Color Management with 3DCG

This booklet is for animators that want to improve efficiency and quality by implementing 3DCG color matching. Here, everything from the benefits of color management to the correct software settings is explained.

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1

Getting Started

The installation of the linear workflow into color management is essential as a method for handling 3DCG color, a component of color management. However, because linear workflow is a method to handle the input and output of image data in 3DCG software only, adopting color management is necessary in the event that you want to establish a material database, match monitor displays, or match displays between software.

This booklet, the first of its kind by EIZO, was created with the intention of assisting those who are considering adopting, or are interested in linear workflow or color management.

Achieve a reduction in production costs and an improvement in work efficiency by referring to this booklet and adopting color management.

index
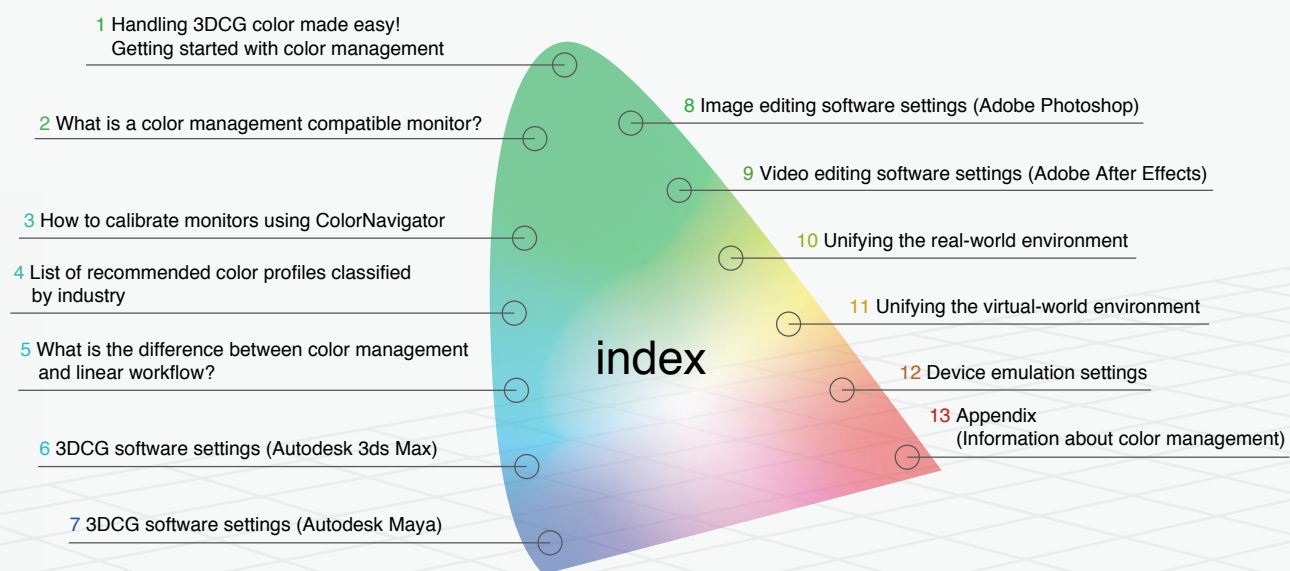
How to use this booklet

With this booklet you will learn everything from basic knowledge about "color management" and how to make hardware/software settings, to specific usages.

In addition, information relating to color management, which is not limited to this booklet, can be found in the "Information about color management" section at the end of this booklet.

How are color management and linear workflow different?

I adjusted the gamma values, so why don't the colors match?

Why is it that the colors don't match in 3DCG software and Photoshop?

The first handbook to answer these kinds of questions relating to color.

Handling 3DCG color made easy! Getting started with color management

What is color management?

Color management is a system to handle colors that increases work efficiency by matching the colors of input devices, monitors, and output devices, etc.

By working, you can match colors within your team or workplace, or with subcontractors. As a result, pipelines or material databases relating to color will improve.

By working with correct data, sharing data, reusing past data, and sharing images between staff will improve greatly, and it will also contribute to an improvement in final products and operational efficiency.

Color management: Matching the colors in every process

Shooting · Scanning · Viewing · Color measuring · Smartphones · Video games · Projectors · Printers · Monitors · 3DCG Editing, etc. Computers

What you can do with color management

● Create a material database with accurate colors
● Match the display between multiple monitors
● Match the display between software
● Reduce production time

Benefits of adopting color management by industry/scene

Entertainment

● Create while simulating the final dislay devices
● Optimize the use of the color reproducibility of final display devices and create even more beautiful images
● Reduce color corrections that occur due to miscommunication between in-house creators and/or external subcontractors

Product Design

● Reproduce the accurate colors of materials on monitors, etc.
● Correctly compile a database of materials and color samples
● Increase work efficiency by confirming accurate colors within the workplace without the actual materials or mock-ups

Architecture

● Correctly create data for the colors of materials
● Reproduce correct colors when rendering so it is possible to perform correct color and lighting simulations
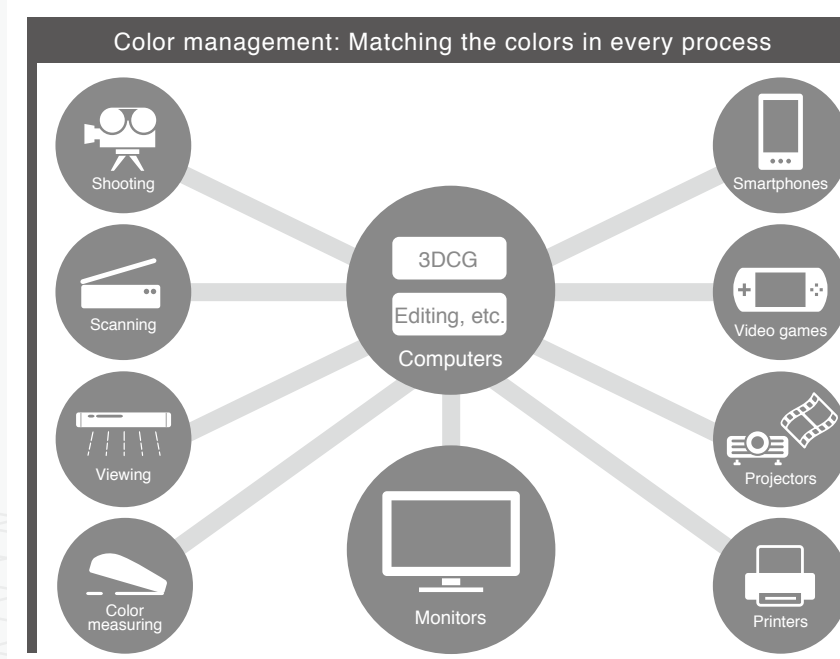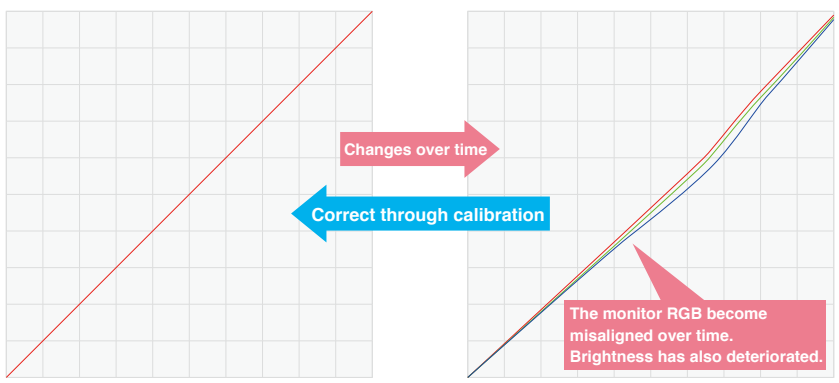● Correctly compile a database of materials and color samples

Advertising

● Accurately reproduce the colors of products/materials
● Compile a database according to the work
● Match the colors of 3DCG and prints/websites
● Coordinate with the color management system already adopted

2 What is a color management compatible monitor?

Why a ColorEdge special-purpose monitor is necessary

Because the colors of a monitor change over time, it is necessary to check them regularly, and adjust (calibrate) the color balance of each RGB color. In such a case a "Profile", or file that shows the colors' properties, is used as a standard. ColorEdge monitors have excellent color reproducibility, and are able to reproduce various standard colors within the industry. In addition, it is possible to perform accurate calibrations quickly because of circuitry installed inside the monitor.

Changes over time

Correct through calibration

The monitor RGB become misaligned over time. Brightness has also deteriorated.

What is ColorNavigator color management software?

ColorNavigator, independently developed by EIZO, is software that can adjust color on a ColorEdge monitor quickly and easily using a color measurement sensor. By correcting the brightness and color temperature, which change noticeably over time, it can ensure color management between devices. In addition to being able to easily create profiles, ColorNavigator, when used with a ColorEdge CG monitor, supports 3D-LUTs, so a wide variety of devices and mock reproductions of profiles are possible. What's more, updates are performed as needed and creative work is strongly supported.

What is a hardware calibration compatible monitor?

Calibration is the process of adjusting the misaligned colors of a monitor to their correct state, which is performed on hardware or using software. Hardware calibration, which directly adjusts the settings inside the monitor, does not disrupt any gradations so precision adjustment to utilize the monitor's performance is possible. On the other hand, as software calibration is the adjustment of colors inside the graphics board, gradations are reduced and colors are disrupted. ColorEdge uses ColorNavigator to perform hardware calibration.

		Hardware Calibration Monitor		Software Calibration Monitor
		Built-in color measurement device (ColorEdge CG Series)	External color measurement device (Color measurement devices such as i1 and ColorMunki are used with ColorEdge CX and CS Series monitors)	External color measurement device (Color measurement devices such as i1 and ColorMunki are used with general monitors)
Quality	Accuracy of matching the target profile	High	High	Low
	Degree that data is displayed accurately	High	High	Low
Adjustment	Adjustment time	About 3 minutes	About 5 minutes	About 20 minutes when monitor settings are done manually About 10 minutes when all adjustments are done through graphics board output
	Regular readjustments	Automatic	Automatic	Manual

Recommended ColorEdge models to create 3DCG

ColorEdge, which provides accurate color reproduction, stable display, and ease of use, comes in three series: CG, CX and CS. For the creation of 3DCG, which requires exact color management and color display, the CG or CX series is recommended. Although each lineup has been prepared so that it can accommodate all uses and user environments, here we will introduce the 4 models most suitable for creating 3DCG. The table lists functions that are particularly useful in creating 3DCG.

	ColorEdge CG247	ColorEdge CG277	ColorEdge CX241	ColorEdge CX271
Size	24.1 inches 1920 x 1200 resolution	27 inches 2560 x 1440 resolution	24.1 inches 1920 x 1200 resolution	27 inches 2560 x 1440 resolution
Features	CG Series: Models for professionals. Reduce the time and effort spent managing conventional monitors, and meet the requirements for accurate color management.		CX Series: For those who already own a standard high performance external color measurement device. Calibration can be performed with ColorNavigator.	
Built-in Sensor	Calibration Sensor Creates a highly accurate, integrated color environment as it performs calibration automatically.		Correction Sensor By storing the adjustment results of the external color measurement device in the sensor, regular display corrections are automatically performed to maintain the calibration settings.	
Equipped with ColorNavigator	○	○	○	○
Device emulation function * Refer to pp.16 - 17	○	○	×	×
Other product features useful for creating 3DCG	● Black tones are displayed in detail, which has been difficult due to characteristics of LCD monitors ● Preset color modes such as Rec. 709 and DCI that are often used as broadcast standards ● LED buttons on the front for easy operation even in dark places	● Black tones are displayed in detail, which has been difficult due to characteristics of LCD monitors ● Preset color modes such as Rec. 709 and DCI that are often used as broadcast standards ● LED buttons on the front for easy operation even in dark places	● Black tones are displayed in detail, which has been difficult due to characteristics of LCD monitors	● Black tones are displayed in detail, which has been difficult due to characteristics of LCD monitors

Necessary monitor functions to use color profiles

A "Select Target" function is required when adjusting a monitor in order to form a pipeline with a target color profile or 3D-LUT, etc. Please check whether the monitor you are currently using or the monitor you are considering purchasing has software for adjusting with this function or not.

The ColorEdge Series supports color profiles and 3D-LUTs together. ColorNavigator is essential to perform these settings, so a model that includes it is recommended. (It possible to purchase the license alone, having purchased a model that does not include ColorNavigator.)

Standard lighting uses fluorescent lights for color evaluation (Ra=98 or above, 6500 K)

Fluorescent lights for color evaluation create suitable lighting for viewing materials. Such fluorescent lights have a high color-rendering index (Evaluated as an Ra value, with natural light being 100. The color evaluation for our fluorescent lights has an Ra value of 98 or higher.) and colors can be accurately checked. Caution is necessary as under common lighting with a low color-rendering index, a phenomenon may occur (metamerism) where the colors differ for certain parts depending on the material.

Please choose a color temperature to match your company's pipeline. In addition, D65 is recommended because the color temperatures of sRGB, Rec. 709, etc. in the 3DCG industry are D65 (6500 K).

[Tried-and-trusted high color-rendering fluorescent lights for color evaluation]
● Toshiba D65 fluorescent lamp for color comparison and examination
● Mitsubishi Osram fluorescent lamp for color evaluation

color management for 3DCG

3 How to calibrate monitors using ColorNavigator

Due to the changes that occur to monitors over time, it is necessary to measure the amount of change, approximately once a month, and correct it. Calibration software and a sensor (color measurement device) are used to perform this measurement.
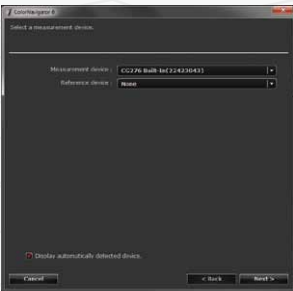
Let's check the steps to calibrate using ColorNavigator 6 and a built-in sensor or external color measurement device. For external measurement devices, X-Rite i1 Pro series or ColorMunki, etc. are recommended.

Step 1

Having connected EIZO ColorEdge to the computer, launch the ColorNavigator 6 calibration software.
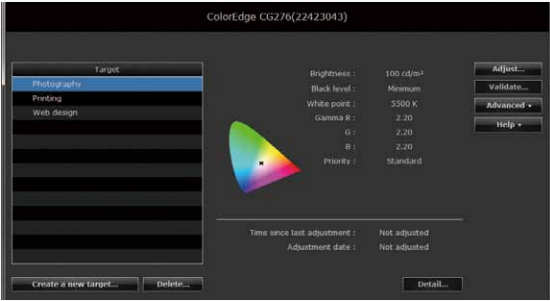
Select [Load a profile] from [Create a new target...]

Step 2

Create an adjustment target. Set the target color profile. It is also possible to customize brightness, gamma, white point, etc.

Step 3

Specify the sensor (select a built-in sensor for the CG Series, and ColorMunki for the CX Series) and calibrate.

For CG Series   For CX Series
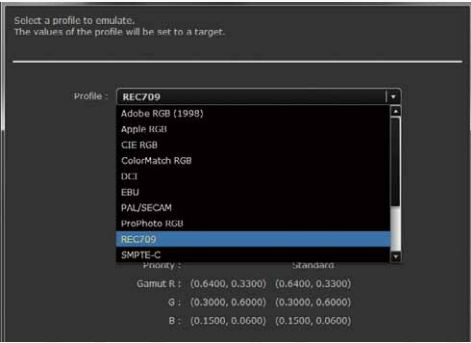
Step 4

Begin the measurement. The monitor's white point, black point, and each RGB color are all measured and adjusted automatically.

Multiple colors are measured step-by-step and adjusted.

Step 5

Once color measurement is finished the color profile for the monitor will be created so it can then be saved.
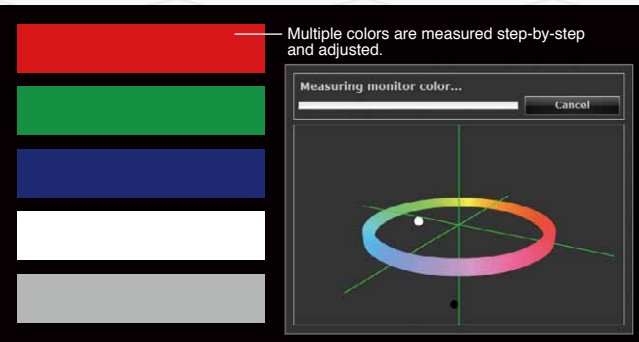
Step 6

The created adjustment target is saved in ColorNavigator. By creating multiple targets, and clicking on one to display it, you can match the intended use, and easily set the color environment for a production.

Furthermore, automatic readjustments are performed regularly by storing these adjustment targets in the built-in ColorEdge calibration sensor and correction sensor through which correct display is maintained.

CG Series Built-in Calibration Sensor (left)
CX Series Built-in Correction Sensor (right)

4 List of recommended color profiles classified by industry

Which representative profile should I use as a standard?

Something called an ICC Profile is mainly used in current color management. A profile is a file which describes the measured color characteristics of equipment, however there are also theoretically established profiles where equipment is not measured. The following are used as standard profiles, which become the benchmark for pipelines.

Typical profiles include Adobe RGB, sRGB, Rec. 709, DCI, etc. When creating a pipeline having adopted color management, first select a benchmark profile and match all devices and software to that profile. Please select a profile from the list below that is most suitable to your business.

Type of Business	Output Equipment	Each Equipment's Profile	Recommended Profile
Video Game Production	HDTV	Rec. 709	Rec. 709
	Computer Monitor	sRGB (Adobe RGB in some cases)	
	Digital devices such as cell phones	Various (with each model)	
Commercial Production	HDTV	Rec. 709	Rec. 709
Movie Production	Movie Theater	DCI	DCI
	HDTV (making DVD, Blu-ray)	Rec. 709	
Advertising Photography	Print	FOGRA	Adobe RGB (recommended within the industry pipeline)
	Printer (when checking)	Various (depending on the equipment and paper)	
Architectural Perspective	Printer	Various (depending on the equipment and paper)	sRGB / Adobe RGB (when wanting to accurately reproduce the wide range of hues of building materials)
	Computer Monitor	sRGB (Adobe RGB in some cases)	
	Projector	Various (depending on the equipment and images projected)	
Product Development (Product Review)	Computer Monitor	sRGB (Adobe RGB in some cases)	Adobe RGB (suitable for accurately reproducing a wide range of hues)
	Printer	Various (depending on the equipment and paper)	
	Projector	Various (depending on the equipment and images projected)	
	HDTV	Rec. 709	
Web Browser	Computer Monitor	sRGB	sRGB
	Digital devices such as cell phones	Various (with each model)	

3D-LUTs – Color management standards other than color profiles

Other than color profiles, 3D-LUTs are used in the standards of color management pipelines. They both have the same objective and results.

Set the benchmarks taking into account the software being used and the whole pipeline. Depending on the software, there are various patterns from not being able to set the benchmark at all, to being able to set gammas, color profiles, and 3D LUTs.

For example, as shown in the pictures on the right, gamma or 3D-LUT can be selected and set with 3ds Max whereas 3D-LUT can be set with Smoke.

Autodesk Smoke 2013 (LUT setting)
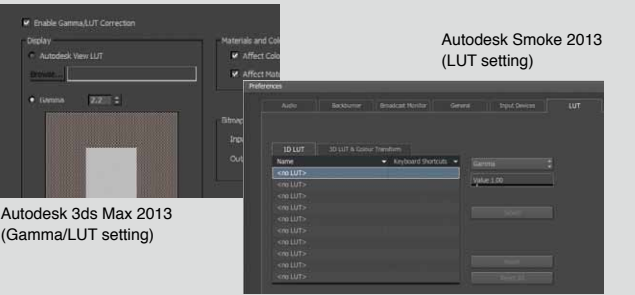
Autodesk 3ds Max 2013 (Gamma/LUT setting)

5 What is the difference between color management and linear workflow?
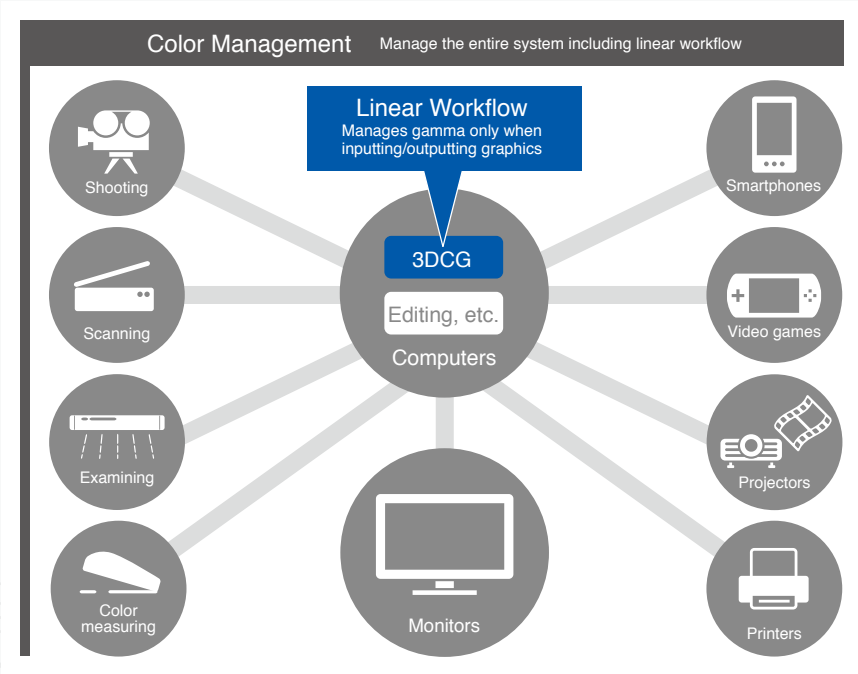
The relationship between color management and linear workflow

Color management involves all production devices and production data, and is a "system operation to see correct colors." Linear workflow is a method to correctly run data when it is input or output with 3DCG software.
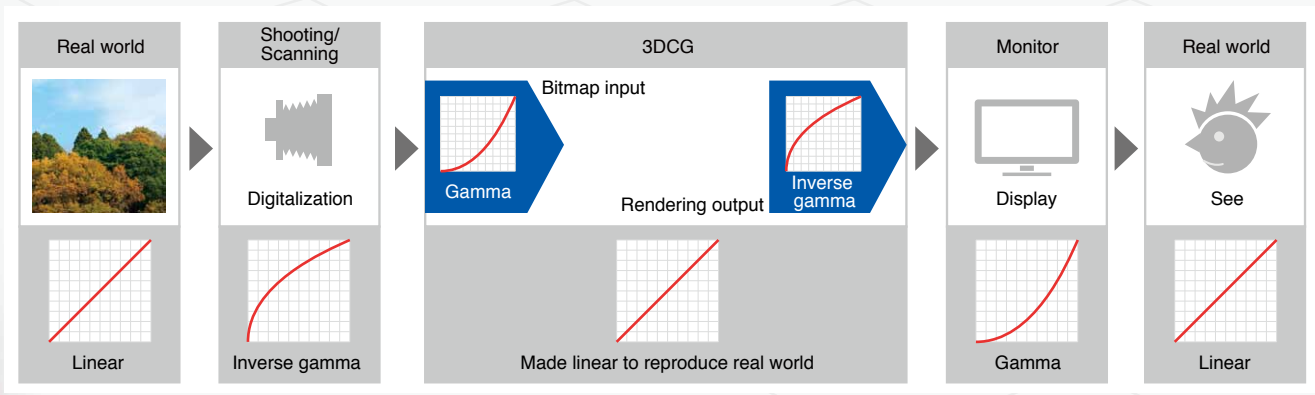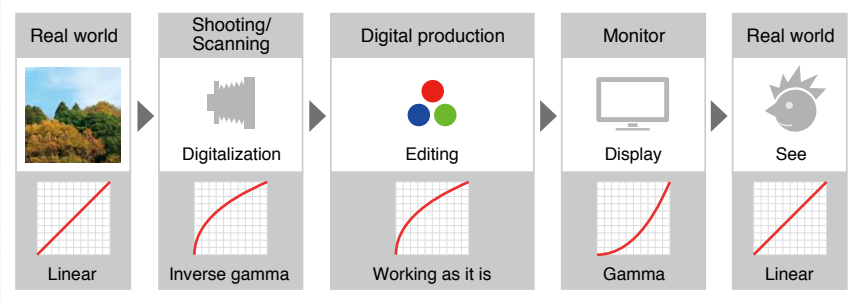
Because a lot of hardware and softwareare are involved in creative work, it is necessary to integrate all settings and rules, and manage all elements including linear workflow.

As linear workflow is a system to solve specific problems associated with 3DCG software, it is necessary to implement a color management system into pipelines which have 3DCG software.

Color Management — Manage the entire system including linear workflow

Linear Workflow
Manages gamma only when inputting/outputting graphics

Shooting / Scanning / Examining / Color measuring / 3DCG Editing, etc. / Computers / Monitors / Smartphones / Video games / Projectors / Printers

How linear workflow works

If raw linear data were displayed without any processing, the image density would increase and create a very different impression from reality due to gamma affecting the monitor. Therefore, by adding "inverse gamma" when inputting, it will become linear. Because real world simulations are performed within 3DCG software, the data will be processed as linear. It is here that linear workflow manages gamma when inputting/outputting and runs the correct data.

Real world (Linear) → Shooting/Scanning Digitalization (Inverse gamma) → Digital production Editing (Working as it is) → Monitor Display (Gamma) → Real world See (Linear)

Real world → Shooting/Scanning Digitalization (Inverse gamma) → 3DCG Bitmap input Gamma / Rendering output Inverse gamma (Made linear to reproduce real world) → Monitor Display (Gamma) → Real world See (Linear)

6 3DCG software settings (Autodesk 3ds Max)

With Autodesk 3ds Max it is possible to set gamma just from the three elements that determine color (color temperature, color space coordinates for each RGB color, gamma). Here, let's check the method for setting color management using 3ds Max 2013.

Open [Rendering/Gamma Setting] and make the settings in the 4 areas as shown in the diagram.
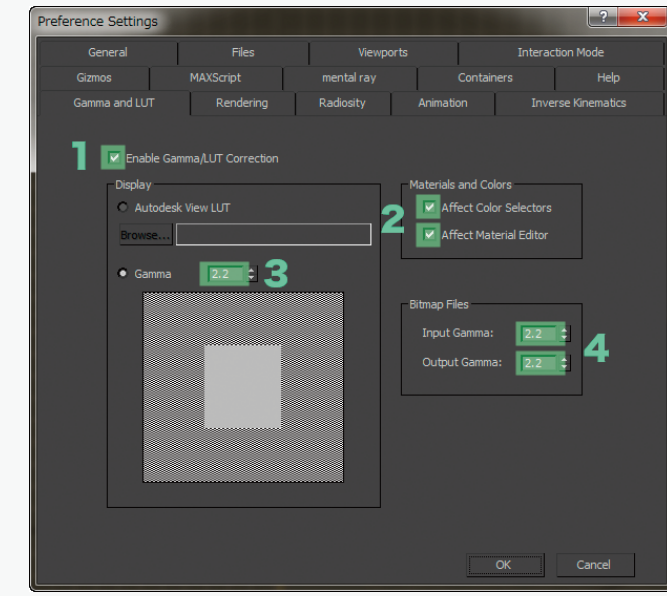
Step 1 Check the box for [Enable Gamma/LUT Correction].

Step 2 Check the boxes for [Affect Color Selector] and [Affect Material Editor].

Step 3 As most devices are 2.2, leave it at that setting. However, adjust it if a different gamma value (1.8 etc.) is being used with another pipeline.

Step 4 The value used when inputting texture or when writing a rendering file. As almost all input/output devices are 2.2, leave it at that setting.

Gamma also applies to the Color Selector RGB value

Having made a gamma setting, a change occurs to the RGB value setting of the Color Selector. For example, a 0.5 value has 50% gray, but after setting the gamma, the value becomes 0.22.

Furthermore, if the check is removed from the Affect Color Selector box, the color chosen from Color Selector will differ from that of the work screen or rendering result, so please do not remove the check.
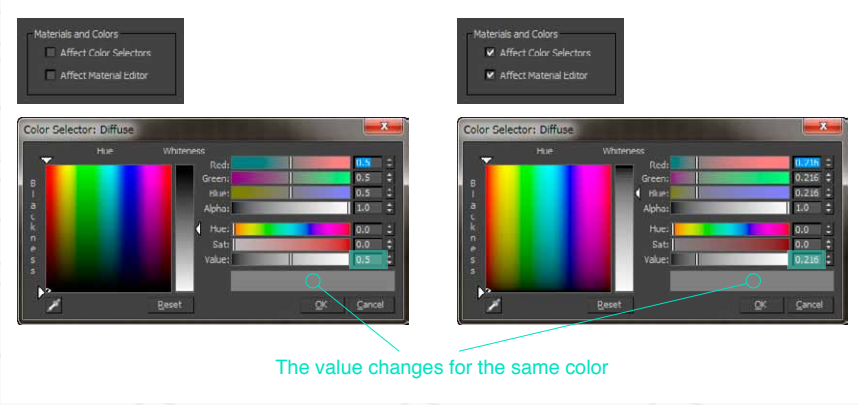
It is helpful to use spreadsheet software such as Excel, when referring to an existing shader value or value from another application. Gamma calculation is performed with the POWER function. Shown in the diagram on the right, after converting the 256 notation to a 1.0 notation for matching the 3ds Max Color Selector, it is converted to the gamma 2.2 values.

The value changes for the same color

H4   =POWER(E4,2.2)

	A	B	C	D	E	F	G	H	I	J
1		RGB 256 step			255 to 1.0			gamma 2.2		
2		R	G	B	R'	G'	B'	R g2.2	G g2.2	B g2.2
3	white	255	255	255	1.000	1.000	1.000	1.000	1.000	1.000
4	10%	229	229	229	0.898	0.898	0.898	0.789	0.789	0.789
5	20%	204	204	204	0.800	0.800	0.800	0.612	0.612	0.612
6	30%	178	178	178	0.698	0.698	0.698	0.453	0.453	0.453
7	40%	153	153	153	0.600	0.600	0.600	0.325	0.325	0.325
8	50%	127	127	127	0.498	0.498	0.498	0.216	0.216	0.216
9	60%	102	102	102	0.400	0.400	0.400	0.133	0.133	0.133
10	70%	76	76	76	0.298	0.298	0.298	0.070	0.070	0.070

7

# 3DCG software settings (Autodesk Maya)

How to make basic settings [Render Settings/Common/Color Management]

Here, we will check the method for setting color management using Autodesk Maya 2013.

Step 1

[Color management] manages those times when graphics such as texture are input, and when rendered graphics are output. Furthermore, this also has an effect on data when rendering.

Open [Render Settings/Common/Color Management] and then check the [Enable Color Management] box so that the profiles below become available. When Color Management is in use, color correction is made taking into account the effect on the monitor (gamma is applied), so a result close to real world is produced, which means the calculation performed by Maya was reflected correctly.
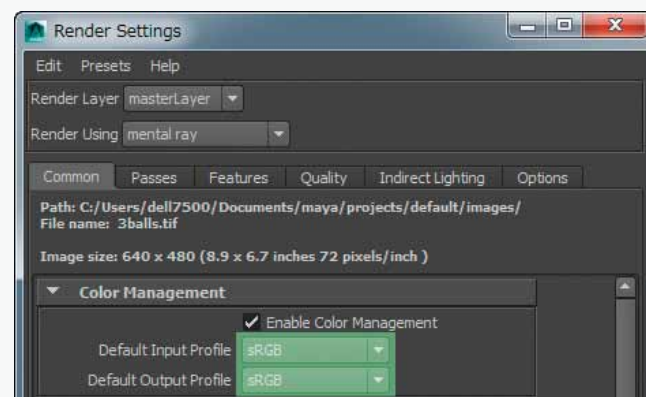
Step 2

Next, set the input and output profiles that match your company's pipeline. Please refer to the list of recommended color profiles classified by industry on page 7 when deciding on the profile.

Management of input and output graphics can be performed on a case-by-case basis. However, unless there is a particular reason, the same profile as [Color Management] in [Render Settings] will be used. This is because if there is a mismatch then the original color will not be reproduced.

Furthermore, when importing texture graphics the same profile can be specified as when making settings at [Color Management]. It is also possible to change this after having made the settings. By selecting the basic configuration of [Use Default Input Profile], the [Default Input Profile] selected in [Color Management] at Render Settings will be used.

Step 3

The profile can also be selected when saving rendered graphics. Once again, unless there is a particular reason, the same profile as [Color Management] will be used.

To save an image, select [Save Color-Managed Image]. Appropriate graphics that have been made effective by the color management output profile can be saved.
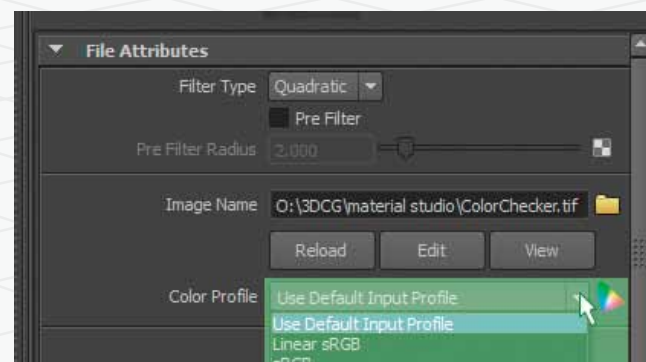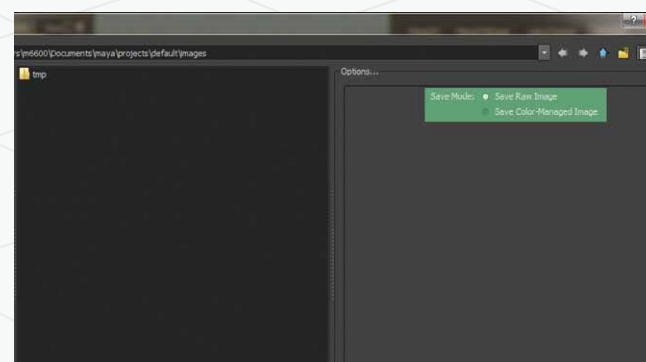
Set sRGB for Color Management when both inputting and outputting. By specifying the [Color Profile] in [File Attributes], which specifies the graphics pasted in materials, color management of input graphics can be done.

How to do a simulation [Render View/Display/Color Management]

In [Color Management], colors relating to the Render View display are managed. Here, graphics with the look of rendering results are managed, so in general the same profile as [Color Management] in Render Settings is used. This is an effective function for simulation when considering "What would these graphics look like in HDTV?"
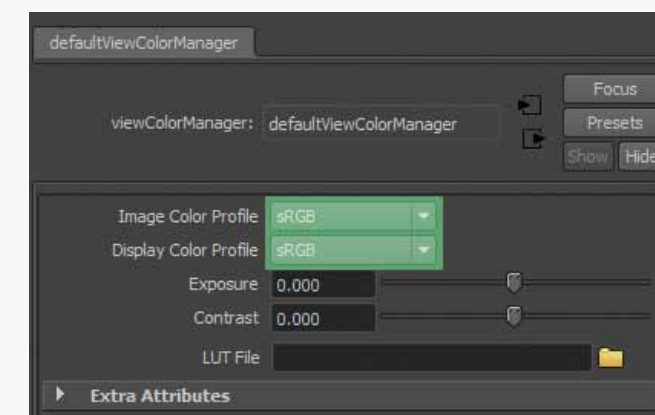
Step 1

Call up settings from [Render View]. By opening [Display] and clicking on [Color Management], the [defaultViewColorManager] attribute editor will open as shown in the diagram on the right.
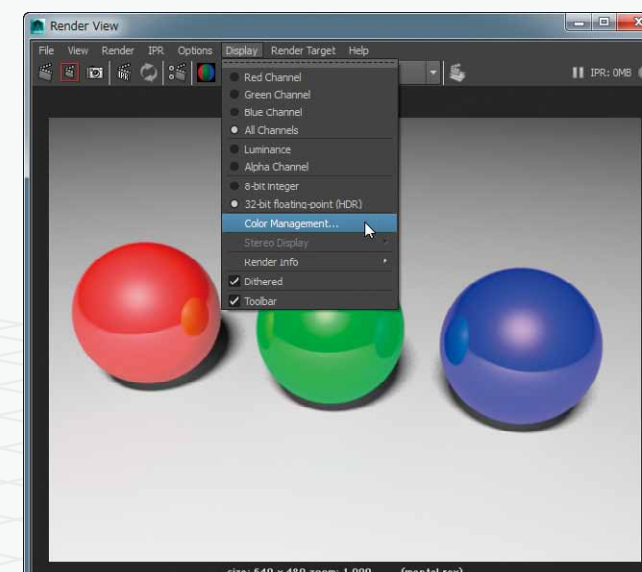
Step 2

[Image Color Profile] changes the color of rendered data, and [Display Color Profile] changes how the color looks.

Important: Maya color management only sets the gamma

Maya performs color settings according to the profile, however this operation differs to Photoshop which performs color management in profiles in a similar way.

The contents of a color profile specify
● The accurate color for each RGB color
● The white point and black point
● Gamma

These three elements are precisely reflected in Photoshop, however Maya only seems to reflect gamma. For this reason please consider it the same as 3ds Max, in terms of a comprehensive management method that includes the monitor.

At the time of setup, the gamma values of settable profiles are ascertained, and settings for the entire pipeline are performed so as to integrate them with monitor settings and editing programs.
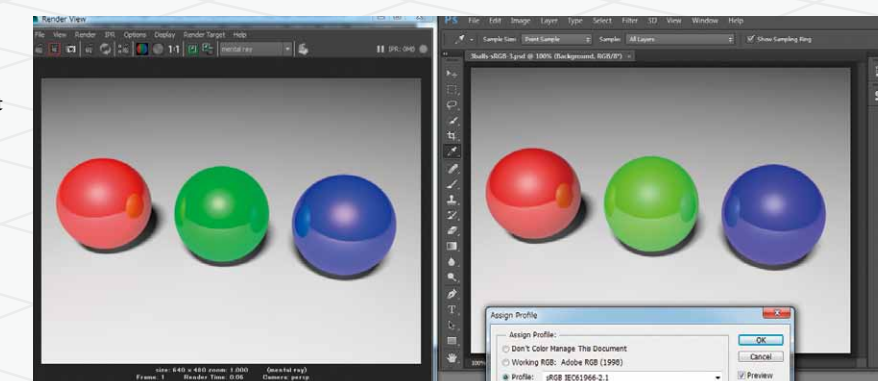
How the monitor looks when set up in Adobe RGB.
On the left is the Maya Render View set up in sRGB, on the right is the Photoshop screen set up in sRGB. The sRGB saturation is low compared with Adobe RGB, however Photoshop correctly reproduces, whereas we can see that Maya relies on the colors set in the monitor.

# 8 Image editing software settings (Adobe Photoshop)

Photoshop Color Settings

Here we explain, with Adobe Photoshop, about color matching when rendered graphics are read by different software. Please set other color management compatible software in a similar way.

Step 1

The dialog box below shows detailed options in [Color Settings] in Photoshop. To begin, at [Working Spaces/RGB], set the color profile used for your company's pipeline. Set the other options in the same way as shown below.
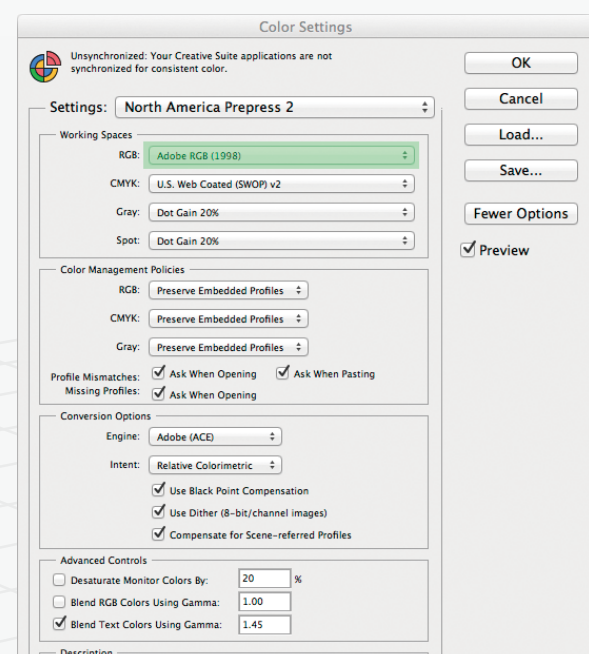
Step 2

Read the graphics that have been rendered with 3DCG software. By doing this a simulation is automatically displayed with the colors that were set at [Working Profile].

Here the rendering window of the 3DCG software and the Photoshop display match. If they don't match, the cause is either that the target profile you chose when adjusting the monitor and the working profile are different, or the display quality or accuracy of adjustment of the monitor is low. Below is a diagram showing the matching of the 3ds Max rendering window and colors of rendered graphics opened in Photoshop, following the procedure described above.
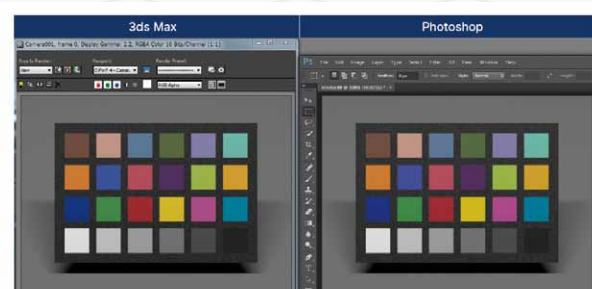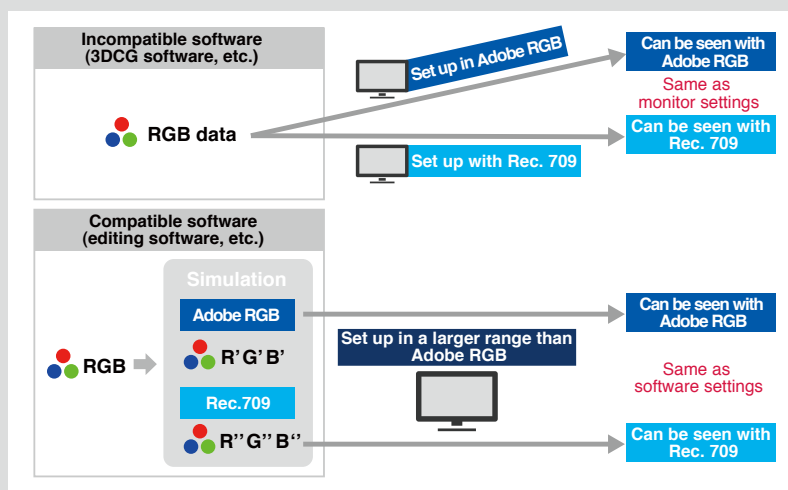
Color management compatible and incompatible software

Within software used for creation, some are compatible with color management and some are not. Most video editing software and other software, such as Illustrator and Photoshop, that are indispensable for making materials, are compatible.

On the other hand, as most 3DCG software only offer some color management functions, considering these as incompatible software will make composing pipelines easier. Because incompatible software doesn't convert colors, the colors become exactly like the monitor settings.

Color conversion is performed within compatible software, so in order to match colors with incompatible software, simulation is done at the same setting as the monitor.

Incompatible software (3DCG software, etc.)
RGB data → Set up in Adobe RGB → Can be seen with Adobe RGB (Same as monitor settings)
Set up with Rec. 709 → Can be seen with Rec. 709

Compatible software (editing software, etc.)
RGB → Simulation: Adobe RGB / R'G'B' / Rec.709 / R''G''B'' → Set up in a larger range than Adobe RGB → Can be seen with Adobe RGB (Same as software settings)
Can be seen with Rec. 709

9 Video editing software settings (Adobe After Effects)

Basic settings: Project Settings

Color management functions are activated from the [Project Settings] dialog box.

Set the target color profile at [Working Space] in [Color Settings] seen in the dialog box on the right. Please do not overlook this setting because it is also related to other settings.
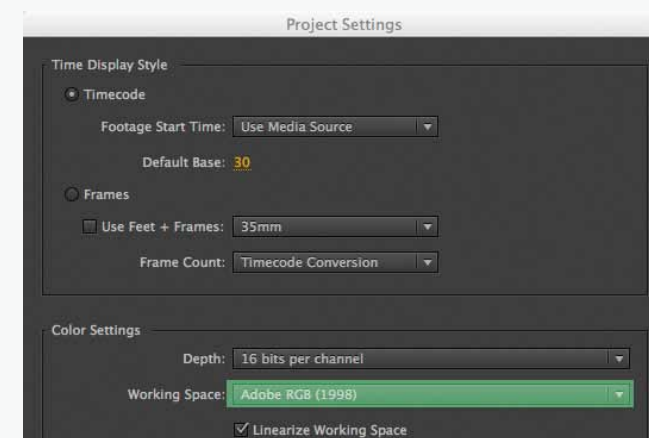
Input/Output settings: Project Settings

Select the read file, select [Interpret Footage], and select the [Color Management] tab. Select the target profile from [Assign Profile].
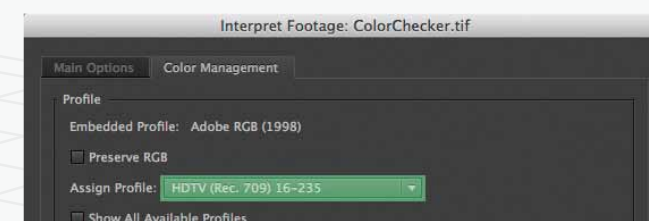
Select [Render Queue] and open [Output Module Settings]. Select the [Color Management] tab. Select the target profile from [Output Profile]. If a profile different to the working profile is selected, color conversion is performed and it is output.
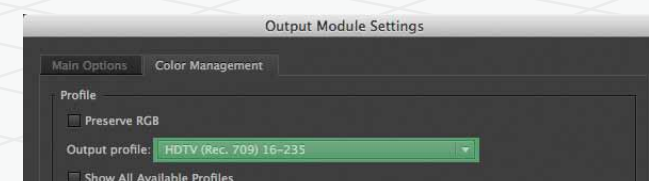
Disable the After Effects color simulation function

Color management compatible software, such as After Effects and Photoshop, changes data for display to the monitor consistently (refer to the frame on the opposite page).

It is possible to disable this function temporarily.

By disabling the function it is possible to match it with color management incompatible software such as 3DCG. Please note however that by using this method, management of the target profile may become uncertain.

To disable the function, use the button at the bottom of the work view. Please refer to the menu bar on the right. Select [Use Display Color Management], which removes the check, and the function will be disabled.
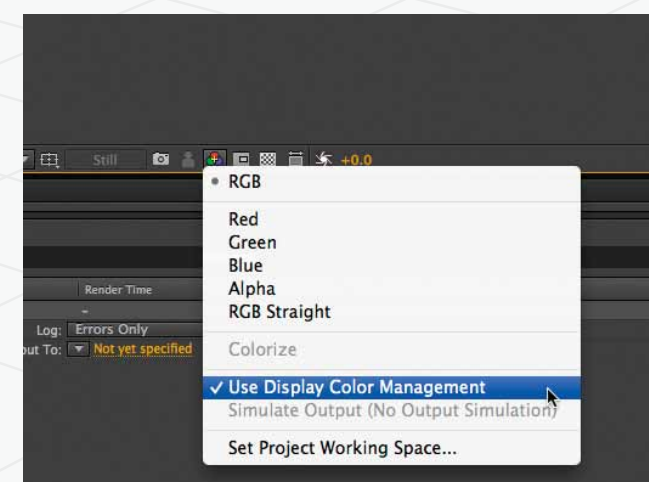
10 Unifying the real-world environment

Blueish white light and warm light: Make the color temperature the same as the monitor
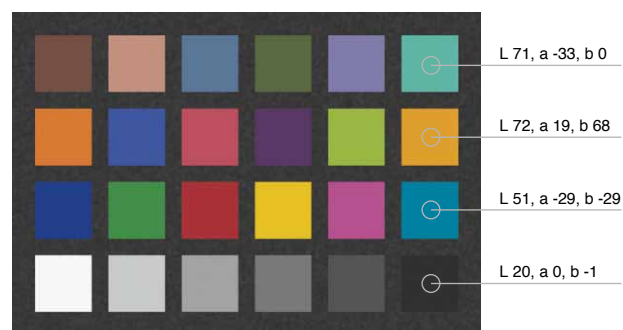
Within fluorescent light, there are "daylight", "day white" and "light bulb (warm white)" that express the difference in the color of light, which is called color temperature (Kelvin). In the 3DCG creation workplace, by using the same color temperature as the monitor, the color of the monitor and of the thing being examined can be matched. The color profiles for sRGB, Rec. 709, and Adobe RGB are 6500 K. However this can be changed when adjusting the monitor. We recommend 6500 K where the monitor is the final output, and 5000 K for printed matter.

Fluorescent light for color evaluation	Color Temperature (Kelvin)	Common fluorescent light	Color Temperature (Kelvin)
Fluorescent lamp for color evaluation	5000 K	Daylight	6500 K
Color comparison/ examination D65 fluorescent lamp	6500 K	Day white	5000 K
		Light bulb (warm white)	4200 K

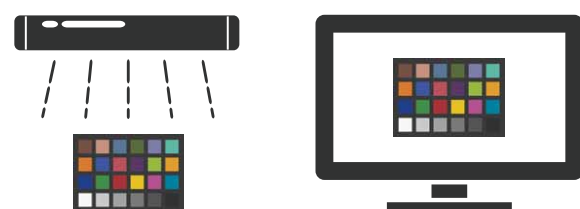## How to decide whether color management is appropriate or not

Step 1 ▶ ▶ ▶ ▶ ▶ ▶

Let's discuss how to decide if the environment you view products in is suitable. Here we will explain using ColorChecker by X-Rite, Inc. ColorChecker is a small board of color samples precisely managed and produced. 24 colors are reproduced from a wide range of colors, and the measured values for each color are included. The measured values are made into image data and by comparing them with ColorChecker you can decide whether your own environment is correct or not.

L 71, a -33, b 0
L 72, a 19, b 68
L 51, a -29, b -29
L 20, a 0, b -1

Step 2 ▶ ▶ ▶ ▶ ▶ ▶

Data for displaying on the monitor is created based on the color measurement values included in ColorChecker. In particular, please create data that resembles ColorChecker itself (materials) and use the color measurement values (lab values) provided by X-Rite, Inc. for color fill. Now accurate data for checking, the same as the good, is complete.

Open Color Picker   Enter the color measurement values   Color fill

Step 3 ▶ ▶ ▶ ▶ ▶ ▶

Compare both together. If they show the same colors, you will know that all the settings and the lighting environment, such as the fluorescent light for color evaluation, are correct.

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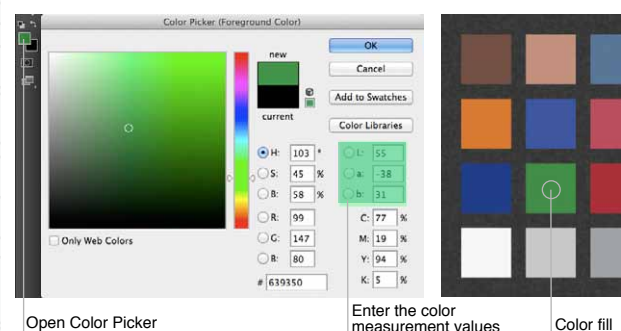
11 Unifying the virtual-world environment

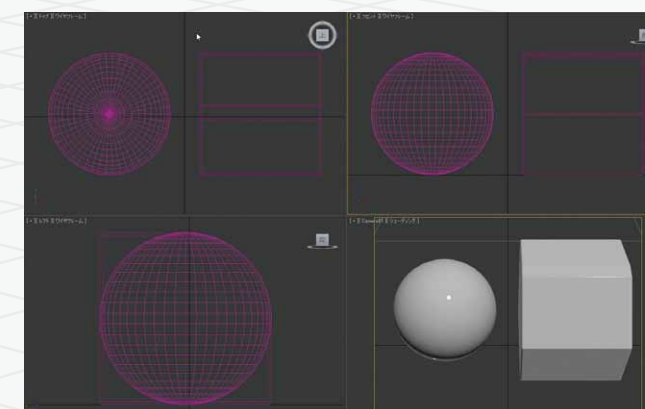## Establish a lighting standard in a virtual world (3DCG)

Here we explain how to integrate the environment for creating materials with 3DCG.
Because colors look different between things viewed under a white bulb and things viewed under daylight fluorescent light, when determining colors in the real world, a particular kind of light called a fluorescent light for color evaluation is used. By doing the same thing within 3DCG software (virtual world), colors can accurately be determined.

Let's call the scene data that creates materials within 3DCG software the "standard environment." No matter what kind of 3DCG software you use, pay attention to the points below and try to create a standard environment that matches how your company uses the software. Here we will explain the points, with 3ds Max.

Step 1 ▶ ▶ ▶ ▶ ▶ ▶

Position an object that is easy to evaluate.
Create an object of allocated material for evaluation. We recommend either using a shape similar to something normally created and often used, or a shape similar to that of a product as a sample for viewing.
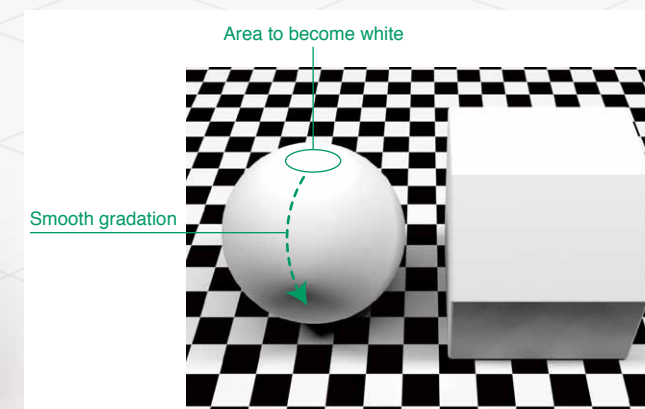
Step 2 ▶ ▶ ▶ ▶ ▶ ▶

Create lighting.
Lighting can either be created with a light object or with HDR, etc. Furthermore, the way of creating material while viewing the product, imitates the environment (form and position of the lighting) to examine the products in.

Step 3 ▶ ▶ ▶ ▶ ▶ ▶

Set the light intensity.
The light intensity must not be too bright or too dark. First, allocate a material, for which the diffuse color has been set to white (R255, G255, B255), to the object for evaluation (no reflection).

Under these conditions, please set the light intensity so that the apex of the object is white and there are color gradients to the bottom.
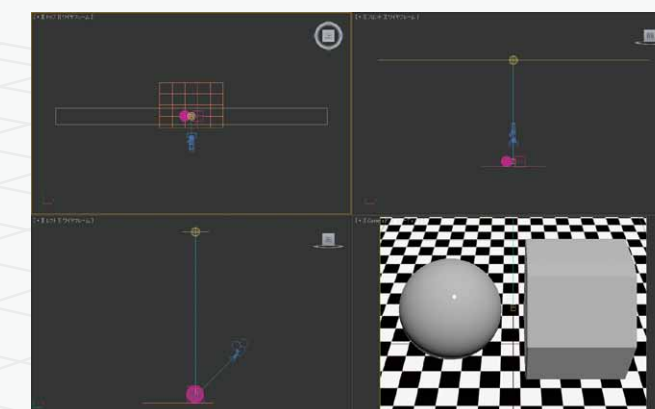
Area to become white

Smooth gradation

Step 4 ▶ ▶ ▶ ▶ ▶ ▶

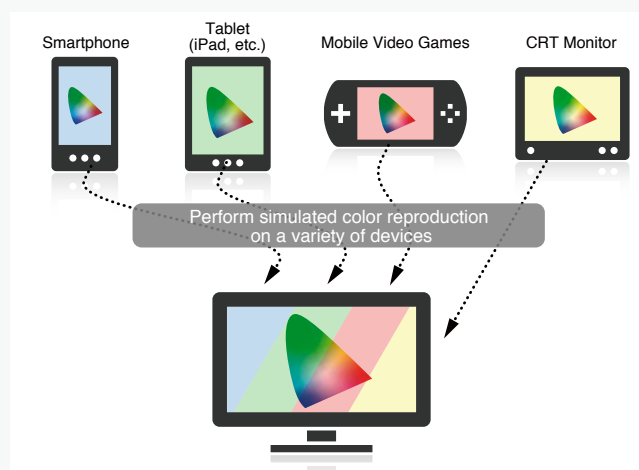Please make other settings that are close to your company's pipeline.
● Environment/Camera/Light, etc. brightness settings
● Environment/Camera/Light, etc. color temperature settings
● Gamma settings
● Rendering settings

The standard environment is now ready. Create materials in this environment, compile a database, and by importing it to a production scene, anyone will be able to reproduce the same color.

12 Device emulation settings

What is device emulation?

The device emulation function installed with ColorNavigator from version 6.1.1 imitates (emulates) the color development of various display devices such as smart phones, mobile video games, tablets, and CRT monitors. By using this function, work can proceed while the color of various devices is constantly confirmed on the monitor of the computer you are using. This is not however limited to only one device, and emulation is possible for multiple devices by changing the settings. LCD screens for pinball and slot machines, or CRT simulations can be reproduced on your own production monitor.

Smartphone | Tablet (iPad, etc.) | Mobile Video Games | CRT Monitor

Perform simulated color reproduction on a variety of devices

How to set device emulation

Let's check how to use emulation and its results. Here we will use the ColorEdge CG246 monitor and an iPad as an example.
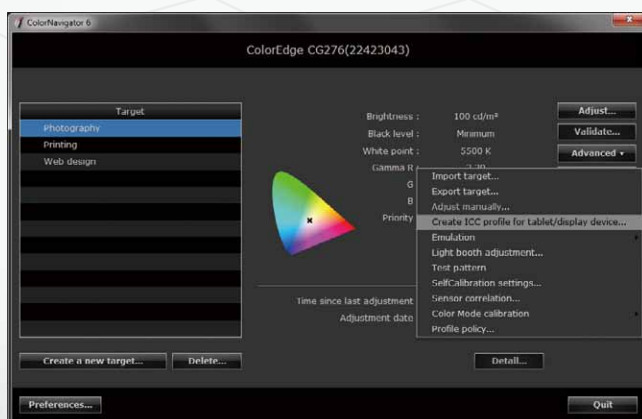
Step 1

Prepare the monitor.
First connect the monitor to the computer, and connect the device you are adjusting to the same network as the computer. Connect to the network with LAN or WiFi.

Step 2

Prepare the device.
Before measuring the color properties of the device, turn the [Automatic Brightness Adjustment] function off to avoid changes in brightness during measurement.

Step 3

Start up ColorNavigator.
Connect the color measurement device to the computer and start up ColorNavigator. From [Advanced] (the third button from the top on the right hand side of the screen), select [Create ICC profile for tablet/display device...].

Step 4

Measure the device.
By indicating the URL in the device's web browser, multiple colors are displayed in turn at fixed intervals, and the color measurement device begins automatic measurements.

(Step 4 Measure the device cont.)
Follow the ColorNavigator instructions and measure the device with the color measurement device. ColorNavigator displays the color patches necessary for measurement on the target device's web browser, using the computer that is runnning as a web server.

Furthermore, it may be necessary to change the color patches depending on the device. Because iPhone, iPad, and iPod touch have good color properties, it is suitable to measure at least 26 colors. Measurement takes about 2 minutes. Where the color properties of the device are unknown, by selecting Auto Select the appropriate number of patches for that device are measured. If there are a large number of patches to be measured, measurement will take from 30 minutes to several hours.

Step 5

Adjust the monitor.
When measurement is complete, save the results (the color profile that represents the color properties of the device).

Next, adjust the monitor so as to optimally emulate the device. Use the adjustment results of the monitor as the "source", and reproduce the device's profile. Consequently, if the monitor is set with an expressive range smaller than the device, optimal emulation will not be possible. Select [Create a new target] on the settings screen to readjust the monitor, and the device's profile can be represented correctly.
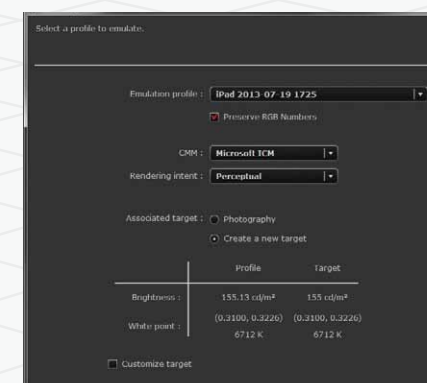
Prepare for measurement on the device.
Launch a browser on the devices and input "http://10.11.255.118:8080" as the URL.
Place the measurement device on the displayed page, and then click [Next].
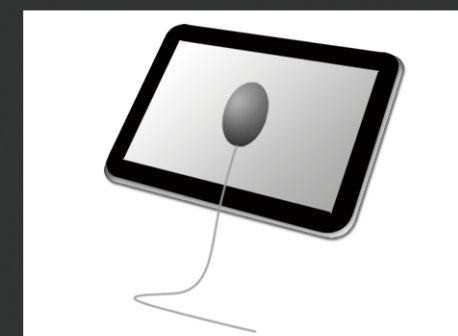
Check the following points to obtain a highly accurate measurement result.
- Turn off the power saving setting of the device.
- Turn off the automatic update setting of the device.
- Turn off the screen saver setting of the device.
- Remove any dust/fingerprints from the surface of the device display.
- When using the Wi-Fi communication, use devices in a stable communication environment.

Step 6

Begin emulation.
The device profile is below the newly measured monitor adjustment. By clicking on it emulation begins. The screen flickers for a few seconds meaning that the color properties of the monitor itself are changing.
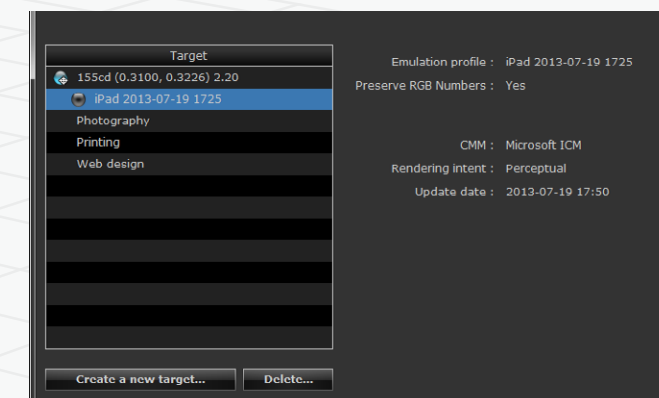
Emulation results for four kinds of devices

The diagram on the left is a compiled color chart for color comparison between four kinds of devices of how they look when displayed. It is clear that the color varies greatly depending on the device. The diagram on the right is a comparison of four kinds of devices after emulation with the ColorNavigator color adjustment software. Please look at the gray area outside the color charts displayed on the monitors. They are all displaying mid gray (R127, G127, B127), however it is clear that there is a considerable difference in hues. The color development for each device is different, the results of which after the monitor is emulated, are displayed like this.

Colormanagement for 3DCG

13

Appendix
(Information about color management)

Color management information

The EIZO web site (www.eizo.com) contains articles and videos about color management. Click on any of the titles to view that article or video.

Color Management

EIZO 🔍 Choosing the Right Monitors for a Color Management System

EIZO 🔍 Color Management Handbook Version 3 (PDF: 9.82 MB)

Calibration

EIZO 🔍 Monitor Calibration

EIZO 🔍 Calibrating a ColorEdge Monitor with a Built-In Sensor

Gamma

EIZO 🔍 Is the beauty of a curve decisive for color reproduction? Learning about LCD monitor gamma

Color Temperature

EIZO 🔍 Altering color dramatically with a single setting: Examining color temperature on an LCD monitor

Look-Up Tables (LUTs)

EIZO 🔍 Maximum Display Colors and Look-Up Tables: Two Considerations When Choosing a Monitor

Device Emulation

EIZO 🔍 [Video] ColorNavigator Media Device Emulation

About the author

PERCH corporation

PERCH

PERCH creates 3DCG for advertising and sales promotions. PERCH has built up expertise in color management through many years of creating advertisements and is applying this knowledge to the 3DCG industry by conducting seminars and supporting pipeline creation. PERCH currently writes columns for CGWORLD.jp and Autodesk AREA JAPAN on color management related information, etc. In addition to color management, PERCH conducts seminars for improving the quality of 3DCG creation and conveys other important information to the industry.
http://www.perch-up.jp

Recommended monitors for 3DCG creation

Professional Level
ColorEdge CG Series

Built-in calibration sensor.
ColorNavigator calibration software included.

🔲 CG277   🔲 CG247

Streamlining calibration work.
The CG Series are professional models with a built-in calibration sensor which is adjusted at the factory to ensure no individual differences between monitors. With the CG series you will reduce time and effort spent calibrating, and meet your requirements for color management.

Standard Level
ColorEdge CX Series

Built-in correction sensor.
ColorNavigator calibration software included.

🔲 CX271   🔲 CX241

Put your external sensor into operation.
The CX Series are wide color gamut monitors that cover most of Adobe RGB and have the equivalent display performances as the CG Series. By using an external sensor for calibrating and the built-in correction sensor to maintain the calibration settings you will improve cost performance and create an accurate color display environment.

color management for 3DCG

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