Компьютерная графика. Часть 3.

Лектор – доц. Беляев Сергей Юрьевич.

Оглавление

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1. Bump mapping

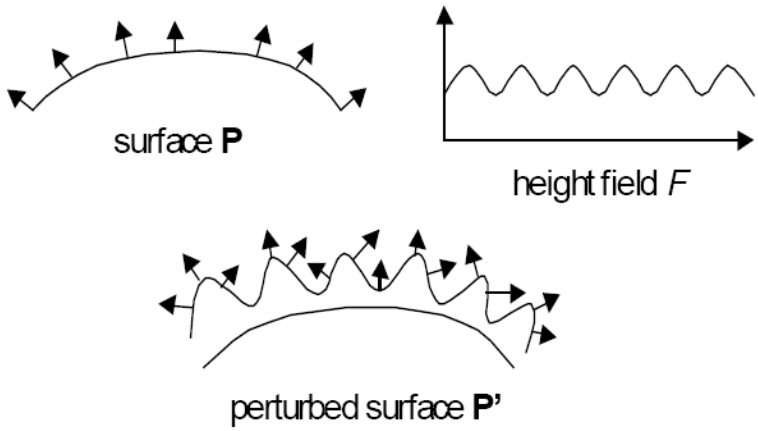


Рис. 1

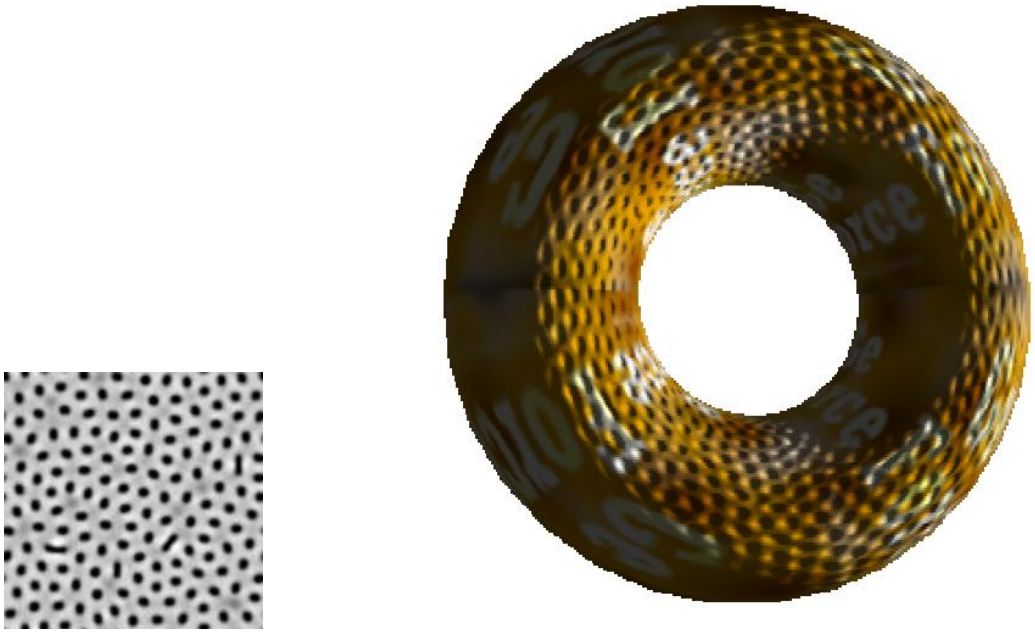


Рис. 2

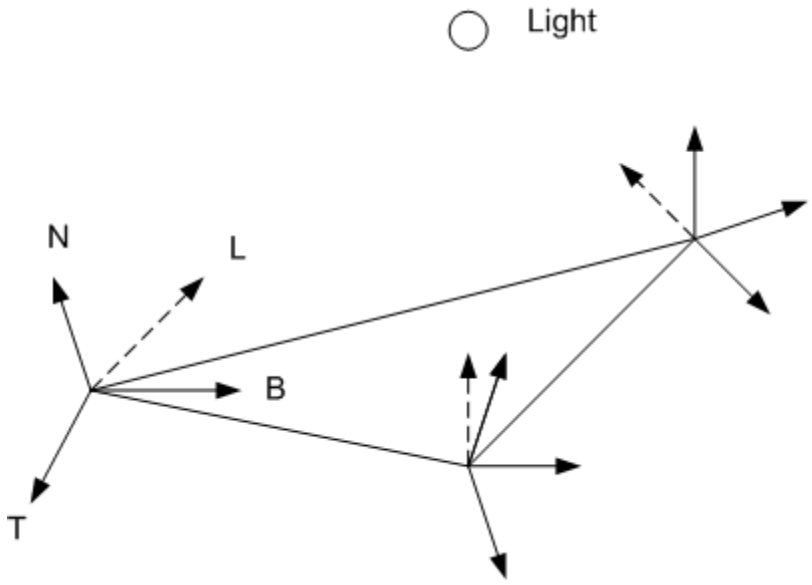


Рис. 3

Pixel:

L, Np=Texure[u,v]; => (Np,L)

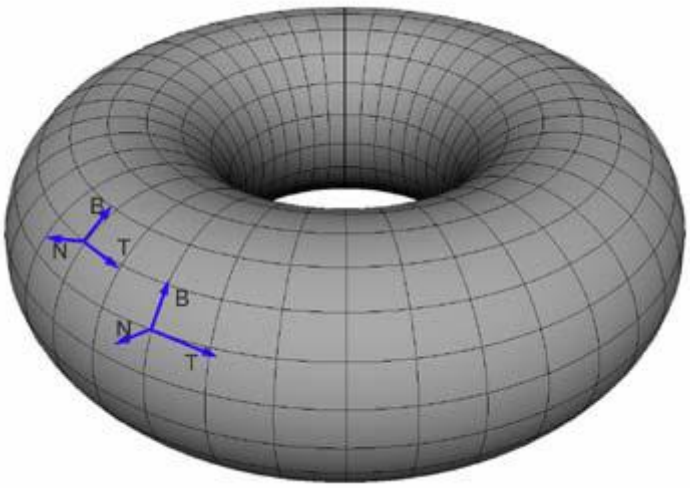


Рис. 4

T - target
B - bi-normal

$$L = L * \begin{bmatrix} Tx & Nx & Bx \\ Ty & Ny & By \\ Tz & Nz & Bz \end{bmatrix}$$

Vertex: Pos, N, T, TexCoord …
B=(NxT)
VertexSader output: L(в T,N,B системе координат), TexCoord …
+Pos (камерной системе координат) если точечный или конусный
Specular bump mapping: + H (for (N,H))

2. Per-pixel displacement mapping

a. Parallax mapping

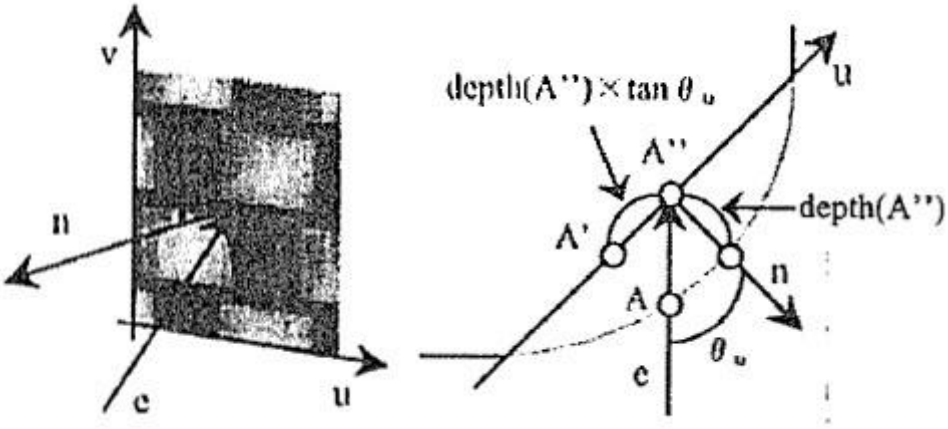


Рис. 5

Рис. 6

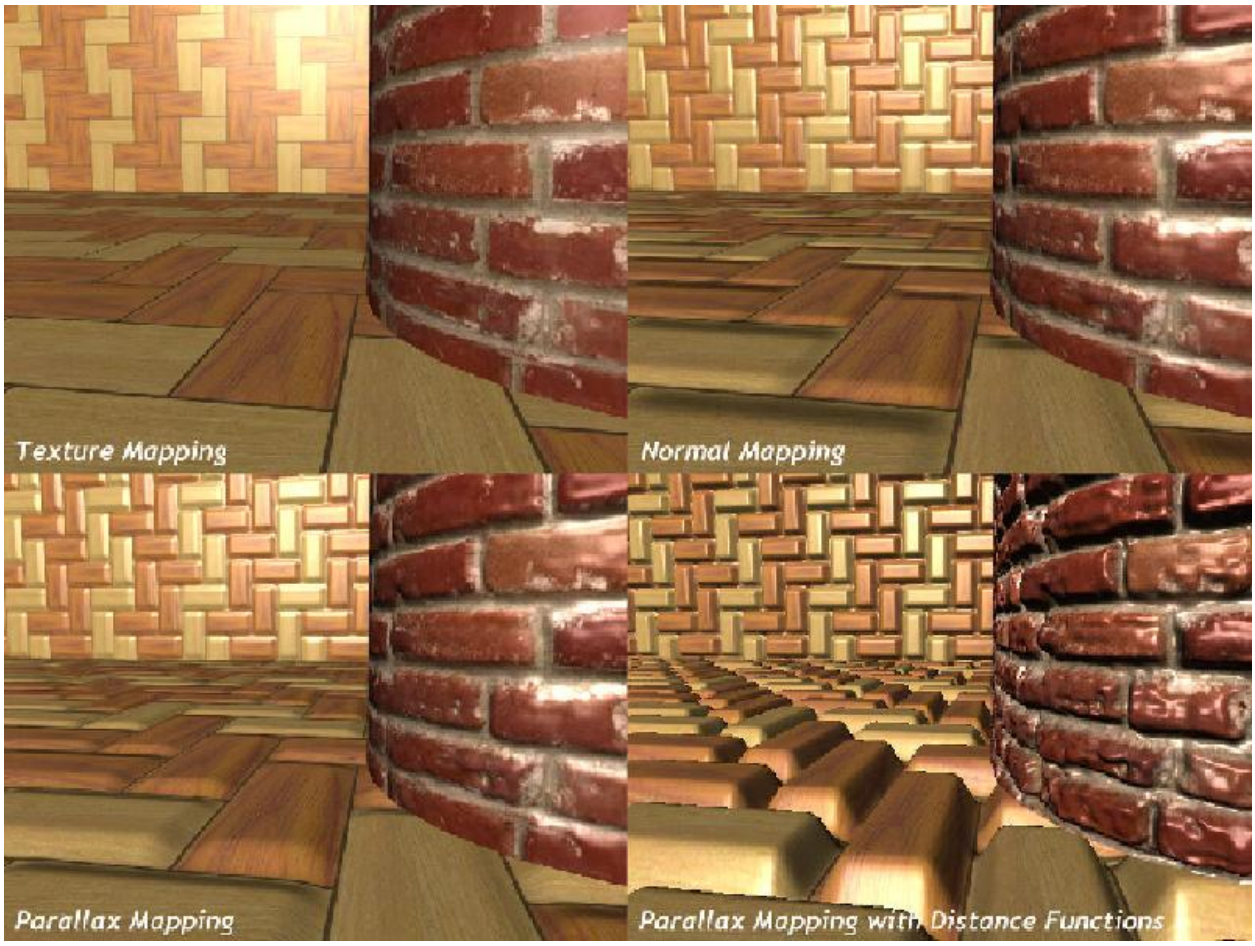


Рис. 7

b. Parallax occlusion mapping

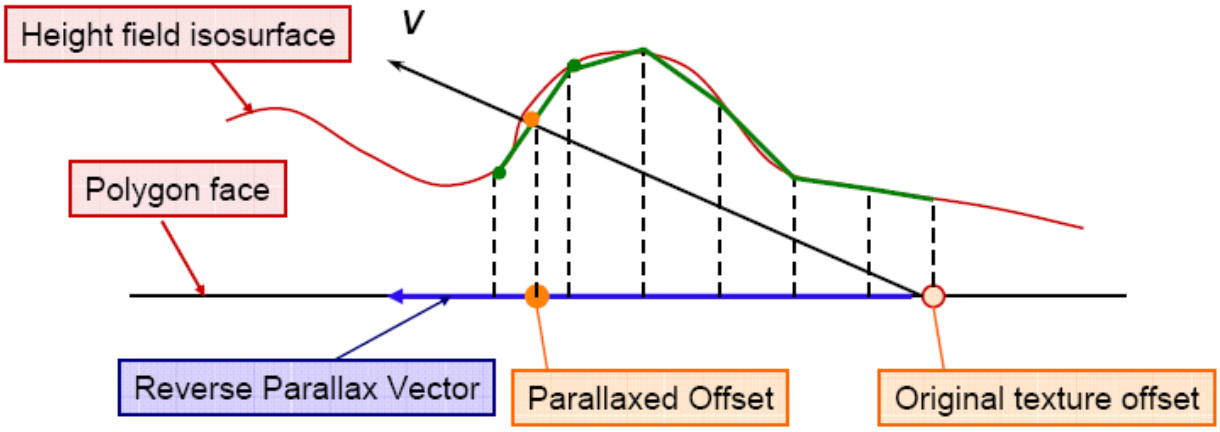


Рис. 8

Рис. 9

c. Self-Occlusion and Shadows

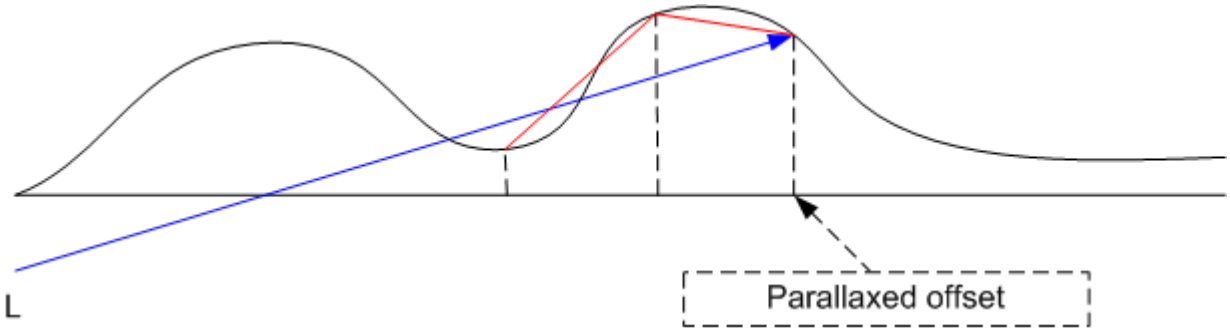


Рис. 10

3. Displacement mapping

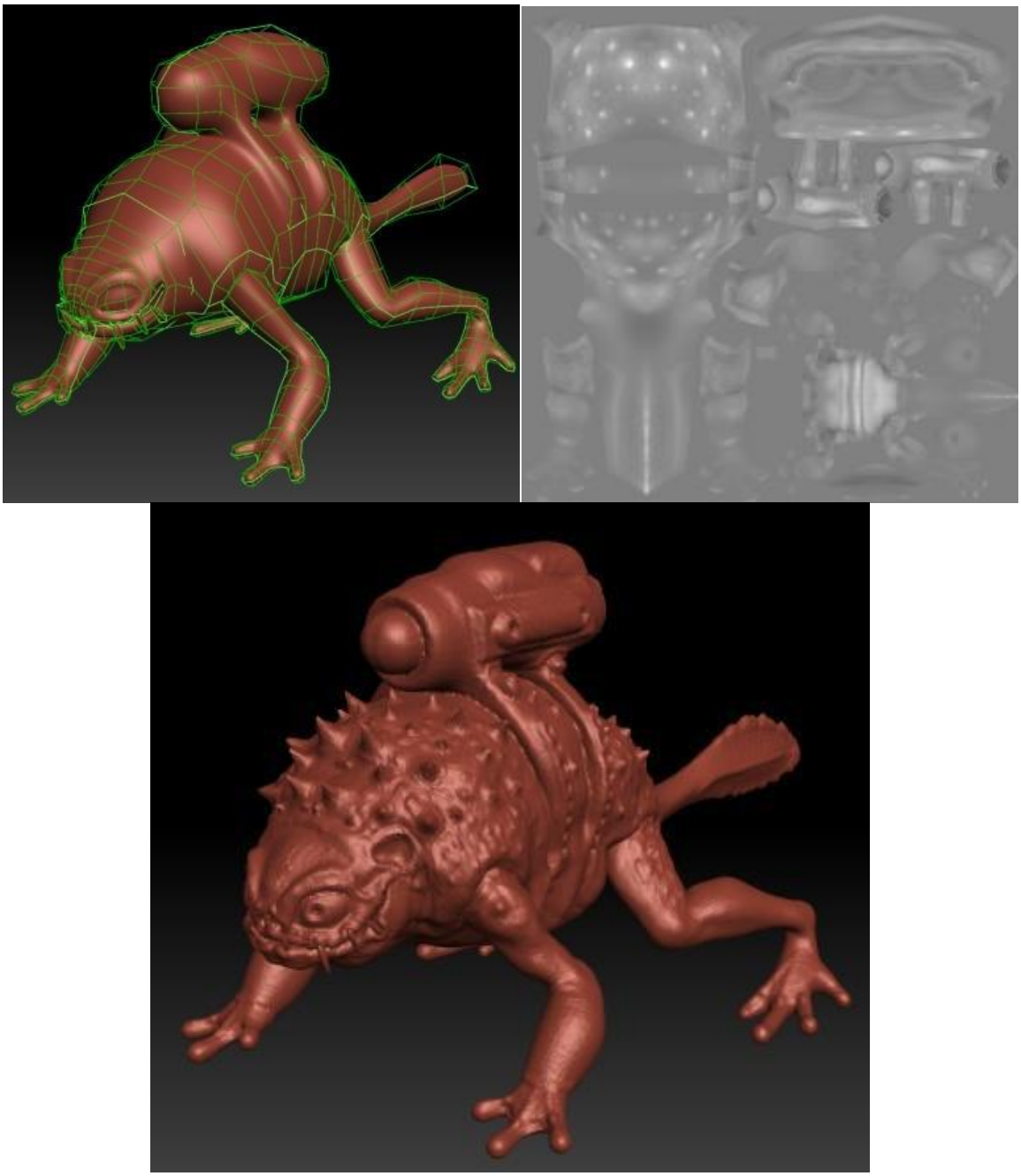


Рис. 11

4. Environment mapping

a. Cubic Environment Mapping

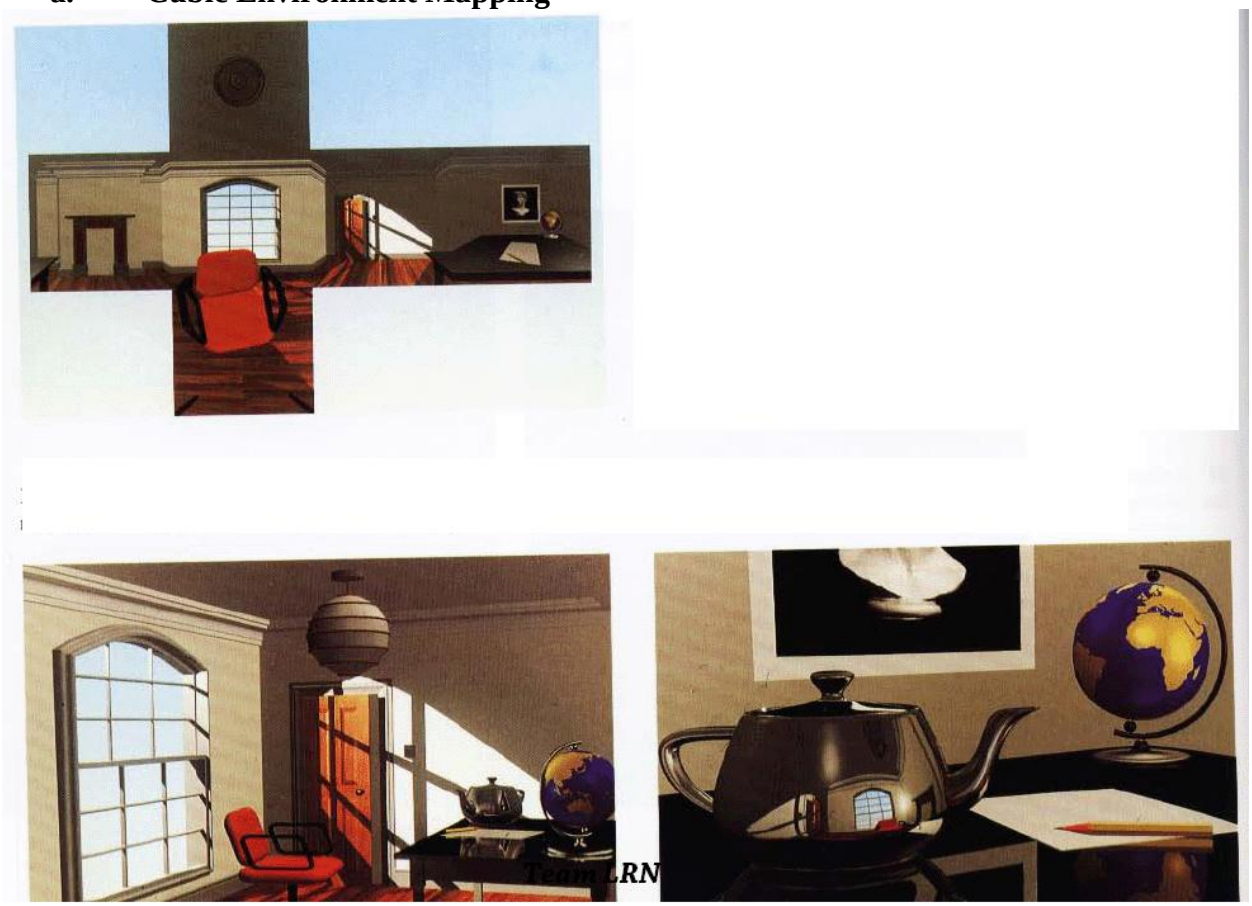


Рис. 12

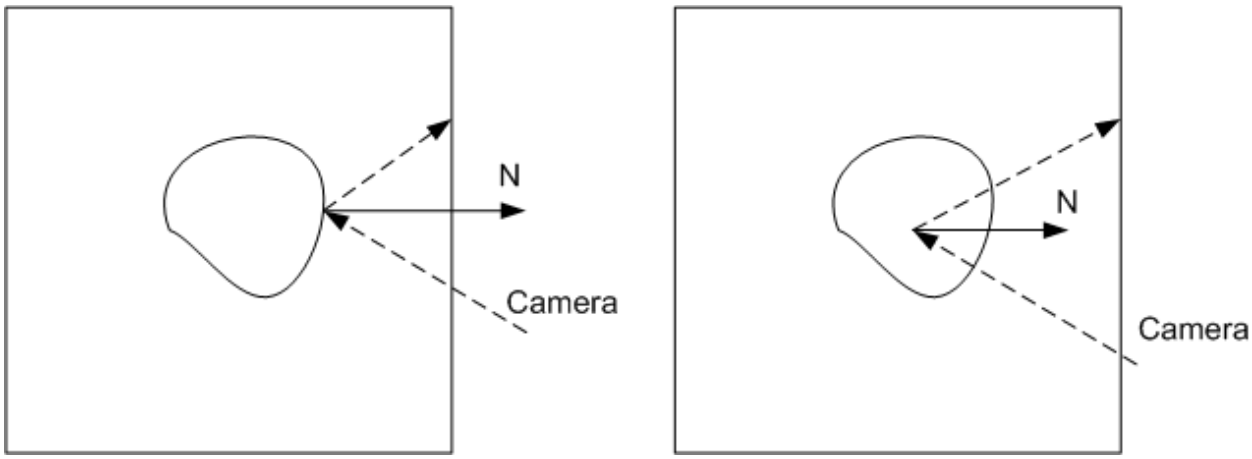


Рис. 13

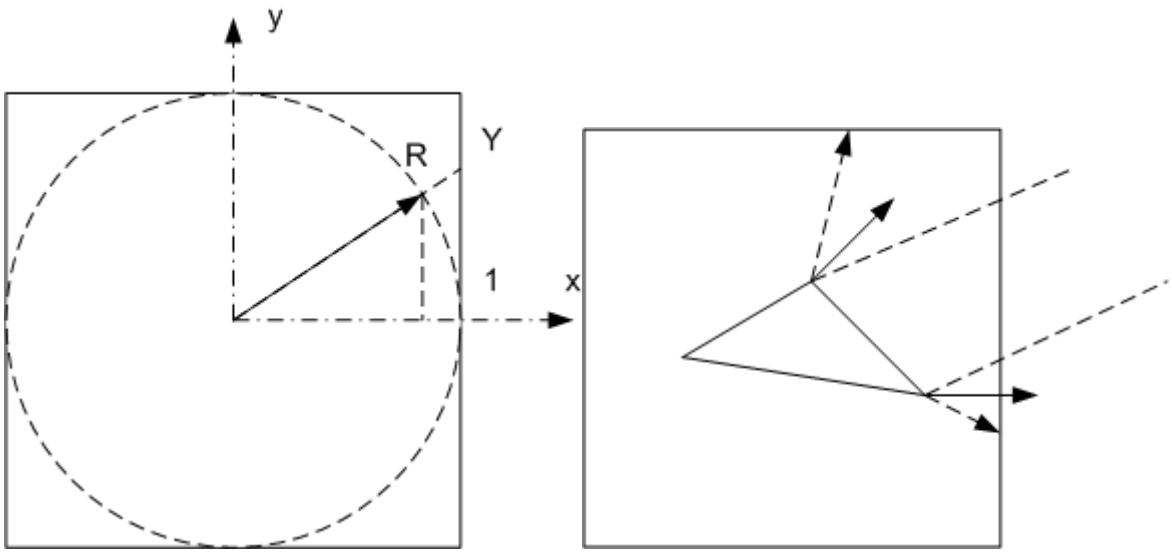


Рис. 14

$Y=R_x/R_y$; $v=0,5Y+0,5$;
Пусть $R_z=\max(R_x,R_y,R_z)$; => $u=0,5R_x/R_z+0,5$; $v=0,5R_x/R_z+0,5$;
Vertex shader output: C (вектор на камеру), N. Оба в world coordinates.
Pixel shader: R=2(N,C)N-C

Reflection map, diffusion map and specular map

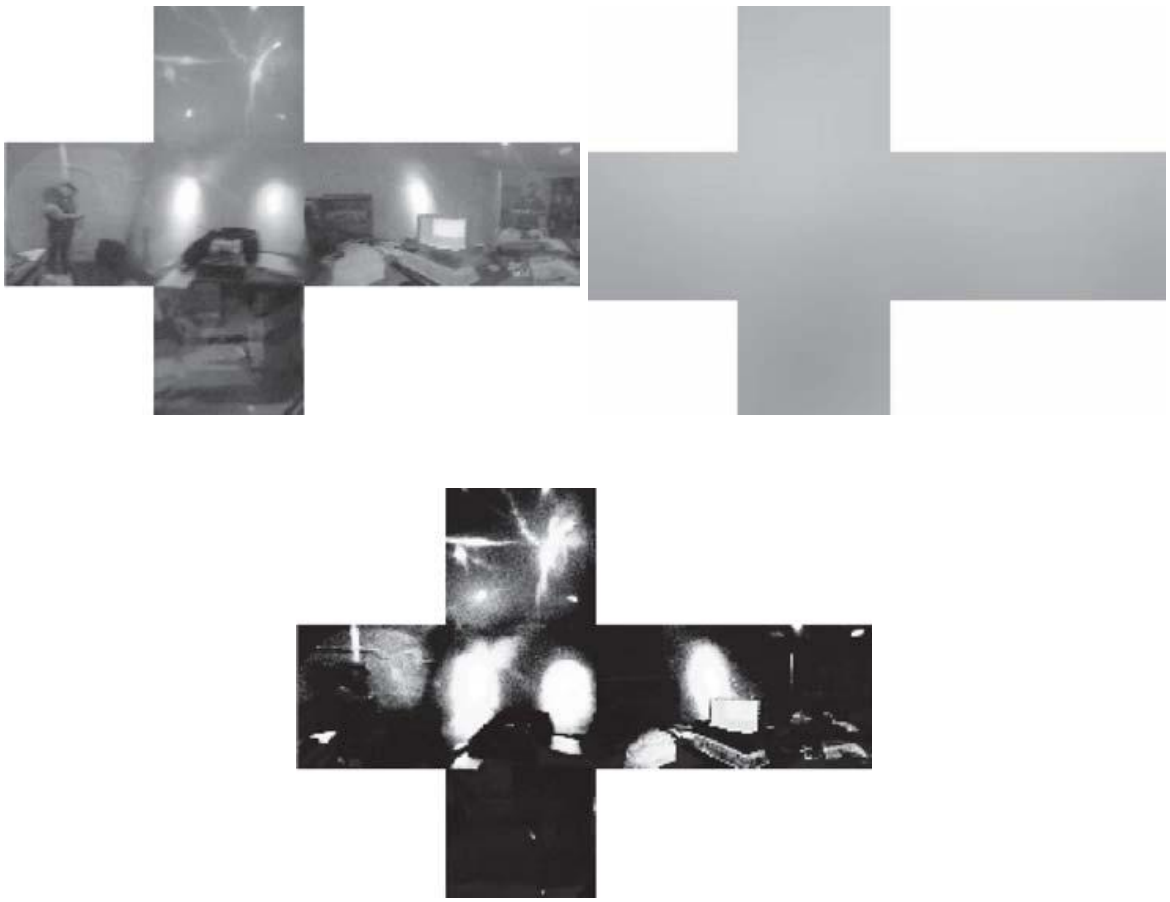


Рис. 15

b. Environment bump mapping

Vertex shader output: T, N, TexCoord;

Vertex shader:

TexCoord => N_{bump}

B=(NxT)

T, N, B => N_{bump} (world coord)

R=2(N_{bump},C) N_{bump} -C

5. HDRLighting

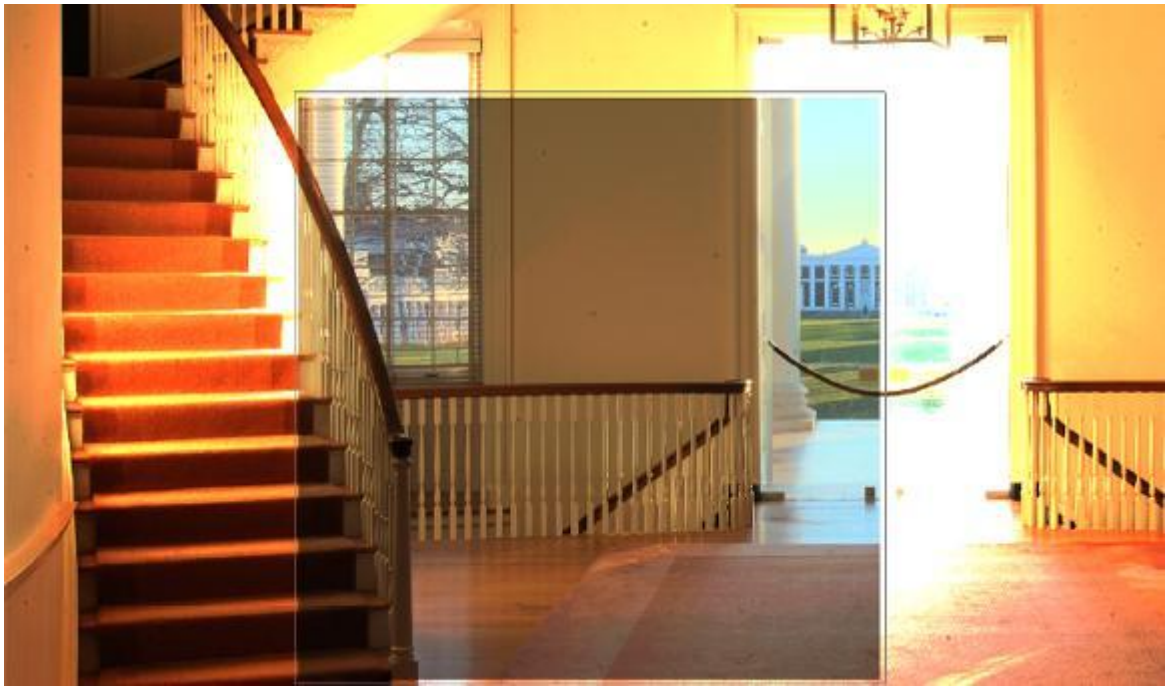


Рис. 16

Рис. 17

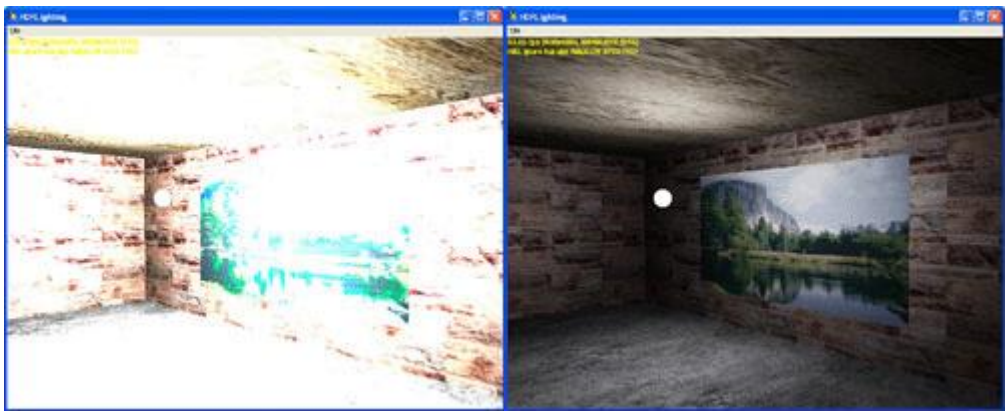


Рис. 18

$$Lum_{avg} = \exp\left(\frac{1}{N} \sum_{x,y} \log(\delta + Lum(x,y)) \right)$$

$$Lum_{scaled}(x,y) = \frac{\alpha}{Lum_{avg}} Lum(x,y)$$

$$Color(x,y) = \frac{Lum_{scaled}(x,y)}{1 + Lum_{scaled}(x,y)}$$

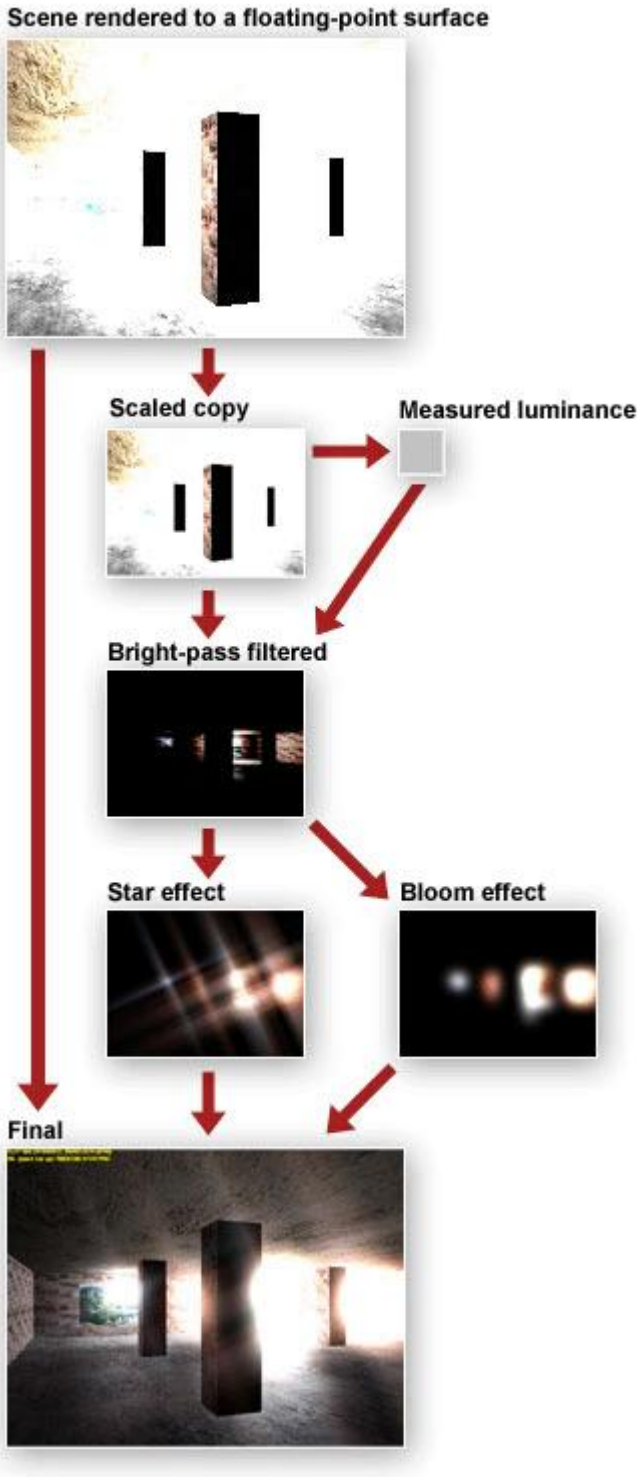

Scene rendered to a floating-point surface
Scaled copy
Measured luminance
Bright-pass filtered
Star effect
Bloom effect
Final

Рис. 19

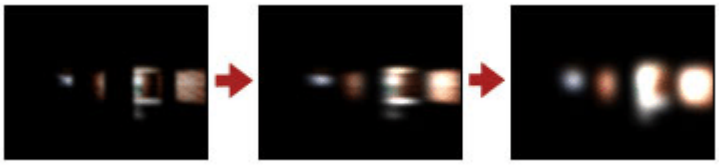


Рис. 20

Рис. 21

6. Shadows

Sshadow maps

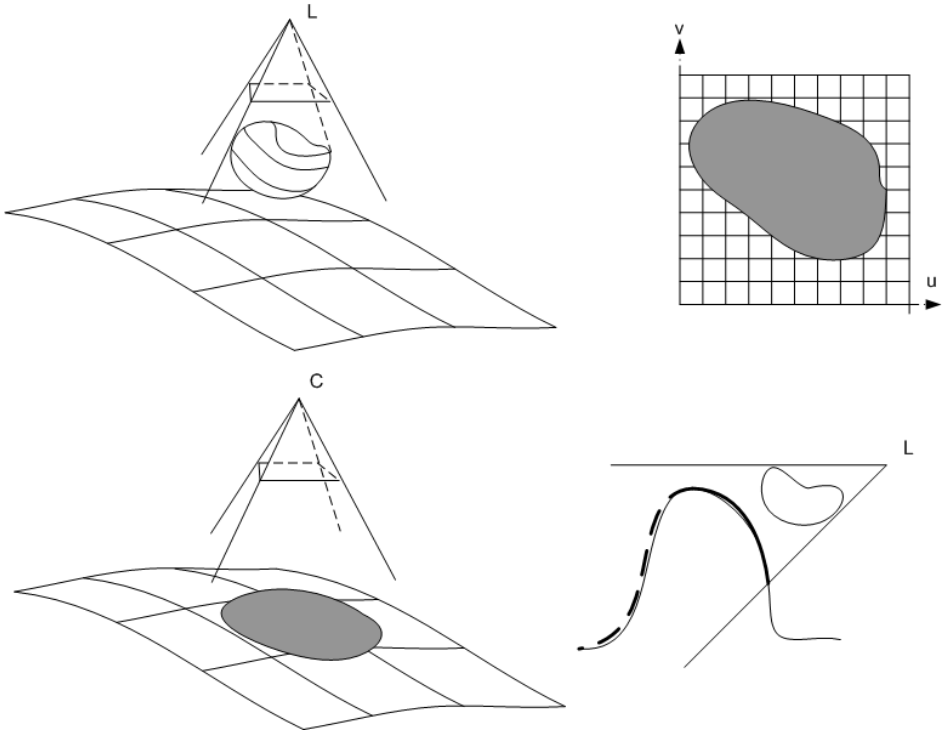


Рис. 22

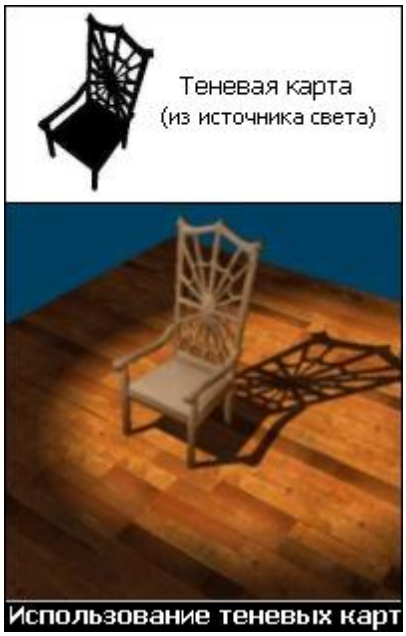


Рис. 23

Soft shadow => фильтрация:

Рис. 24

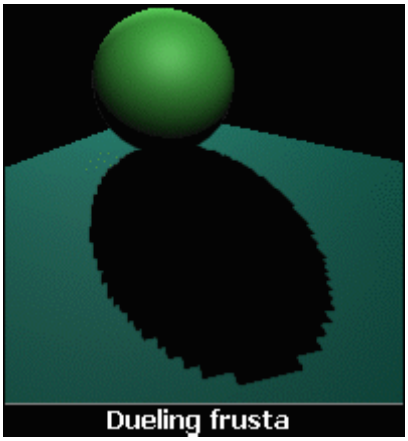


Рис. 25

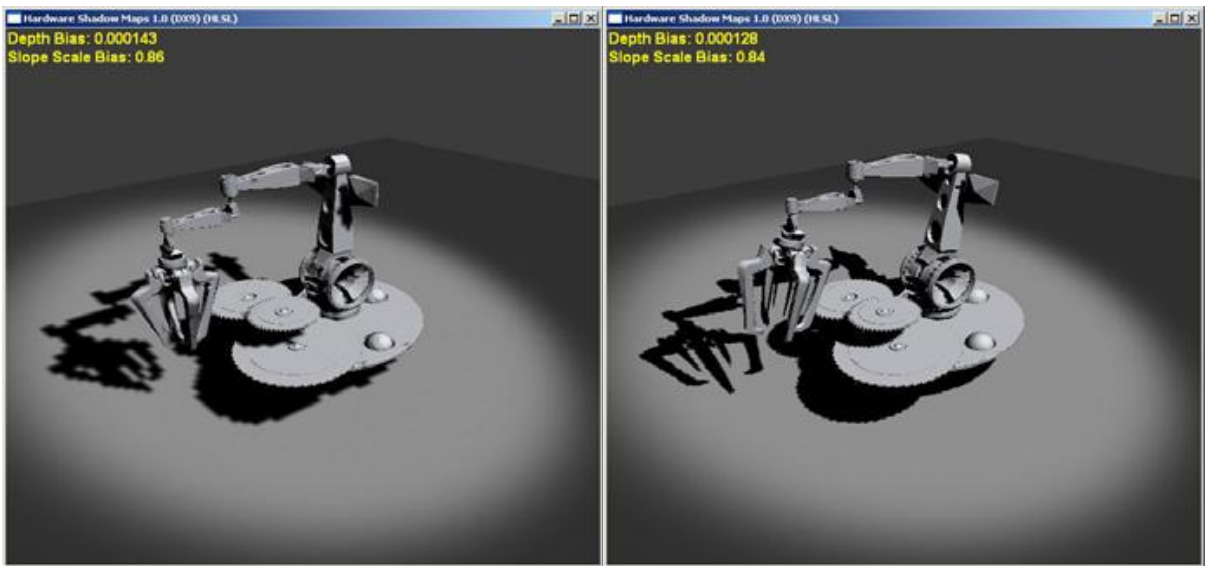
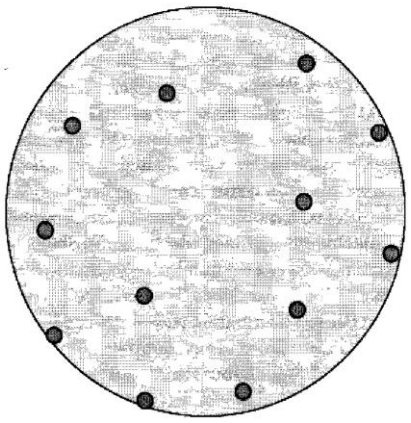


Рис. 26

Рендер квадрата с теневой текстурой. В pixel shader-е:

$$\sum_i w_i T(u + du_i, v + dv_i)$$

Poisson filter



R=R(v)

Рис. 27

Shadow volumes

Использование stencil буфера

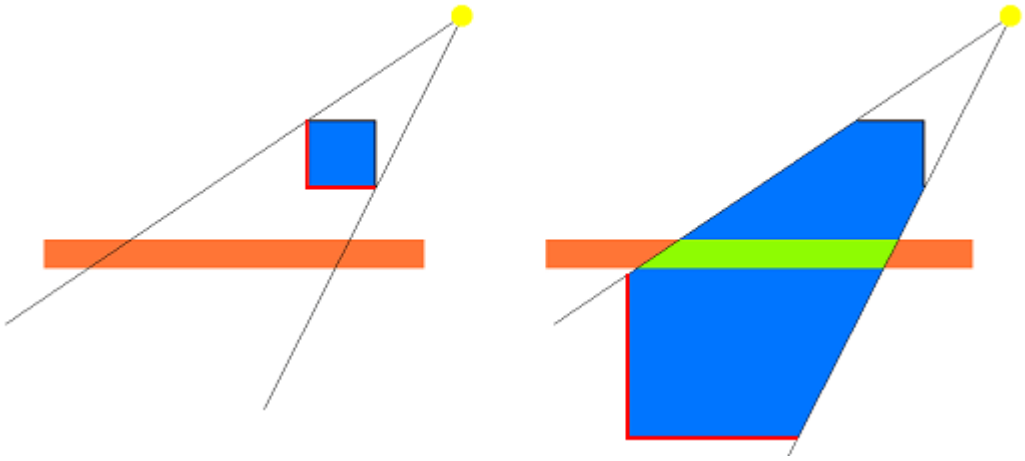


Рис. 28

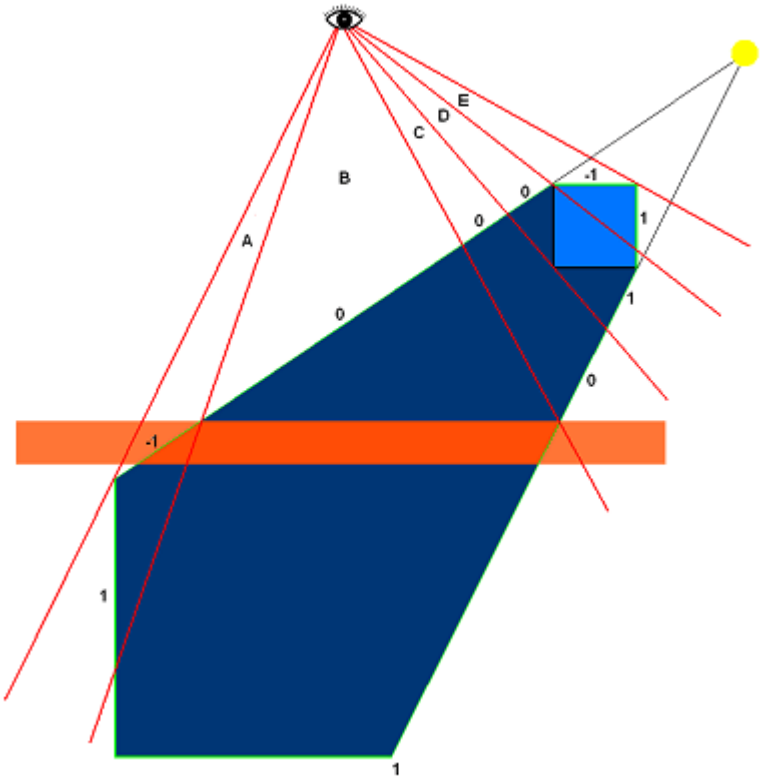


Рис. 29

Построение теневого объема

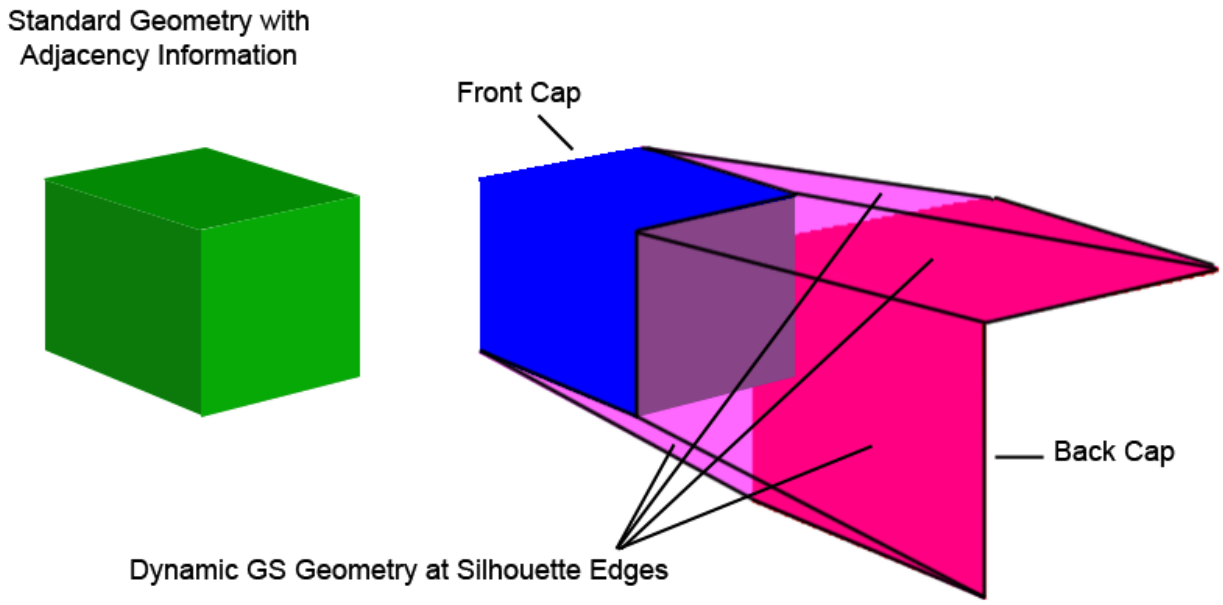


Рис. 30

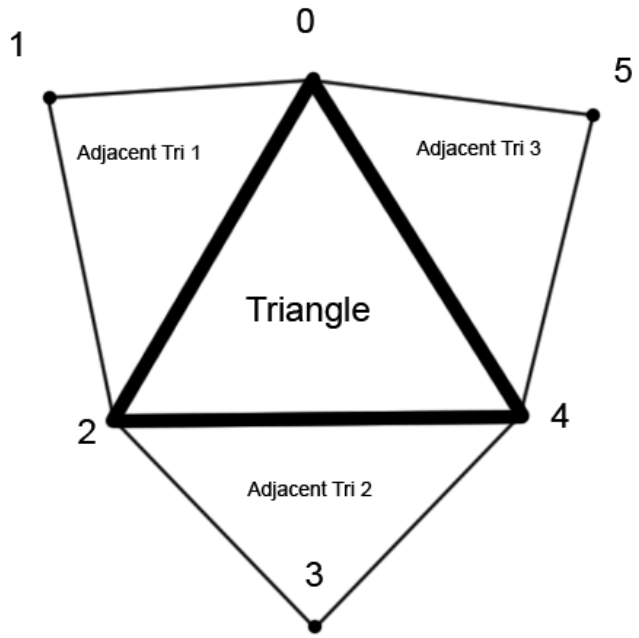


Рис. 31

c. Shadow buffer

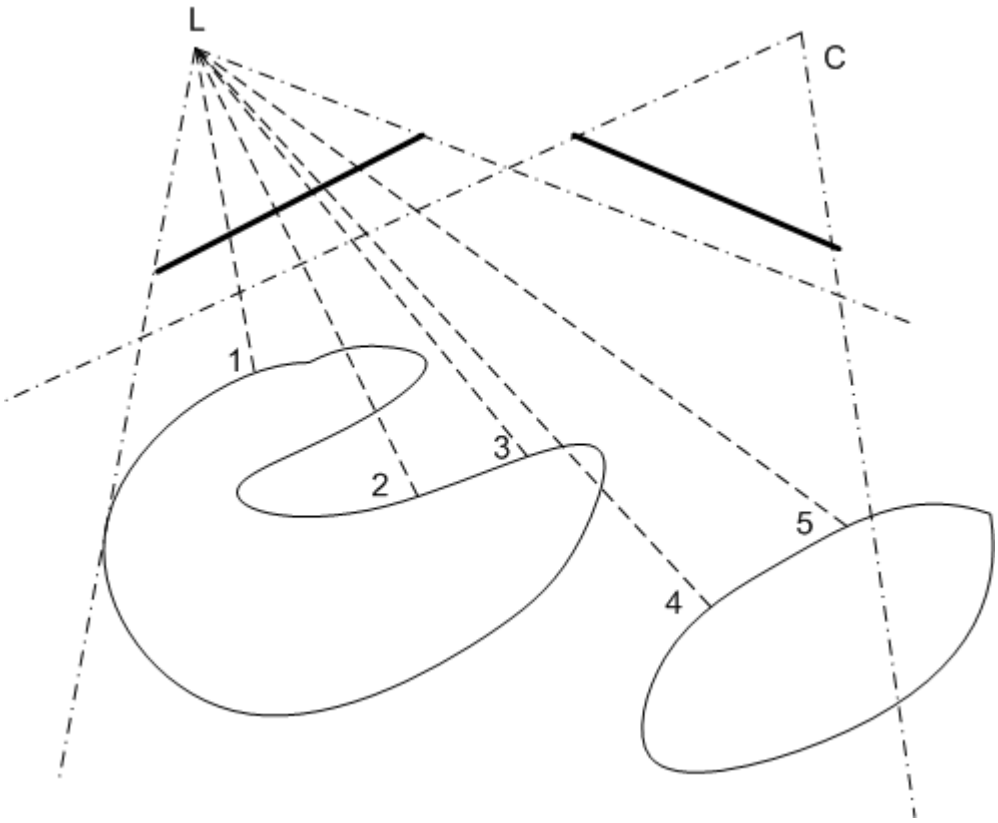


Рис. 32

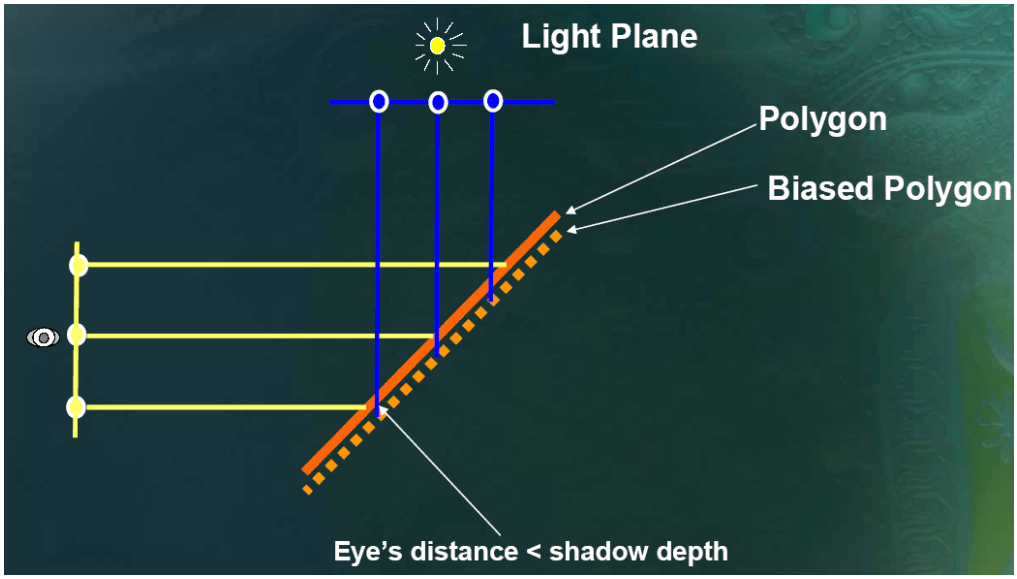


Рис. 33

Object ID.

Фильтрация: **Percentage closer filtering.**

Bilinear filtering

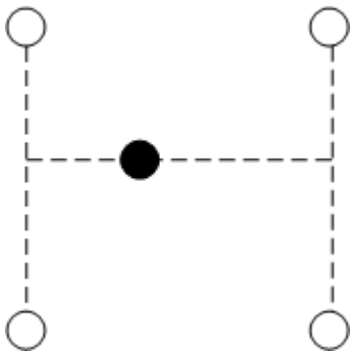


Рис. 34

Variance Shadow Maps (VSM)

$$\mu = M_1,$$

$$\sigma^2 = M_2 - M_1^2$$

$$P(r \geq t) \leq p_{\max}(t) = \frac{\sigma^2}{\sigma^2 + (t-\mu)^2}$$

$$S(s,t,r) = \begin{cases} 1, r < \mu \\ \dfrac{\sigma^2}{\sigma^2 + (r-\mu)^2}, r \geq \mu \end{cases}$$

Рис. 35

Perspective Shadow Maps (PSM)

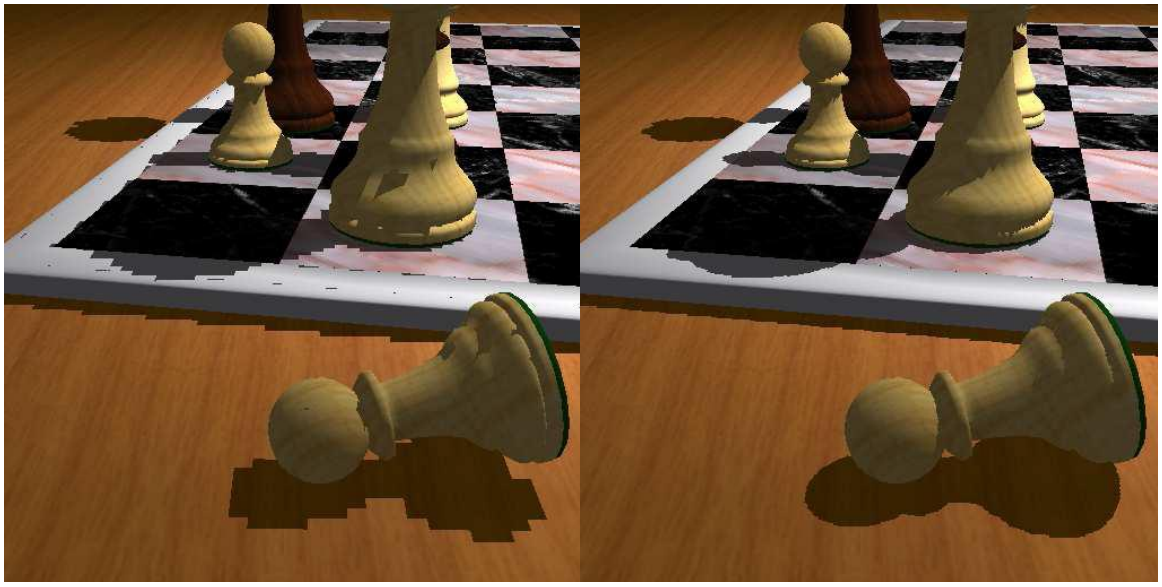


Рис. 36

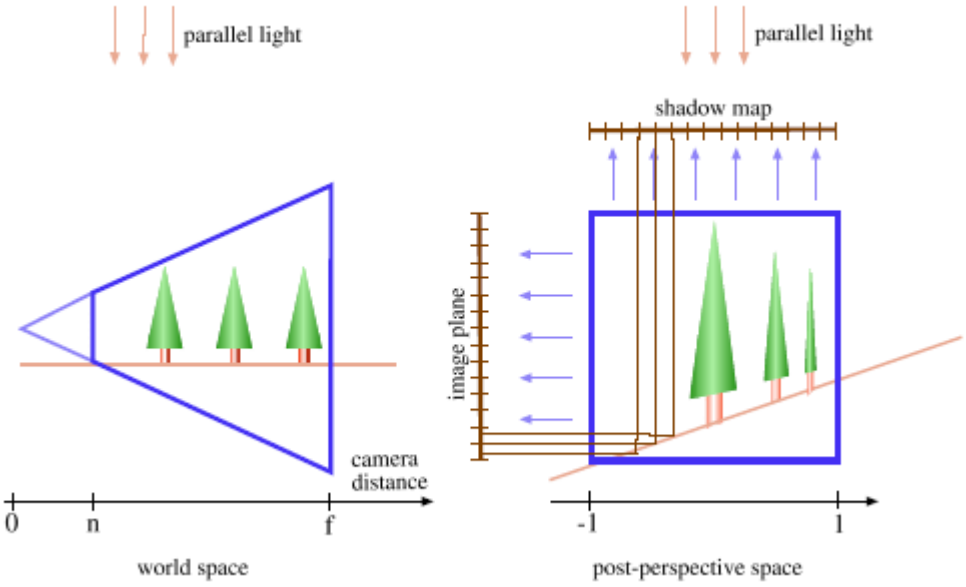

parallel light
parallel light
shadow map
image plane
camera
distance
0
n
f
-1
1
world space
post-perspective space

Рис. 37

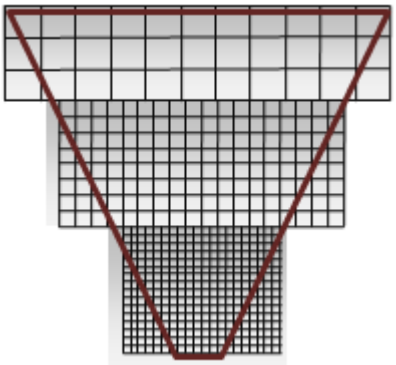


Рис. 38