Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 39 : Assessment of a Canon 5D DSLR

The Canon 5D is a full-size digital single lens reflex camera. Unusually, it also offers HDTV recording. Although there are few of the usual controls that go with video cameras, it was thought worthwhile to check its performance as an HDTV camera. The results were not encouraging.

The tests were done on a pre-production model, serial number 0039900173, software version beta 3.6.1.63..

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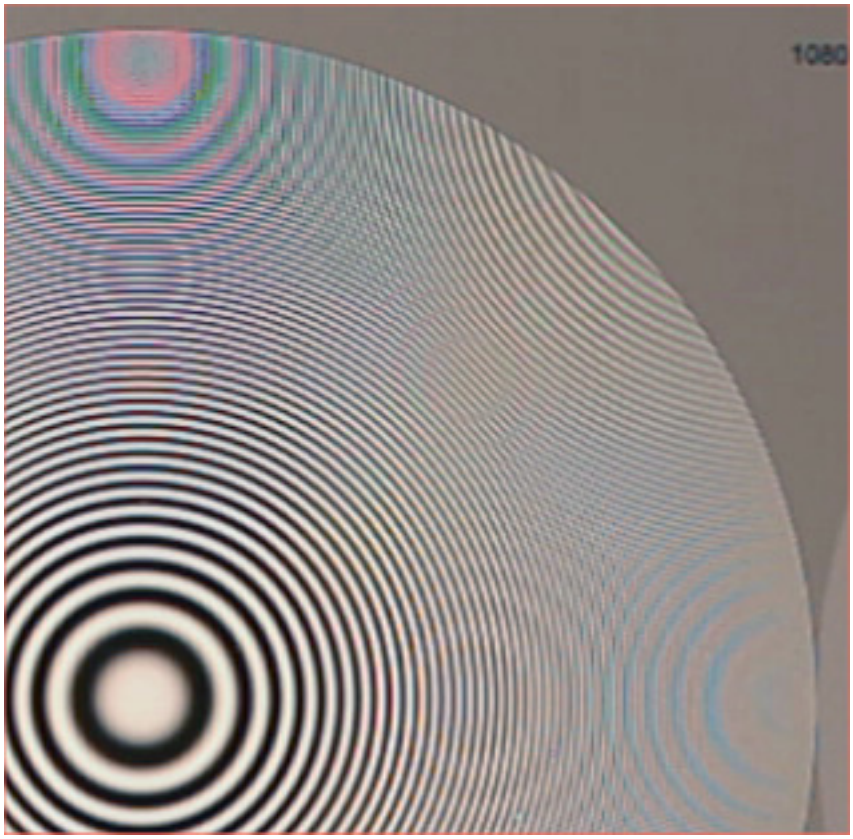
The 5D is a full-size Digital Single Lens Reflex camera, with HDTV recording facilities at 1920x1080. However, monitoring and control of the camera are very different from a conventional video camera, making it rather unsuitable for most video purposes. The camera tested ran only at 29.97 frames/second, NTSC rates. Monitoring is via HDMI, but only from a replay of a recording. During recording, the HDMI output is a 640x480 NTSC feed. This makes it decidedly unsuited to video purposes in Europe.

The camera sensor has approximately 22Mpixels and an aspect ratio of 3:2, so the image dimensions must be about 5760x3840. Since the image size did not change when changing from stills to video, the video feed must be generated from most of the sensor, probably 5760x3240 using a 3:1 down-scaling filter. In theory, this should be a fairly simple conversion.



The camera was exposed to a circular zone plate test chart, containing patterns to test luma, R G and B, and chroma channels. Only one quadrant of the luma pattern is shown here.

This showed some very worrying aliasing patterns, both luma and coloured, indicating that the down-conversion from 5760x3240 to 1920x1080 is not being done at all well.

The strong coloured aliases top and bottom are not matched horizontally, implying that the down-conversion filter is not square, and the strength of the aliases is sufficiently strong to eliminate this camera as a contender for any serious HDTV use. Aliasing of this strength is typical of the bi-cubic interpolation used in stills cameras and graphics converters, where the presence of aliases is much less of a problem because they don't move. Aliases in moving pictures are much more of a problem because, when the image moves, the aliased frequency content moves in the opposite direction to the image motion, causing a rippling effect on edges. Since motion-sensitive compressors such as MPEG2 and MPEG4 depend on the cleanliness of edges to measure motion, these aliases can cause the compressor to allot undue bit-rate to motion and/or result in excessive compression artefacts. Either way, pictures with aliasing at the levels seen here are not acceptable as HDTV.

Also, since the alias patterns are highly coloured, there must be some doubt cast on the actual method of filtering. A Bayer-patterned sensor of 5760x3840 should easily be able to reproduce resolution up to 2880x1280, well in excess of the HDTV frequencies presented by this zone plate test chart. One possible reason for the presence of the coloured aliases would be if the R G and B signals from the Bayer pattern were down-converted to a Bayer pattern at HDTV resolution using simple interpolation, before being decoded, instead of the eminently more sensible approach of decoding at high resolution and then down-converting the very high resolution signal using correct sub-sampling low-pass filtering. From the appearance of the zone plate, the down-sampling could even be as simple as selecting only every third sample of each of R G and B from the sensor pattern to result in a Bayer pattern at 1920x1280, without any filtering or interpolation at all.

Since the camera effectively fails at this test, no other tests were made on it.

It is to be hoped that the production model of the camera will have improved filtering.