IPACO expert report

Expert name	Report date	Last update
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Type	Class	Explanation	Complement
IFO	**A**	CMOS sensor saturation	

Document	Imaging location	Imaging date
Video	Manipur, India	June 19, 2011 03:11 PM local hour

Extracted frame from the video

I. Imaging circumstances

This video, visible on Internet, is accompanied by the following comments:

1- "IMPHAL, June 19 – Believe it or not, mystery shrouded Ngankha Lawai village in Manipur's Bishnupur district, 35 kms south of here after a young farmer fainted and was hospitalized following an encounter with an Unidentified Flying Object (UFO).

The mysterious incident occurred when the 31-year-old farmer Koiremba Kumam was taking video of a fish farm near his house using his mobile phone on June 15 around 3.11 pm.

"Suddenly, I captured the UFO in the sky", the farmer said. "I fainted for a few seconds after a small round black object sped towards me."

*Showing the video image of the UFO captured in his mobile phone, Koiremba claimed he felt an electric shock when it came towards him. He returned home after few moments of unconsciousness." (**Source 1**)*

2- 19th June 2011/Moirang, Bishnupur, Manipur, India.

In an astounding incident, a fish farmer in Manipur experienced loss of consciousness for over 18 hours after he claimed he was hit by shockwave transmitted from an unidentified flying object.

The fish farmer was trying out his in-built video camera on his brand-new Chinese made mobile phone when he accidentally filmed the UFO hovering over his fish farm in Bishnupur district.

*After filming for 19 seconds, 32 years-old Kumam Koiremba experienced loss of consciousness. **(Source 2**).*

II. Camera settings

The camera model that was used is unknown.

III. Data examination

Careful examination of the video reveals that it was taken mainly in the direction of the sun. Moreover, the black "UFO" remains permanently in the same place in time and in relation to fixed points of the landscape.

These data and the circular shape as well as the black color of the object suggest that it is only a saturation effect of the photographic sensor, due to the intensity of the sun and the nature of the sensor used in the camera.

IV. Conclusion

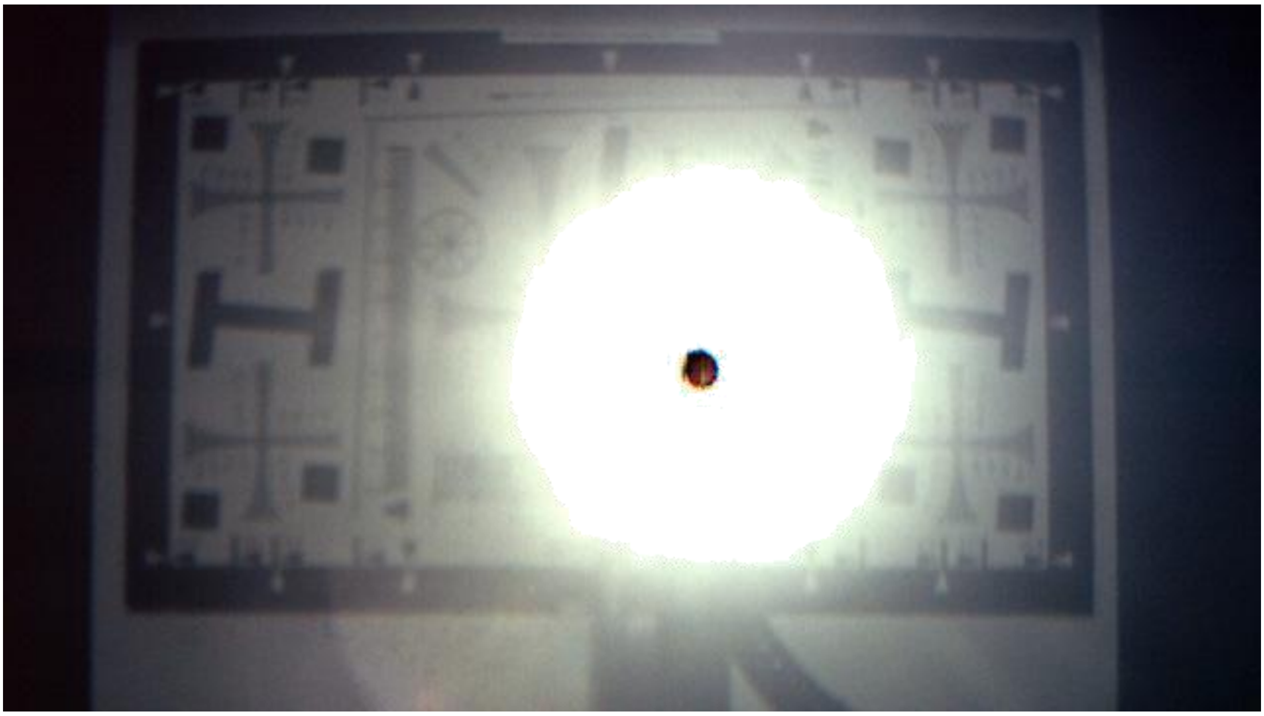
Given the visual and objectives data collected by the examination of the document, we can conclude that the « UFO » is only an effect of the camera CMOS sensor overloaded by the sun light.

V. Technical explanation

Image sensors used in today's video and digital still cameras have come a long way from the grainy, noisy low-resolution devices of 15 years ago. The improvement in image quality has been especially dramatic in CMOS sensors. First generation CMOS sensors (circa 1990), were arrays of 256 X 256 photodiodes that required a good imagination to see an image hiding among the fixed pattern noise (FPN), dark current and high read noise. In 2008, it's commonplace to see CMOS sensors with 5Mpixel resolution or higher, and FPN and read noise have all but been eliminated by a combination of vastly improved pixel design and device fabrication processes.

However, with all the improvements there are still lingering image artifacts that remain in many devices. One of these artifacts is what I call the 'black sun' effect or pixel inversion. This occurs when a camera is pointed at a scene with a very bright, very concentrated source of light like the disk of the sun. (Note – I don't recommend doing this with any digital video or still camera for any length of time because imaging the sun's disk on a sensor with a camera lens may cause irreparable damage to the sensor and or camera optics!)

Under these conditions, we would expect the resulting image to look uniformly saturated across the image of the sun's disk or whatever bright object is in the scene. However, some CMOS sensors actually show these super-bright areas as DARK, rather than saturated, as shown below.



The last picture above shows the output end of an optical fiber bundle placed in front of a digital camera resolution chart. The input end of the fiber bundle is connected to a 150W tungsten light bulb. The measured illumination from the fiber bundle is 20000 lux. The image sensor used is an Omnivision 5610 5Mpixel CMOS sensor, operating in full resolution mode at 4 frames per sec. It is clearly evident from the picture that the central core of the fiber bundle appears black compared to the bright saturated halo around the fiber bundle.

How can this happen?

Explanation

The simplest explanation for this effect uses the 'photo-electron bucket' model of image sensors.

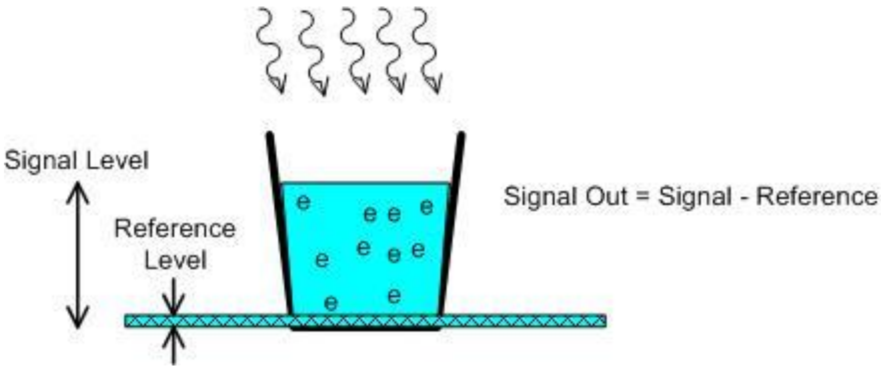


Fig. 1

A single pixel of an image sensor array can be thought of as an electrical charge 'bucket' in which photons (squiggly lines) coming in from a scene are converted to photoelectrons (small 'e's). When a pixel is read out, the level of photoelectrons is compared to a reference level of electrical charge around the pixel. In the case of imaging a very bright object, the number of photons hitting the pixel during a given time period (the exposure time), is far greater than the storage capacity of the photoelectron bucket (See diagram below).

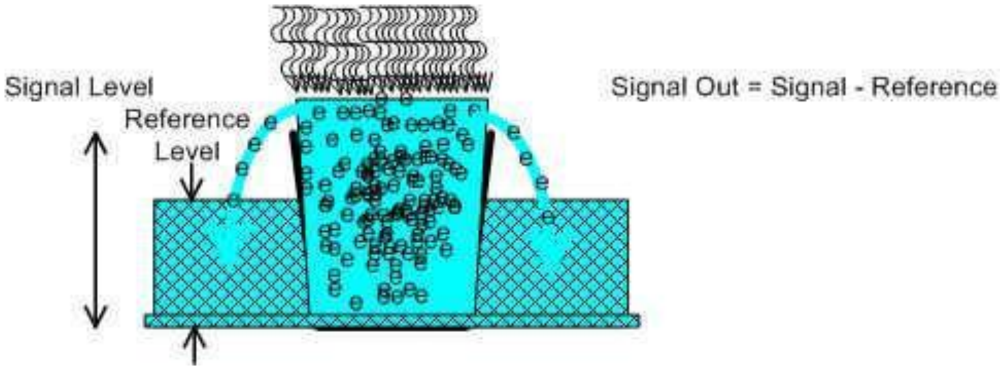
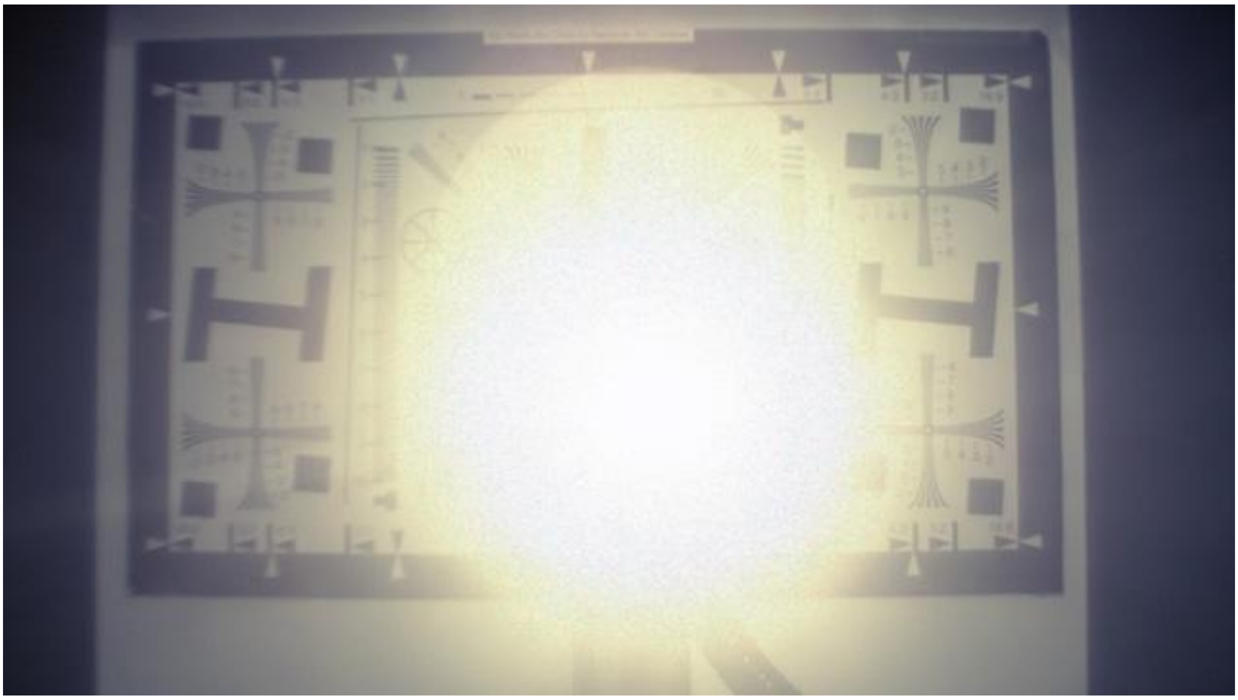


Fig. 2

When this happens, the photoelectrons converted by the pixel start spilling out into the area surrounding the pixel, temporarily raising the reference level of charge surrounding the pixel. As a result, the net signal that is read out from the pixel actually decreases because the signal level cannot exceed the full (saturated) level of the pixel well and the reference level is raised by the overflow photoelectrons. If the incident photon flux is high enough, the signal and reference levels are the same and the net output signal is zero – producing a black pixel.

Solution

If your camera happens to be using an image sensor with this behavior, it is difficult to completely eliminate this effect in post-processing. One can think of several types of software fixes that can set up criteria to test for the onset of pixel inversion and correct for them by substituting saturation values for actual pixel values. The danger with this approach is that there may be legitimate scenes in which a dark core is surrounded by saturated pixels and this approach would incorrectly process them. Fortunately, some CMOS designers/manufacturers have recently devised pixel architectures and processes that appear to have eliminated this effect. An example of this is shown below with a Micron MT9P401 5Mpixel sensor using the same scene and capture conditions as in the Omnivision image above.



VI. Sources – Credits

1- Assam Tribune, June 2011, 12.
2- Video Youtube, June 2011, 19.