CS 348B - Computer Graphics: Brian Curless and Marc Levoy
Image Synthesis Techniques   Winter, 1992
Stanford University   Handout #40

Solutions to homework assignment #2

1. Digital compositing

Each pixel in the B or W image is the result of a linear interpolation

$$B = (1 - \alpha)\, B_0 + \alpha\, I$$

$$W = (1 - \alpha)\, W_0 + \alpha\, I$$

where B_0 is the value of the black background without the model and W_0 is the value of the white background without the model. Solving these equations for unknowns α and I yields

$$\alpha = 1 - \frac{W - B}{W_0 - B_0}$$

$$I = \begin{cases} \dfrac{B - (1 - \alpha)\, B_0}{\alpha} & \text{if } \alpha <> 0 \\[2ex] 0 & \text{if } \alpha = 0 \end{cases}$$

In fact, the value of I is unimportant if $\alpha = 0$; however, since a computer will be performing these calculations, it is worthwhile to avoid divide-by-zero errors.

(a)   For homogeneous backgrounds, we have $W_0 = 1$ and $B_0 = 0$, and the above equations simplify to

$$\alpha = 1 - W + B$$

$$I = \begin{cases} \dfrac{B}{\alpha} & \text{if } \alpha <> 0 \\[2ex] 0 & \text{if } \alpha = 0 \end{cases}$$

(b)   For inhomogeneous backgrounds, we scan the black and white backgrounds without the model to yield B_0 and W_0 and use the general solution given above.

[...solutions to other problems...]