Digital Compositing

CS4340 Digital Special Effects

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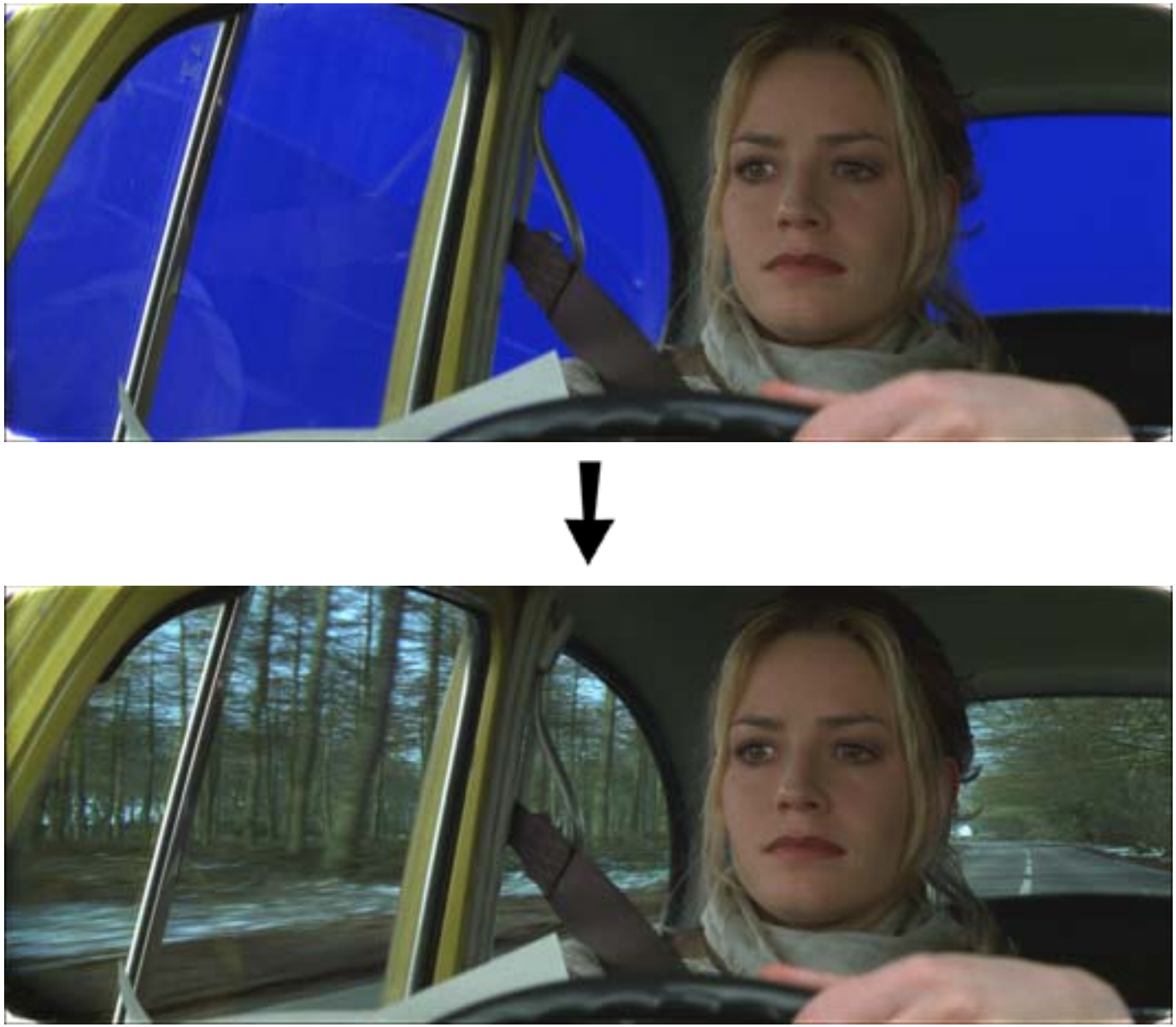
Introduction

Digital compositing means

> *digitally manipulated integration of at least two images to produce a new image.*

- The new image must appear realistic.
- It must be completely and seamlessly integrated, as if it were actually photographed by a single camera.

Example: A scene in *Saint* (1997) shot in front from blue screen.



Main Topics

- Keying
  - Separate foreground elements from background elements.
- Rig Removal
  - Remove unwanted elements in footage.
- Alpha Blending
  - Blend foreground elements with new background footage.

Other topics: Refer to [Kel00].

Alpha Blending

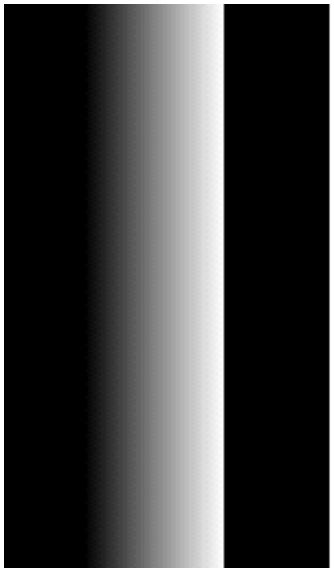
Basic equation

$$C = \alpha F + (1 - \alpha)B \tag{1}$$

- F: foreground image
- B: background image
- C: composite
- α: opacity or transparency
- matte: an image of α values
- The above operation is performed on each corresponding pixel.
- If $\alpha = 1$, then $C = F$,
  foreground is shown, i.e., foreground is opaque.
- If $\alpha = 0$, then $C = B$,
  background is shown, i.e., foreground is transparent.
- $0 < \alpha < 1$: semi-transparent, e.g., shadow, smoke, etc.

Example: No Background B.

foreground F

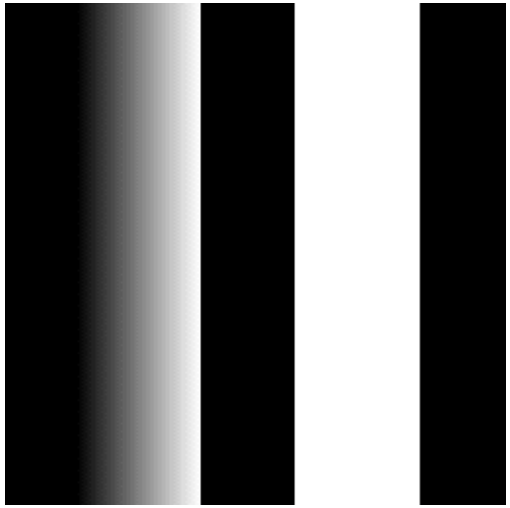


matte α

composite C

Example: With Background B.

foreground F



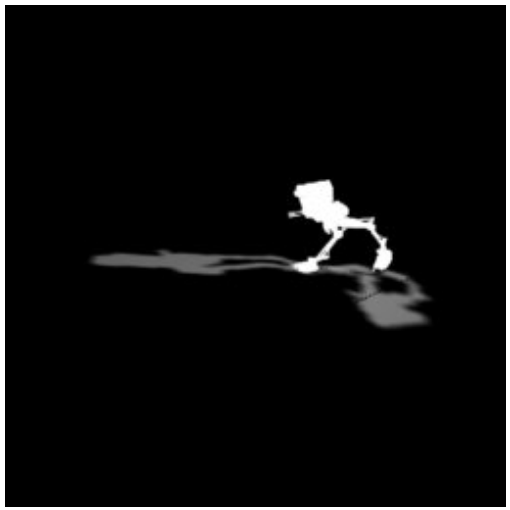
matte α

background B

composite C

Example: Foreground with shadow.

foreground F



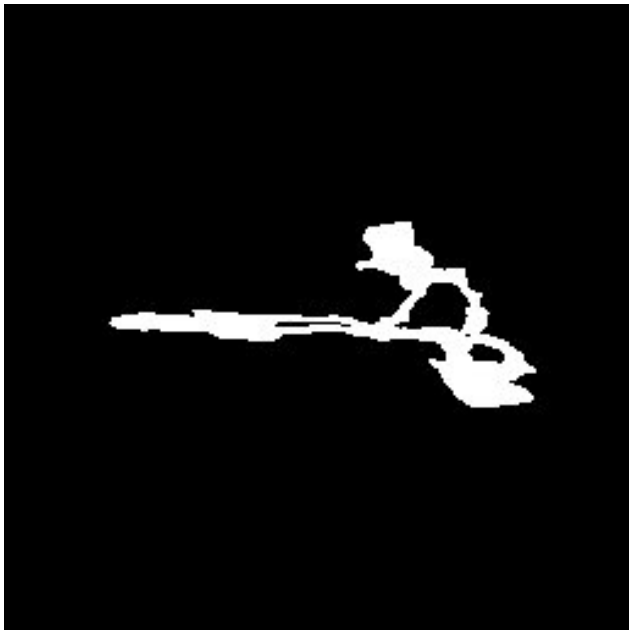
matte α

background B

composite C

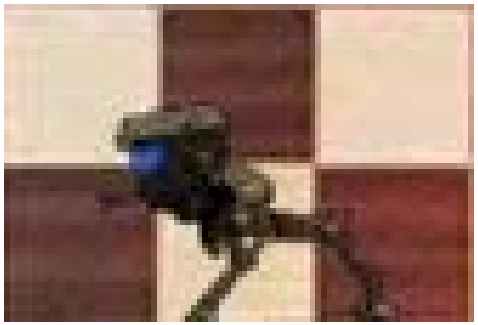
Important Notes

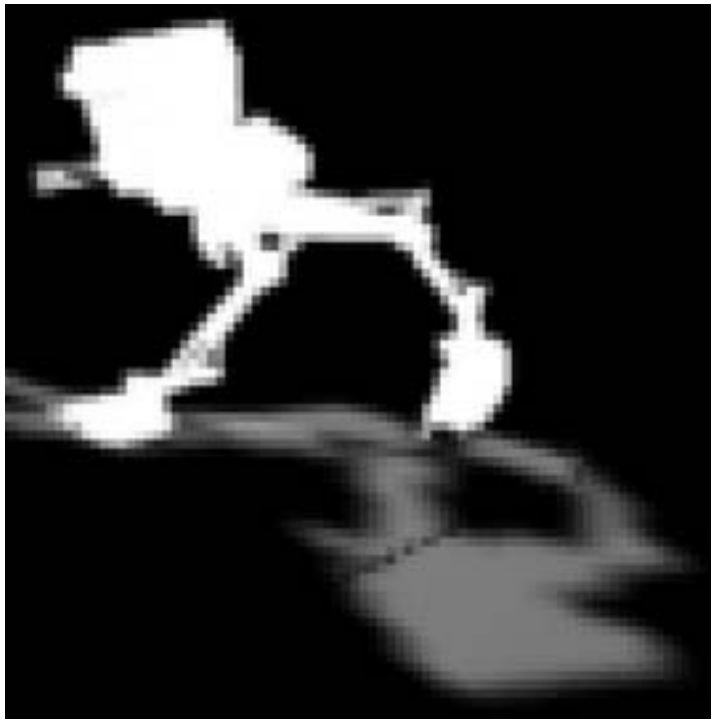
- α of shadow should take intermediate value ($0 < \alpha < 1$). Otherwise, shadow looks unreal.



- A bad matte results in a bad comp.

- α at boundary should also take intermediate value.
  Otherwise, have dark fringes.
- Good matte has intermediate α at boundary and in shadow.

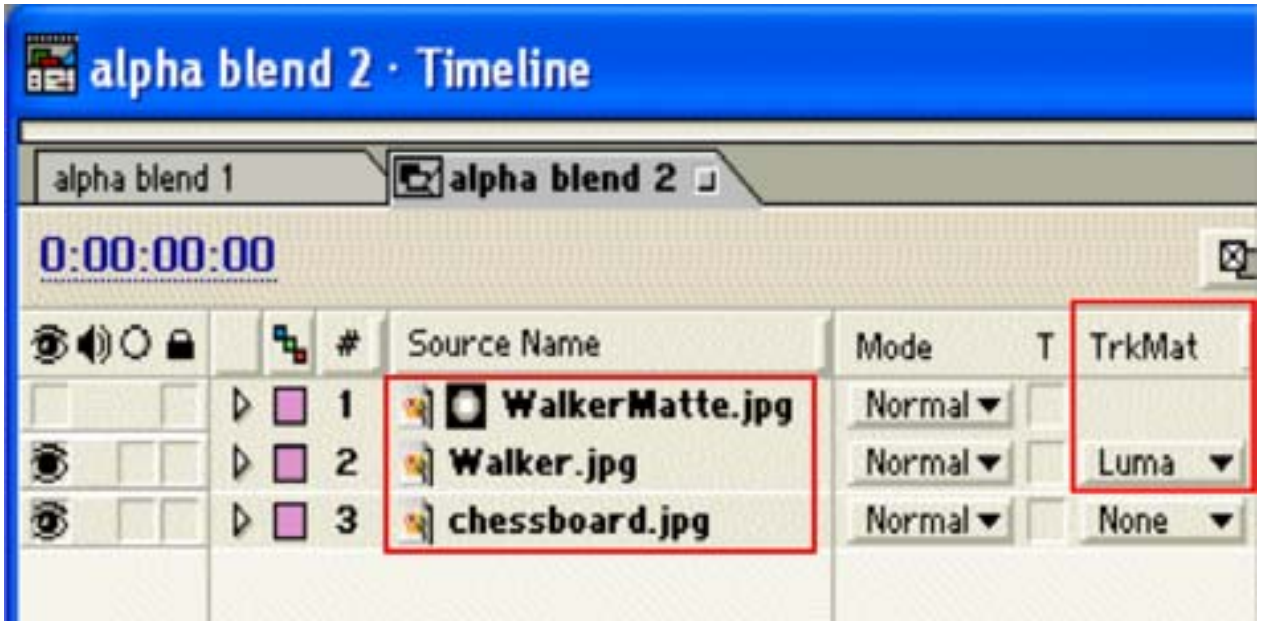




- Real images have smooth boundaries, no fringe.

Alpha Blending with After Effects

1. Create a comp with matte, foreground, and background stacked in layers.
2. Composite using luminance-based track matte.



Keying

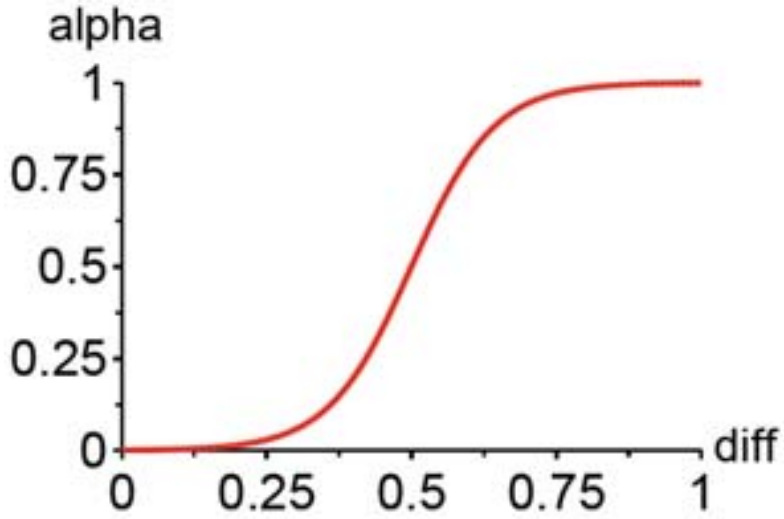
- Separate foreground elements from background elements, creating a matte of foreground.
- Also called pulling a matte (of foreground), or keying out (i.e., making transparent) background.
- Recall:
  A good matte has intermediate α in shadow and along object boundaries.

Basic methods

- Luma keying
  - based on luminance, i.e., intensity.
- Chroma or color keying
  - based on color, i.e., blue screen, green screen.
- Difference keying
  - requires clean plate,
    i.e., background image without foreground element.

Basic Ideas

- Compute difference between foreground and background (based on luma, chroma, or color).
- Map difference value to α.
  - Very small diff $\Rightarrow \alpha = 0$.
  - Very large diff $\Rightarrow \alpha = 1$.
  - Intermediate diff $\Rightarrow$ intermediate α.



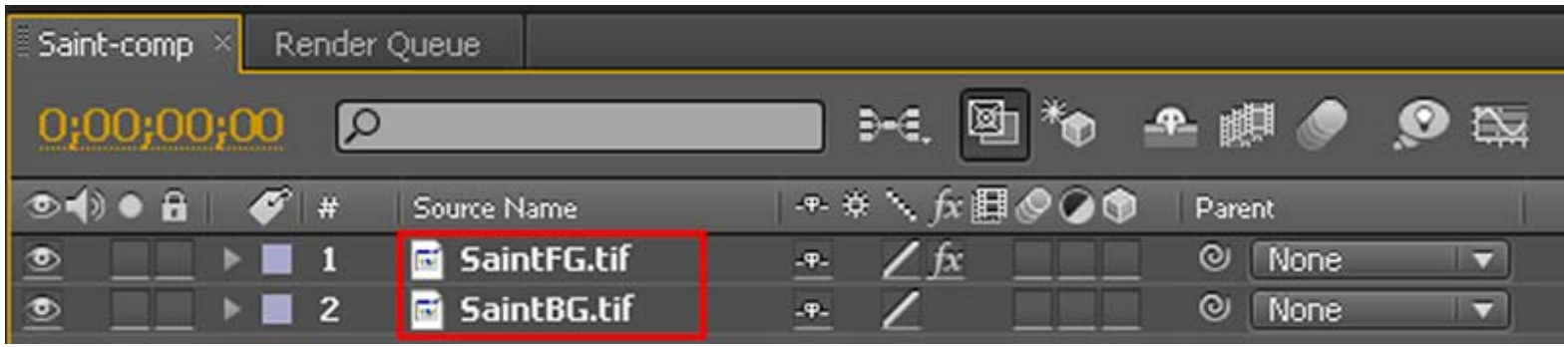
Color Keying with Keylight in After Effects CS4

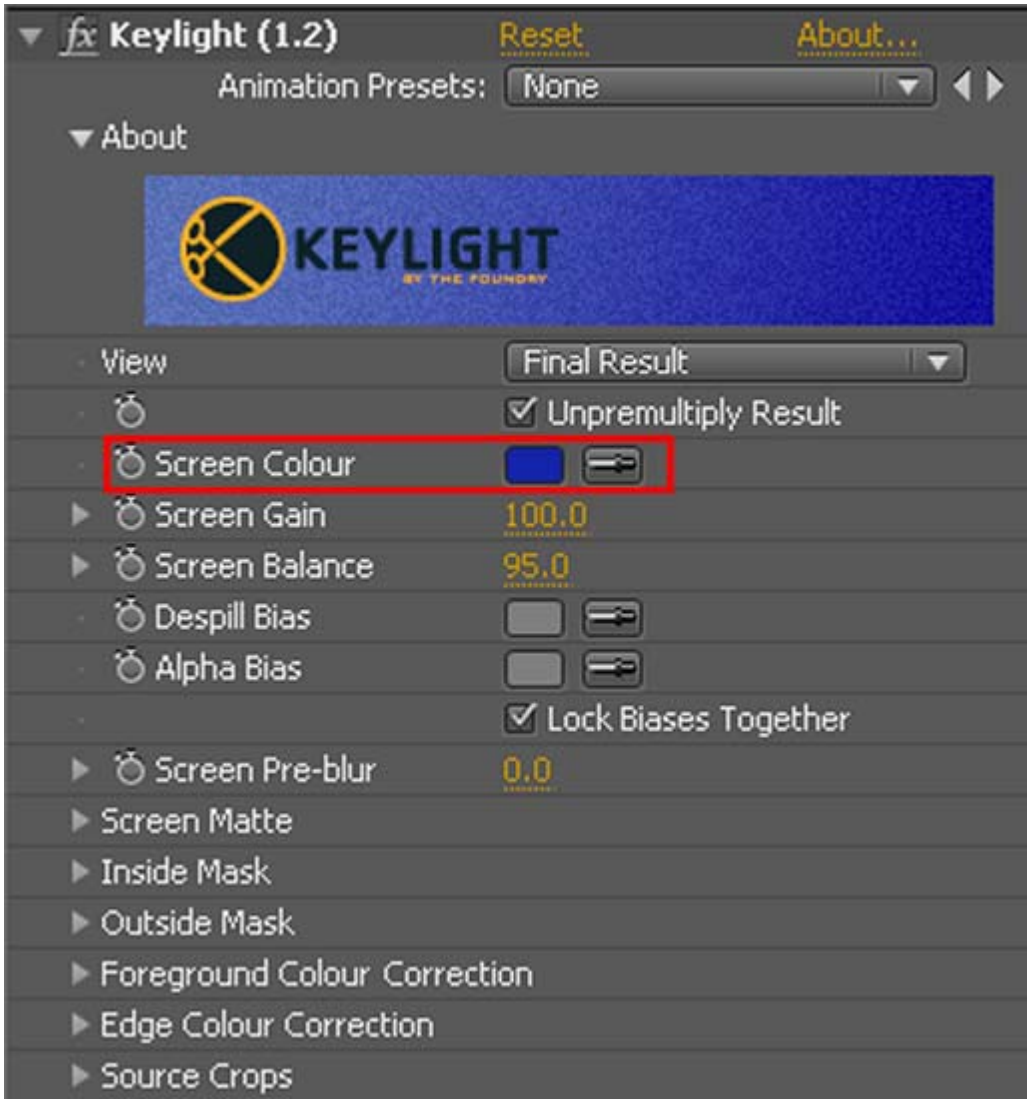
Keylight [Key]

- An Academy award winning blue and green screen keyer.
- Core algorithm was developed by the Computer Film Company.
- Further developed and ported to After Effects by The Foundry.

Use Keylight in After Effects CS4

- Create a comp with background below foreground in timeline panel.

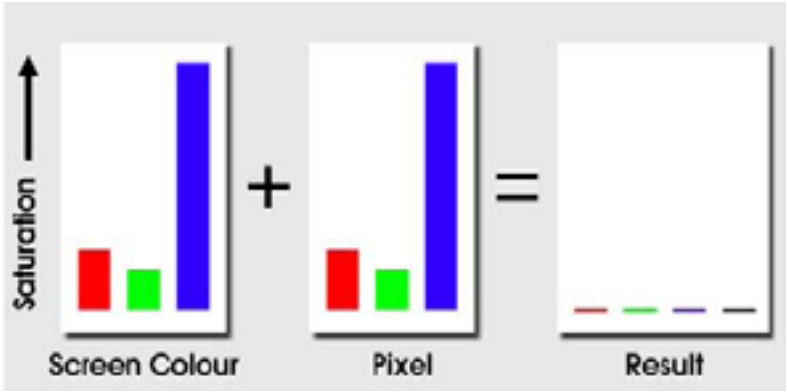


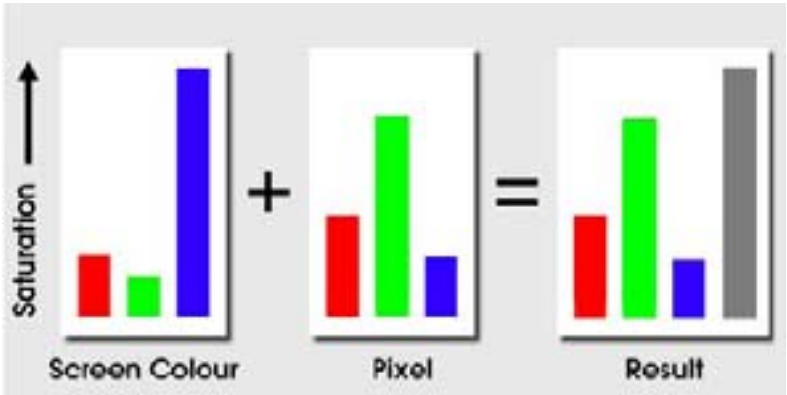


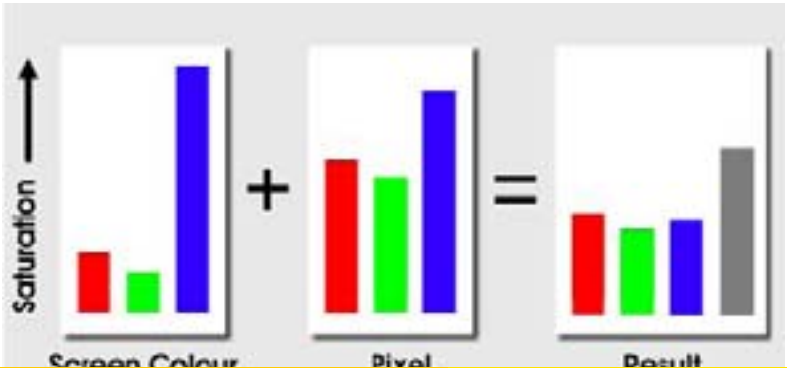
- Select foreground, then select "Effect → Keying → Keylight".
- Use dropper to select Screen Colour for keying.
- Screen Balance is adjusted automatically.

Keylight performs color keying as follows:

- Compare intensities of primary components of a pixel and screen color.
  - If small diff, set $\alpha = 0$: transparent background pixel
  - If large diff, set $\alpha = 1$: opaque foreground pixel
  - If moderate diff, set intermediate α: semi-transparent edge pixel



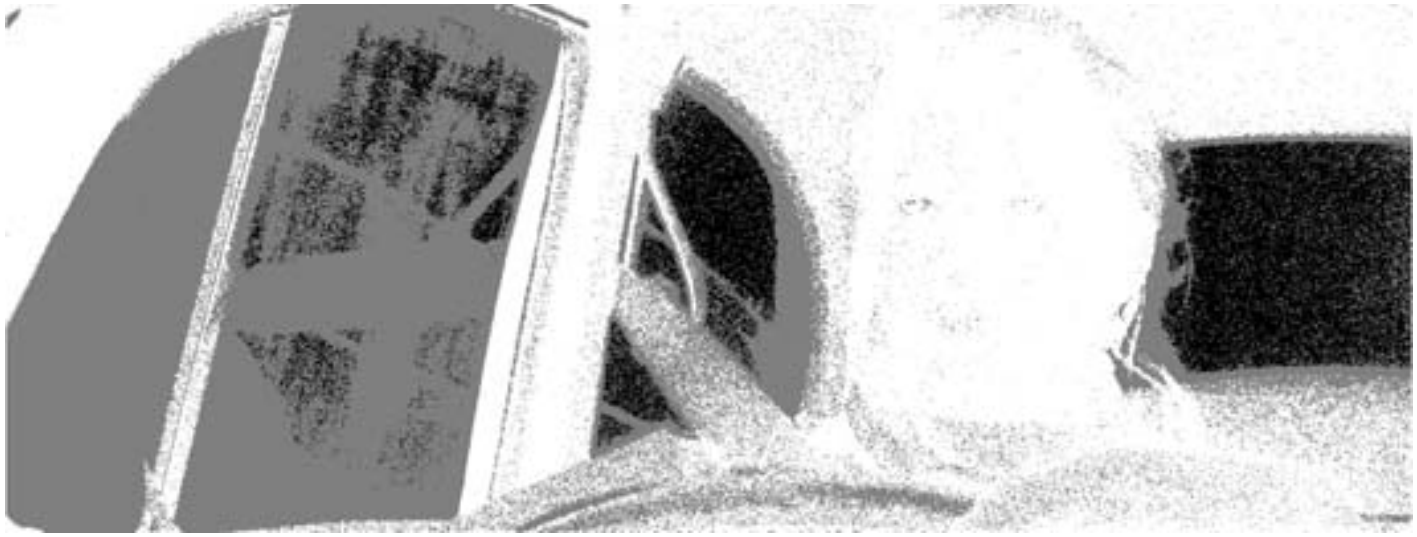




Blue screen is keyed out.

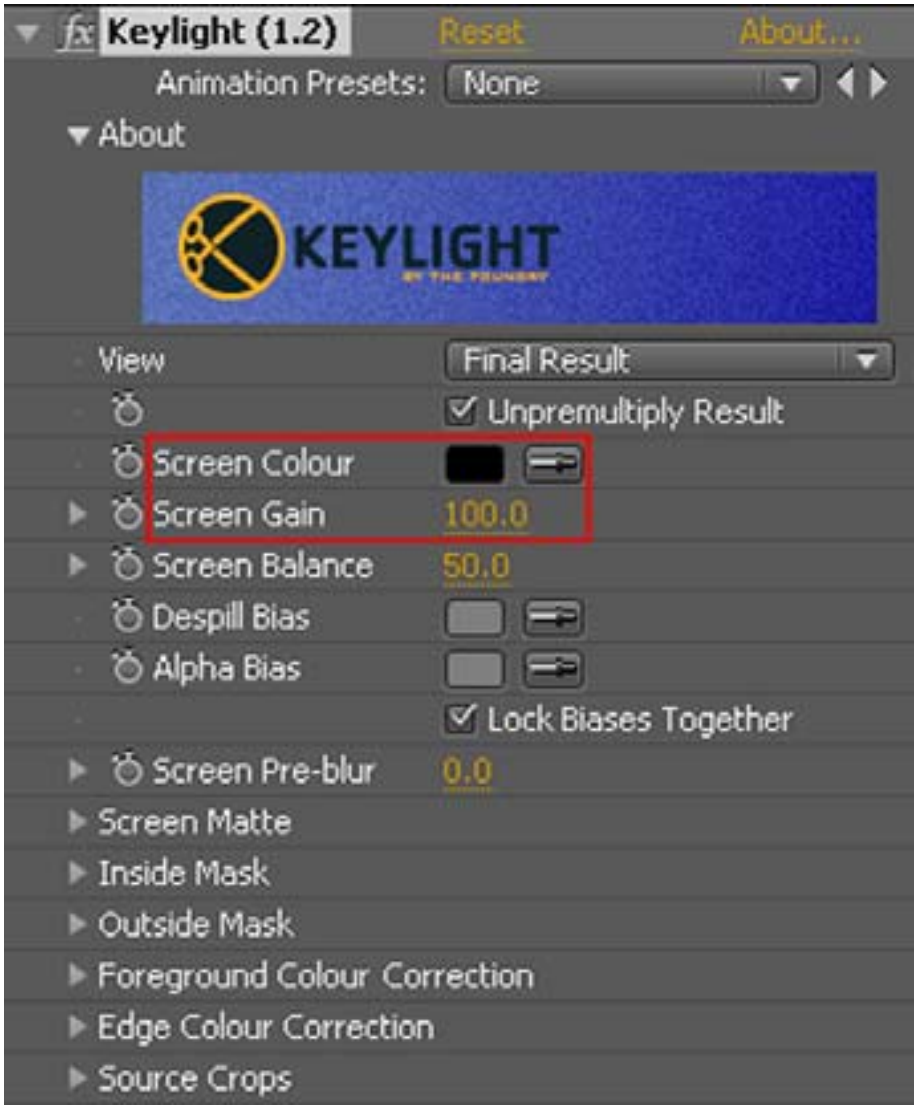
Foreground element is blended with background.

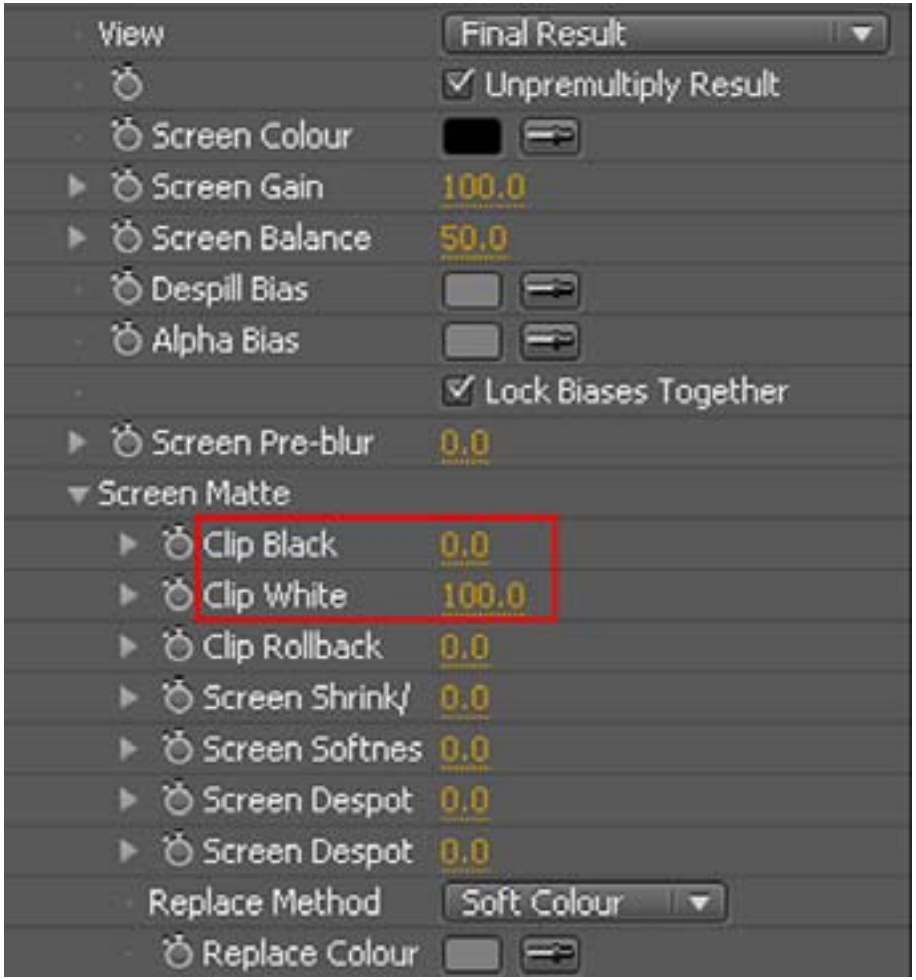
Display Status view to check result.



- White: opaque
- Black: transparent
- Gray: semi-transparent
- Car window is not very transparent.
- Hands and steering wheel are a bit transparent.
- Need to fix transparency problems.

In Keylight, transparency can be adjusted using the following features:

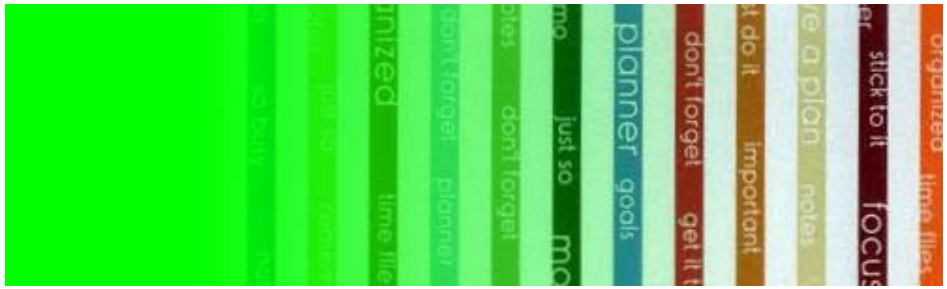




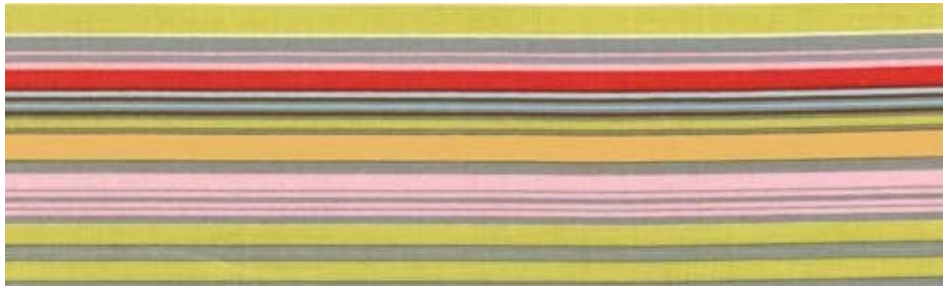
Let's illustrate their functions using these test images:

foreground image

foreground blended on green screen



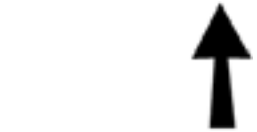
background image



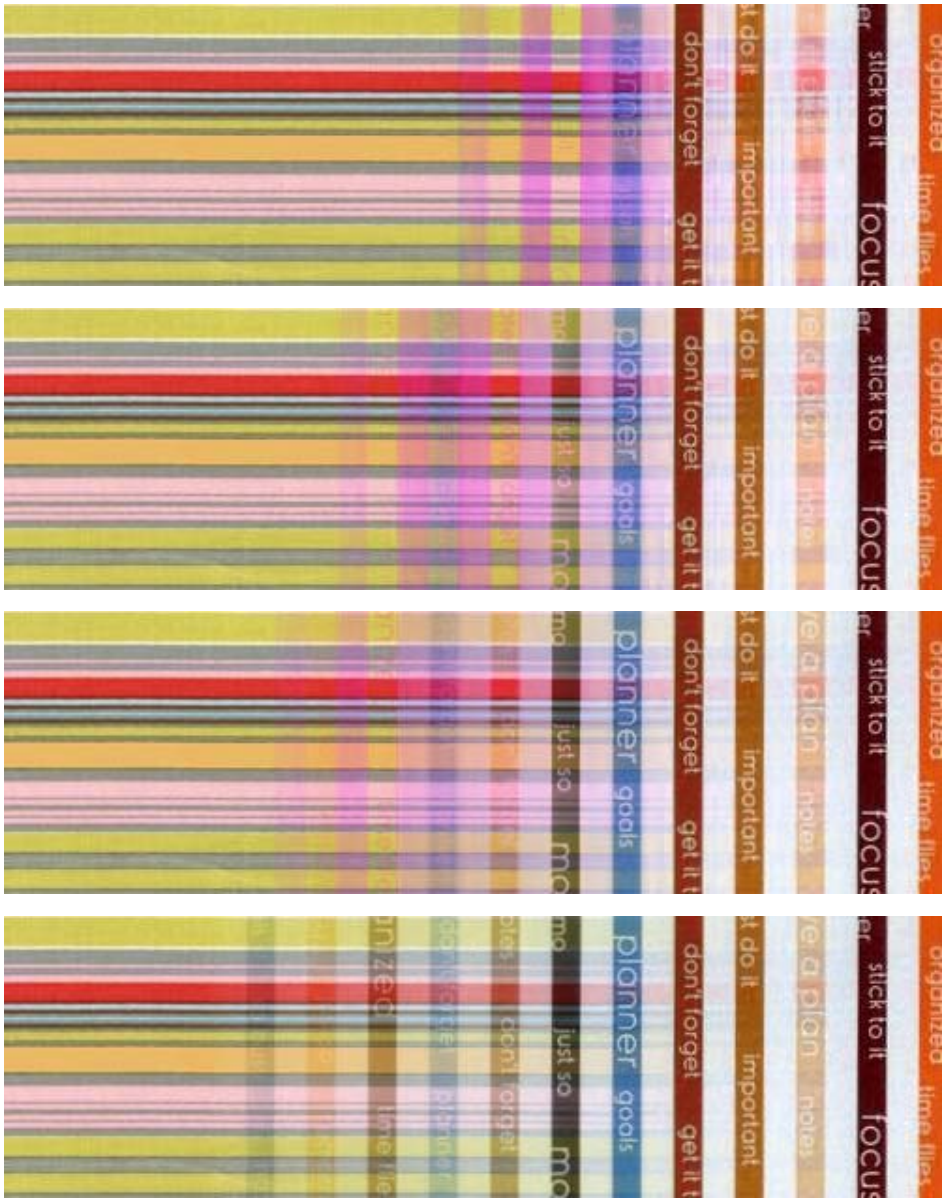
Screen Gain

more red
more transparent

increase gain



default = 100

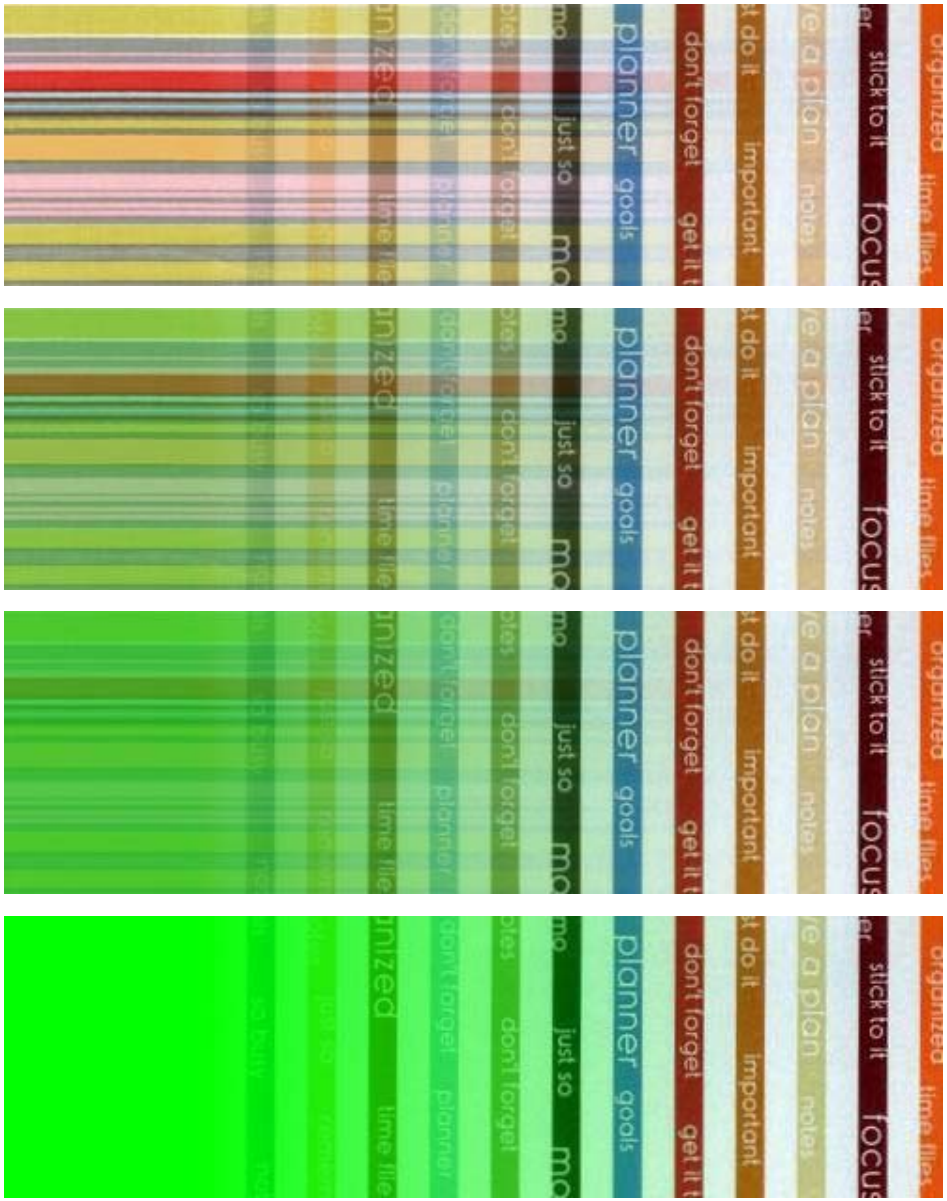


Screen Gain

default = 100

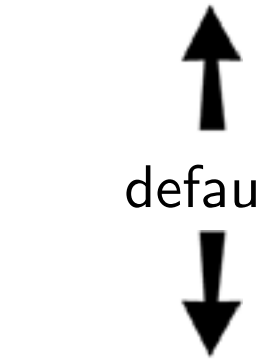
decrease gain

more opaque
more blue/green

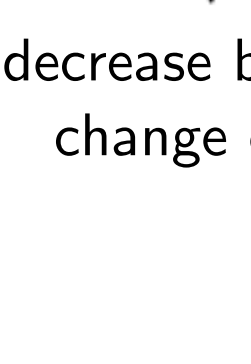


Screen Balance

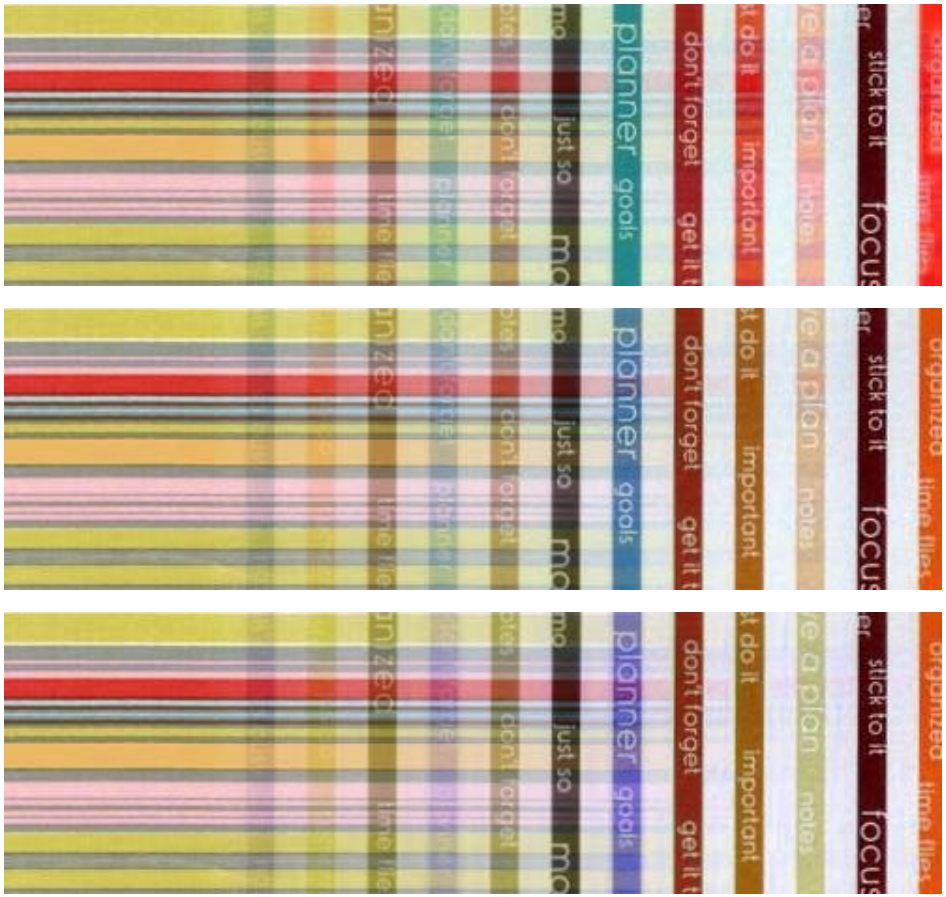
change color
increase balance



default



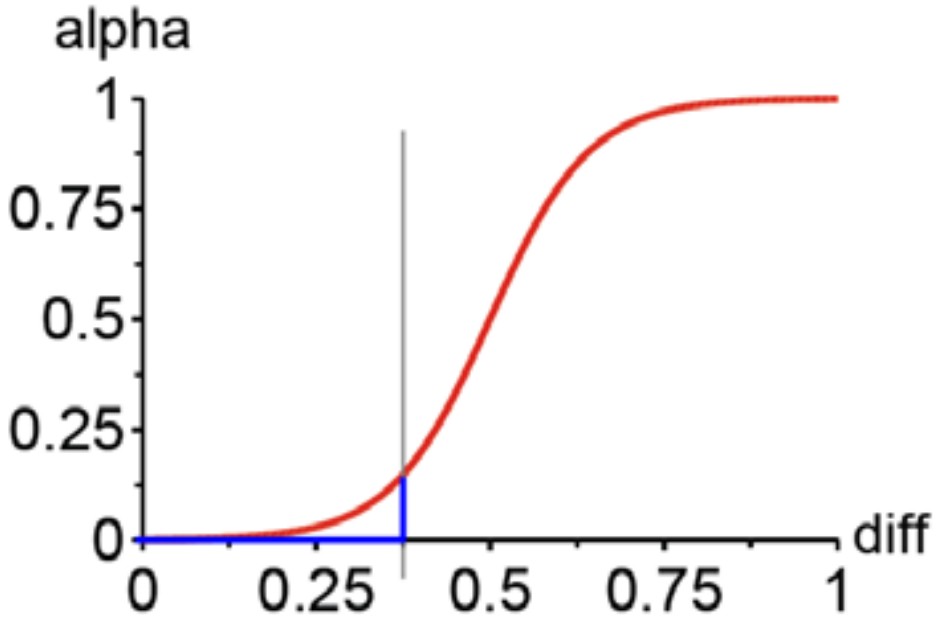
decrease balance
change color



Clip Black

Differences below Clip Black are assigned $\alpha = 0$.

Result: Affected foreground pixels become totally transparent.

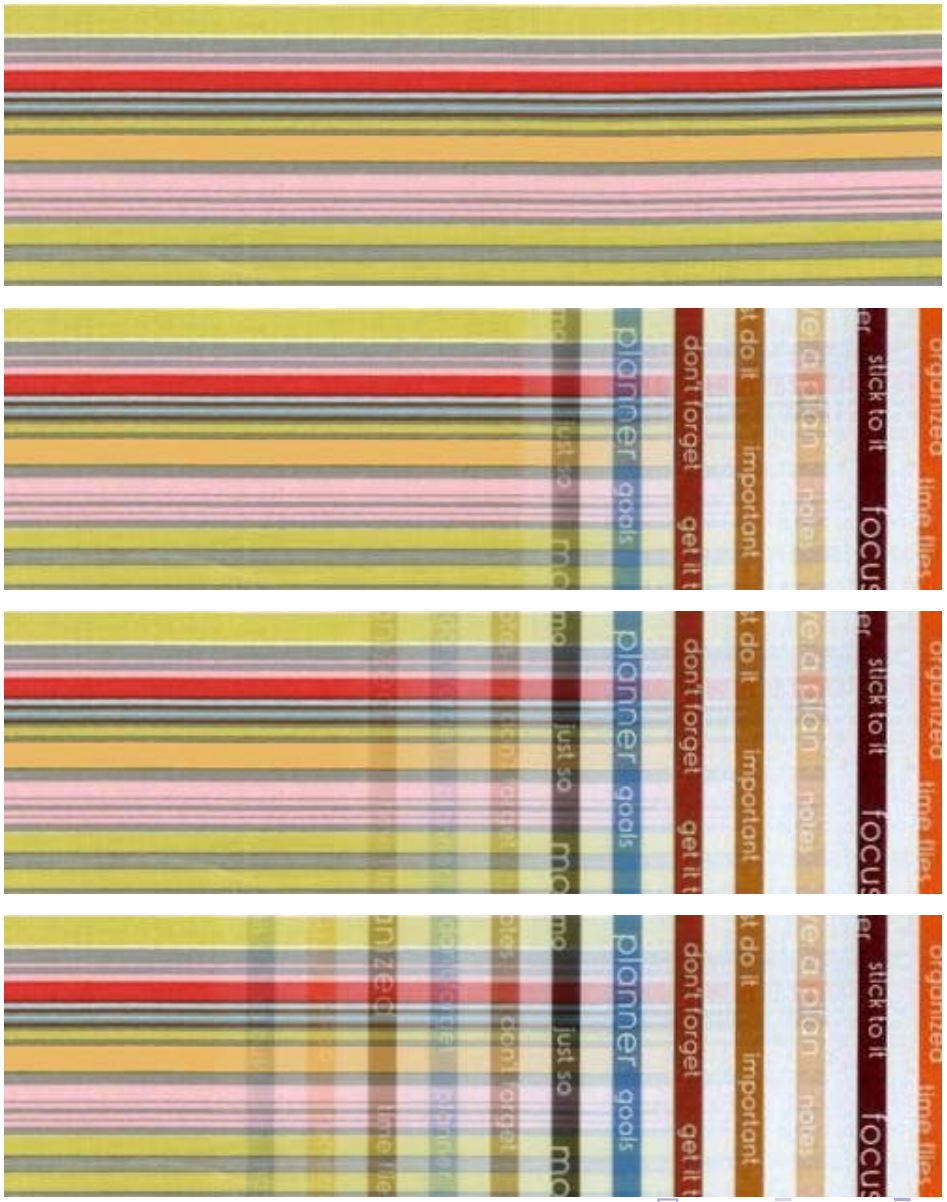


Clip Black

more transparent

increase clip black

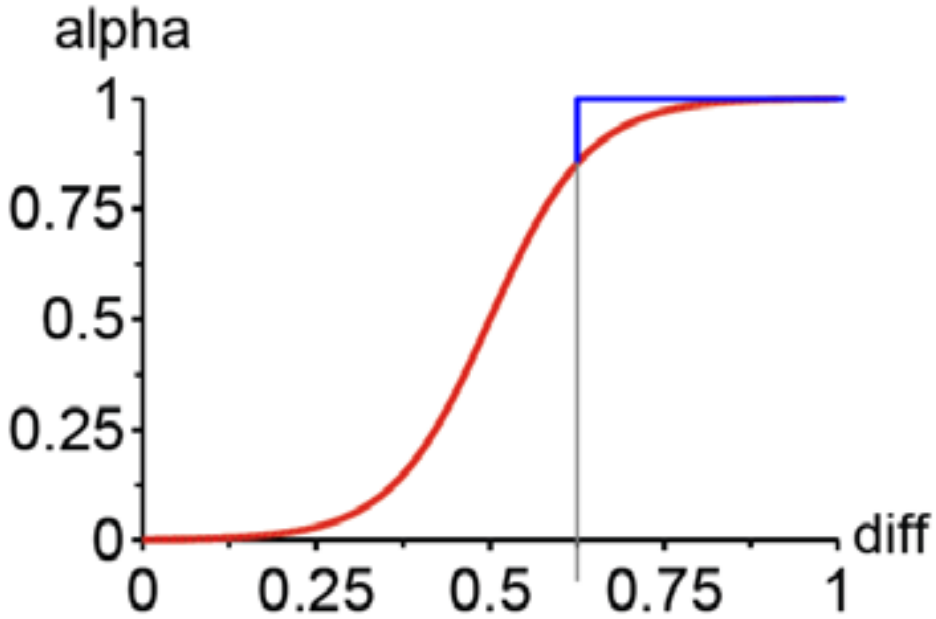
default = 0



Clip White

Differences above Clip White are assigned $\alpha = 1$.

Result: Affected foreground pixels become totally opaque.

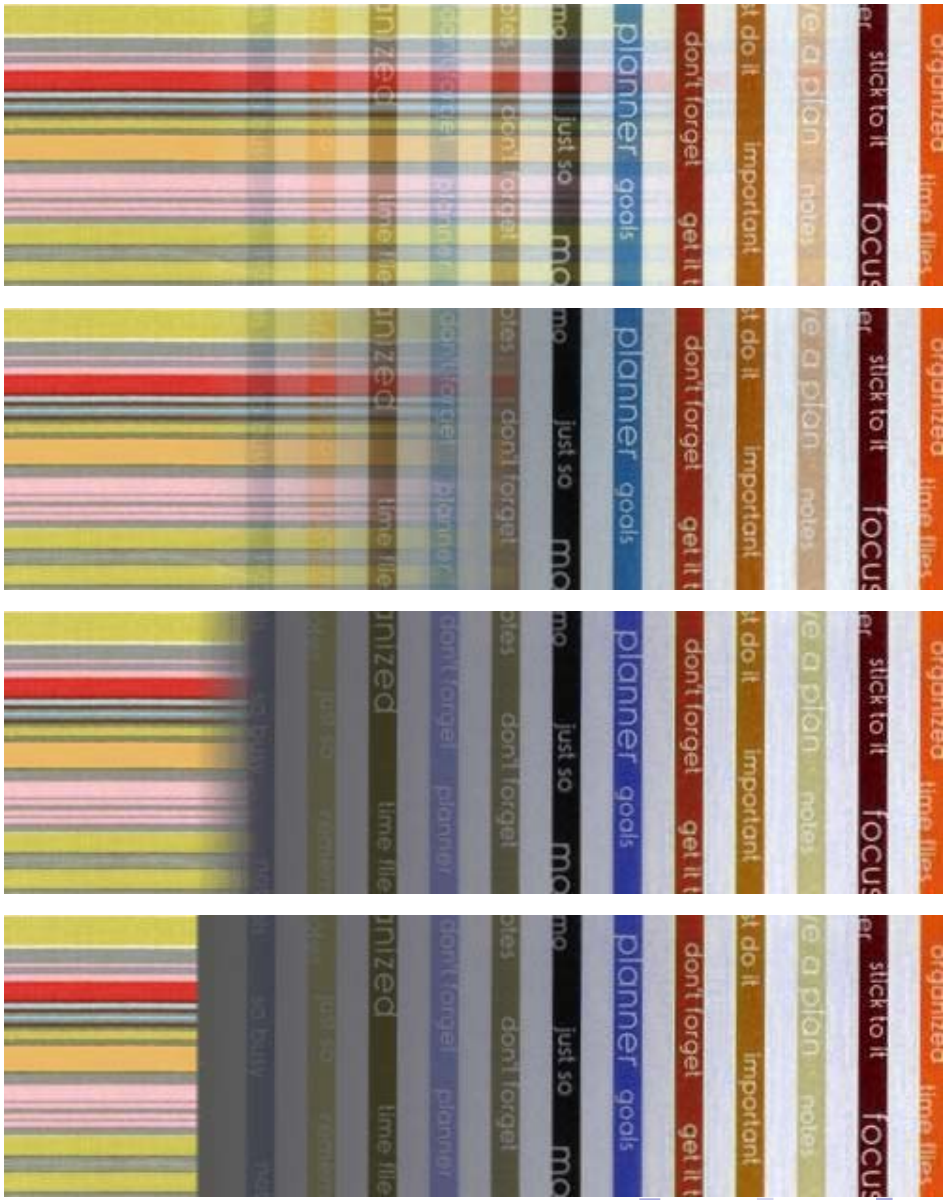


Clip White

default = 100

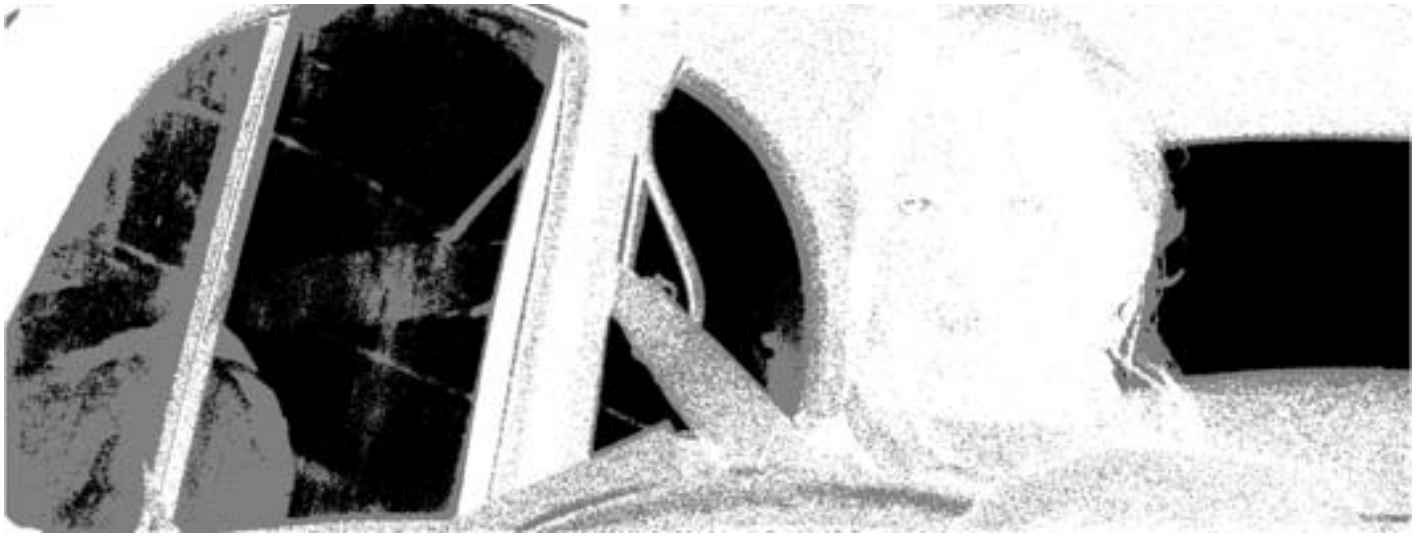
decrease clip white

more opaque



Apply to our example: increase screen gain.

Status



Matte

Final comp:

Handling Blue Spill

Blue spill is due to light reflected from blue screen.

(a)

(b)

(a) Hair looks blue or purple.
(b) Skirt has blue color.

Key out blue screen using Keylight and blend with background.

Example images from *Merlin* (1998).

(a)

(b)

(a) Background not clear.
- Increase screen gain to improve transparency.

(b) Hair looks purple: blue spill.
- Adjust screen balance to remove some blue spill.

(c)

(d)

(c) Still have blue spill.

- Uncheck check-box for Lock Biases Together.
- Select skin color for Despill Bias using dropper.

(d) Final comp.

Sometimes, the blue/green screen may be poorly done.

Example: from *Executive Decision* (1996).

- The green screen has more red than green!

When the image is keyed, the foreground looks transparent.

To fix the problem, need to tell Keylight to scale down red component so that the green component is the most prominent.

- Check check-box for Lock Biases Together.
- Select skin color for Despill Bias using dropper.
- Need to select from Source view, i.e., input image.
- Alpha Bias is selected automatically.

Display Status view to check result.

- Pilot's mask is transparent.
- Cockpit glass canopy is not totally transparent.
- Need to fix transparency problems.

Increase Clip Black to make the glass canopy more transparent.

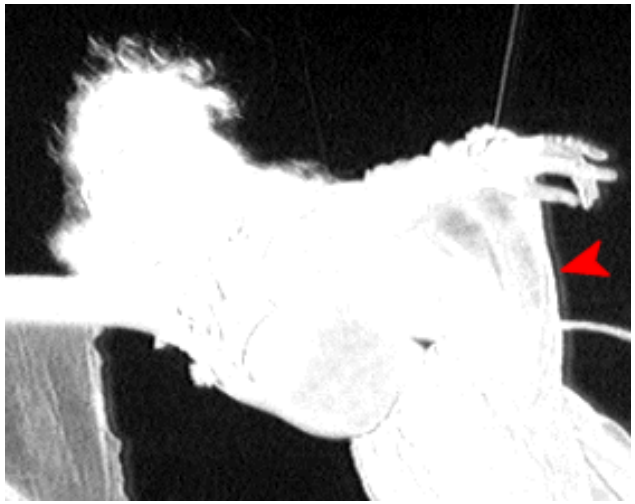
Decrease Clip White to make the mask opaque.

There are some spots on the foreground and background, most apparent in the Matte view.

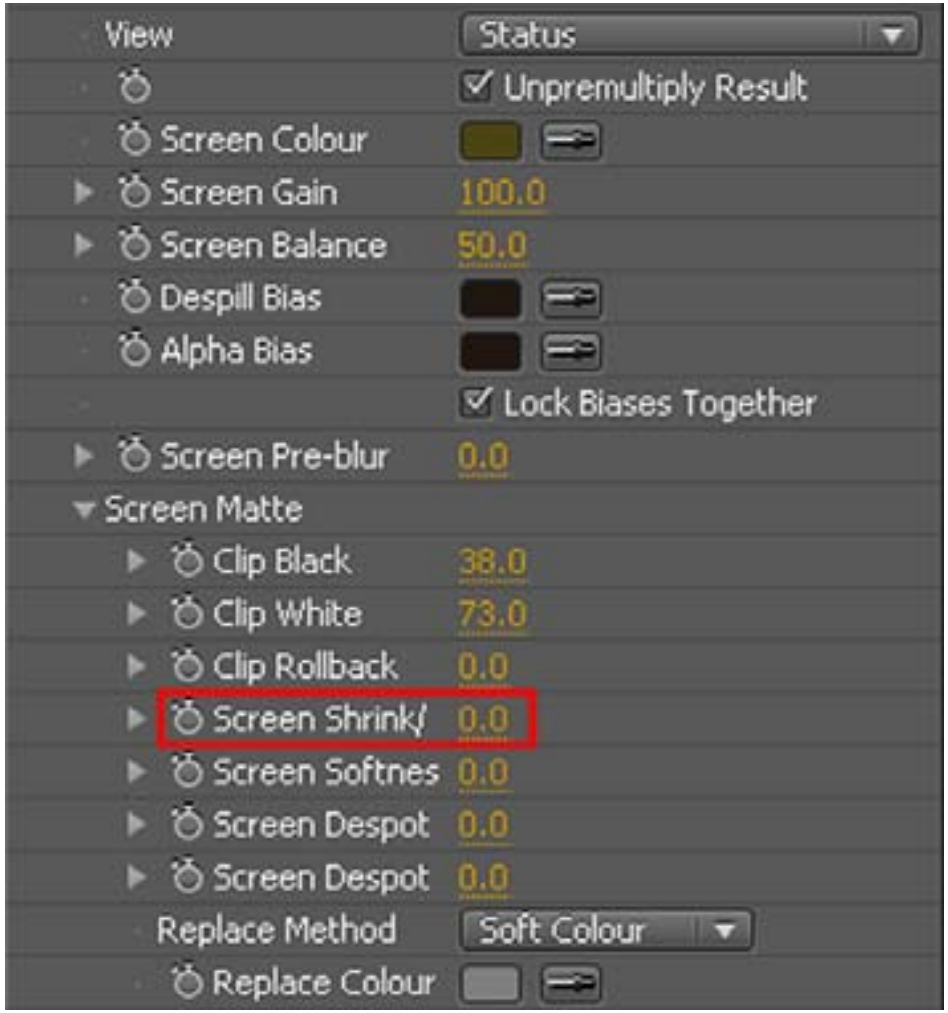
Increase Screen Despot Black and Screen Despot White to remove spots.

Handling Fringes

Sometimes, adjusting Clip Black and Clip White can produce fringes.
Adjusting Screen Gain usually doesn't produce fringes.



One method of removing fringes is to shrink the screen matte.
Set Screen Shrink to small negative value.



Large negative value
Shrink too much

Small negative value
Just nice

Positive value
Expand too much

Demo: keyed by Keylight, keyed by Ultimatte AdvantEdge.

Rig Removal

Rigs are equipment that support the actors or props.

- Sometimes, rigs cannot be removed by keying alone.
- So, have to apply masking technique to remove rigs.
- Need clean plates of background footage.
- If camera moves, then need motion-controlled camera.
- Computer controls camera to move the same way twice:
  - Without foreground objects; get clean plates.
  - With foreground objects.

Basic Idea:

- Apply a mask to mask out the rig.
- Replace pixels in masked area by corresponding pixels in clean plate.
- If rig moves, then animate the mask accordingly.

Example: Let's assume that this chess piece is a rig.

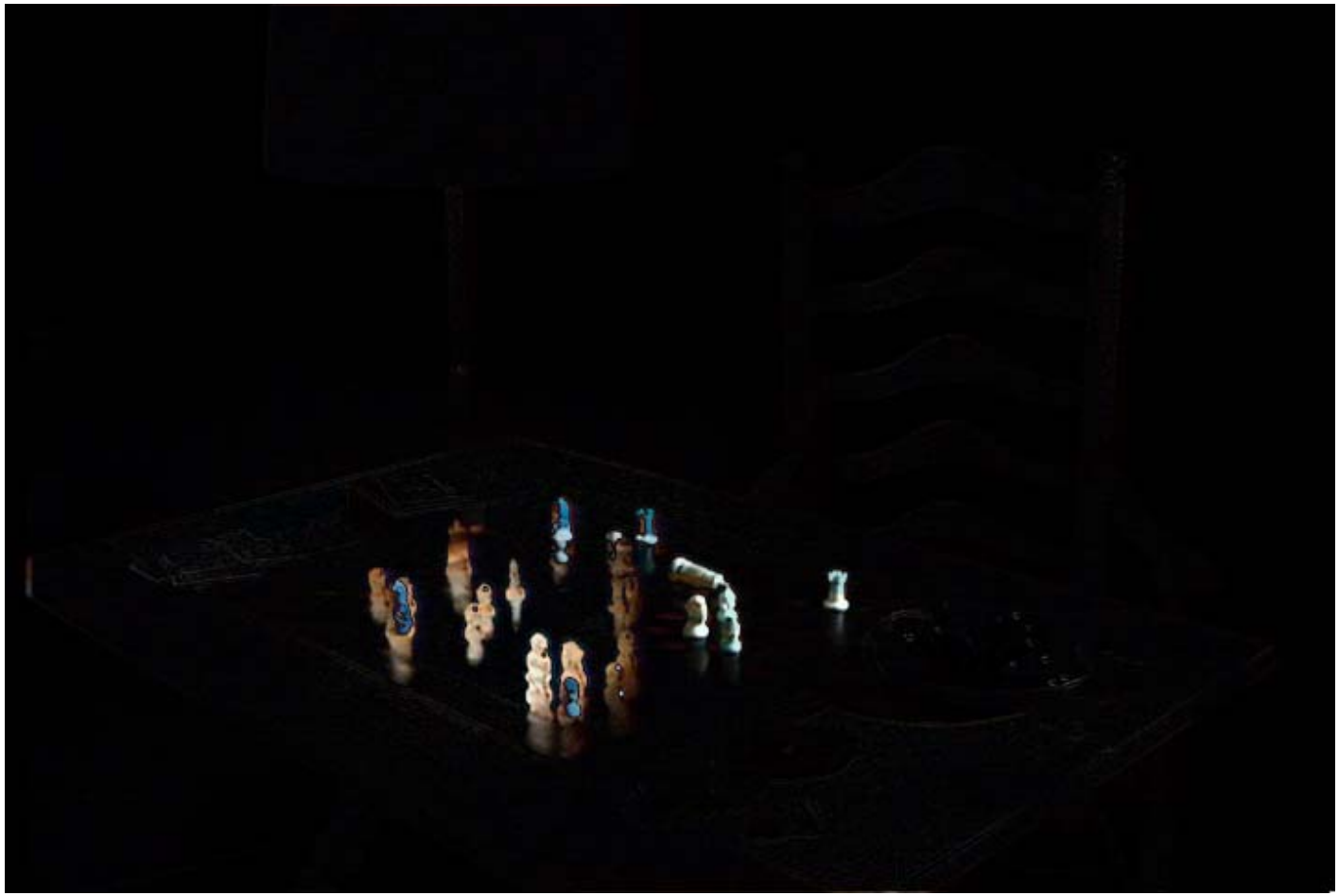
Show: Chess footage, clean plate.

Step 1: Align Clean Plate

- Check misalignment between foreground and clean plate.
- Motion-controlled camera can't be perfect.
- Difference of foreground and clean plate can reveal misalignment.

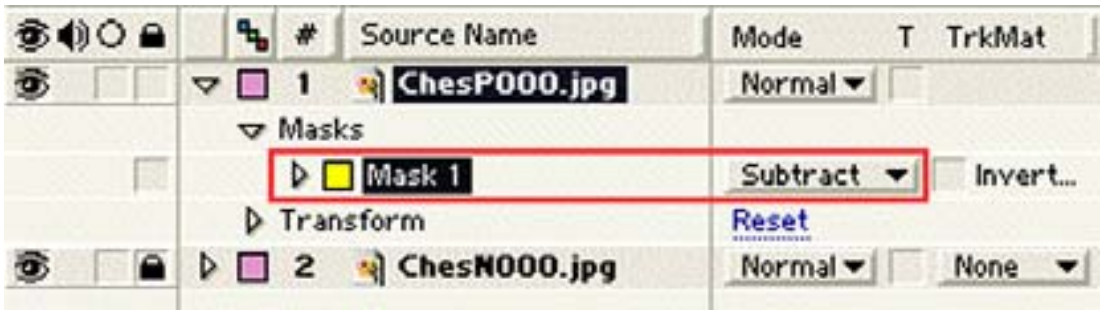
- Translate clean plate to align.
- Use real number coordinates get more precise alignment. Have to set layer quality to "Best".

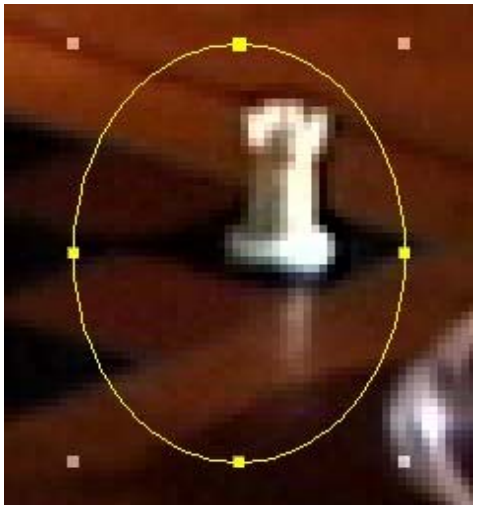
Difference comp after alignment:



Step 2: Mask Out Rig

- Lock clean plate to avoid accidental change of position.
- Put a mask over rig, include rig shadow.
- Set mask mode to Subtract.



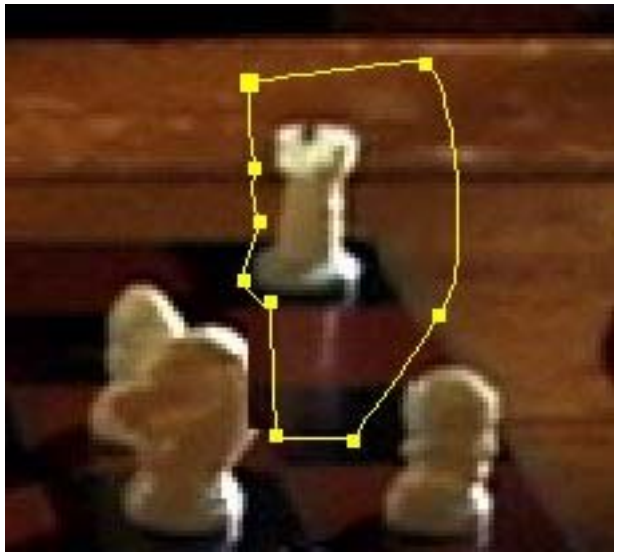


Rig removal result for first frame:

Oval shaped mask may not work in general.

- May mask out part of foreground element.





Need to manually set the mask shape.

- Rotoscoping: manually set outline of mask, matte, or foreground.

3. Animate Mask

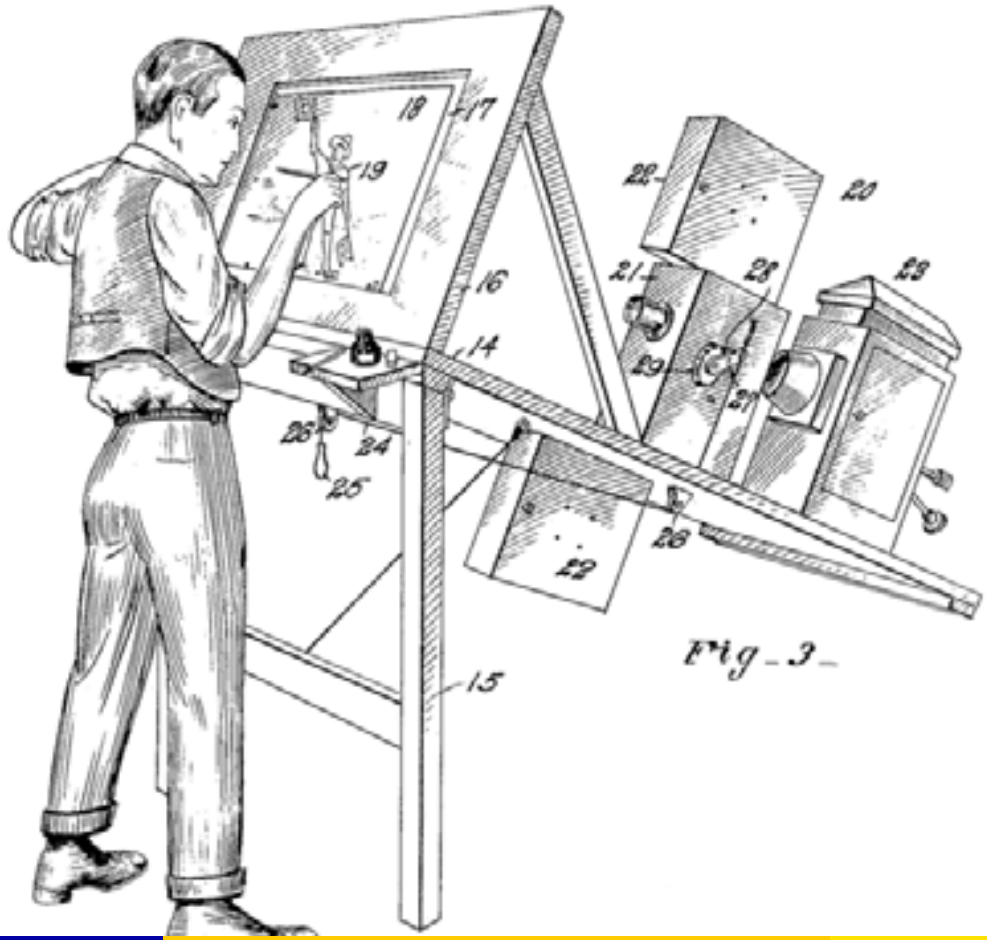
- Move mask to cover rig in subsequent frames.
- Make large mask to minimize the number of keyframes that need rotoscoping.

Rig removal result:




Rotoscoping

- a.k.a. Traveling matte
- A matte that isolates an object from the background, and which changes according to the object motion.



- Used to be a tedious, manual process done on each frame.
- But now AE CS5 has included the useful Rotobrush.
- Rotobrush can be used to pull a matte for the object, or simply to get a mask for the object.

Summary

Further readings and exercises:

- Other miscellaneous topics in compositing [Kel00].
- Adobe After Effects CS4 User Guide [Aft].
- Keylight User Guide [Key].
- Do the tutorials in Keylight User Guide.
  Download test images from The Foundary [Fou].

References


After Effects CS4, www.adobe.com/products/aftereffects/.


The Foundary, www.thefoundry.co.uk.


D. Kelly.
Digital Compositing In Depth.
Coriolis Group, 2000.


Keylight, www.thefoundry.co.uk.