

ICC Display Profiles with Control over the VCGT

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In some cases it is desirable to profile a color display without changing its calibration state. Many commercially available software packages insist on 'improving' the calibration by setting the Video Card Gamma Table (VGCT) in order to meet some predetermined aim such as sRGB calibration. It is sometimes desirable to fine tune the color display and then when this step is complete to create a color profile that describes its color response. One such example is the proposed dRGB/mRGB display calibration where the neutral response is set to match the DICOM Grayscale Standard Display Function (GSDf). This white paper provides one suggestion as to how separate calibration and profiling may be achieved using open-source software ArgyllCMS [1] and dispCALGUI [2] to create a display profile.

The situation we consider is:

- 1) There is a PC that is connected to a specific display to be profiled.
- 2) The video card contains non-trivial video LUTs for that display. They may have been loaded by anything, e.g. the operating system, or another calibration application.

The goal is:

- 3) Create an ICC profile for that display, so that:
 - a. during profiling (measuring the color patches), the non-trivial video LUTs in 2) must remain loaded.
 - b. when profiling is complete, the video LUTs must be written to the **vcgt** tag in the profile

In ArgyllCMS and dispCALGUI the video LUTs are called the *calibration curves*, and we use these 2 terms interchangeably.

At the time of this writing, the software is supported on these operating systems:

- Windows XP or later
- Apple OSX
- Linux with X11

The rest of the instructions are Windows-specific, but should require little change for Apple OSX or Linux.

1. Installation

First, we recommend downloading and installing ArgyllCMS. For convenience when testing, consider adding the ArgyllCMS **bin** folder to your PATH environment variable. Next, test your colorimeter or spectrometer. A good program for testing is **spotread**, whose documentation is here:

<http://www.argyllcms.com/doc/spotread.html>

For troubleshooting these devices see:

- the installation page: http://www.argyllcms.com/doc/Installing_MSWindows.html

- the mailing list: <https://www.freelists.org/archive/argyllcms>

Next, download and install dispcalGUI. Do: **File** → **Locate Argyll CMS executables...** and pick the proper ArgyllCMS **bin** folder.

By default, dispcalGUI saves the profiles and associated data in a hard-to-find folder:

```
c:\Users\<yourname>\AppData\Roaming\dispcalGUI\storage
```

So you might consider doing: **File** → **Choose save path ...** and selecting a folder that is easier to find. We will call it the *storage folder*.

If you have multiple displays connected, you must find the 1-based index of the display you want to profile. In dispcalGUI, the box **Display Devices** list all the displays in order, starting with index 1 (you can ignore the special options: Web, madVR, Untethered, etc.). Note that powering the displays on and off can trigger re-indexing, and this requires clicking a button to the right to re-detect. This display index is denoted by N below.

2. Prepare

The first task is to put the calibration curves in 2) into a file. ArgyllCMS uses **.cal** files for this data. These are CGATS-compatible files that start with the line CAL. For more details see: http://www.argyllcms.com/doc/cal_format.html. This step is optional, but necessary for the **Verify** step below.

Open a command window and execute:

```
dispwin -dN -s mycal.cal
```

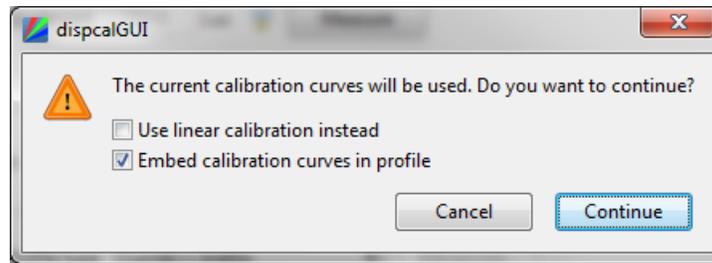
where N is the 1-based index of the display to be calibrated, and *mycal.cal* is any filename convenient to you. If there is only 1 display connected to the PC, you can omit the $-dN$.

3. Profile

Start dispcalGUI and take some time to familiarize yourself with all the options. This can take a while ! If there is more than one display, be sure to select the right one under **Display Devices**.

The display colors may flicker during startup as dispcalGUI clears and reloads the video LUTS. This flicker may make one skeptical that the original calibration curves are *still* loaded. This skepticism is another reason to capture *mycal.cal* in the previous section, so you can **Verify** later. If you know what the original calibration curves look like, you can verify they are still loaded by doing **Tools** → **Curves** and check the box: **Show actual calibration curves from video card gamma table**.

Press the **Profile only** button. A confirmation dialog similar to this should open:



Note that the first sentence of the dialog satisfies goal 3a, and the checkboxes are set to satisfy goal 3b. There are only 3 valid combinations of the checkbox states – one cannot uncheck both of them.

Press **Continue** and follow the instructions. When done you should see a new subfolder of the storage folder with many files, including:

- a **.cal** file
- a **.log** file
- a **.ti1** file, with the RGBs of the patches. This is the Testchart File
- a **.ti3** file, with patch measurements and a copy of the **.cal** file inside it
- the **.icm** file you desire

Inspection of the **.log** file reveals that:

- **dispwin** ran with the **-s** option to save the current video LUTs to the **.cal** file. This step is a repeat of what you already did in **Prepare**.
- **dispread** ran with the **-k** option to read the **.cal** file from the previous step. **dispread** read the **.ti1** file, displayed and measured the patches, created the **.ti3** file with patch measurements, and placed a copy of the calibration curves at the end of the **.ti3** file.
- **colprof** read the **.ti3** file for both the patch measurements and the calibration curves. It created the **.icm** file and copied the calibration curves to the **vcgt** tag.

You will also find a file ending with **all.cmd** that contains the actual command lines executed, except that it omits the **dispwin** part.

4. Verify

To verify that the new **.icm** file contains the desired calibration curves, you can open a command shell and do:

```
dispwin -dN <your new>.icm
```

```
dispwin -dN -V mycal.cal
```

The first command loads the **vcgt** tag inside **<your new>.icm** into the video LUTs. The second command compares the contents of the video LUTs with the contents of **mycal.cal** and reports whether **mycal.cal** is loaded or not. If there is only one connected display, you can omit the **-dN** option.

5. References

- [1] Argyll Color Management System. <http://www.argyllcms.com/>.
- [2] dispCALGUI. *Open Source Display Calibration and Characterization powered by Argyll CMS*. <http://dispCALGUI.hoech.net/>