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CINE 3403: Video Preservation

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A1: Waveform Monitors Write-Up

Waveform monitors are a tool that allows video engineers and archivists to view the luma makeup of the video at any given time. They work by analyzing the luma (read by the machine as the voltage) within the video signal, on every line that would be displayed. Because they operate on a line-basis, they appear as a graph, where the horizontal, bottom, or X axis shows the distance across the lines of video, and the vertical (Y) axis corresponds to the amount of luma[1]. I have drawn a very basic figure of this below, using a plain white dot as an example:
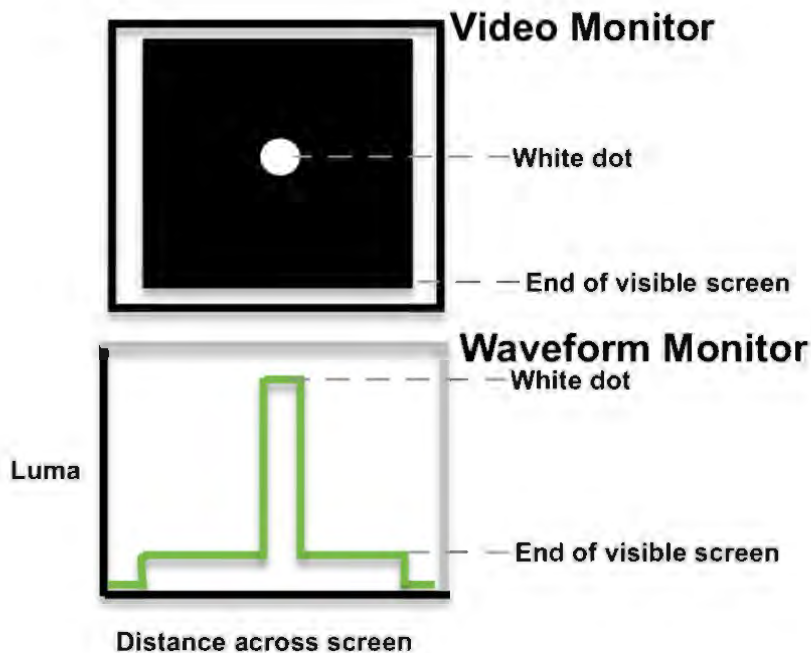

Because this white dot is the only signal in the middle of an all black screen, it will appear as a single high peak in the horizontal middle of the waveform monitor, exactly at the same horizontal location that the dot is. Because the waveform monitor is *only* monitoring the horizontal position of the luma and not the vertical, this white dot could be at the top of the screen or at the bottom, and the waveform monitor would look exactly the same.

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[1] Baker, Logan. "How to Read Waveform Monitors." *RocketStock* (blog), January 19, 2017.

In this example, the areas surrounding the dot but still within the confines of the "visible screen" are all at an equal level, which is black. The areas outside of the visible area that are lower are for syncing the video signal, and are interpreted by the waveform monitor as "blacker than black".

In addition to displaying only the luma within the video, waveform monitors can also indicate color. Unlike plain luma which will display as a line, as seen above, saturation (which is the luma plus hue of the color - a less saturated image has very little color, while a very saturated image can have too much color) can be seen on the waveform monitor as well. Using the same example, a pastel yellow dot will have the same level of brightness (luma) as white, but will show a fuzzier, thicker area on the waveform monitor, indicating that there is chroma added:
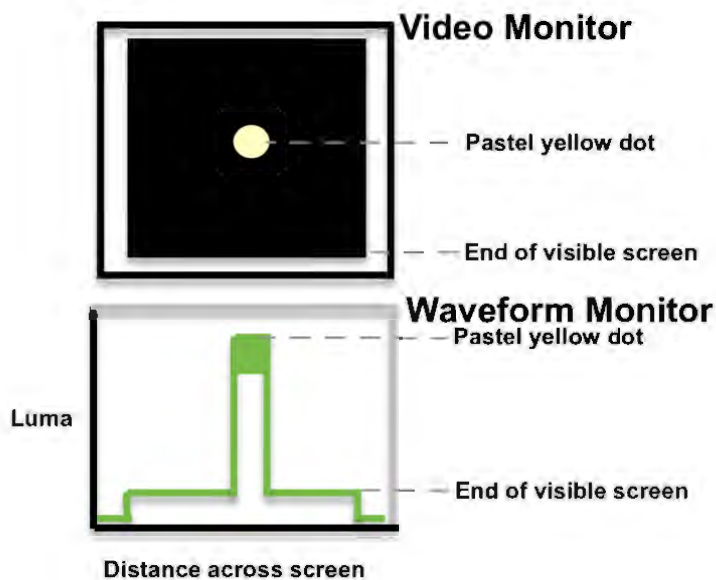
The thicker that area on the waveform monitor, the more chroma is present. So if the dot becomes bright yellow (with the same level of luma), the resulting waveform might look something like this diagram, instead:
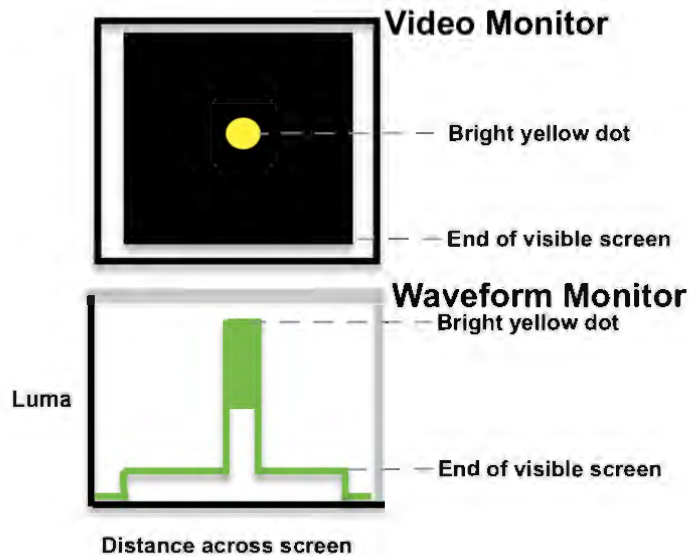
In both production and digitization, waveform monitors are a valuable tool to help analyze the video signal. Luma ranges are standardized, so the whites are not able to exceed a certain level, and the blacks are not able to appear too black. These values can be calibrated, so that if the whites or blacks exceed permissible values (7.5-100IRE in analog video[2] and 0-100 in digital[3]), it's possible to bring them to within appropriate levels. If they're not brought to within the standards, the video signal can be clipped, and that data can be lost[4]. Although some can easily tell from the image whether a white is "too white", using a waveform monitor is a sure way to tell whether there's a problem with the video signal exceeding the standardized ranges, and therefore how the video signal is going to appear on any monitor, anywhere[5].

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[2] "Measuring VIDEO Signals with a Oscilloscope?" Forum for Electronics. Accessed October 21, 2017.

[3] "What Is a Waveform Monitor and How to Read a Waveform Monitor (Part One) | Wolfcrow." Accessed October 21, 2017.

[4] "An Introduction to Waveforms, Scopes, and Exposure." B&H Explora. Accessed October 21, 2017.

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