

# DRIFT COMPENSATION

By Joel Barsotti and Tom Schulte

*A monitor or TV display's luminance and chromaticity characteristics typically drift over an extended period of time while the display is being measured to profile its detailed response characteristics. These drifting display characteristics reduce the accuracy of 3D LUT correction data that is created from the display's profile measurements.*

*This paper presents a new method of compensating for drift in display characteristics that occurs during an extended period of display profile measurements. This drift compensation allows the final 3D LUT data to be as accurate as if the profile measurements had all been made on a fully stable display.*

## Display Stability Issues

To create 3D LUT calibration data for a monitor or TV display, a large number of light measurements are often made on the display over an extended period of time, to profile the non-linear luminance and chromaticity characteristics of the display. The profile data is then sent to a LUT rendering engine to create the desired display calibration data.

However, the luminance and chromaticity characteristics of displays change over the period of time that a display warms up after it is powered on. The change is most significant in the first 30 minutes, becoming less significant in the next 15 minutes. After 45 minutes of warmup, most displays, while not fully stable, continue to change only a small amount due to thermal changes.

If some of the profile measurements are made before the display becomes thermally stable, those measurements won't accurately represent the luminance and chromaticity performance of the stabilized display. That causes the final calibration data to be less accurate than it could have been, had all of the profile measurements been made after the display stabilized.

Plasma TVs present an additional stability issue. When a test pattern window is rendered on a plasma screen, the window area starts going through a change process known as pattern image retention. While the change in the screen characteristics may not be permanent, after the pattern has been displayed for a period of time, it produces a short-term change in the measured luminance and chromaticity. Plasma pattern image retention follows a stability curve over time that is similar to thermal warmup.

Both the common thermal warmup effect and the plasma image retention effect cause a drifting result in luminance and chromaticity measurements that are made for display profiling. If the initial color measurements were repeated at the end of the profile measurements, different results would be obtained. Both of these measurement drift effects limit the accuracy of rendered 3D LUT calibration data.

## Drift Compensation

SpectraCal has now developed drift compensation for CalMAN Intelligent Resolution Profiling™ (IRP). Unlike CalMAN Lightning LUT™, which creates a 3D LUT in less than five minutes for a fairly linear display, IRP 3D LUT calibration typically measures 2000-4000 colors to create an accurate profile for a less linear display. During this extended display profiling time, measurement drift can have a significant negative effect on the accuracy of the final 3D LUT calibration data.

During its IRP profile measurements, CalMAN periodically takes a set of reference WRGB measurements. These recurring reference measurements allow CalMAN to quantify luminance and chromaticity drift that occurs from the beginning to the end of the profile measurement time. The quantified drift characteristics of the display are then used to correct the profile data to be consistent with

the display's characteristics at the end of the IRP profile period.

This applied drift compensation corrects the CalMAN profile data to be accurate to one point in time, when the display has reached its most stable condition. The drift-compensated profile data is then sent to the LUT rendering engine to create 3D LUT calibration data that accurately corrects the display in its stable running mode.

## Conclusion

A large number of display profile measurements, which are made over an extended period of time, can be negatively affected by drifting characteristics of the display.

CalMAN's new drift compensation for its IRP 3D LUT calibration tool corrects its profile measurements to compensate for drift in the display's luminance and chromaticity characteristics. This results in more accurate display performance that is totally corrected in its stable operating condition.

**About SpectraCal:**

SpectraCal specializes in the tools and training necessary to achieve images representative of the content creator's intent for environments from low to high ambient light while achieving the colorimetry, contrast, and dynamic range necessary for the image to have the proper impact on the viewer.

SpectraCal CalMAN software was developed to support the display calibrator in the step by step process of screen optimization. The foundation of screen optimization through display calibration is to understand the elements in a display that require adjustment and how each element inter-relates to the others. From its inception, CalMAN has earned rave reviews and has become the preeminent display calibration software package on the market, compatible with virtually all color meters available today. As display technology evolves, CalMAN will continue to provide the first choice for display calibration solutions.

**More Information:**

For more information on CalMAN professional quality solutions for your displays:

Visit: <http://studio.spectracal.com/store/calman-software/calman-studio.html>,

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**Joel Barsotti** is Head of Advanced Color Research at SpectraCal. He has been the primary architect of every version of CalMAN since version 4.0. Joel has designed several iterations of 3D LUT profiling code, each of which has significantly advanced the state of the art. His innovations include: CalMAN AutoCube technology, CalMAN Dynamic Profiling process, Dynamic Linearity Correction, Intelligent Resolution Profiling, Lightning LUT, 3D LUT Retargeting, the adaptation of volumetric cubic spline interpolation to color science, grayscale priority interpolation, and grayscale tint reduction, making CalMAN one of the most sophisticated color management packages available.

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