A Statistical Method for SVBRDF Approximation from Video Sequences in General Lighting Conditions (Additional Materials)

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Appendix A

Let $\mu$, $m$ and the $\sigma$ be respectively the mean, the median, and the absolute deviation of a random variable $X$. Then

$$|\mu - m| < \sigma.$$  

Proof From the Jensen’s inequality we know that if $X$ is a random variable and $\phi$ is a convex function, then $\phi(\mathbb{E}[X]) \leq \mathbb{E}[\phi(X)]$. Then we have

$$|\mu - m| = |\mathbb{E}[X] - m|$$

$$= |\mathbb{E}[X] - m|$$

$$\leq \mathbb{E}[|X - m|]$$

$$\leq \mathbb{E}[|X - \mu|] = \sigma$$

where the first inequality comes from the Jensen’s inequality applied to the absolute value function, which is convex. The second inequality is true because the median minimizes the absolute deviation.

Appendix B

Given the unknown $\rho_s$ and $\alpha$ the following system of equations:

$$\begin{align*}
\rho_s A^\alpha &= L_A - L_d \\
\rho_s B^\alpha &= L_B - L_d
\end{align*}$$  

(1)

can be solved by applying the logarithm to both the equations:

$$\begin{align*}
\alpha &= \frac{\ln(L_A - L_d) - \ln(\rho_s))}{\ln(A)} \\
\alpha &= \frac{\ln(L_B - L_d) - \ln(\rho_s))}{\ln(B)}
\end{align*}$$  

(2)

and by setting the equality between the two equations:

$$\frac{(\ln(L_A - L_d) - \ln(\rho_s))}{\ln(A)} = \frac{(\ln(L_B - L_d) - \ln(\rho_s))}{\ln(B)}$$

(3)

From equation 3 we compute the value:

$$\rho_s = e^C$$  

(4)

where:

$$C = \frac{\ln(L_B - L_d) \ln(A) - \ln(L_A - L_d) \ln(B)}{\ln(A) - \ln(B)}$$  

(5)

With the value of $\rho_s$ we recover the value of $\alpha$ by solving one of the equation in the system 2.
Figure 1: Camera path reconstructed with the registration algorithm: (Top-Left) HEAD; (Top-Right) SLEEPING BUDDHA; (Bottom-Left) DWARF; (Bottom-Right) GNOME.

Figure 2: Quality computation: (Left) map of the border distance from the depth discontinuities; (Left-Center) depth map; (Right-Center) dot product between the normal and the view direction; (Right) final quality.
Figure 3: Comparison of environment maps: (Top-Left) first real environment scenario; (Top-Center) first environment scenario reconstructed from the DWARF’s videos; (Top-Right) first environment scenario reconstructed from the GNOME’s videos; (Bottom-Left) second real environment scenario; (Bottom-Center) second environment scenario reconstructed from the HEAD’s videos; (Bottom-Right) second environment scenario reconstructed from the SLEEPING BUDDHA’s videos.
Figure 4: Segmentation of the basis materials: (Top-Left) HEAD; (Top-Right) SLEEPING BUDDHA; (Bottom-Left) DWARF; (Bottom-Right) GNOME. For each image there is the rendering of the object with the diffuse color (left) and the rendering in false color of the basis materials (right).
Figure 5: HEAD: (Left) rendering; (Right) original frame.
Figure 6: SLEEPING BUDDHA: (Left) rendering; (Right) original frame.
Figure 7: DWARF: (Left) rendering; (Right) original frame.
Figure 8: GNOME: (Left) rendering; (Right) original frame.
Figure 9: Rendering of the SLEEPING BUDDHA with the “Uffizi Gallery” environment map
Figure 10: Rendering of the SLEEPING BUDDHA with the “Dining room” environment map
Figure 11: Rendering of the SLEEPING BUDDHA with the “Pisa” environment map