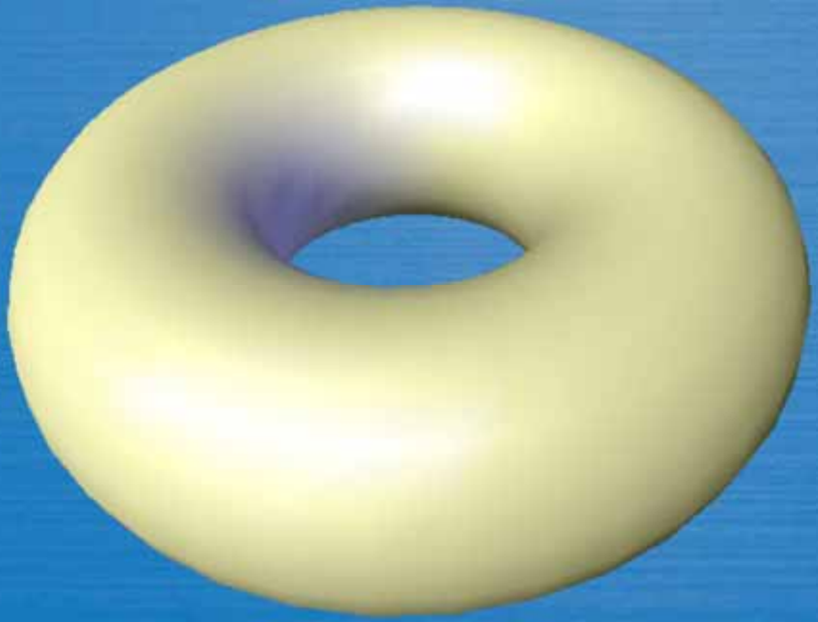
An Image Synthesizer

Ken Perlin (1985)

Presented by Marc Olano

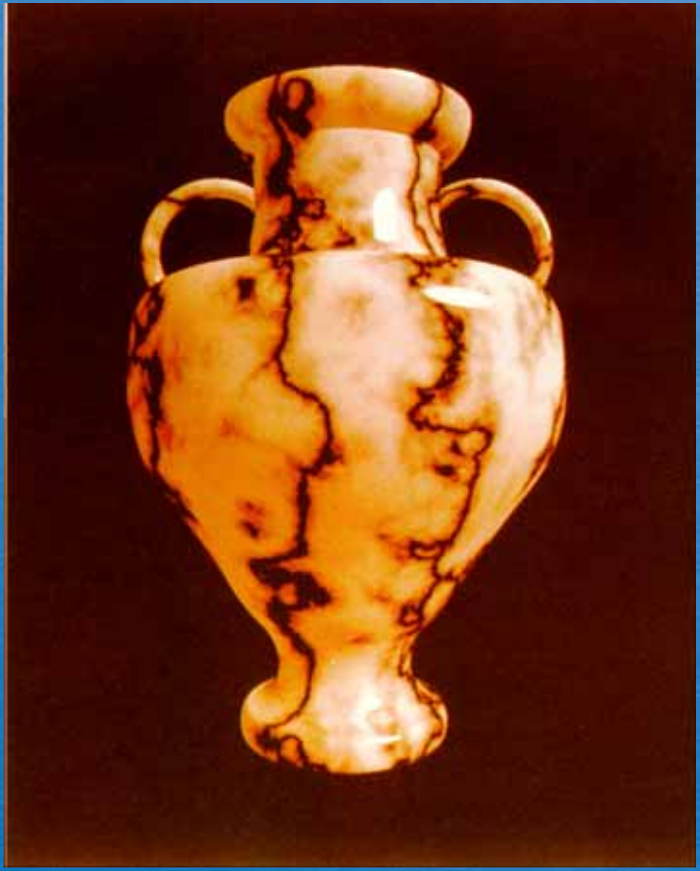
Traditional Graphics

- Fixed functions
- Hard to change
- Simple



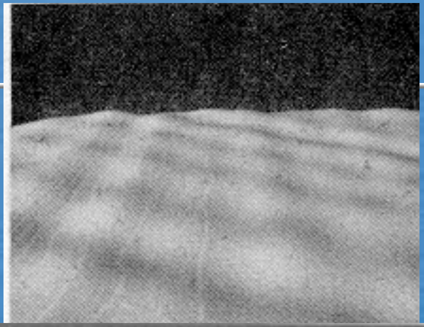
Pixel Stream Editor

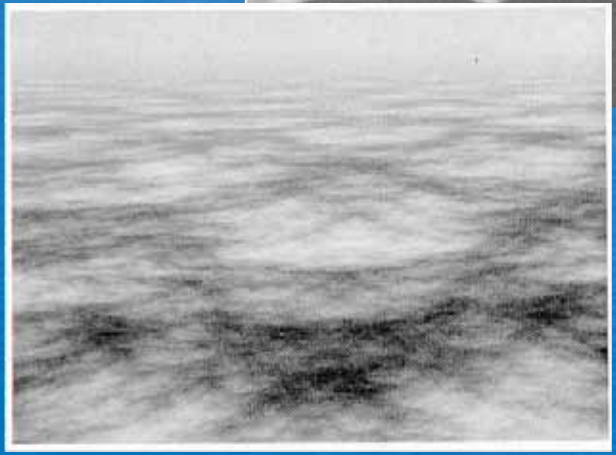
- High-level programming
- Realistic stochastic natural texture
- Solid texture



Related Work

- Programmable Shading
  - Shade Trees [Cook 1984]
- Stochastic Texture
  - [Schacter 1980]
  - [Fournier et al. 1982]
  - [Gardener 1984]





Organization

- Introduction & Related Work
- Pixel Stream Editor
- Noise
- Conclusions

Pixel Stream Editor

- High-level language
- Runs on every pixel
  - Fat pixels [surface point normal …]
- Interpreted
- Fast design cycle
  - Edit + view low resolution < 1 minute

High level language

- Includes *if*

```
if surface == 1
     color = [1 0 0] *
          max(0.1, dot(normal, [1 0 0]))
else
     color = [0 0 0.1]
```

- and loops

```
f=1
while f < pixel_freq
     normal + = Dnoise(f * point)
     f*=2
```

Language Features

- Indentation = nesting
- Scalar & vector variables
- User-defined functions
- Rich built-in functions
  - dot, norm, direction, Noise, …

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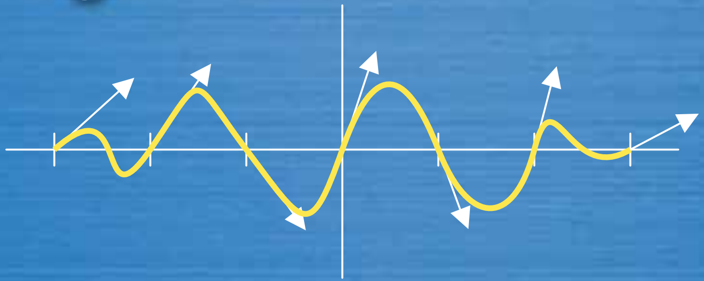
Noise

- Tool for Stochastic Solid Textures
  - Statistical invariance under rotation
  - Statistical invariance under translation
  - Narrow bandpass

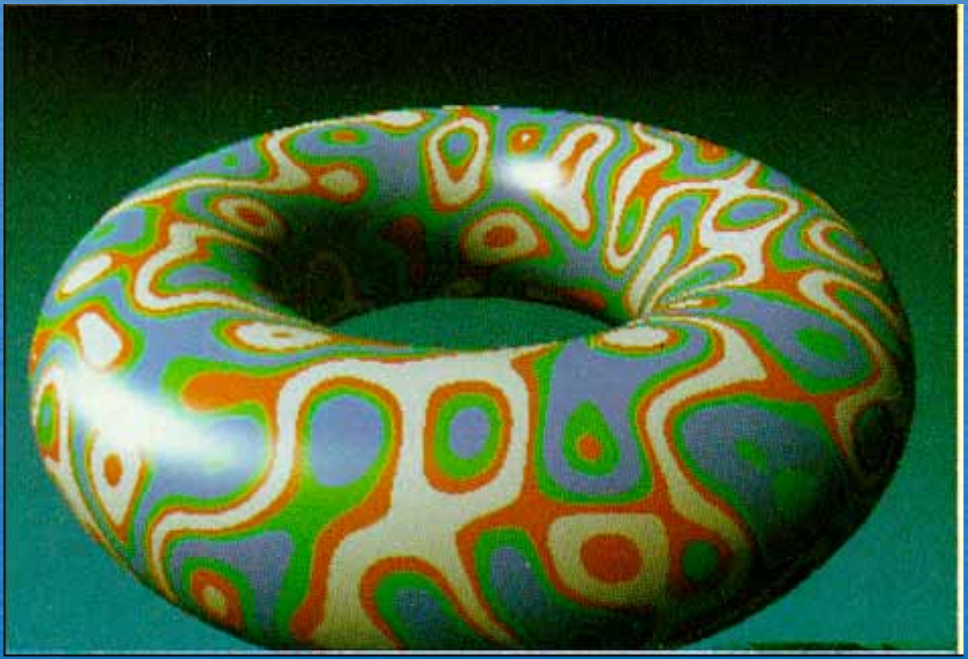
Noise details

- When x,y,z integer = integer lattice
- On lattice
  - Noise=0
  - Random gradient
    - Hash(x,y,z)
- Off-lattice
  - Smooth interpolation



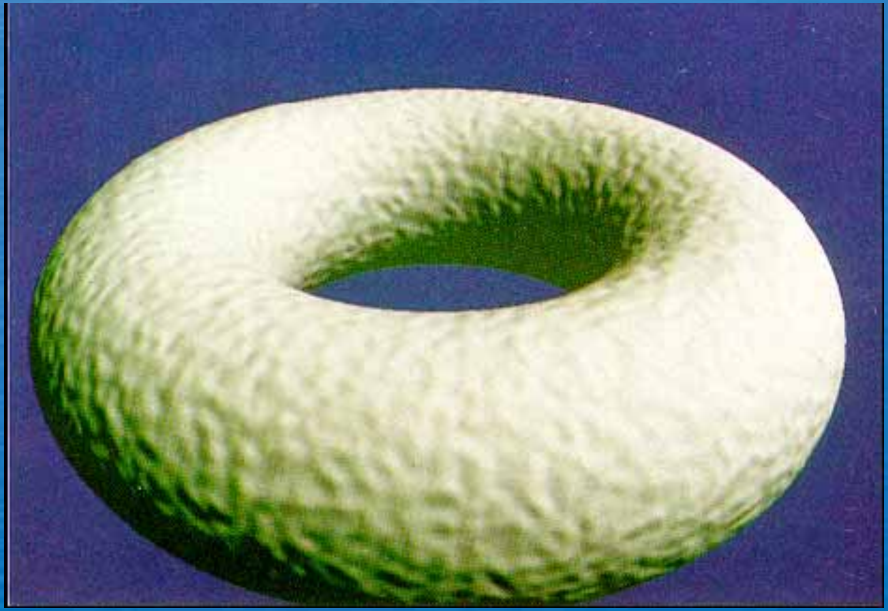
Compute Using Noise

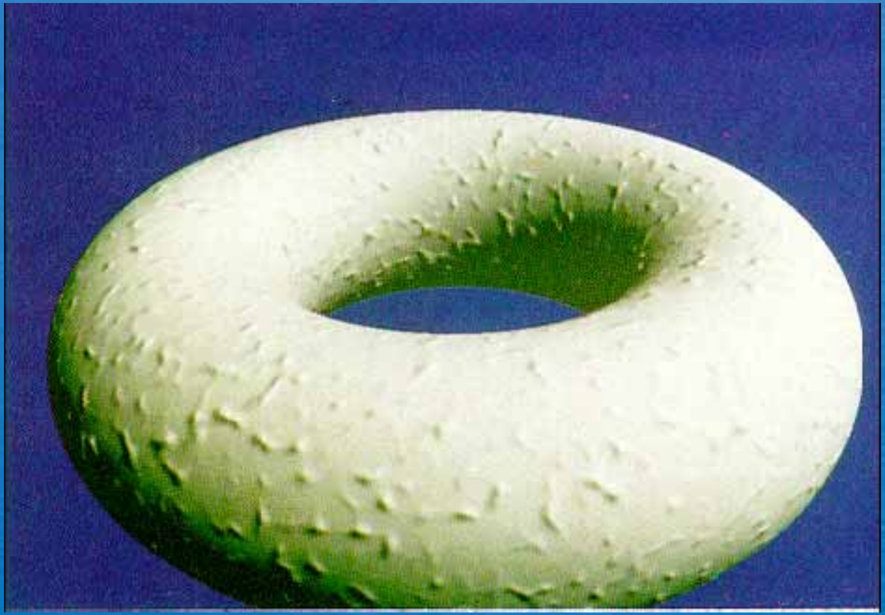
```
Colorful(Noise(k * point))
```



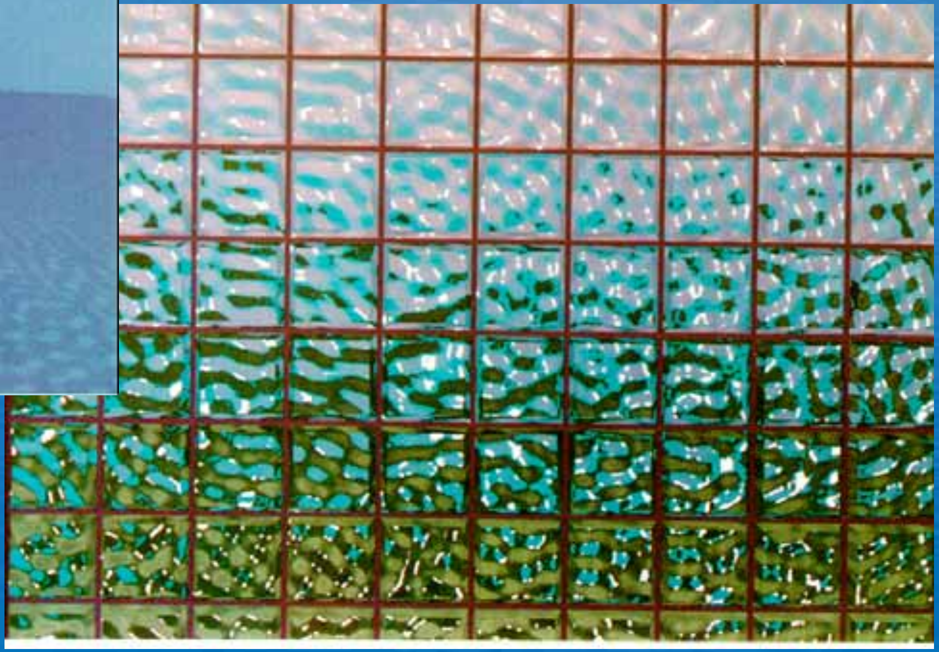
Bumps & Noise Derivative

```
normal += Dnoise(point)
```



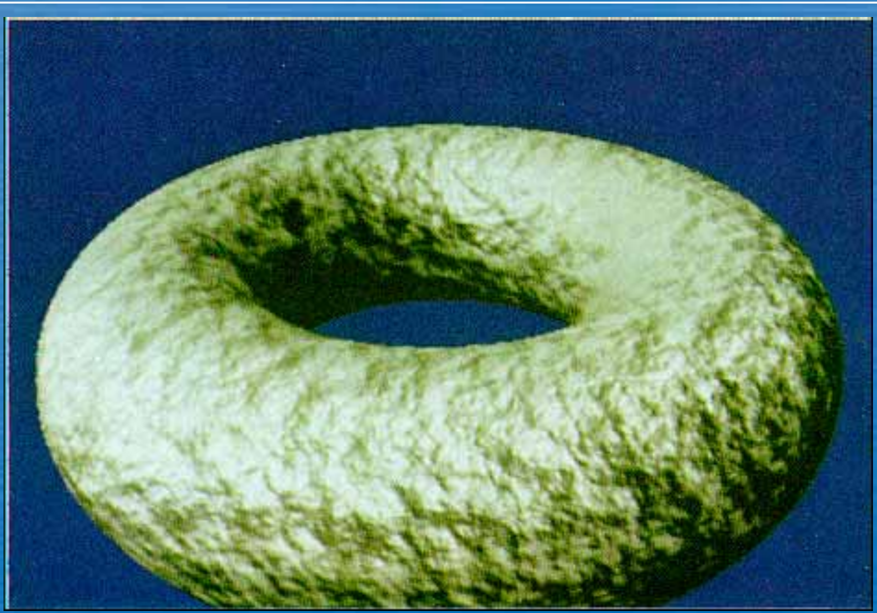


Noise Bumps & Refraction



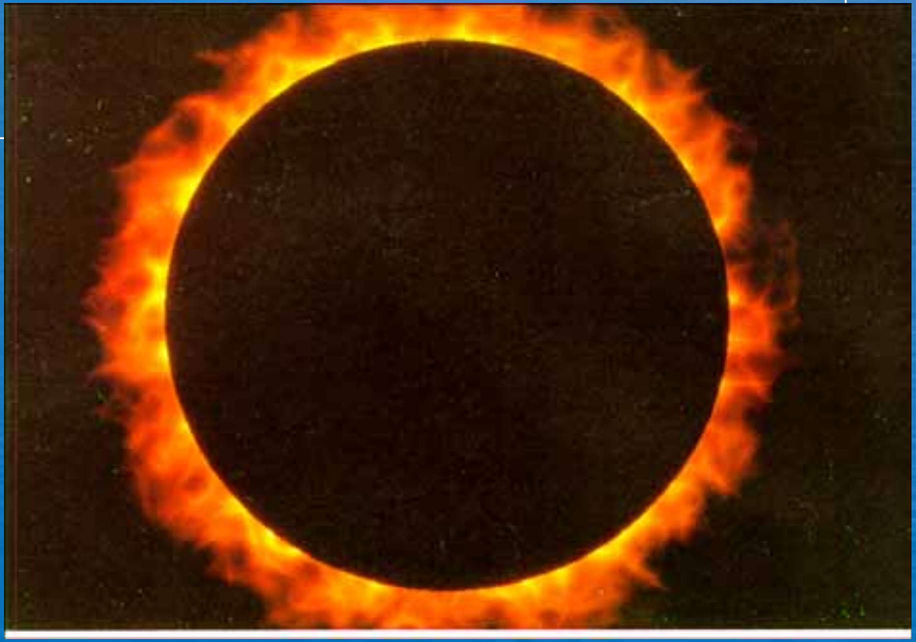
Frequency Composition

```
f=1
while f < pixel_freq
     normal + = Dnoise(f * point)
     f*=2
```

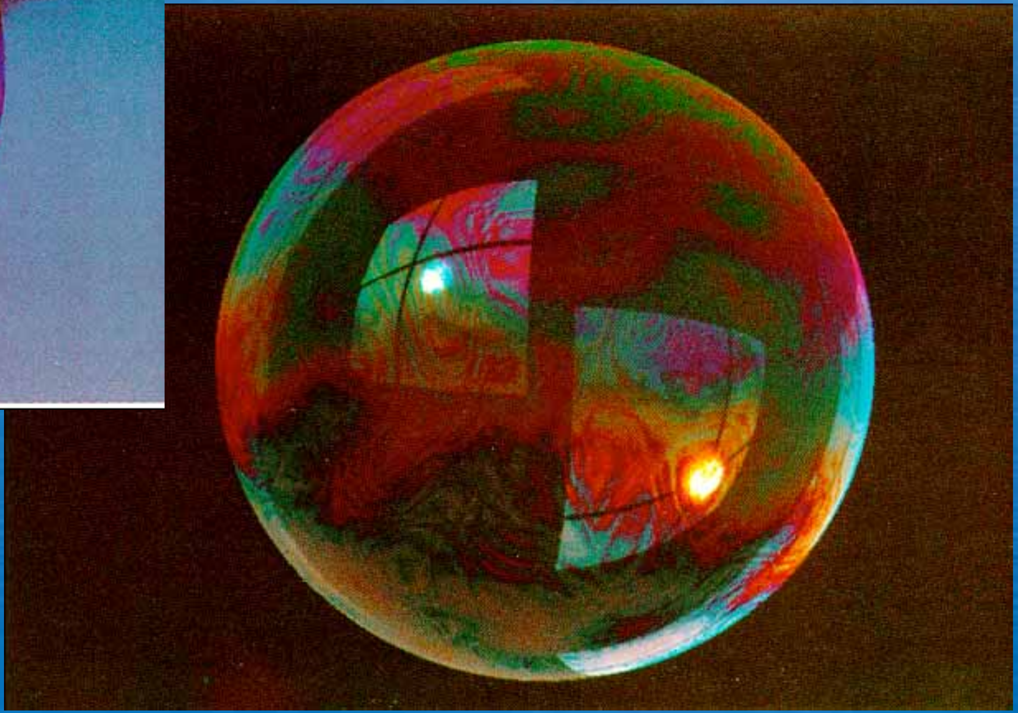


Turbulence

```
t=0
scale = 1
while (scale > pixelsize)
     t + = abs(Noise(p / scale) * scale)
     scale/= 2
return t
```



Turbulence & Diffraction



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Conclusions

- New approach for designing texture
- Fast and easy iterative design
- Powerful new Noise primitive
- Stochastic solid textures