Evolutionary Design of BRDFs

Jennis Meyer-Spradow
Universität Hannover

Jörn Loviscach
Hochschule Bremen
Outline

- Genetic Art
- Application to BRDFs
- Examples
- Implementation
Genetic Art

Genetic Algorithms ...
- to create graphics, sounds, etc.
- with a human in the loop to evaluate the results
Genetic Art: Karl Sims


Genetic Images, 1993

(round (log (+ y (color-grad (round (round (+ y (log (invert y) 15.5) x) x)) (log (invert y) 15.5)) x) 3.1 1.9)

http://www.genarts.com/karl/
Genetic Art: Kai Krause

MetaTools Kai’s Power Tools 2.1: Texture Explorer, 1994
Evolutionary Design

• explore a vast space of possibilities
• no complex parameters to control (and learn)
• learn what is possible and be inspired by the things found on the way
• no clear idea needed in advance
Application to BRDFs

Genetic programming of \( f(\omega_{\text{out}}, \omega_{\text{in}}) \)

as pixel shader on a graphics card

Intuitively generate complex “looks”...

- without dozens of parameters
- that nobody has conceived before, no Phong/Blinn/Cook-Torrance + x
Examples

100 genetic instructions

Videos

COS H4.zw, -H2.x;
DST H2.xyz, H4.zxyy, -H1.yxxz;
DP3 H4.yw, -H2.xyxz, H6.yzzx;
COS H4.xw, -H5.y;
FX3C H3.xzw, H6.zw;
Implementation

Surround the genetic code with other code to ensure that:

- result is physical (non-negative, reciprocal)
- result depends smoothly on direction (can’t use simply $\phi$, $\theta$)

Optimize against code bloat.
Questions?