Digital Airborne Cameras

Large-Format, Multihead, Frame Cameras

System	Image Size	CCD Sensor Size	Number of Sensors	Pixel Size [micron]	Dynamic Range (bits)	Maximum Frame Rate (seconds per image)	FOV	GPS/IMU	Software
 **DMC** Digital Mapping Camera Intergraph Z/I Imaging *www.intergraph.com/earthimaging*	13,824 x 7,680	7,000 x 4,000 (pan) 3,000 x 2,000 (multispectral)	4 + 4	12	12	2.1	69° x 42°	Optional Integrated	Any system (frame camera model)
 **UltraCam X** Vexcel *www.vexcel.com*	14,450 x 9,420	4,992 x 3,328	9 + 4	7.2	14	1	61° x 42°	Optional Integrated	Any system (frame camera model)
 **UltraCam D** Vexcel *www.vexcel.com*	11,500 x 7,500	3,680 x 2,400	9 + 4	9	14	1	55° x 37°	Optional Integrated	Any system (frame camera model)
 **DiMAC** DIMAC Systems *www.dimacsystems.com*	10,500 x 7,200	7,216 x 5,412	2-4	6.8	16	2.1	66° x 48°	Optional Integrated	Any system (frame camera model)

Large-Format, Linescanner Cameras

 **ADS40** Airborne Digital Sensor Leica GeoSystems *http://gi.leica-geosystems.com*	12,000 x any	12,000 (2x)	3 (2x) + 4	6.5 (3.25)	16	n/a	64°	Mandatory Integrated	GPro, ORIMA, LPS SOCET SET, VIRTUOZO KLT Atlas, DIGI3, ImageStation
 **JAS150** Jena Airborne Scanner Jena-Optronik *www.jena-optronik.de*	12,000 x any	12,000	5 + 4	6.5	16	n/a	30°	Mandatory Integrated	JenaStereo, SOCET SET
 **3-DAS-1 and 3-OC** Wehrli Associates *www.wehrliassoc.com*	8,002 x any	8,002	3 (x3)	9	14		36°	Mandatory Integrated	Proprietary

Medium-Format, Multihead, Frame Cameras

 **SpectraView8** Airborne Data Systems *www.airbornedatasystems.com*	8,000x 2,672	8,000 x 2,672 4,000 x 2,672	2 + 4	9	12	n/a	64°	Mandatory Integrated	Any system (frame camera model)

Medium-Format, Singlehead, Frame Cameras

 **Digital Sensor System (DSS)** Applanix *www.applanix.com* photogrammetry tools,	5,436 x 4,092 7,216 x 5,412	5,436 x 4,092 7,216 x 5,412	1	9 6.8	12	2.5 <3	60 mm lens: **40 mm lens:** 62° x 49°	Complete GPS-aided INS solution with integrated flight management system and controlled azimuth mount (USGS certified)	Supported end-to-end workflow that includes POSPac Post-Processing modules, photogrammetry/ calibration tools, INPHO DT Master and Orthobox. RapidOrtho enabled (eliminates AT requirement)
 **DigiCAM** IGI *www.igi-systems.com*	5,440 x 4,080 7,216 x 5,428	5,440 x 4,080 7,216 x 5,428	1	9 6.8	16	2.5	35 mm lens: **69° x 55°** 50 mm lens: 52° x 40° 80 mm lens: 33° x 25° 100 mm lens: 28° x 21° and more	Optional Integrated	Any system (frame camera model)
 **AIC** (with Light Meter Unit) Rollei *www.rollei.com*	5,440 x 4,080 7,228 x 5,428	5,440 x 4,080 7,228 x 5,428	1	9 6.8	16	1.7 1.9	Central shutter 1/1000 s 50 mm lens: 52° x 40° 80 mm lens: 34° x 25° 120 mm lens: 23° x 17° and more	Optional Integrated	Any system (frame camera model)
 **NexVue** Spectrum Imaging *www.specmap.com*	4,080 x 4,080	4,080 x 4,080	1	9	12	2.5	90 mm lens: 23° 50 mm lens: 42°	Optional Integrated	Any system (frame camera model)

Image Size: Defines the size of the output image of the digital camera system in pixels. The output image may have the size of the imaging sensor for a single-head camera system, or it could be the size of a virtual image composed from several images captured by different cameras in a multihead camera system.

CCD Sensor Size: Provides the size of the imaging sensor in pixels. There are a few varieties of sensor size, such as the total number of the pixels, the number of effective pixels, and the number of active pixels. The last one is the most important for the user. A charge coupled device (CCD) is one of the two main imaging sensor types used in airborne digital cameras and is the equivalent of film in digital cameras. Implemented in silicon semiconductor, the individual CCD sensor elements, pixels, convert the light during exposure into electric charge that is stored and then read out in a subsequent process.

The Number of Sensors: Provides the number of the CCDs used in a digital camera system. There could be several sensors in a single camera head, such as several linear CCDs in a linescanner or several area CCDs in beam splitter-based multispectral cameras. For multihead cameras, this number is typically equal to the number of cameras used in the system.

Pixel Size: Defines the physical size of a CCD sensor element. The smaller the size the more pixels can be placed on a CCD sensor, but as the size decreases the noise level increases, and diffraction becomes a setback.

Dynamic Range: Defines the intensity resolution of the output image in bits. The number of bits of the D/A converter connected to the CCD sensor could be different from the actual intensity resolution. In addition, imaging systems typically work with 8- or 16-bit image intensity data (per band). For example, a digital camera may use a 14-bit converter and can provide the output data in a 16-bit number while the actual dynamic range of the image is the typical 10-12 bits. In comparison, scanned analog film has a 6-8 bit dynamic range.

Maximum Frame Rate: Defines the maximum frequency images can be captured by a system. In practice, however, the inverse of this parameter is used for mapping, which simply states the minimum time needed between two image captures.

FOV: Defines the field of view (FOV), the size of the area that can be seen while looking through an optics device. Typically FOV is expressed in degrees.

GPS/IMU: Stands for Global Positioning System/Inertial Measurement Unit, a device for measuring position and attitude of a moving vehicle such as an aircraft. The integrated system uses the GPS receiver for position measurements (XYZ or latitude, longitude and elevation) and the IMU (a combination of accelerometers and gyroscopes) for attitude measurements (roll, pitch, heading). GPS/IMU systems typically blend the two data streams to increase accuracy and correct measurement drift.

Software: Defines a suite of algorithms required to download and process instrument data. Instrument software usually contains a method for radiometric correction of imagery (to a calibrated light standard) and geometric correction of imagery using information from the GPS/IMU (if available). Some software suites may provide for an atmospheric correction so that measured energy is only from Earth's surface. The objective of software is to obtain an image map.

Source: Much of the information in this chart originally appeared in the online version of "Converging Airborne Technologies Support Diverse Applications," *Earth Imaging Journal*, July/August 2006 (*www.eijournal.com/Airborne_Technologies.asp*). The article was written by Karen Schuckman, URS Corp., and Charles Toth, Ohio State University.