
- Maya Base Package: doesn't exist
- Mari: Triplanar Projection, although once baked into your final bitmap, you can't edit its size, bitmap, etc. in your final 3d program.
  http://www.youtube.com/watch?v=EBsaccegYDc

Advantages:

- Easy to assign any bitmap to a whole set of objects.
- Not limited by available procedurals.

Disadvantages:

- Only good for noisy textures, textures with an obvious pattern such as scales or large contrasty dots do not work well because you can see the pattern fade in and out at the edges.
- If using 3dsmax, my scripted hack requires all objects have their xforms reset.

9.3) Occlusion

Ambient Occlusion (AO) is a pattern that creates a gradient. The Gradient is based on how much of a particular surface sees of the sky (Or for the more technical minded, its the amount a particular point sees of a hemisphere centered at the point and oriented by the face normal (unless you have a cutoff distance, in which case it's far more likely you'll be simply calculating how close you are to adjacent surfaces)). You then use the resulting gradient to mix between materials or maps.

Here's a lesson on Occlusion...

- Occlusion Rust

Examples In Software:

- 3dsMax Base Package: mentalray "Ambient/Reflection Occlusion" map
- 3dsMax Plugins: Vray "VrayDirt" map
- Maya Base Package: mentalray mib_amb_occlusion

Advantages:

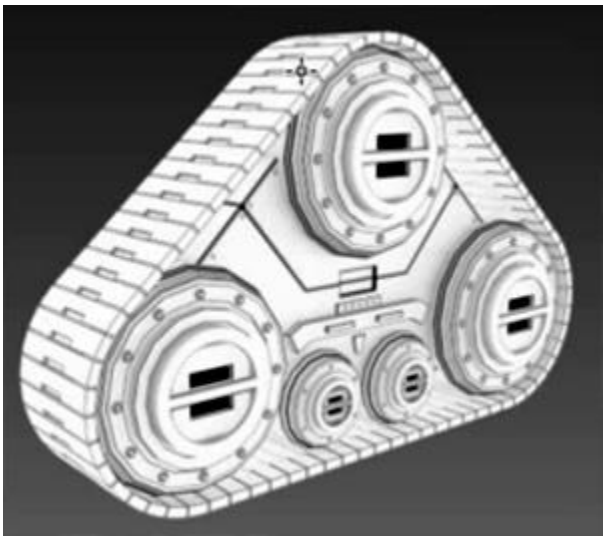
- Great for placing stuff like rust or dirt into the spots these things would naturally occur.
- Unlike Curvature, deals well with interpenetrating objects.

Disadvantages:

- The gradient isn't terribly useful as a pattern directly, has to be enhanced using some other method, like for example using Procedural Noise in XYZ Space.
- Not terribly intuitive to control.
- If rendered in realtime, can be slow to compute, if you decide to bake out the occlusion, you have to deal with a lot of extra files, and possibly applying good uvs to all your objects to bake to.
- If for animation, result must be baked so that you don't see dynamic occlusion. This requires you to deal with a lot of extra files, and possibly applying good uvs to all your objects to bake to.

9.4) Curvature

This pattern creates a gradient. The gradient depends on the concavity or convexity of an area. You use the resulting gradient to mix between materials or maps. Similar to Ambient Occlusion.



Here's a lesson on Curvature...

- Worn Edges Using A Distorted Vertex Map

Examples In Software:

- 3dsMax Base Package: doesn't exist

- 3dsMax Scripts: Soulburnscript CornerEdgeToVertexMap calculates Curvature then bakes it into your object's Vertex Color Map.
- 3dsMax Plugins: F-Edge, Tension Modifier, QuickDirt
- ZBrush: Bronze Shader

Advantages:

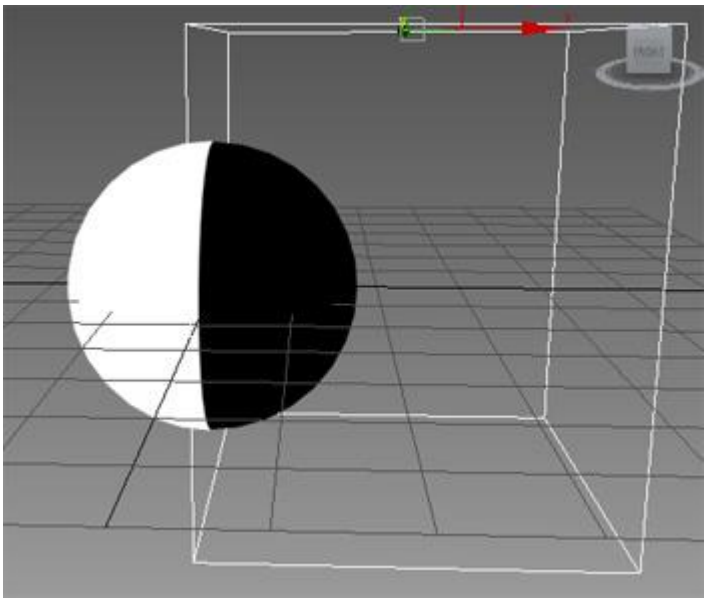
- A real Curvature map is faster to calculate than Ambient Occlusion
- Captures convex areas that Ambient Occlusion doesn't

Disadvantages:

- The Gradient isn't terribly useful as a pattern directly, has to be enhanced using some other method, like for example using Procedural Noise in XYZ Space.
- Captures edges and concave areas, but doesn't deal with object interpenetration.

9.5) Reference Object

Map that creates a gradient. Areas inside a particular reference object is one color, outside is a second color, with controls for a soft transition (object can be Geometric, a special widget, even lighting). You use the resulting gradient to mix between materials or maps.



Examples In Software:

- 3dsMax Base Package: doesn't exist
- 3dsMax Plugins: Vray "VrayDistanceTex" map
- 3dsMax Plugins: Chameleon

Advantages:

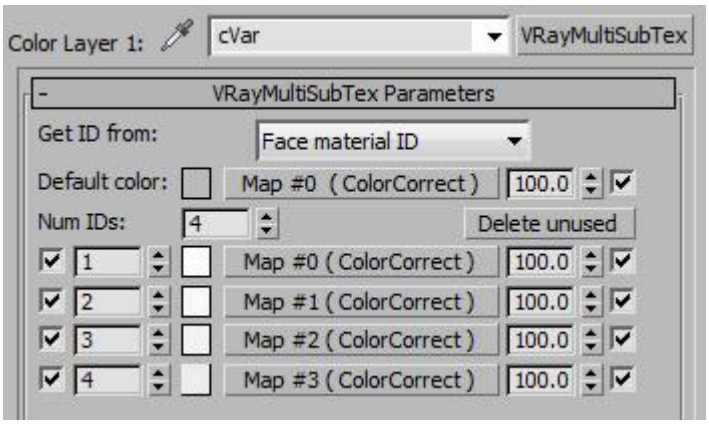
- Specific placement of a feature using an easy to manipulate object in 3d space.

Disadvantages:

- The Gradient isn't terribly useful as a pattern directly, has to be enhanced using some other method, like for example using Procedural Noise in XYZ Space.

9.6) Switcher

A switcher is the simplest of pattern placement. Basically, you define a set of patterns, and they get assigned to specific groups of objects, faces, etc., usually using some sort of ID value that connects the pattern to the thing its being applied to. So for example, you create a rock material that has 5 different rock colors, and then spread randomly the ID 1 to 5 on a bunch of rocks, and each rock receives one of the 5 rock colors.



Here's a lesson on switchers...

- Switchers For Randomizing Patterns
- Switchers For Specific Patterns On Specific Objects
- Switchers and IDs, Which To Use When

Examples In Software:

- 3dsMax Base Package: map switcher: Multi-map in 3dsMax (mentalray only and limited to 20 slots)
- 3dsMax Base Package: material switcher: Sub-object Material
- 3dsMax Plugins: map switcher: MultiIDMap by Grant Adam compatible with other renderers (not mr compatible, limited to 15 slots)
- 3dsMax Plugins: map switcher: VrayMultiSubTex (vray only)
- 3dsMax Plugins: map switcher: VrayHDRI (vray only)

- 3dsMax Plugins: texture map switcher: CG Source's MultiTextureMap
- Maya Base Package: Single Switch, Double Switch, Triple Switch, Quad Switch

Advantages:

- Great for adding variety to your scene without the need to create almost identical materials with only one or two small things changed.

Disadvantages:

- The Switcher result isn't terribly useful as a pattern directly, has to be combined with another pattern placement method (like UVs, for example).
- Objects / faces inside max can only have a single Material ID, so you can't switch multiple parameters independently of each other without using Mat IDs AND Object IDs. VrayHDRI can use User Defined Properties, which means any object can have unlimited named IDs, but it's Vray only and works only with bitmaps.
- In 3dsmax, there isn't a single full featured Switcher map that works in all renderers.

9.7) Direction

Map that creates a gradient. Areas pointing in a particular direction get one color, areas pointing away get a second color, and a soft transition in between. This can be in camera space (so faces pointing towards the camera get 1 color, faces perpendicular to the camera get another color), or this can be in world space (all faces pointing up in Z get one color, all other faces get the second color.) You use the resulting gradient to mix between materials or maps.

Here's a lesson on direction...

- Dust Material
- Complex Organic Materials Using Falloff
- Toon Material Using Falloff Maps

Examples In Software:

- 3dsMax Base Package: Falloff Map set to "Perpendicular / Parallel - Viewing Direction" or "Perpendicular / Parallel - World Z Axis", etc

Advantages:

- Useful for fresnel effects
- Useful for glowing energy effects
- Useful for dust / snow / wear that's landed on the up facing surfaces

Disadvantages:

- The Gradient isn't terribly useful as a pattern directly, has to be enhanced using some other method, like for example using Procedural Noise in XYZ Space.

9.8) Distance

Map that creates a gradient. Areas that are a certain distance from an origin point get one color, areas near a second origin get a second color, and a soft transition in between. Origins can be a point object in space, a coordinate in world space, the distance from a camera, etc. You use the resulting gradient to mix between materials or maps.

Examples In Software:

- 3dsMax Base Package: Falloff Map set to "Distance Blend - Viewing Direction" or "Distance Blend - World Z Axis", etc

Advantages:

- Useful if you want to fade colors on something as it gets further from the camera.
- Useful if you want everything above a certain height in your scene to receive some other material.

Disadvantages:

- The Gradient isn't terribly useful as a pattern directly, has to be enhanced using some other method, like for example using Procedural Noise in XYZ Space.

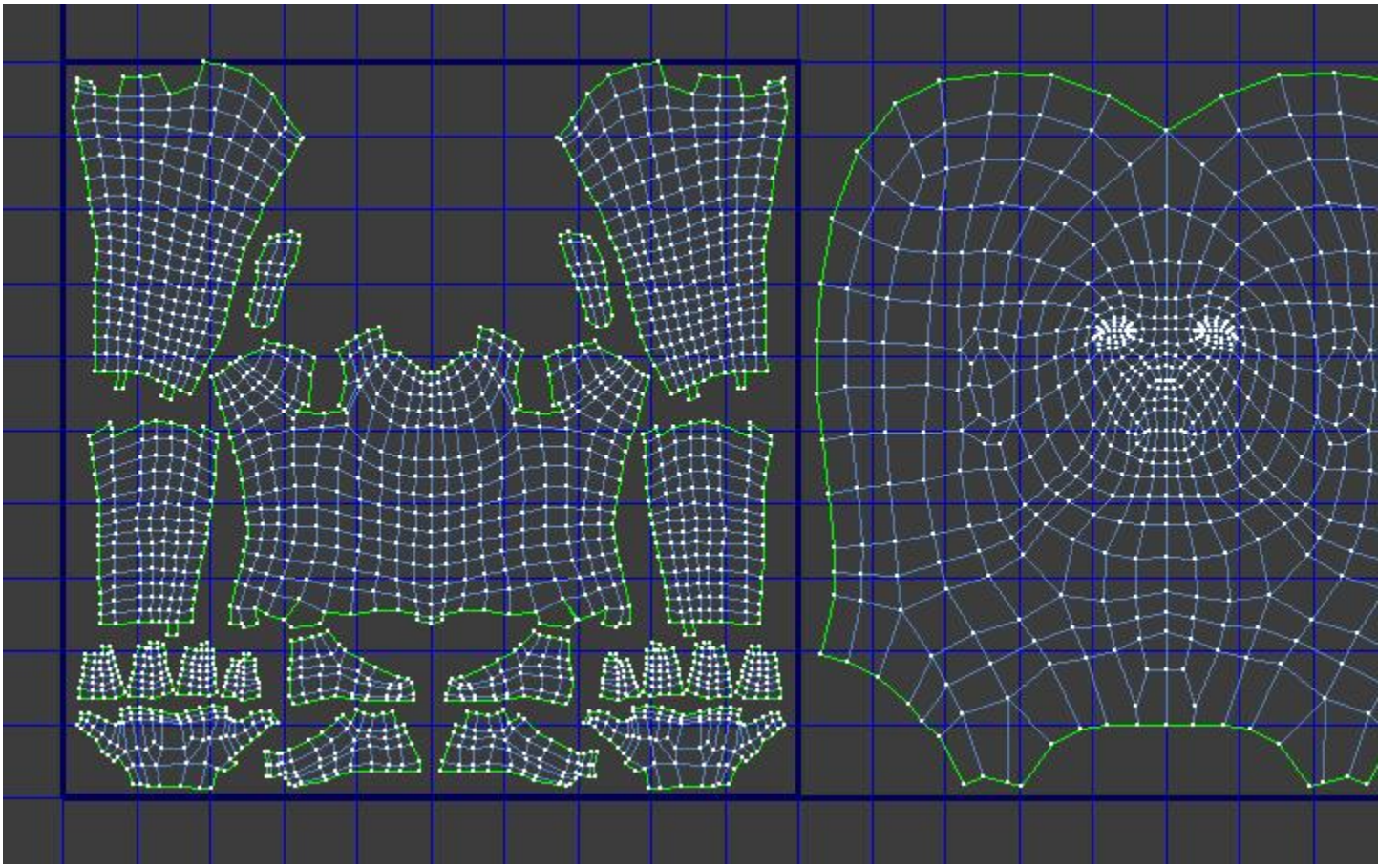
10) Specific Pattern Placement

Now lets look at the 6 Pattern Placement methods for Specific Patterns:

1. Atlas
2. Projections
3. UV Projections
4. Camera Mapping
5. Environment Mapping
6. 3D Paint

10.1) Atlas

A texture atlas is a large 2D image containing a collection of sub-images, or "atlas" which contains many smaller sub-images, each of which is a texture for some part of a 3D object. In other terms, this is breaking up your 3d model into flat sections and then applying the pattern to these. Frequently this is done using UVs, where you set up a set of flat 2D uvs that correspond to the vertexes of your 3d object. But Disney's 3d paint software also lets you flatten an area of a mesh to paint on while writing out the final paint to PTEX.



Here's a few lessons on Atlases...

- Multiple UV Tiles
- Pelt Mapping

Examples In Software:

- 3dsMax Base Package: UVWUnwrap Modifier (Manual Hand Editing, Pelt Mapping, Flatten Mapping, UVPacking)
- Maya Base Package: UV Texture Editor
- ZBrush: Auto Mapping
- UVLayout (Headus)

Advantages:

- Common technique that exists in pretty much every 3d app.
- You have a lot of control over how the pattern is placed on the surface

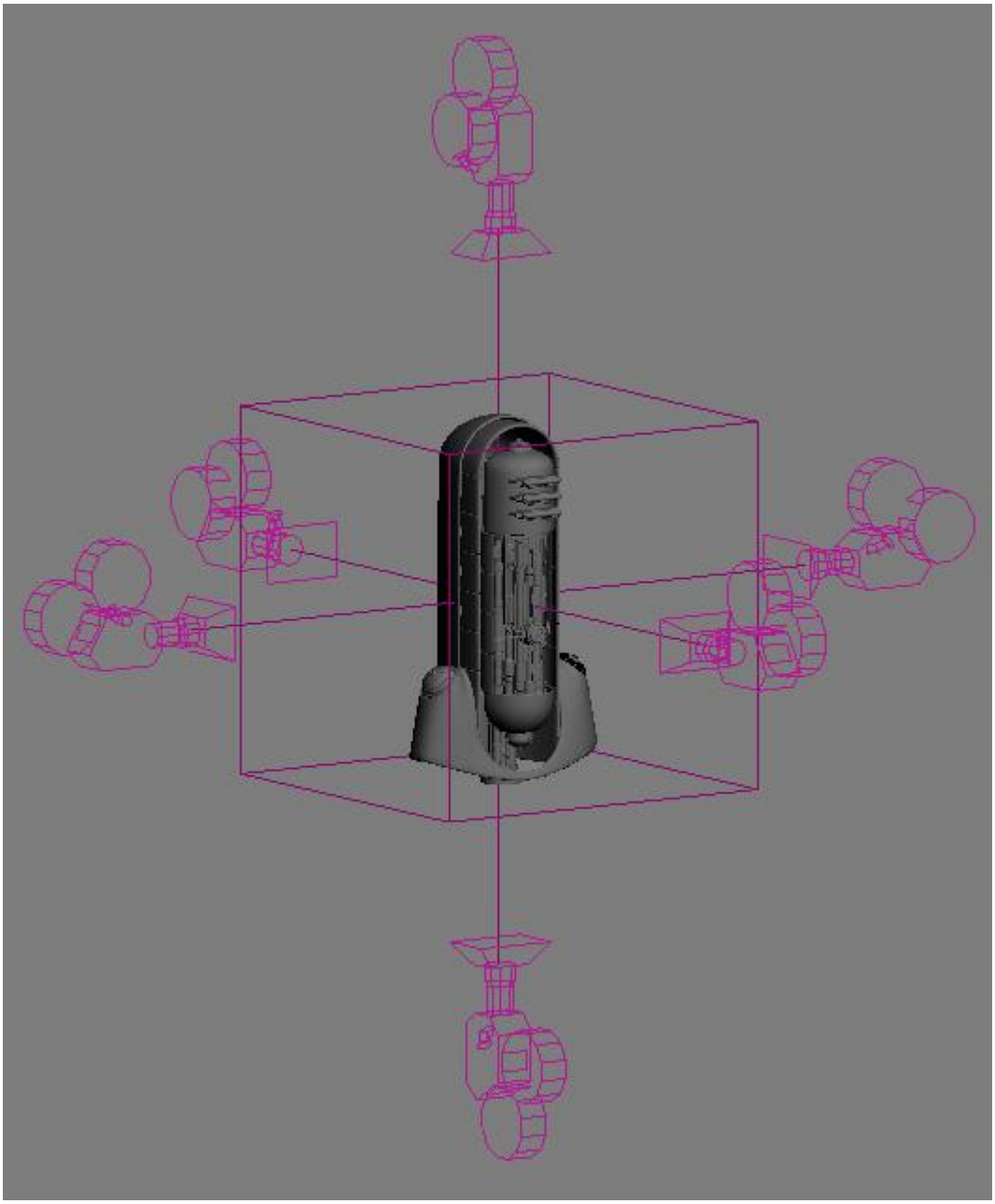
- Some patterns are more easily applied to a flattened object (like a stitch pattern on cloth)

Disadvantages:

- Extra memory is required if your object has multiple UV sets
- Changing the mesh can sometimes mess up your atlas.
- Takes time to setup, may not be the best method if you have 20,000 objects to shade.
- Sometimes hard to visualize the relationship between the atlas and the 3d model.
- Texture stretching can occur because you're trying to represent a 3d object in 2 dimensions.
- Possible artifacts at shell edges.

10.2) Projections

Your pattern is projected from a projector source. The Projection Source is decoupled from the object (like in Camera Mapping), but your camera isn't your final scene camera, and the camera is generally orthographic.



Here's a lesson on projections...

- Blended Cube Projection

Examples In Software:

- 3dsMax Base Package: doesn't exist. You could use the Camera Map to simulate a projection in 3dsMax, except 3dsmax's standard camera map is tied to the aspect of the

final render, whereas projections should have their own aspect ratio and size. Also, Camera Map in 3dsMax doesn't work with Orthographic cameras.
- 3dsMax Plugins: CameraMapGemini
- Maya Base Package: Hypershade, Create Maya Nodes, General Utility, Projection

Advantages:

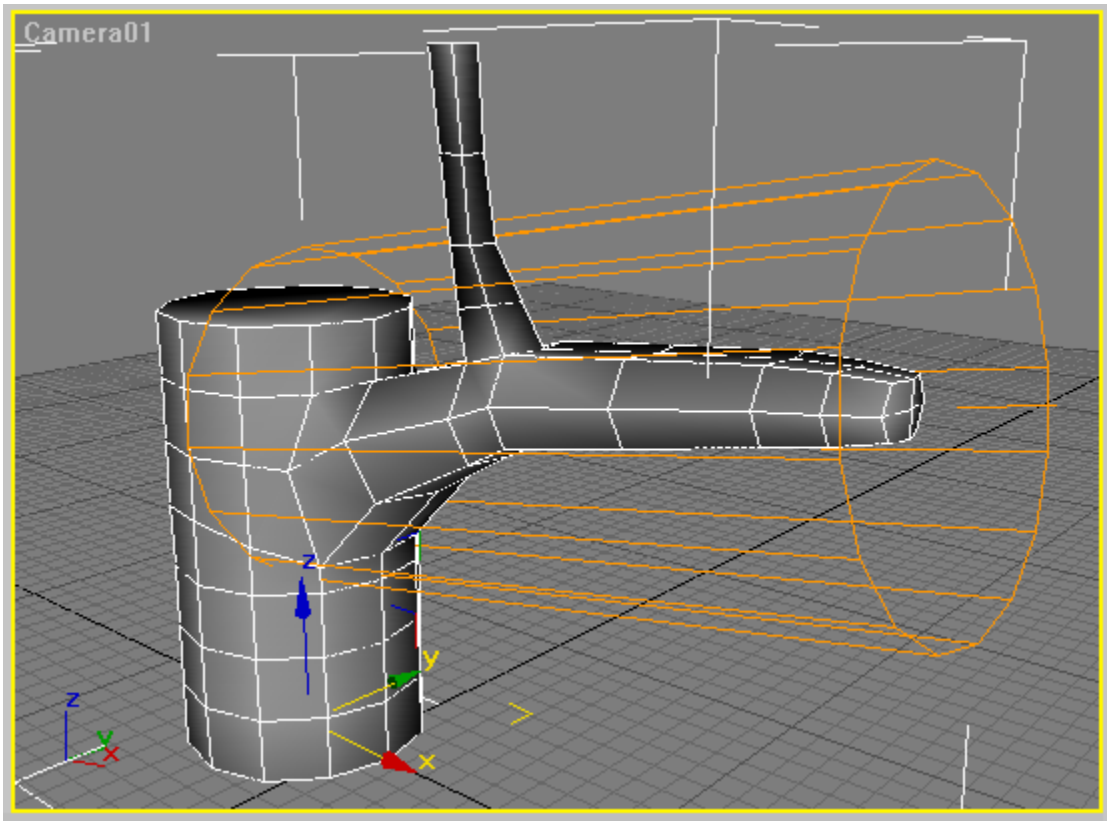
- Projections can be applied easily to an ever changing number of objects.

Disadvantages:

- Projections are more difficult to deal with if the object is round
- If your objects have a lot of overlaps, you need to assign many projections to add all the details.

10.3) UV Projections

This is a subset of Projections, your pattern is projected from a projector source. This pattern is applied via UVs. Ideally, this projector source is procedural so you can make tweaks to its size and position later on. Since they're applied as UVs, you can flatten the projector and then just treat the resulting UVs as an Atlas.



Here's a lesson on projections...

- Mapping Complex Shapes Using Multiple Map Channels

Examples In Software:

- 3dsMax Base Package: UVW Mapping Modifier: Planar, Cylindrical, Spherical, Shrink Wrap, Box, Spline Mapping (but this is not a procedural modifier, so once you're done editing, you can't go back and tweak)
- 3dsMax Plugins: Texture Layers (Mankua): Spline Mapping (this is a proper procedural modifier) and FFD Mapping
- Maya Base Package: Polygons -> Create UVs -> Planar Mapping, Cylindrical Mapping, Spherical Mapping, etc.

Advantages:

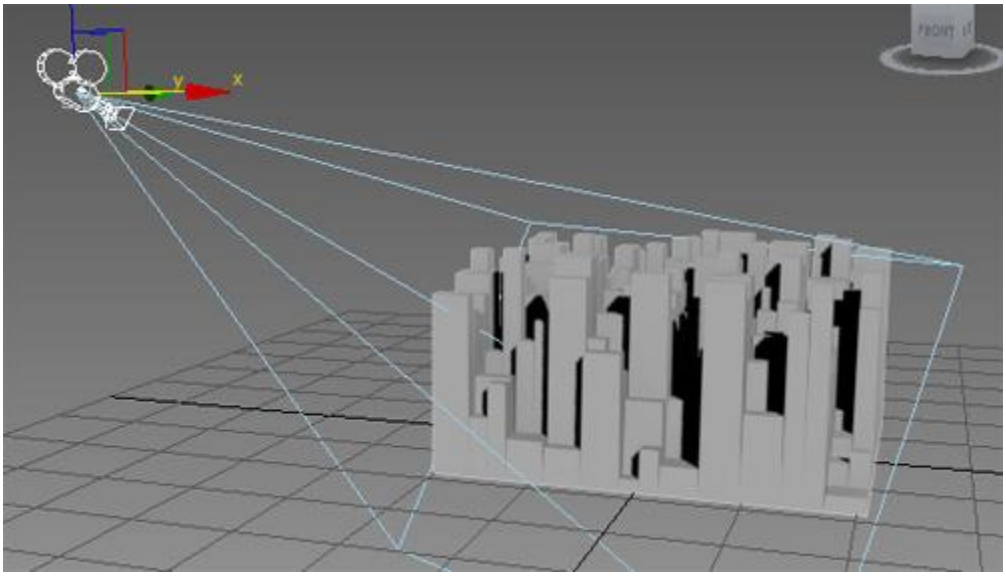
- Changes to your mesh will not mess up your projection
- Changing the projection can affect many objects at the same time

Disadvantages:

- Limited to certain shapes (plane, sphere, cylinder, etc.)
- In 3dsMax, difficult to add an object to an existing projection because of the way the modifier system works

10.4) Camera Mapping

This is another subset of Projections, but you project your pattern from the viewpoint of your final perspective camera, or a camera or set of cameras similar to your final camera. Frequently used in Matte Painting.



Examples In Software:

- 3dsMax Base Package: Camera Map Per Pixel
- 3dsMax Plugins: CameraMapGemini

Advantages:

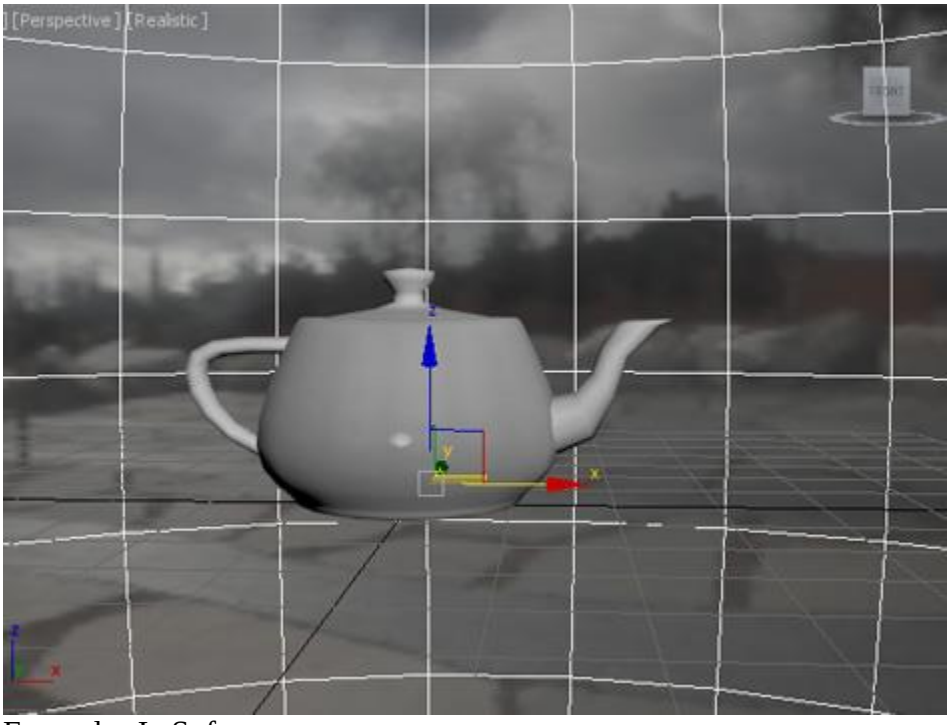
- Easy to visualize detail placement, since you're looking through the final Camera.
- Lets you add detail to only where you need it for your shot.

Disadvantages:

- If the camera moves a lot, you need to setup a lot or projections to avoid stretching
- In 3dsMax, map aspect ratio is locked to the final aspect ratio of the render, and doesn't allow Orthographic Cameras
- Camera Mapping is more difficult to deal with if the object is round
- If your objects have a lot of overlaps, you need to assign many camera maps to add all the details.

10.5) Environment Mapping

This is yet another subset of Projections, the map that is applied in world space, generally projected from an infinitely large sphere or cube towards your object. Used to simulate an environment to appear in reflections. This is in the Specific Pattern category since frequently you want to line up your environment map with the actual environment in your scene, or to your lighting. Could also be considered a General Pattern if using a generic Environment Map that doesn't relate to your scene.



Examples In Software:

- 3dsMax Base Package: Bitmap map, choose Spherical, Cylindrical, Shrink Map or Screen.
- Maya Base Package: Env Textures

Advantages:

- Much faster than ray tracing a real environment in your scene.

Disadvantages:

- This is useful for environments in reflections, not really useful for diffuse textures.

10.6) 3D Paint

Software that lets you paint on the model in a 3D view. Sometimes also called Tumble Paint. Paint can be applied to a 2d plane above your surface, and then the result gets projected onto your surface (Zbrush, Mari), or the paint can be applied directly to the surface (Mudbox). Or in many 3d apps you can use a paintbrush to paint colors on your vertexes.

Examples In Software:

- 3dsMax Base Package: Viewport Canvas
- Mudbox (Autodesk)
- BodyPaint 3D (Maxon)
- ZBrush (Pixologic)
- Mari (Foundry)
- Modo (Luxology)
- 3D Coat
- Vertex Paint Modifier

Advantages:

- Easy To Visualize Detail Placement
- See results as you paint them
- Round objects or objects with overlaps are no longer difficult to apply your pattern to.

Disadvantages:

- Usually requires model to be transferred to a separate application (Cameras tend to not transfer well)
- Need to buy and learn separate application
- What you paint in the viewport isn't always 100% what's rendered due to OpenGL limitations
- Generally not as full featured as a 2D paint program like Photoshop
- If you're using bitmaps and uvs with your 3d paint package, then this technique has all the added disadvantages of the atlas placement type and the bitmap storage type.

11) Pattern Storage And Texture Baking

Once you decide how you want to place your pattern, you have to decide how that pattern will be stored.

Now lets look at the 5 Pattern Storage methods:

1. Bitmaps
2. Vertex Colors
3. PTEX
4. 3D Volume
5. Algorithm

11.1) Bitmaps

This is the most common Pattern Storage method. The pattern is stored in a bitmap image and is applied to your object using UVs or projections.

Examples In Software:

- 3dsMax Base Package: Bitmap Map
- Maya Base Package: File map node

Advantages:

- Bitmaps are one of the most easily manipulated storage methods because so many applications allow you to edit them.

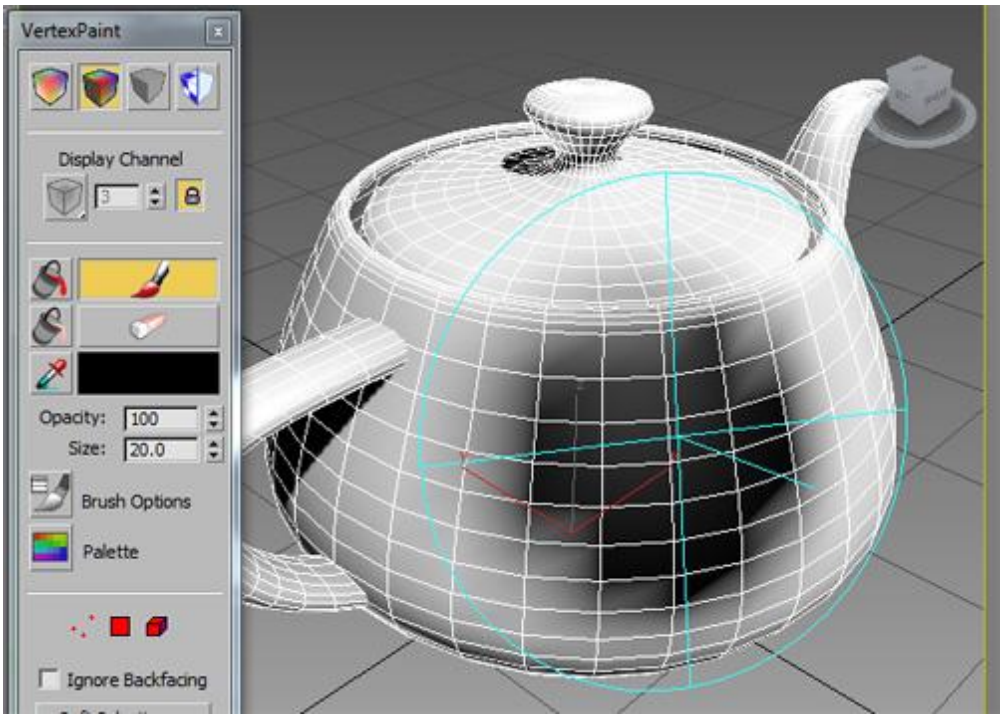
- Bitmaps tend to filter (antialias) easily.

Disadvantages:

- Many bitmaps or large bitmaps can take up a lot of memory.
- Limited resolution, if you save a bitmap that's too small, it will start looking bad as you get closer to your object.

11.2) Vertex Colors

Pattern is stored on the vertexes of your object. Each vertex has a color assigned.



Examples In Software:

- 3dsMax Base Package: EditablePoly, Edit Mesh Modifier (does not exist in Edit Poly Modifier), Vertex Paint Modifier
- Maya Base Package: Color Sets
- Zbrush: Polypaint

Advantages:

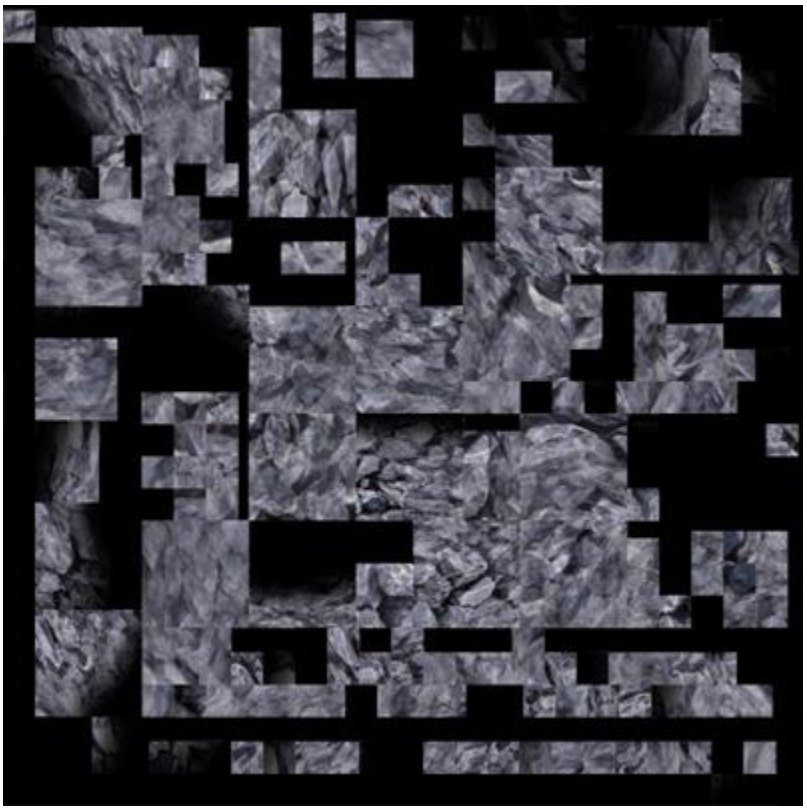
- Easy to visualize detail placement
- See results as you paint them
- Frequently built into the 3d App, so you don't need a separate application to paint with.

Disadvantages:

- Map is only as detailed as the amount of vertices in your mesh. So you need lots of geometry to get detail.
- Not a full featured paint program
- Some mesh operations can mess it up

11.3) PTEX

A per face mapping developed originally at Disney. Each face gets its own map, and these are collected together into a ptex file.



Here's a few lessons on PTEX...

- Ptex
- Ptex Use In Mudbox 2013

Examples In Software:

- 3dsMax Base Package: doesn't exist
- 3dsMax Plugins: Vray has ability to render Ptex maps.

- Mudbox: has ability to read and write ptex files

Advantages:

- No more uv setup, which means a lot of saved time
- No texture stretching. Setting up good uvs can be time consuming, and even the best uvs sometimes lead to faces receiving too many pixels compared to their neighbors, causing texture stretching to occur
- No artifacts at shell edges. When defining uvs, the edges between uv shells frequently leads to artifacts. Not so with Ptex.
- Each face can have a different resolution, so it's quite easy to add extra detail to a specific area of your model. More difficult to set this up with UVs.

Disadvantages:

- No photoshop support. Photoshop is the most common tool for painting textures in the industry, but it does not allow you to paint on Ptex files. As 3d paint programs like Mudbox, Mari, etc. become more feature complete, the need to use Photoshop to paint will probably decrease.
- Changing the geometry of the model (like adding or deleting faces or edges) requires you to bake the Ptex file from the old geometry to your new geometry with possible quality loss. This is a solvable problem, Mudbox for example has the ability to transfer ptex from one model to another. But it is an extra step you have to worry about.
- Ptex files are generally associated with their corresponding object by name, so Hand01.ptx is assigned to the 3d object in your scene called Hand01. So if you rename your model, you also need to rename its corresponding Ptex file.
- Again, since ptex are associated to their object by object name, if you have 200 objects that need an identical color map, its easier to do that using uvs than to create and maintain 200 identical ptex files that are named for each object.

11.4) 3D Volume

The pattern is stored in a 3d volume, such as a point cloud or brickmap file, and then projected at rendertime onto a surface, or in some cases the 3d representation is rendered itself.

Examples In Software:

- 3dsMax Base Package: doesn't exist
- Prman: Point Clouds and Brickmaps

Advantages:

- Paint exists in 3d space, just like your model
- Automatic mipmapping, objects further from camera can read coarser point clouds

Disadvantages:

- Can take up a lot of storage space
- Changing the mesh can sometimes mess up your point cloud.

11.5) Algorithm

The pattern is not stored at all, but is generated at rendertime by evaluating an algorithm at a point in space. Frequently this is true for procedural patterns.

Examples In Software:

- 3dsMax Base Package: Many procedurals (Noise, Smoke, Dent, Gradient Ramp, etc.)
- Maya Base Package: Many procedurals (Checker, Noise, Mountain, Ramp, Cloud, Marble, etc.)
- Darktree (Darksim)

Advantages:

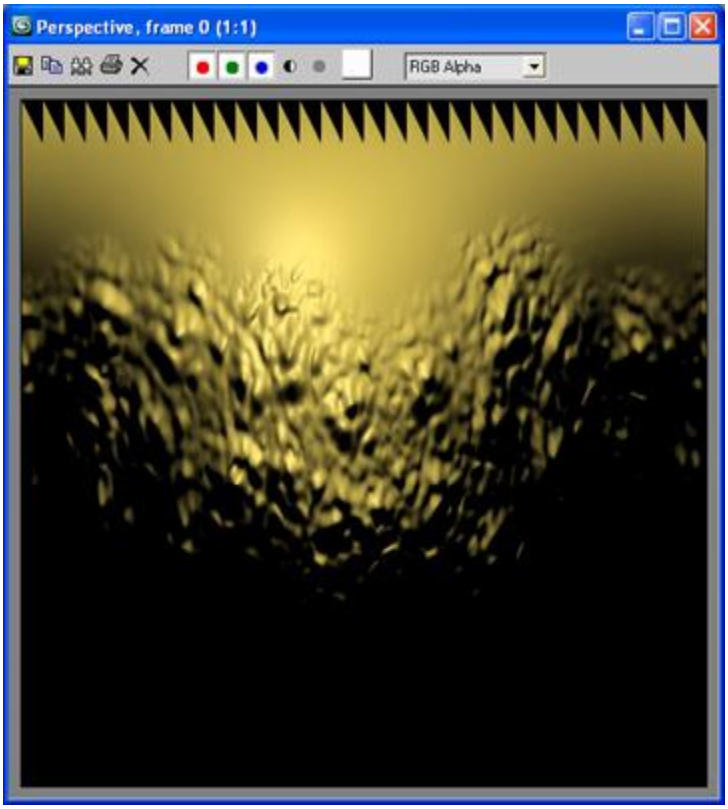
- Takes up no disk space
- Changing your geometry doesn't affect pattern
- most algorithms produce more detail as you get closer to your object

Disadvantages:

- Takes longer to render since it has to do calculations at rendertime

11.6) Texture Baking

Texture Baking is the process of converting the storage type from one type to another.



Baking Examples:

- Algorithm -> Bitmaps: Say you have a procedural in XYZ Space, but you want to edit it in a paint program, you can bake the Procedural pattern into a bitmap
- Algorithm -> Bitmaps: 3dsmax UVWMapping Modifier: XYZ to UVW, bakes procedural patterns using XYZ Space into UVs, good for deforming objects
- Algorithm -> Vertex Color: Baking Curvature into Vertex Colors using SoulburnScript CornerEdgeToVertexMap
- Algorithm -> Bitmaps or PTEX: Baking Occlusion into UVs / Bitmaps or PTEX, so the occlusion doesn't change when the object moves / deforms
- Bitmaps / Algorithm -> Bitmaps: Baking Multiple Maps Into Single Map Using UVs (which can speed up renders)
- Baking sculpted details into displacement map or normal map using UVs / Bitmaps or PTEX (common workflow for transferring sculpted models from ZBrush or mudbox to max / maya / xsi)

Here's a lesson on Texture Baking...

- Texture Baking: Baking Patterns To Use In An Incompatible Render

Examples In Software:

- 3dsMax Base Package: Texture Baking
- 3dsMax Plugins: Flatiron

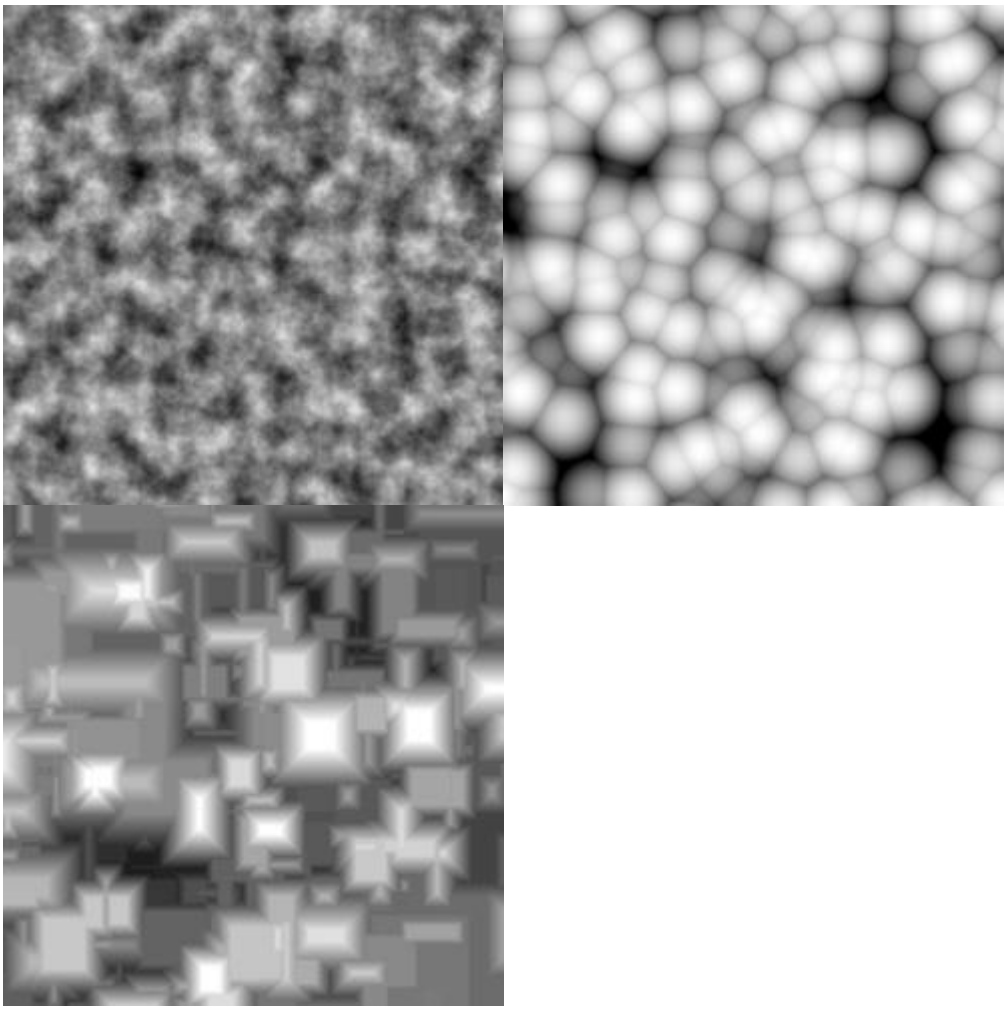
12) Pattern Creation

So now that you've looked at the different ways to place your patterns, and how to store them, you need to decide a method to create these patterns. The 3 main ways are...

- Procedurals
- Painting
- Photo Manipulation

12.1) Procedurals

Algorithmically defined patterns. Great for General Patterns.



Here's a few lessons on procedurals...

- Fractal Noise
- Procedural Noise

Examples In Software:

- 3dsMax Base Package: Many procedurals (Noise, Smoke, Dent, Gradient Ramp, etc.)
- Maya Base Package: Many procedurals (Checker, Noise, Mountain, Ramp, Cloud, Marble, etc.)
- Darktree (Darksim)
- FIlterforge
- Allegorithmic MaPZone, one of the few procedural packages that let you "move" details, which may make it useful for Specific Patterns.

Advantages:

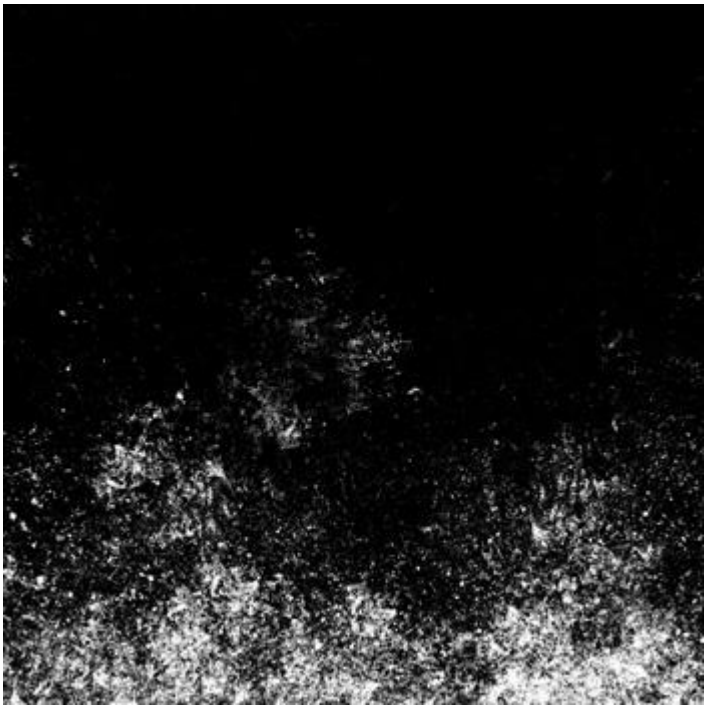
- Unlimited Resolution
- Easy To Create Pattern Fast
- Easy to change some features like overall size of pattern
- Takes up less memory than large bitmaps

Disadvantages:

- Difficult to get a complex look without layering lots of procedurals together, or programming your own.
- Sometimes slower to compute than a bitmap due to extra calculations
- Generally more difficult to anti-alias than a bitmap, which means potentially longer rendertimes or sparkling
- Very difficult to place specific details exactly where you want them, hence not the best option for Specific Patterns.

12.2) Painting

Using brushes and filters in a piece of paint software and create a digital pattern. Can be used to make General or Specific Patterns.



Here's a few lessons on painting textures...

- Additive Mode In Photoshop
- Spun Pattern
- Weathering A Model: It's All About Erasing The Dirt

Examples In Software:

- Photoshop (Adobe)
- Painter (Corel)
- 3dsMax Base Package: Viewport Canvas
- BodyPaint 3D (Maxon)
- Mudbox (Autodesk)
- ZBrush (Pixologic)
- Mari (Foundry)
- Modo (Luxology)
- 3D Coat

Advantages:

- You can get a pattern to look exactly how you want
- Sometimes faster to calculate than procedurals, since the final color is read from a bitmap rather than calculating a complex algorithm

- Easier to antialias than a procedural

Disadvantages:

- It takes time since much of the process is manual. The use of custom brushes can help speed up the process.
- Resolution is not unlimited, you have to pick a res and then stick with it.
- Large bitmaps take up more memory than many procedurals.

12.3) Photo Manipulation

Taking photos and editing them to get the result you want. Many times combined with Manual Painting. Source photos should be preferably taken on cloudy day so you get pure flat color without lighting information. Can be used to make General or Specific Patterns.

Here's a few lessons on photo manipulation...

- Changing A Photoshop Layer's Color To A Different Color While Keeping Transparency
- Converting A Grayscale Image To Black On Transparent
- Cropping An Image That's Off The Canvas
- Removing Brightness Variation To Make Tileable Textures

- Offset Filter To Make Tileable Textures
- Scratch Patterns Using A Scratchboard
- Weathering A Model: Extracting A Pattern From A Photograph

Examples In Software:

- Photoshop (Adobe)

Advantages:

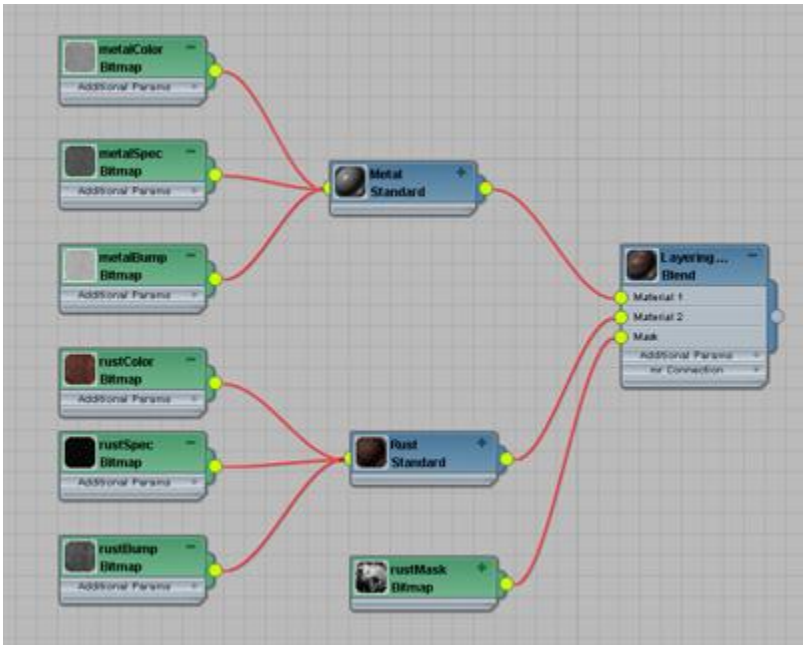
- You can start from something realistic right off the bat.
- Sometimes faster to calculate than procedurals, since the final color is read from a bitmap rather than calculating a complex algorithm
- Easier to antialias than a procedural

Disadvantages:

- Removing artifacts from your photos can take time (such as removing lighting information from your photo)
- You have to have a photo of what you want in order to get a result (which is why this is frequently combined with manual painting).
- Removing the specific details from the Photo can take time
- Resolution is not unlimited, you have to pick a res and then stick with it.
- Large bitmaps take up more memory than many procedurals.

13) Layering

Now we combine the shaders and patterns to create your final result.



Three methods:

- Layering Materials
- Layering Patterns
- Layering In Paint Program

Here's a lesson on layering...

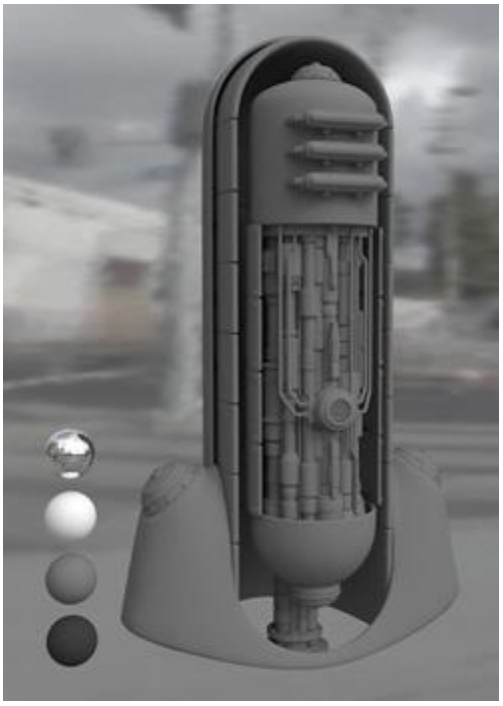
- Layering Materials

Examples In Software:

- 3dsMax Base Package: Composite Material, Blend Material, Composite Map, Mix Map, Mask Map
- 3dsMax Plugins: CompositeMode (Michael Spaw) and sciAnaComp (David Gohara)
- 3dsMax Plugins: VRayBlendMtl
- Maya Base Package: Layered Texture

14) Lighting Rigs

To see the results of your material, I highly recommend you creating a standardized lighting rig to view all your models in.



A lighting rig should ideally…

- Show off the local color of the object
- Show off your Reflectivity, Spec and Bump
- Be similar to the rig your lighter will use.
- Be used to show off every model for consistency

Having all 4 things 100% is almost impossible, so you do the best you can to make a compromise lighting rig.

Here's a lesson on creating a lighting rig...

- Neutral Lighting Rig

15) Final Material

The final step is taking your layered material, testing it in your lighting rig, and now you have your final material.

Conclusion

So hopefully this gives you a little more information on not only how to go about shading an object, but also the different methods you can use and what are their advantages and disadvantages. I use a lot of different methods, use what's easiest for a particular situation. My

most commonly used techniques are...

Hard Surface Models:

- General Patterns:
  - XYZ Space - Algorithm - Procedural
  - Blended Box Maps - Bitmaps - Painting / Photo Manipulation
  - Occlusion - Algorithm - Procedural
  - Curvature - Vertex Colors - Procedural
  - Switcher
- Specific Patterns:
  - Projection - Bitmaps - Painting / Photo Manipulation

Organic Models:

- General Patterns:
  - Blended Box Maps - Bitmaps - Painting / Photo Manipulation
  - Switcher
- Specific Patterns:
  - Atlas - Bitmaps - Painting / Photo Manipulation
  - 3D Paint - Bitmaps / PTEX - Painting / Photo Manipulation

So knowing there are lots of options out there, the advantages and disadvantages of each will hopefully let you texture objects faster and more efficiently. Oh, and here's a tutorial called Dirty Rusty Decaled Painted Worn Metal that's a good practical example of most of the pipeline I discuss above.