VFX Shooting Guide

By Ben Jones, adapted & extended from The School of Visual Arts Lighting elective course material Shooting Guide by Andy Rowan-Robinson.

Introduction

When shooting footage for Visual Effects, whether it be plate augmentation or CG additions, there are a number of steps we can take on-set to minimize guesswork, maximize plate integration, and achieve the most realistic results possible in CG reproductions.

While much reference and information can be gathered after the fact, there are some time-crucial steps that can only be undertaken at the time of principal plate photography that will maximize VFX efficiencies at crucial processing points.

These core points for plate footage are:

- ***2D or 3D Camera Tracking.***
  - *on-set LIDAR or photogrammetry scans*
  - *Tracking markers*
  - *Distance measurements*

    - *Camera, format & lens information*
    - *Lens distortion information*
- ***Object modelling*** *(i.e. the augmentation, modification, substitution or removal of an existing in-plate object, or the addition of entirely new CG assets)*
    - *on-set reference photography*
    - *photogrammetry or LIDAR of reference objects in on-set lighting conditions.*
- ***Scene Lighting***
    - *Spherical High-Dynamic Range Imagery (HDRI) Light probes for accurate light recreation*
    - *Direct multi-exposure light source captures.*
- ***Compositing***
    - *Any or all of the above*

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Tracking Preparation

Put simply, both 2D and 3D tracking software like Mocha, Nuke, 3dequalizer, Syntheyes, Boujou, or PFTrack work by defining a pixel pattern, and a search area in which to look for that same pattern in the previous or following frames. It can do this with any geometric feature in shot, but the best 'handles' with

which to work have clear edges, high contrast, and a consistent pattern from frame to frame. Most tracking software has the ability to choose a single color channel to extract features, so contrast in any color will help. In 3D tracking, not only is it important that we have patterns, but that those patterns also convey parallax (i.e. that the reference planes are at different depths from camera) for the most accurate solve.

Hardware

Green, Blue, Black, or White Masking tape - using the tone that will provide you with the best contrast to your plate footage.

Tracking Prep Process

Before the camera rolls, consider if we're going to be able to track with the natural features, this means:

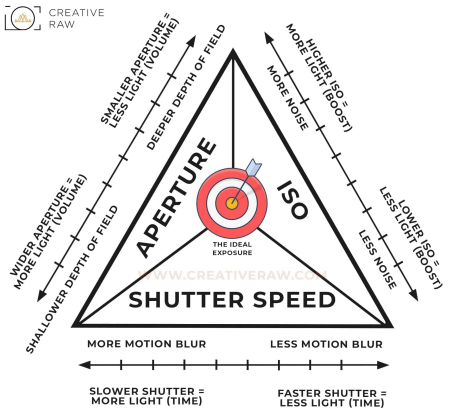
- Static objects
- Objects without transparency
- Edges that are not created by lighting (shadows/highlights) as these shift and change.
- Defined edges that don't decrease readability with shifting perspective (eg overlapping leaves)
- Many objects and different levels of parallax (distance from the camera)

If no good 'geometry' exists, then we need to place small markers (usually an 'x' or something with square edges is best) so that the software has actionable cross-frame patterns

- if needed, place markers and make them small. The more uniform the surface they're placed on the easier painting them out will be
- If there is a lot of movement through the shot, you need to ensure 'handoff' that is, if some tracking points are lost over the course of camera travel, there must be overlap with points that continue the action.

The Camera

Record as many metrics as possible. Be familiar with the camera triangle



Shoot Variables:

- Make/Model (e.g. ‘Sony A7 III’, ‘Arri Alexa Mini’)
- Output format (including color space & compression format)
- Output Resolution
- Sensor size (’Film Back’ or Horizontal Aperture)
- Frame Rate/FPS

Shot Variables

- Color Temperature / White Balance
- Lens details & Focal length
- Height/Tilt/Bearing if relevant
- Distance of travel (if camera is not static)
- Focus Distance

Considerations

- Set as many camera metrics as possible to non-variable values
  - ISO (light your scene well so this is as low as possible)
  - Set a consistent White Balance & record it (as above)
- Deactivate any post-processing on the camera
- Shoot a slate so you know which footage matches which settings
- Keep movements as smooth as possible for easy tracking.

Prep Shooting

Clean Plates

In order to paint in lost details introduced by tracking markers, ensure you film some clean plates that maintain all of the above settings, while removing any markers, actors or obstacles

Reference

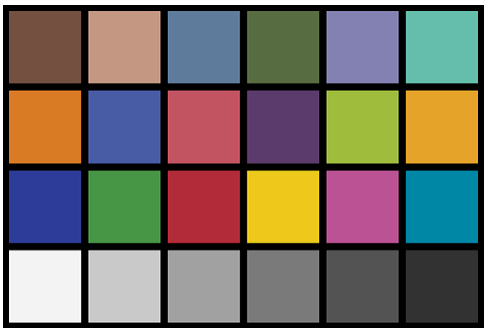
The most important trio of reference objects to capture on the day are probably the Macbeth chart, and a Chrome and Grey ball. The Macbeth chart can be used to neutralize the lighting to a neutral white-point and align all reference photography and plate footage. While the grey and mirror balls provide reference for light and reflection contributions at the position of intended CG insertion. We can render a similar chrome and grey ball at roughly the same position with our HDRI lighting, and assume that our CG renders will match the practical counterparts. Historically, mirror balls were also photographed with a zoom lens at multiple exposures so that the hemispherical contribution were captured for use as an HDRI light probe. While this is still possible, typically 360 degree multiple exposure sets using fish-eye lenses are preferred

Hardware

2 Reference Spheres

- 1 Chrome Ball
- 1 Grey Ball (usually low sheen grey)

- Macbeth or X-rite/Pantone colorchecker chart



Reference Photography Process

Stand-in objects that may be a similarly textured object that represents the final VFX element.

For example

- if making a CG teddy bear, use a standin teddy bear.
- If shooting a car commercial, have a toy or object with glossy reflections
- If shooting a hair commercial, get someone with the type of hair

- Place these objects where the CG element is going to be
- Use same lighting and camera settings as plate
- Take video footage of reference

HDRIs

An 'HDRI' is a shorthand term for a high bit-depth 360 degree stitched image that includes a large exposure range encoded into the pixels, they are used in CG lighting and rendering in order to capture the light information present at the time of principal shooting. Also called a 'light probe', these images are created by attaching a fisheye lens to a camera, taking usually anywhere from 5-11 exposure samples (using an uneven number of samples so that there is a midpoint centred around the plate exposure level), and rotating the lense so that full 360 degree coverage is obtained. These images are usually processed by specialized software like PTGuiPro where they are combined into exposure 'sets' of similar angles, and then stitched together to create a 'latlong' panoramic image of the scene (a rectangular projection of the spherical

scene). Some hardware, like the Ricoh Theta can pre-stitch the photos into a latlong for you, and these may simply be merged to HDR in Photoshop.

In order to sample the light that the CG objects are going to receive, we need to ensure that these exposure sets are taken as close to the position of the CG element to be added as possible. If you are creating a whole environment, capturing probes where a single scene contains multiple lighting scenarios, or replacing or adding multiple objects; multiple probes may need to be taken to account for such variances in light information.

Hardware

Non-Optional Hardware includes a fisheye lens

Optional Hardware include the Promote and Nodal Ninja or similar.

HDRI Process

1) Place Macbeth chart in frame

2) Set constant white balance temperature

3) Set a low ISO

4) Set shoot to 'RAW'

5) Set metering to 'Centre Point Sampling'

6) Level camera on tripod

If using **Promote**:

7 i) In program mode, take a light reading by firing the shutter

7 ii) Feed exposure value into Promote

7 iii) Set to 5, 7, 9, or 11 exposures

7 iv) Set exposure steps to 1 stop

7 v) Set camera to manual mode

7 vi) Shoot first set from Promote

7 vii) Check range in the histogram display checking:

- Very Dark to Very Blown out across teh images
- No clipping the highlights in the lowest exposure

- No clipping the blacks in the highest exposure

7 viii) Adjust exposure and/or number of images if required and repeat set.

If ***not*** using **Promote**:

8 i) set exposure level to

e-((*n*-1)/2)

where

e = yourplate exposure level (your midpoint exposure), &

n = the number of exposures you wish to take

8 ii) using a timed shutter as to not disturb the exposure, take your first exposure.

8 iii) increase the exposure by a single stop and take subsequent photos, increasing the exposure by a single stop with each photo, until you reach the desired number of exposures (*n*)

9) Rotate Camera 120 degrees

10) repeat either step 7 or 8 to capture your second set

11) repeat steps 9 and 10 for your third set.

12) Additional sets may optionally be taken pointing the directly camera up or down 90 degrees.

Set Measurements and Reference

We need to do a full survey of the set to scale and orient the CG scene correctly aiding tracking.
This will also help should we decide to rebuild parts of the environment for render, or in order to aid lighting (we can project HDRI images onto geometry or cast shadows from it).

Process

- Draw plans of the set and annotate with measurements (there are also apps that let you annotate on photos you take). Important objects are
  - Anything that casts a shadow

    - Anything that interacts or may interact with our render objects
- Distance from Camera is nearly always relevant.
- If possible take a full set of photogrammetry images that we can use to build the set in photoscan.

Photogrammetry

Photogrammetry is the process by which we generate 3D geometry from reference photography. Photogrammetry software like Agisoft Metashape (formerly Photoscan) or RealityCapture detects similar pixels across photos containing different parallax, generates a pointcloud from them, and then reconstructs surfaces from those points . The greater the number of images we take from different vantage points, , and the more parallax we can achieve across all pixels, the more accurate the 3D reproduction we are able to achieve.

Process

This means we want both ***rotation***, and ***translation*** of **the camera position as we circle the object/s we wish to scan.**

The Spiral technique is good for an overall capture, while multiple angle closeups on important features is recommended.

Some surfaces work better than others, highly reflective objects are hard to scan and the software will struggle to recreate them.

Scans in the range of upward of 50 images, but can easily reach the hundreds or even thousands for high-detail photogrammetry scans. Generally speaking, More is more, provided ***parallax is conveyed***

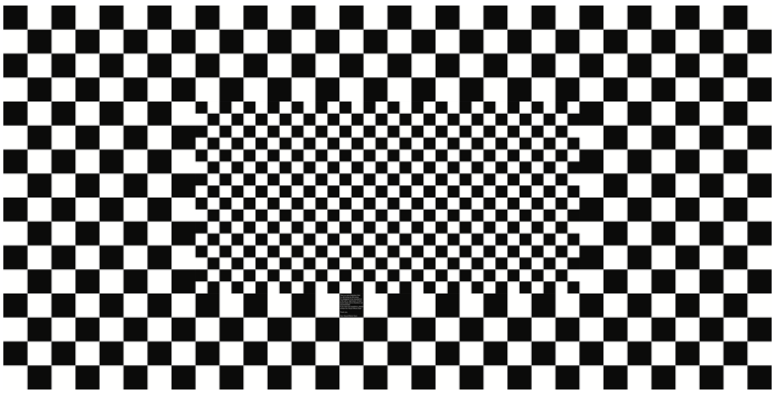
Shoot Lens Grids

Due to the translation of round camera lenses to rectangular footage, all footage has some degree of lens distortion. This distortion typically increases

toward the edge of frame. In order to counter the effects of this when using typically undistorted CG renders, 3D tracking software is able to generate maps which will allow us to freely un and re-distort plates as needed.

In order to more accurately gauge the amount of distortion for a given lens & focal length, we can take footage of a black and white grid, often a checkboard pattern, that can then give the software some sense of how much the plate footage has been distorted.

Some can be found here.



Process

- Slate all grids so you know exactly what follows - i.e. the lens and camera information you are gauging the distortion of.
- Shoot the grid so that it entirely covers the frame from a distance that allows sharp focus and that is mounted entirely flat.
- In order to account for the ‘breathing’ of lens distortion through zooms, step through zoom lenses shooting at constant increments. Record the Focal Length of each step.

Shoot Kit Packing List

- Tape (for tracking markers)
- Measuring tape / tape measure
- Angle measurer (optional)

- Diffuse Ball (or volley ball)
- Mirror Ball (can be purchased as silver ‘Christmas Baubles’ from craft supply stores or online)
- Macbeth Chart
- Maquette / Stuffy / 3D Print of character
- Notepad & Pen & Clapper board for slating
- Camera Body / batteries / SD Card
- General Lens for shooting footage through
- Pano head (eg Nodal Ninja) (Optional)
- Fisheye Lens
- Promote & Cables (Optional)
- Tripod / Mini Tripod (for table top HDRIs)
- Dolly / Slider (optional)
- Lens grids (optional in most cases)