From rgmr@ing.iac.esWed Feb 12 16:46:52 1997
Date: Wed, 12 Feb 1997 16:13:51 +0000 (GMT)
From: Rene Rutten <rgmr@ing.iac.es>
To: Peter Moore <pcm@ing.iac.es>
Subject: more on CCD TVs

And here is a further thing on preliminary tests I did to compare the ISEC TV with CCD images. These tests were confirmed last summer by work a student and I did.
R.

Hi Paul,

Let me give you some more details of what I did to compare TV images with CCD images. The comparison between our current TV system and CCD images was indeed with images stored from the ISEC system, and images from TEK1 at AUX port in standard readout mode (i.e. noise ~4 ADU). The seeing was pretty bad. I looked at a Landold field from which two standard stars fitted on the TV and CCD field of view (using TVscale 5). The stars had the following magnitudes:

star	V	B
98-624	13.8	14.6
98-626	14.8	16.2

The gain on the TV was turned up all the way. The TV was used without a filter. The TEK AUX port images were taken in the V and B band. The stored digitized TV images cover a range of integration times from 1 frame (40 ms) to 64 frames (2.5 sec). Integrating any further was not worth it because of the quick saturation of the TV images. To give you an idea of how poor the dynamic range of the TV is: the 'bias' level is about 52 TV-ADUs, while the image saturates at about 120 TV-ADUs !
TEK images were 10 and 100 seconds, so I had to extrapolate the results for the TV images to match the exposure time of the TEK images.

Since I don't know what the 'gain' of the ISEC-TV is, I took the very simple-minded approach for the S/N calculation. For both the ISEC-TV and the CCD images the noise in the backgroud determines the S/N in these cases. I determined the counts (and variance) on a number of apertures on the stars and sky. I sky-subtracted the star counts and determined the S/N using the variance in the sky counts. An identical calculation was done for the TEK images. For the TEK the S/N turns out to be limited by pixel-to-pixel variations. I did not flat-field those out (which would have boosted the S/N for the TEK images dramatically) since I did not do that for the TV images either.
So, having calculated the S/N on the TV and TEK images accordingly, and extrapolating the TV results to the TEK exposure time, I get a S/N for the TV of 35, 25 (for the two stars respectively), and a S/N for the TEK images of 99 and 40, respectively.
Note that these numbers are probably over optimistic for the TV since the limited pass band of the CCD is ignored, such high S/N can never be attained on the TV in the first place given the poor dynamic range, and that the CCD images can do much better if they would have been flat fielded (actually, a S/N as high as ~800 could be attained on the brighter of the two stars !).

Apart from that, the TV images look horrible, with brighter and fainter lines mixed. I think the S/N calculation above is generous towards the ISEC TV as it does not really take the poor image quality into

account. Then there is also a large brightness gradient accros
the TV field. I think the ISEC TV images are largely unsuitable
for much more than just viewing the sky.

An accurate comparison of the S/N between the TV and CCD systems
would require taking the band pass and different optical paths
into account more accurately than I could.

The other thing you asked is whether one can use the TEK, ISEC TV,
and CCD-autoguider on the WHT to look at the same object: yes, one
can. Maybe we need to do more test to quantify things further. I
have not looked at the autoguider images.
I'd welcome any suggestions.

Cheers,
Rene'