SURVEY WORKFLOW WITH AERIAL DIGITAL CAMERA

Vexcel UltraCam D in Operation

Use of the digital camera Vexcel UltraCam D was introduced in early 2004 by Aerodata International Surveys. Up until then solely analogue photo cameras such as the Zeiss LMK 2000 and Wild RC10 had been in use. The author describes considerations underlying the purchase of the new camera and presents operational experience.

User demands on aerial imagery are changing in many ways. First of all, users are looking for higher update frequencies for photographs and derived map products. Instead of updating every five years, the update frequency is increasing to once in three years, once in two years and even to annual update. This change goes hand in hand with fast delivery times. User standards of quality are simultaneously rising, whilst prices are under pressure in a competitive market. The range of applications for which recorded imagery is used is also broadening. The demand for ground resolution varies from 5cm to 50cm for mapping accuracies of centimetres to metres. There is also an increasing market for 3D applications such as city models and landscape models with photo-realistic appearance. Meeting these demands challenges the aerial data acquisition workflow not only technically but also with respect to cost-effective production and shortening total throughput time. The quality of these products must meet high standards and the range should show versatility.

UltraCam

The features of the UltraCam digital camera address all these challenges. It is a large-format, digital photogrammetric camera giving image size 1,1750 x 7,500 pixels, resulting in image dimensions comparable to an analogue image size of 23cm x 15cm. As a result of large image size the flight plan is similar to an analogue camera flight; this is a flight-economical advantage compared to small-format digital cameras. Electronic FMC (Forward Motion Compensation) enables recording of very high-resolution imagery at great flying speed. The forward overlap can be set at virtually any percentage because the data transfer rate is high; the time interval between two recordings is up to 0.75 seconds. The storage capacity in the aircraft is around 2,700 images (more than 1.5 TB). Film development and scanning are redundant, resulting in several advantages including:

- immediate processing of data after return from flight, substantially shortening total workflow time
- absence of grain, noise and dust particles in the imagery, resulting in better quality; the images look clean and bright.

Panchromatic, red, green, blue and near-infrared channels are recorded simultaneously so that a single mission suffices to produce a wide range of products for different applications, for example colour infrared for environmental inventories and true colour for real-estate mapping. Most flights are carried out under sunny conditions, leading to heavy shadows in built-up areas. The 12-bit dynamic range for every channel enables much more information to be derived from shadowed areas as compared to 8-bit scanned imagery. The camera can be used under relatively low light conditions, resulting in wider data acquisition time-windows over a day or season.

Flight/Data Planning

Day-to-day flight planning and execution is not affected by the introduction of the digital camera. Project specifications permitting, the decision to use digital or analogue camera is mainly taken on flight operation grounds. Procedures are virtually the same because the GPS-navigation systems are comparable. Managing the camera differs from managing an analogue camera but an experienced photo-navigator quickly masters it. Pre-processing may begin on-board the aircraft when the distance back from survey area to base is large. Large volumes of data result when high forward overlaps are chosen and the imagery is recorded in 16-bit per channel. Since one image is about 250MB and a typical survey consists of 800 images, 200GB of data are produced per survey. When aircraft and camera have again to be operational the next day, after landing the data stored on-board has to be downloaded on large-capacity hard drives for further processing. All the data has to be checked for integrity and completeness immediately after the flight. For security reasons, a back-up tape is necessary, doubling the necessary storage capacity to 400GB. An example of a suitable back-up medium is the HP Ultrium tape and any back-up should preferably be stored in a fireproof environment.
The further pre-processing chain brings the images to a level, â€˜level 3â€™, comparable to scanned imagery with additional â€˜quickviewsâ€™ for rapid access. At this level each colour or colour-infrared image covers around 500MB for the 16-bit option. Such data volumes require an amazing number of external hard disks. Level 3 is the starting point for the production of orthophotomaps and digital terrain models and for vector mapping in softcopy photogrammetric workstations.

Archiving Data

Archiving data is an important aspect of the workflow and is a service to clients who have mistakenly lost or corrupted their data. Archiving also enables reselling data off the shelf.
We have recently disclosed our digital archives via www.aerogrid.nl. The life cycle of aerial photography is short and with the tendency towards increasing update frequencies becomes shorter and shorter. The value of an image is highest immediately after recording and

diminishes rapidly thereafter because it covers a past situation. So the sooner the client gets the data the better. Within a few years of it having been acquired aerial imagery has lost virtually all its commercial value. After a couple of decades the value may increase again, because now the recorded past represents a real historical situation. What to do with imagery when it has reached zero value? For film the answer is easy: delete the scanned images and save the film in the archive. The only costs associated with film archiving concern physical storage space. For digital imagery the answer is different. Digital storage media and formats are still rapidly developing; todayâ€™s standards will probably differ from those of the future. Keeping digital data accessible for the future thus requires regular checking and transferring to new media. The costs of archiving digital imagery should be less than any expected future revenues; the break-line lies at perhaps three to five years. Maybe a day will come when digital data will be written on film just for archiving purposes!
