

# **The ASPRS Digital Imagery Product Guideline Project<sup>1</sup>**

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The American Society for Photogrammetry and Remote Sensing (ASPRS) Primary Data Acquisition Division is developing a Digital Imagery Product Guideline in conjunction with NASA, the U.S. Geological Survey (USGS), the National Imagery and Mapping Agency (NIMA), academia, and industry. The goal of the guideline is to offer providers and users of digital imagery a set of recommendations analogous to those defined by the ASPRS Aerial Photography 1995 Draft Standard\* for film-based imagery. This article offers a general outline and description of the Digital Imagery Product Guideline and Digital Imagery Tutorial/Reference documents for defining digital imagery requirements.

## **Background**

Because of the continued development of aerial and spaceborne sensors, digital storage, and soft-copy photogrammetry, applications have moved rapidly toward totally digital imaging solutions. Although the Aerial Photography Draft Standard provides a common basis for film-based requirements definition, it is insufficient when considering digitally acquired imagery. The proposed Digital Imagery Product Guideline is a relatively short document describing various product recommendations and is designed to enable users to quickly define imagery requirements. The guideline does not state how a task must be performed—this is to be determined by the customer, service provider, and systems manufacturers—but it can serve as a common interface between client and provider. A companion document, the Digital Imagery Reference/Tutorial, discusses many of the concepts mentioned in the short-form document. The role of the reference document is to offer the background information necessary to obtain and utilize imagery optimally.

## **Digital Imagery Product Guideline**

The Digital Imagery Product Guideline focuses primarily on the data and derived products rather than on the type of sensor used in the acquisition. Because there is a wide variety of digital remote sensing systems, the guideline addresses products from systems operating in the passive reflective domain (400 to 2500 nm) using solar illumination. Two main types of systems are addressed: panchromatic and multispectral. Panchromatic systems have a single, relatively broad band, usually covering the entire detector response. In the case of a silicon-based detector system, this band can cover the visible through near infrared (400 to 900 nm) region. Many of the multispectral systems flying today have 2 to 10 bands in the reflective spectral domain. The digital imagery from these types of systems offers a range of products not possible

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from traditional film and naturally facilitates the development of new methods and applications. The guideline is thus a pathfinder, which will evolve significantly over the next few years. Thermal, hyperspectral, and active sensors will be considered for future drafts of the document. Linkages to the International Society for Photogrammetry and Remote Sensing (ISPRS) Commission I Working Group 1 will also be reviewed.

The document is divided into three major sections. The first, Intrinsic Data Product Specifications, addresses those areas dominated by the physics and engineering aspects related to spectral, radiometric, and spatial properties of the imagery. The second section, Deliverable Products, addresses the types of data and products that can be provided. These include Level 0, 1, and 2 products. Level 0 is raw (unprocessed) data that may be formatted (i.e., GeoTiff). Level 1 products are radiometrically and/or geometrically corrected. Level 2 products are atmospherically corrected. The third section, Flying Conditions and Imagery Coverage, is analogous to that in the Aerial Photography 1995 Draft Standard. All metadata are designed to be Federal Geographic Data Committee (FGDC) compliant.

Throughout the guideline, three product requirements-classes are defined: standard, enhanced, and precision. In general, the data specifications and level of certification become more refined as one progresses from standard, through enhanced, to precision. Standard-level products might typically be obtained using commercial off-the-shelf (COTS) components, while enhanced- and precision-level products might use custom components. Precision products are designed to emulate EOS<sup>2</sup> type of products and describe more highly processed data sets. Rigid adherence to a single class for all specifications may not be necessary since the data product for a given application might be satisfied by a combination of standard-, enhanced-, and/or precision-level components. The guideline should therefore be used as a menu addressing each individual requirement of the particular application for which it is intended.

### **Digital Imagery Reference/Tutorial**

The companion Digital Imagery Reference/Tutorial discusses edge response, modulation transfer function (MTF), aliasing, radiometry, calibration, and geolocation. A review of image scale and the National Imagery Interpretability Rating Scale (NIIRS) is provided for guidance in determining the spatial resolution requirements for resolving objects of interest. The General Imagery Quality Equation (GIQE) is covered in detail and a NIIRS example imagery set is provided. The reference also contains a bibliography and a glossary describing many common terms used in both documents.

To fully exploit digital imagery, data products should be specified and characterized in many more dimensions than film systems. The USGS certification process for film cameras has standardized the aerial photography remote sensing industry. However, the scope of the analog camera model characterization by USGS does not currently consider the additional parameters inherent in digital systems. ASPRS is exploring the implementation of a NASA, USGS, NIMA, and the National Institute of Standards and Technology (NIST) team for developing spatial, spectral, radiometric, and geolocation certification methods. This is well beyond the scope of present USGS certification. That function could potentially be performed by a commercial, nonprofit, or government agency and would require augmentation or replacement of long-term

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<sup>2</sup> The Earth Observing System (EOS) is the centerpiece of NASA's Earth Science Enterprise (ESE). It consists of a science component and a data system supporting a coordinated series of polar-orbiting and low inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans. ( -- from NASA web site <http://eosps.gsfc.nasa.gov/>)

policies to be successful. There is a high-priority need to address this subject, and it will be a topic of discussion at the ASPRS 2001 meeting (see below).

### **Certification**

The instrument certification process requires both laboratory and in-flight characterization. As part of the NASA Scientific Data Purchase, NASA has characterized digital imagery from multispectral framing and scanner systems. NASA has initiated the development of prototypical methods for laboratory characterization of multispectral charge-coupled device (CCD) cameras, including measurement of radiometric response, spectral response, edge response, and MTF properties. Using permanent and deployable targets, NASA has also pioneered in-flight verification of MTF, radiometry, and geolocation accuracy of framing cameras. These techniques could serve as a starting point for developing the certification methods.

In addition to certification techniques, there is a strong need for developing a better understanding of the requirements for various applications. Many of the values in the guide are based on current methods and instruments for image acquisition, and they may need reconsideration as the state-of-the-art changes. Also, requirements for the science community are not clearly defined, which implies that parametric trades (i.e., between ground sample distance (GSD), signal-to-noise ratio (SNR), and spectral bandpass) and application requirements cannot be generally made. These issues are being prioritized by ASPRS and NASA and will be subjects for future studies.

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Beta versions of the Digital Imagery Product Guideline and Tutorial were presented at the spring 2000 ASPRS and December 2000 ASPRS meetings. The Digital Imagery Product Guideline will be discussed in a special session scheduled for Tuesday, April 24, 1:00 – 3:00 p.m. at the ASPRS Annual Conference in St. Louis, Missouri. For more information about the conference, please consult the ASPRS website at [www.asprs.org](http://www.asprs.org). The draft version of the guideline will be released on the web for public comment shortly after the April ASPRS 2001 meeting. Presently, the guide does not discuss digitized film, but that may be included in a future revision.

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\*Aerial Photography 1995 Draft Standard, ASPRS Professional Practice Division, Specifications and Standards Committee.

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