

DCGI

DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION

APG Homework Assignment V

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Outline

- Area lights
- Environment map
- Bonus: textures



Area Lights

■ Emissive triangles

- `sglEmissiveMaterial`

■ Random point in triangle

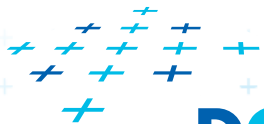
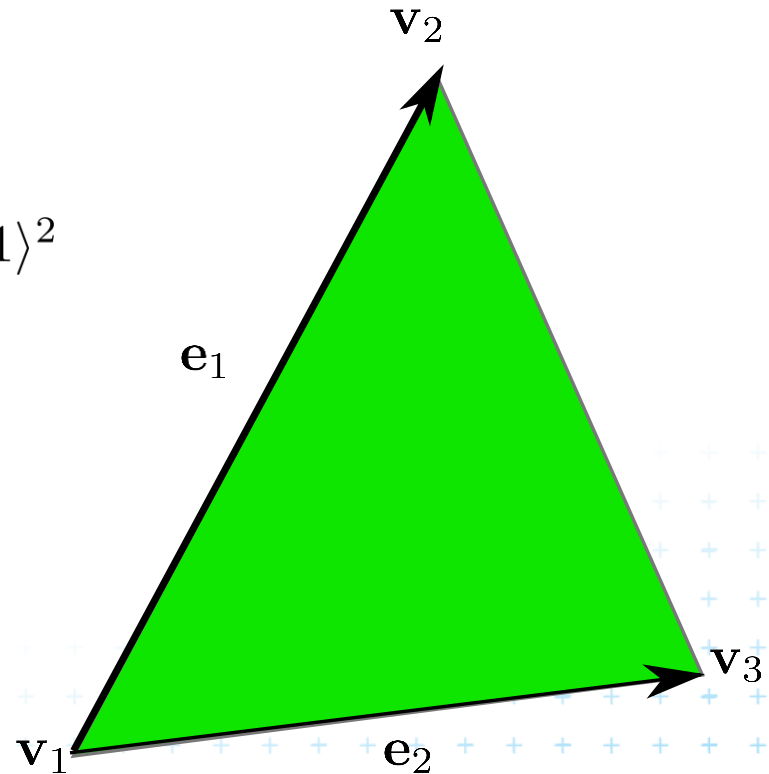
- Random vector $\mathbf{r} = [r_1, r_2]^T \in \langle 0, 1 \rangle^2$
 $u = 1 - \sqrt{r_1}$ $v = (1 - r_2)\sqrt{r_1}$

- Or:

$$u = \begin{cases} 1 - r_1 & r_1 + r_2 > 1 \\ r_1 & \text{otherwise} \end{cases}$$

$$v = \begin{cases} 1 - r_2 & r_1 + r_2 > 1 \\ r_2 & \text{otherwise} \end{cases}$$

- Random point $\mathbf{p} = \mathbf{v}_1 + u\mathbf{e}_1 + v\mathbf{e}_2$



Area Lights

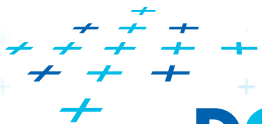
■ Light sample weight

- Normalized shadow ray direction \mathbf{d}
- Number of samples n
- Distance to the sample point d
- Attenuation vector $\mathbf{c} = [c_0, c_1, c_2]^\top$
- Light triangle area $A = \frac{1}{2} \|\mathbf{e}_1 \times \mathbf{e}_2\|$
- Light triangle normal

$$\mathbf{n} = \frac{\mathbf{e}_1 \times \mathbf{e}_2}{\|\mathbf{e}_1 \times \mathbf{e}_2\|}$$

- Light sample weight

$$w = \frac{A \mathbf{n}^\top (-\mathbf{d})}{n(c_0 + dc_1 + d^2c_2)}$$



Environment Map

- Background color

- `sglEnvironmentMap`

- Maps ray direction to 2D image

- Normalized ray direction $\mathbf{d} = [d_x, d_y, d_z]^\top$

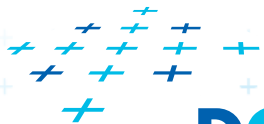
- Texture coordinates $[u, v]^\top$

$$c = \sqrt{d_x^2 + d_y^2}$$

$$r = \begin{cases} \frac{\arccos d_z}{2c\pi} & c > 0 \\ 0 & c = 0 \end{cases}$$

$$u = \frac{1}{2} + rd_x$$

$$v = \frac{1}{2} + rd_y$$



Textures (2 bonus points)

- Diffuse texture
 - 2D image
- Texture coordinates
 - Sphere, triangle



Thank you for your attention!

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