

Strong Points for Analogue Aerial Photography.

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With all of the hype now surrounding “Digital” image capturing for aerial photography, I consider it high time for someone to list the many strong points which favour the continuing use of film. Film is still a very valuable medium for capturing and storing vast amounts of information.

From my world-wide contacts with users of both analogue and digital aerial cameras, I have gathered a lot of detailed information which is not often openly discussed. I shall attempt to relate the facts as they have been explained to me.

The following should not be ignored:-

- Modern colour negative films capture a very large amount of information compared with any existing “Digital Aerial Frame Cameras”. A typical frame of Agfa Aviphot X-100 colour negative 24cm x 24cm, when scanned at the highest possible resolution, will result in a file size of more than 2,000 Mb. By comparison, a typical frame from a large format digital camera produces a file size of about 500 Mb. Any mathematician will see that this is about 4 times the data on the film frame.
- What does this mean? It means several things:-
 - The actual area covered by the film frame is greater – this means less images for the same square kilometres/miles
 - There are more shades and tones of colours rendered on film. All digital sensors use cut-off filters to capture only a slice of the visual spectrum for each of the primary colours and near-infrared band. This is done to limit the amount of data captured and in so doing, to limit the storage space required. This limited “slice” of data is most obvious when viewing false colour infrared images made with digital sensors. There are a very limited number of different magenta tones visible in these typical images compared with the number of tones found in false colour infrared images made with film. This must have a bearing on the usefulness of these images in analysing vegetation types and the health of them. A technician from one of Europe’s leading Aerial Survey Companies confirmed this when he told us of the lack of image detail in the IR band from their digital camera, compared with colour IR film images. The same type of analysis possible with the film images was not possible with the digital files.
 - There is more detail and a higher resolution with large format film based images.
- Artificial image sharpness from Digital Cameras. It is often heard that the images from digital cameras are sharper than from film images. Images whether from film or digital sensors are all a product of light, subject matter and the atmosphere that the light travels through. The digital images are all processed by software which artificially sharpens edges in the images. Images from film can also be processed by software to make edges look sharper, but those images from films will also retain all of the extra data that has been captured.
- All Digital Sensors whether they are in small format cameras or large format aerial cameras suffer from a cutting off of information in highlight areas especially when there is reflected light from the sun off mirror-like surfaces such as metal roofs and water. The sensors will accept information up to a certain light intensity and then no more which results in no detail

being recorded in strong highlight areas of an image, and in some cases a wide area around the reflection is also affected. Film will continue to record information in these strong reflected areas to a much higher level of light compared with digital sensors.

- No genuine raw images can be shown from Digital cameras – they have all been digitally enhanced and manipulated. There are many contracts for aerial photography which clearly state that raw (un-manipulated) images must be supplied. These raw images can only be supplied with film.
- It is argued that Digital Systems save on the cost of film and processing. This is a false argument when the cost of purchasing any system of € 700,000.00 to € 1 million plus extras, as well as the monthly maintenance charges are considered, it is easy to see that a lot of film and processing can be purchased just for the value of the maintenance charges, without considering the capital cost and amortisation of the system.
- How long does a Digital camera system last? One associate told me that he has owned 7 film cameras in his life and they all still work. He has owned 7 digital cameras (small format) and none of them are still working. We heard the story of the owner of an old model digital aerial camera who asked to have it repaired and who was told that it is an old camera and it cannot be repaired. Does this mean that the expected life cycle of the digital aerial cameras is as short as 3 years? This is the same story when a new computer is purchased – as soon as it is unpacked, it is almost obsolete.
- Aerial Survey film cameras are still going strong after 30 years or more.
- Film cameras have many lens options – up to 4 different focal lengths. These options allow operators to choose the lens to suit the needs of the job best. For example when a large scale project is required, which would normally be flown at about 1,000ft AGL, and for air traffic control limitations can only be flown at 6,000ft AGL or above, then there is only one option – use a film camera with an extremely long lens. There is an example of this problem which occurred in the USA recently – a company was flying a project over a major airport with a digital camera which required many more flight lines compared with a film camera. Air Traffic Control (ATC) had to repeatedly move them out of the control zone and in the end the job could not be completed as planned. ATC was only able to offer the company a restricted number of slots for subsequent flights. The answer in this case again would have been to use a film camera and fly at a higher level to avoid any ATC conflicts.
- High resolution images flown over cities can be a problem with wide angle lenses causing the buildings on the edges of the frames to fall over. The answer is to use a longer focal length lens with a film camera. With any digital camera it would be necessary to fly very low and to use 60% or more side lap to avoid the worst of the fall-over effect. This of course means more frames, more flight lines, more flight hours and more costs.
- One customer has explained that the most accurate way they have to produce photogrammetric results is to fly with film, and to use optical analytical plotters. They have tested results against ground surveying and have found the accuracy to be +/- 5cm.
- Archiving, which means long term (hundred years or more) safe storage of data, is most easily achieved with hard copies including paper and film. There are many legal requirements to store original data including aerial images for later reference such as in land boundary disputes which in some cases require evidence (images) up to 15 years old. The most convincing court evidence is original film images which can be shown and proved to be un-altered. Digital files are too easy to manipulate. One of the biggest problems associated with images produced by digital camera systems is the safe long term storage of the data. It is necessary to create back-ups of original raw data, and then double back-ups of the processed data files (digitally corrected images). After 2 to 3 years, it is the necessary to

re-back-up all of the backed up files because there are no absolutely secure digital data storage methods available. Also, with the progress of development in computer technology it is anticipated that new systems and software will replace existing systems with the probability of the new systems not being able to read the old files. All of this backing up is an enormous cost to the operators in both time and in the cost of the storage medium.

- It is ironic to note that there has been a big interest in a film writing system which is now capable of recording large (digital camera) image files in very high resolution (with a 3 micron spot) in colour onto high resolution film for permanent storage of images. This will be the only safe and secure method of permanently storing images from digital cameras.
- The recent Imaging Association meeting in Vancouver, BC listed “Archiving 2008” as a major topic. Many presentations covered the growing problems of digital archiving, but no one presented any real solutions. It is also widely acknowledged that analogue film may still offer the best solutions to archiving, and that microfilm archiving continues to thrive in many libraries. The National Archives in the USA and the Australian War Memorial continue to support analogue film archiving and they use large quantities of Agfa duplicating films to copy their aerial and other archives.
- From the USA we have reports that at least 2 State Government Authorities have specified aerial photography must be done with analogue (film) systems. This is because of the problems that have been experienced in matching up images from previous years with current digital images.
- A legal issue has just been reported. The Attorney General in the State of Tennessee has declared that aerial images from Digital Cameras will not be accepted as evidence in Court hearings. Film is still the only medium where a clear chain of evidence can be proven.
- Also from the USA we have reports that large projects are being flown with film, even though the companies have digital systems, because of the lower costs in flying the projects. Film cameras will capture larger areas per frame from higher levels in a shorter time. Post processing is easier because of the reduced number of images.
- Analogue (film) aerial cameras have always been subjected to rigorous calibration tests to ensure the accuracy of any subsequent measurements from the images. This is not so easy to achieve with digital aerial cameras and so a variety of other methods have had to be found to make software adjustments to the images.
- The latest information that we have received from the USA is from an aerial company using a large format digital camera. They were informed by their client that some small important details were missing from the images that they had provided. It seems that the software which was processing the images ignored, or didn't recognise these parts of the subject, and they were left out. The job had to be re-flown with film and now the company doesn't know what they can do or not do with their digital camera.
- New information recently received from a colleague responsible for the aerial markets in Scandinavia, tells an interesting story. There is a trend happening also in Scandinavia for a return to analogue aerial photography. One company in the region has recently re-commissioned their photo laboratory and they are reporting a return to analogue for about 30% of their work. They were 100% digital. Another company, also in Scandinavia, has experienced a similar trend and they too are gearing up to return to analogue for a reasonable portion of their work.

Conclusions:-

Analogue photography should not be ignored, just because it has been around for more than 100 years. There are projects which can be done well with digital photography, but there are also many projects which could be done better and more efficiently using film.

I do not understand why some end-user customers are specifying that projects have to be flown with digital cameras. If the facts set out above are properly considered, then we should see that the decisions on which camera systems are to be used in any given circumstance should be left up to the contractor to advise and recommend. It is obvious that suppliers of these “new” systems have been doing a good job of convincing the survey industry and in particular the end customers, that because “digital” is new, therefore it must be better. This is simply not true in many cases.

We are seeing a repeat of the circumstances when FMC (forward motion compensation) was first introduced on aerial film cameras. The customers started to specify that only FMC cameras should be used for projects, even though we know that operators would turn off the FMC function above 12,000 – 15,000 feet AGL. This demand ignored other possible solutions to the problem of image motion, such as using higher speed films and high shutter speeds which in fact could do a better job than FMC at low levels by also compensating for sideways movements in turbulence.

Final Note:

At the recent ASPRS Meeting in Baltimore, USA, it was interesting to note that there were at least 11 different digital image capturing systems being offered to the industry. This included 3 different “sweep broom” systems, at least 3 different large format “frame” systems and a wide range of different “medium format” systems.

On the other hand, all of the traditional film cameras have the same format no matter whether it is a camera from LMK, RMK or RC-10/20/30. The film image will be the same with the same scales no matter which type of film camera is used.

Feedback from the industry suggested a state of confusion – aerial photography companies were saying that they are reluctant to invest in digital systems. The absence of any common standards is another problem facing the end customers. We have heard that this is the reason that film is now being specified for many projects.