

Why and Where we need 'Black Stretch'

Richard Stevens, considers the case for Black Stretch in the broadcast chain from camera to monitor and where it should be applied.

The Diagnosis

- Have you noticed that your brand new HD picture doesn't have the same superb tonality in the dark areas that your old SD archive does?
- Is the HD looking black-crushed or even posterized?
- Does editing in post-production just make things worse by aggravating the quantising errors in the blacks?
- You need 'Black Stretch,' *in the camera*, before the video signal is chopped up into discrete steps by quantisation.

The Monitor

Please, please don't try fiddling the monitor to see more in the blacks when it is the source material at fault. This is the same as shutting the stable door after the horse has gone. A sufficiently large number of programme makers have requested, and display manufacturers accordingly introduced this 'feature,' that the EBU needed to amend their monitor testing guidelines with a note to help prevent this major error. This note can be found in para 5.4 about Gamma Characteristics in the EBU document <http://tech.ebu.ch/webdav/site/tech/shared/tech/tech3320.pdf>

In essence, *all* displays should look as if they have CRT gamma, which is a simple power law with a coefficient in the region of 2.35.

Do not attempt to apply the converse of camera gamma to a display!

If a monitor uses 'Black Stretch' it will be non-standard, and if several monitors each claim this as a 'feature', then none will look alike, none will be Grade 1, and all will certainly be different from the customer displays.

The Camera

Camera gamma is designed to be different from the display gamma, to give an overall system gamma of approximately 1.2. This is because of two reasons. First, in general, the camera captures its image in a brighter lit scene than the normal display viewing conditions. Second, the eye has a slightly different response in dimmer light to when in brighter light.

Additionally, it is impossible to extend the power law of the camera gain indefinitely down into the blacks, mainly because the noise floor is lifted by the increasing gain requirement. In the 'good old days' of Standard Definition most broadcasting organisations tended to set the limiting gain slope at the black end of the camera gamma somewhere between 8 and 10. HD Rec709 specified 4.7, and immediately the camera manufacturers recognised this was inadequate and introduced 'Black Stretch' to allow the toe slope to be increased. Recently the SD equivalent standard has also adopted the same flawed gamma as the HD.

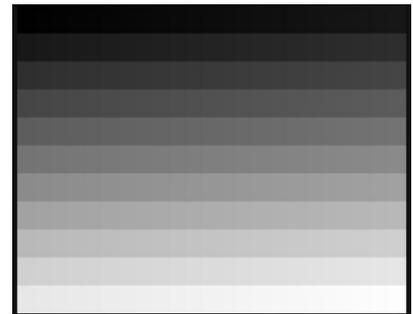
However this is not all bad news, since a small amount of additional noise produced by introducing some extra 'Black Stretch' gain in the deep blacks can become a very effective true-random dither source. Dither is a powerful tool widely used to help to minimise the inevitable quantising effects (or posterizing) consequential on digital television.

Alan Roberts at the BBC has produced a suite of calibration settings appropriate for most broadcast cameras to address this and several other more obscure pitfalls. For full and complete details please read his family of white papers, starting with <http://www.bbc.co.uk/rd/pubs/whp/whp034.shtml>

Summary

'Black Stretch' is a useful, and often necessary, modification of the bottom end of the gamma transfer characteristic for a camera.

There should never, ever, be any such control on a monitor.



A simple pattern of 253 grey-blacks of incrementing brightness will show how a monitor responds to all brightness levels