Image Compositing and Matting

Colbert Challenge

Key Concepts

Image composition

Mattes and the alpha channel

Fragments

Compositing operators

Matte extraction

Image Mattes

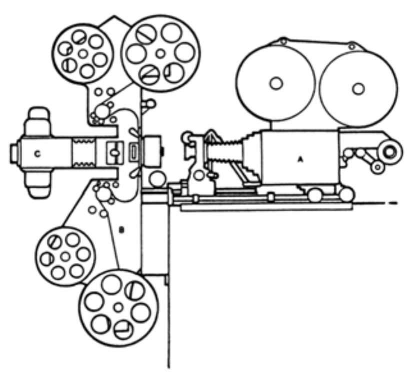
Defn: Combine *foreground* element with *background*

Examples:

- **Graphics arts: masks, friskets, stencils**
- **Film: optical compositing and mattes, bluescreen**
- **Video: chroma-keying**
- **Animation: cels**
- **Computer graphics: alpha channel**

Demonstration: Photoshop selections, masks, layers

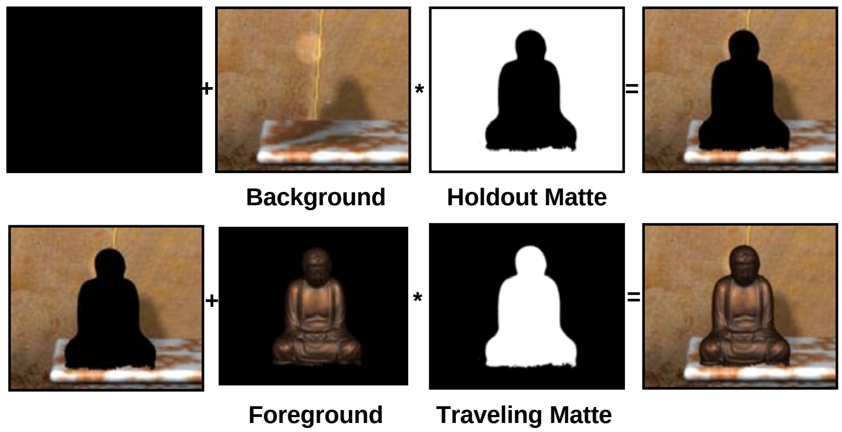
Optical Printing



From: "Industrial Light and Magic," Thomas Smith (p. 181)

From: "Special Optical Effects," Zoran Perisic

Composing Two Elements



Mattes and Masks: The Alpha Channel

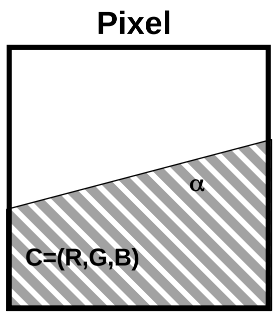
A alpha channel is an additional image that defines:

- The transparency or opacity of an image
- The presence or absence of imagery
  - Geometric coverage: soft-edge
- Or both coverage and transparency

Alpha channels may be

- Masks: all or none, binary
- Mattes: 0 to 1, n-ary

Fragment: Color + Coverage



α = A
= Coverage
= Area
= Opacity
= 1 - Transparency

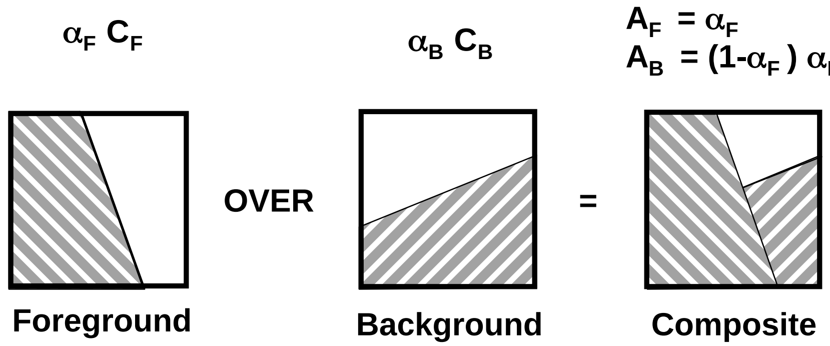
Final color C' of pixel is a area-weighted average of C

(assumes black background)

$$C' = \alpha C$$

OVER Operator

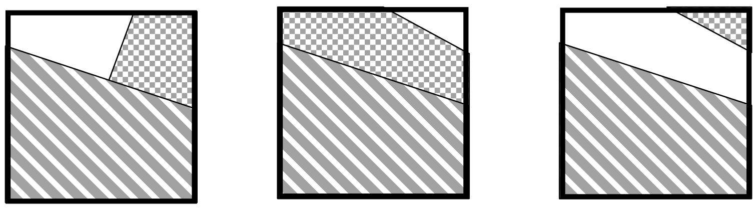
$A_F = \alpha_F$
$A_B = (1-\alpha_F)\,\alpha_B$



Composite color: $C' = A_F C_F + A_B C_B = (\alpha_F C_F) + (1-\alpha_F)(\alpha_B C_B)$

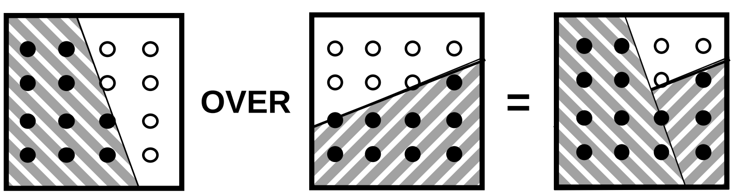
Composite alpha: $\alpha = A_F + A_B = \alpha_F + (1-\alpha_F)\,\alpha_B$

Assumptions



Uncorrelated | Correlated | Anticorrelated

A-Buffer: Bitmask Fragments



C_A

M_A

$\alpha_A = \text{bits}(M_A)$

C_B

M_B

$\alpha_B = \text{bits}(M_B)$

$C' = \text{bits}(M_A)C_A + \text{bits}(M_B\text{-}M_A)C_B$

$M = M_A | M_B$

$\alpha = \text{bits}(M)$

Pre-multiplied Alpha

Represent as $C' = \alpha C = (\alpha r, \alpha g, \alpha b, \alpha)$

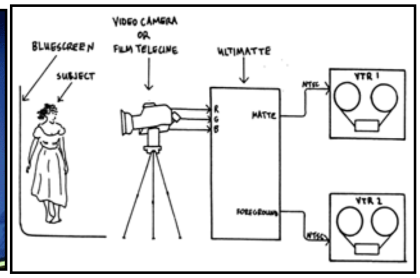
- **One formula for compositing color and alpha**
  - $C' = C'_F + (1-\alpha_F)\, C'_B$
- **More efficient**

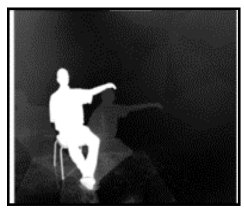
  Associated: OVER (1 sub, 4 muls, 4adds)

  Unassociated: OVER (1 sub, 7 muls, 4 adds)
- **Closure**
- **Display C' ; C' over K = $C' + (1-\alpha_C)\, K = C'$**
- **Rarely need to recover unassociated color**

Perception

Blue Screen





"Pulling a Matte" - Matte Creation

From digitized images

- Image processing
  - Set of colors marked transparent, region growing ...
  - Demonstration: Photoshop magic wand
- Video or chroma-keying
  - Range of luminances marked transparent
- Blue-screen matting (Petro Vlahos)
  - Separate blue background from foreground image

Blue-Screen Matte Extraction

Given:

- **C - Observed color at each pixel**
- **C_B - Backing color (perhaps at each pixel)**

Compute:

- **$C_F = (\alpha_F R_F, \alpha_F G_F, \alpha_F B_F, \alpha_F)$**

Matte Equation

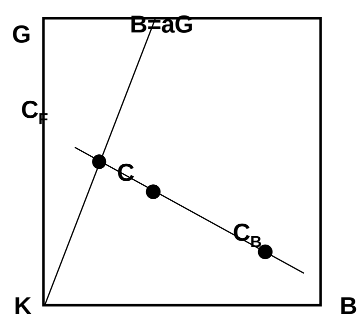
- **$C = C_F + (1-\alpha_F)\, C_B$**

(3 equations (R, G, B) in 4 unkowns (Rf, Gf, Bf, α_F)

Petros Vlahos Assumption

Clever practical solution that works well!

Assume: In foreground colors, amount B < aG



1-α = b (Bf - a Gf) clamped to 0 and 1 (Vlahos patent)