Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 63 : tests on a Hitachi HV HD201 mini-camera

Data for this section is taken from a very brief examination of a Hitachi HV HD201 mini-camera as part of a group test of HDTV mini-cameras. There was no manual available at the time of testing.

The camera is small (50x50x55mm), with a CCU (188x75x190mm). The camera has 3 ½" CCD sensors, each 1440x1080 according to the specification. It has a C size lens mount. The control unit has one HDSDI output BNC connector, and one HDMI, plus sync connection and analogue outputs for SDTV. Control is via a separate control panel. There is no menu system as such, all control is via knobs and buttons.

It can operate at 1080i (50 and 59.94Hz) and 720p (50 and 59.94Hz), and SDTV (at 50 and 59.94Hz).

There are no controls on the camera itself. Unfortunately, the camera shows significant response to infra-red illumination.

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1 Camera controls

There are no menus in the camera as such, and no detailed notes were made of the menus available from the CCU.

2 Measurement results

All measurements were made by capturing video on a NanoFlash solid-state recorder using HDSDI output from the control unit. Pictures were extracted for measurement using proprietary software for analysis.

2.1 Sensitivity

Exposing the camera to a 90% reflectance card (the white side of a Kodak Gray Card) at 870 lux required an aperture of F/7 to get peak white. Correcting to 2000 lux illumination returns a value of about F/10.6, which is normal for a camera with ½" sensors. Unusually, this value is significantly better than the specification claim, of F/8.0 at 2000 lux.

2.2 Colour performance

Using a Colorchecker chart, the colour performance was judged to be reasonably good. No individual colour stood out as being significantly wrong, but the yellow patch was a little green, read and blue a little desaturated, all of which is quite normal for any small camera. This is fortunate, since there are no controls which affect colour performance.

2.3 Resolution and aliasing

All testing was done with a circular zone plate test chart having 6 sinusoidally modulated patterns. The six patterns explore luminance and chroma channels on the top row, RGB channels on the bottom row, the samples shown here are each only one quadrant of the luminance (grey scale) pattern.

In 1080 interlaced mode, 1920x1080i/25 in EBU parlance, there is some aliasing horizontally near 1920, but none vertically. This is undoubtedly due to the non-square-pixel sensor resolution (1440x1080). However, the resolution falls quite rapidly as well, so some degree of detail enhancement is essential. After some experimenting with the available controls, a combination of detail Level (+20) and H/V ratio (-15) was derived which seemed to improve things a little. Some resolution has been gained, but the level of

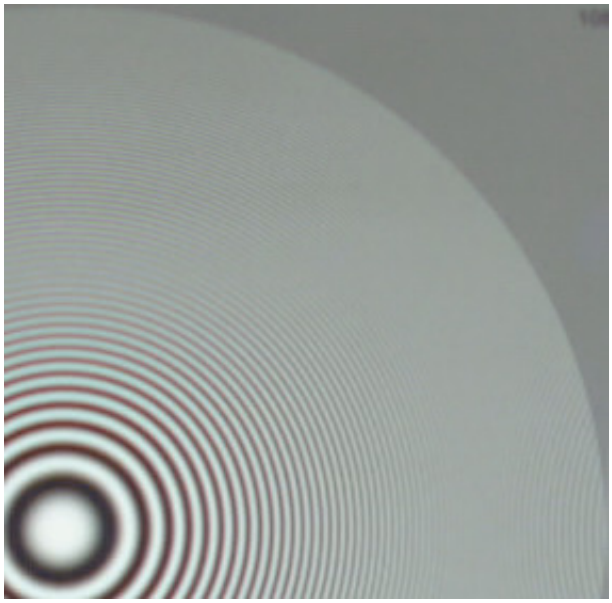

Figure 1 Resolution 1080i, detail off

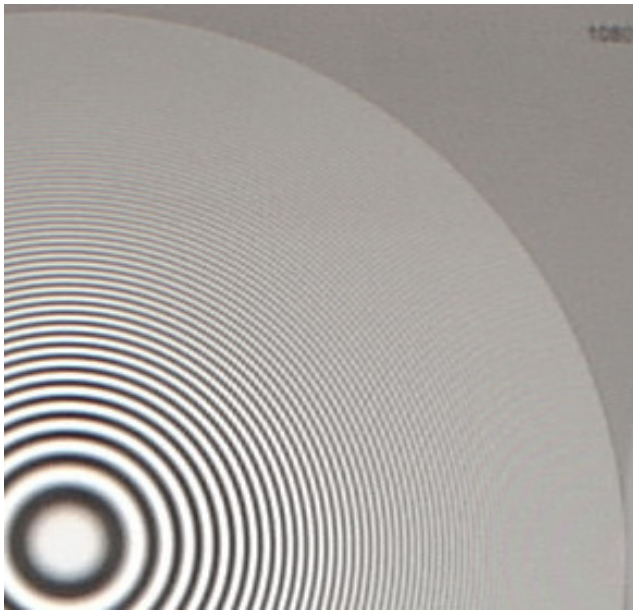

Figure 3 Resolution 1080i, detail+20 H/V-15

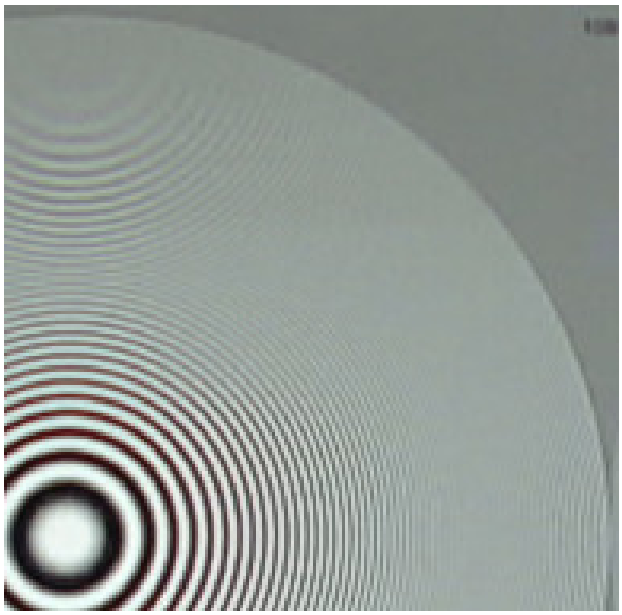

Figure 2 Resolution 720p, detail +20 H/V-15

spatial aliasing has risen as well. It was not found possible to improve the vertical resolution significantly in this way.

Performance at 720p is not particularly good, the level of vertical aliasing is high, and likely to cause problems in motion-sensitive coding such as MPEG. Horizontally, a little resolution is lost as expected, and a strong null zone has appeared centred at 875, and a weak one centred at 1440 is still visible.

2.4 Video Noise

Measurements were taken on an evenly lit white card, exposed at various levels. Image files were captured then decoded in software before performing a software noise analysis. The plot shows the noise level in dB versus video signal level.

The camera gain was set to 0dB, and the measurement files were high-pass filtered to remove any image shading and tilt, and 6dB gain applied to avoid any effects due to premature data quantising. So, 6dB compensation has been applied to the results, thus the graph is representative of the camera performance at normal 0dB gain setting.

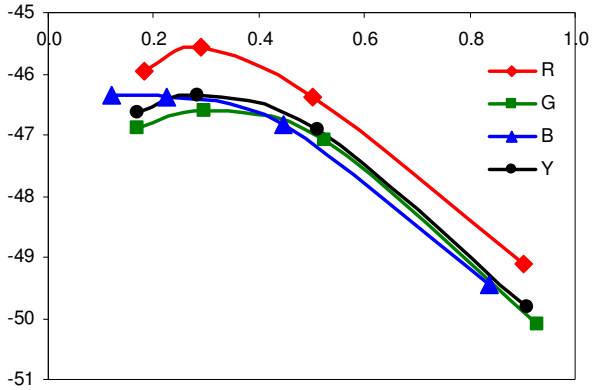

Figure 4 Noise levels

The result is reasonable. The noise levels rise smoothly from white towards black level, but then stabilise below about 40% video level. The normal distribution of noise follows the slope of the gamma curve, thus noise should be least near white, greatest near black, differing by about 13dB. This flattening of the curve near black is an indication that gamma-correction may have been done on the analogue signals rather than after digitisation. The noise level at mid-grey is about -47dB, which is adequate but not especially good for a ½" camera.

2.5 Infra-red response

The camera showed significant response to infra-red illumination. This is to be expected in low-cost cameras, but can distort colours under some illuminants, and can cause instability in black levels.