

CERTIFICATION OF DIGITAL AIRBORNE MAPPING PRODUCTS (1)

USGS QA Plan

To facilitate acceptance of new digital technologies in aerial imaging and mapping, the US Geological Survey (USGS) and its partners have launched a Quality Assurance (QA) Plan for Digital Aerial Imagery. This should provide a foundation for the quality of digital aerial imagery and products. It introduces broader considerations regarding processes employed by aerial flyers in collecting, processing and delivering data, and provides training and information for US producers and users alike.

Since 1973 the US Geological Survey (USGS) has provided analogue calibration services within the US. Interior orientation parameters and other characteristics of an individual camera were stipulated in a USGS Report on Camera Calibration, adopted by many organisations as a de facto requirement for aerial mapping within the US and perceived as a 'certificate of quality' actually beyond its original intent. The need for more comprehensive quality assessment (QA) was highlighted by the manner in which aerial-imagery consumers interpreted the Camera Calibration report.

Background

The emergence of digital technologies for aerial imaging led to the American Society of Photo-grammetry and Remote Sensing (ASPRS) setting up a special panel of experts from industry, academia and government. In 2000 this panel recommended that the USGS continue its leadership role within the US in research, calibration of film and digital aerial cameras, and establishing a US standard for camera and sensor calibration. In 2002 the USGS established the Remote Sensing Technologies Project at the USGS Center for Earth Observation and Science (EROS) to research digital technologies and calibration. In 2005 the USGS invited thirteen other federal agencies, each significant users of aerial imagery, to form the Inter-Agency Digital Imagery Working Group (IADIWG), which brings broader experience and insights into digital imagery acquisition, guidelines and policies common to all agencies. The USGS QA Plan of Digital Aerial Imagery has been approved by the IADIWG.

Four Parts

The new plan moves far beyond the individual camera characterisation still in use for analogue cameras to address activities in requesting, collecting, processing and assessing digital aerial imagery products. Covering the end-to-end data procurement and data-generation process, the plan pleads for the use of consistent processes and standards by buyers and users of data, and expects producers of digital aerial data to demonstrate high quality standards. The four components of the plan are:

1. Contracting guidelines for digital aerial imagery.
2. Manufacturer type certification.
3. Data provider certification.
4. Acceptance standards for digital aerial data.

Parts (1) and (4) belong in the Data Procurement domain and refer to both specification and contracting of data and assessment of the final products to ensure meeting the specifications. Parts (2) and (3) lie within the Data Production domain and address technical generation of data.

Data Procurement

Although similar to analogue imaging, digital technologies introduce users to additional capabilities and terminology. In order to communicate to producers their requirements and expectations, buyers and users of digital-image products must understand the capabilities of digital sensors and use terminology that correctly specifies their needs. They should share with producer common criteria and methods to determine whether digital products meet contractual specifications. The USGS is working with its partners to develop contracting guidelines and web-based specification tools that employ such common terminology. Similarly, the USGS will be developing QA guidelines and web-based examples of imagery to aid users in identifying image-quality issues. The USGS has recently prepared the first draft of contracting guidelines and has developed a web-based specification tool capable of generating requirement sections for contracts using common terminology. These tools are expected to undergo continuing refinement and improvement based on user experience and feedback. The QA tools are currently developmentally behind schedule but should appear in their first iteration in 2008.

Data Production

This domain refers not only to traditional camera calibration but has been expanded to cover the entire production process. The focus has been removed from the imaging characteristics of an individual camera and placed on overall performance and quality contribution made by the many steps. The camera itself is only one part of the total system, which now includes GPS, Inertial Measurement Unit (IMU) and processing systems. Other areas include both Manufacturer Type and Data Provider Certification.

The former refers to standards set to ensure that the manufacturer-made sensor system has been designed to reliably, repeatedly and routinely deliver an output product of consistent quality, and that this meets the claims of the manufacturer. Data Provider Certification, however, covers the part of the image production chain that has the greatest effect on the overall quality of the final product. These elements are described below.

Manufacturer Type

Certification covers all identical systems: once a particular make and model has been 'type certified', all copies, whether made prior to certification or after, are also considered certified. Systems that have been significantly changed, upgraded or enhanced may require new certification. This does not imply that certified systems from different manufacturers are capable of delivering data of identical quality or characteristics. To obtain certification a manufacturer must demonstrate the design, manufacturing processes, testing, calibration and support for the camera model, as well as the ability of the camera model to reliably meet performance claims. To date the USGS has worked with four camera manufacturers (Applanix, Intergraph, Leica and Vexcel) and has issued certification for the Applanix DSS-322, the Intergraph Z/I DMC and the Vexcel UltraCamD. Certification of the Leica ADS40 is underway at the time of writing and expected to be complete by publication. The certification process will be revised based on the experiences of these four manufacturers and then opened up to others. The recently unveiled EuroDAC2 plan will also be of particular interest as this process is revised. This exciting new effort opens up many possibilities for learning, collaboration and partnership.

Data Provider

The data provider acquires and processes the imagery and interacts with buyers and users. Poor performance of camera operator or data processor can negate camera performance capabilities. The Data Provider Certification process involves a review of the processes and QA in use by the data provider; a USGS team inspects these processes, from mission planning and flying to product generation and delivery. The data provider is also required to fly over an USGS-sanctioned test range and deliver a small ortho-mosaic product for assessment and evaluation. Certification is valid for three years, but the provider must annually deliver for assessment a test product made over a USGS range. The accuracy of the test-range imagery must meet national map accuracy standards. The USGS is currently working with five data providers who are assisting in the development of this portion of the plan; their certification is expected to be complete by the end of 2008, when routine data-provider certification will begin in the US.

Concluding Remarks

The USGS and its partners are currently working to finalise and implement the four areas of the plan throughout the US but, recognising that this is a worldwide industry and community, look forward to partnership and collaboration with other international mapping agencies, industry and academia. The USGS is also committed to continuing research and testing the capabilities and promise of new technologies for aerial remote sensing.

Acknowledgements

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Websites

- The USGS Plan for Quality Assurance of Digital Aerial Imagery, Draft Contracting Guidelines and Draft Manufacturer's Certification Plan.
- (Draft) Digital Aerial Imagery Specification Tool.

Editor's Note

Certification of the chain of activities involved in the production of image and map products from digital airborne cameras is a hot issue, and treated in two articles in the present magazine. This article covers the new Quality Assurance (QA) Plan for Digital Aerial Imagery from the US Geological Survey (USGS) and its partners, while the other describes the new EuroDAC2 Certification initiative led by EuroSDR – formerly OEEPE.

<https://www.gim-international.com/content/article/usgs-qa-plan>
