Sam Salek i7970695

Introduction
Colour matching is the final stage of CG integration that happens in a compositing package. This is with no doubt the most important stage that determines the successfulness of an integration. Although Colour matching being a very important stage especially in achieving photorealism, there are a very limited resources available to the digital effects artists about this technique. In the course of my research I did not even find one book specialized in colour matching and the on-line resources are not comprehensive as well. In this research I have looked into Colour matching technique and how to go about it as well trying to find an alternative method to help speeding up the CG integration process. I hope this paper will be helpful for future students.

Colour Matching
After the CG element (or any additional elements that needs to be comped on the main plate) is designed and lit according to the final plate, it needs to be refined and matched with the background to make it look as it's actually there.

The idea of colour matching is to match the CG elements white and black levels with the background's Black and White levels and then apply the same colour range exists in the background to the CG object using the colour channels. For example a very bright green cannot exist in a dark room, so if the colour of the element is green it's need to be within luminance available in the environment.

This process is then developed by colour grading to further blend the CG elements with the background but without a good colour match the grading will not be effective.

Eye Matching
Colour matching process is usually down by trained eyes and comes down to the compositor's skills and understanding of light and colour. The idea is to first match the black and white levels of the element with the background but that's not the only thing needs to be taken into account to achieve a successful colour match. Colour matching is a process that needs to be applied to a lot of different elements and every interactions made between the CG object and the back plate such a shadow, reflections etc. needs to be matched accordingly as well. Some of those important elements are as followed.

1- **Colour**: Each red, green and blue channels will be checked against the back plate in turn to find the right colour range for the CG element. To help this process the image can be extremely brightened (e.g. using a gamma node) so the white and black points of the image will stand out. RGB values available in the background can be used as a reference. In the following image you can see how a matched CG box will appear in different channel. The red figure was used as a reference for matching the box.

2- **Depth**: The furfur objects are from the camera, or a light source, the less saturated the colours become. This needs to be taken into account when matching the colours. This can be seen on image above the how much the value of the same colour will change in depth. A depth map could also be generated using a 3d package to help adding volumetric layers to create the depth illusion as well finding the right RGB Values.

3- **Shadow**: Shadow is another element the also needs to be matched not only in terms of opacity and sharpness but also colour. The same principles are applied here, each channel could be checked in turn and also the image can be brightened to help the process. The shadow should be rendered as a separate pass to give more control to the compositor.

4- **Reflection:** Like other passes, the reflection pass coming out of a 3d package will need refinement too. Each material and surface has a different effect on colour which needs to be matched.

5- **Light**: The intensity and direction of the light is determined in the 3d package (although a limited control can be obtained in the compositing package using a normal pass). In term of colour matching, light creates highlight, shadows and mid-tones that needs to be matched accordingly.

6- **Colour spill:** Depending on type of material and the environment light, colour spill might happen. Since this usually happen in the contact areas with the surface, colour matching a reflection pass could help creating the illusion of the colour spill too. (Usually the colour spill pass is generated using a GI light and photons map inside the 3d package)

7- **Noise**: The level of video noise can vary in difference channels. Using nodes such as Grain, noise or Film noise this effect can be added but in needs to be modified for different channels individually. Again the same method of using a gamma node to brighten the image will be an effective starting point and also it is important to find out what channel is carrying the highest level of noise first. (The speed of the noise should be considered too)

8- **DOF** : Depth of field is also affecting the colour which is something that's often overlooked and simply applying a blur filter will not be enough. Colour will be more spread out with less saturation.

Sam Salek i7970695

Alternative Methods:
Although colour matching is an eye-matching exercise, there are ways to utilities the tools available
In the compositing packages to base the colour matching process on a more procedural basis.

1- Black & White Points

       One of the colour correction tools in Nuke is 'grade'. Using the back and white points eyedropper tool, the brightest and darkest area of the background can be chosen and applied to the CG element. This will result in a good luminance starting point.

2- Histograms

       Histograms can be utilized to check the colour values of the reference in the backplate and CG elements. This is a great tool in evaluating how close is the colour range to make minor adjustments .

3- Evaluating RGB values
This may sound very simple, but it is effective – (the result not good – not to be used in the posted; image below – not able to use it to match the colour values, only the luminance)

4- Alternative test

Inversion
Using a gamma node to super expose the image to help the colour match is a very useful method as it points out the darkest areas of the backplane and helps the CG integration. In a similar method, with or without the gamma node active, an invert could be used to help the colour matching. This is works particularly well when adjusting the gain and gamma levels.

Sam Salek i7970695

Bibliograohy

1- Hullfish,S., 2008. *Color Correction for Video: Using Desktop Tools to Perfect Your Image.* Ontario: Focal Press
2- Hullfish,S., 2008. *The Art and Technique of Digital Color Correction.* Ontario: Focal Press

Reference:

1- http://www.digitalartform.com/archives/2005/10/compositing_pre.html
2- http://www.thejuniorcompositor.com/2009/04/12/tips-using-rgb-mattes-in-cg-compositing/
3- The Foundry YouTube Video Channel
http://www.youtube.com/user/TheFoundryChannel