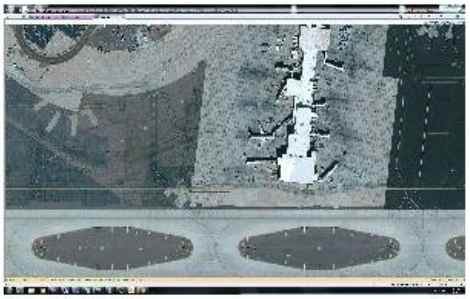
CONTINUOUS, CONSISTENT AND CURRENT COVERAGE

Global Ortho Project



Microsoftâ€™s Global Ortho (GO) project aims to capture the entire continental United States and Western Europe at a spatial resolution of 30 centimetres, using UltraCamG digital aerial cameras. The GO project produced the first imagery in August 2010 and has to date captured 46% of the area and published 2.21km2. The entire project is scheduled for completion by June 2012, to be followed by a three-year refresh cycle. The author discusses the GO project, as well as features of the UltraCamG and the new UltraCam Eagle digital aerial cameras. The latter was launched as a commercial offering in May 2011.

Microsoft has been in the mapping business for more than a decade, with the consumer trips planning programme Streets and Trips as one of its first mapping products. During development, a massive database of map vector data and imagery were collected. Most of these data were initially acquired from third-party sources. But to improve its mapping offerings the company's Virtual Earth business unit I acquired Vexcel Imaging GmbH, manufacturer of UltraCam aerial cameras and specialised in photogrammetry and 2D and 3D imagery in May 2006. This enabled Microsoft to establish its photogrammetry division and enter the aerial digital camera business, making and selling the UltraCam line of cameras as well as using them to collect map data. The legacy of the camera business allows Microsoft to understand the end-to-end collection and processing of imagery. Today it provides maps and imagery to both consumers, through Bing Maps, and to businesses by enabling a web services API that allows enterprises to write software and access Microsoft's database. Businesses use the API for routing delivery trucks and other internal purposes, as well as providing information to consumers such as store locations.

GO Project

To achieve coverage that is continuous, consistent and current, Microsoft launched the Global Ortho (GO) programme in spring 2010, the single largest imagery project ever undertaken. In less than two years it aims to collect the entire continental United States and Western Europe, or about 10.5 million km2, at a spatial resolution of 30 centimetres, significantly higher than that of commercial imaging satellites. Speed of collection, image accuracy and resolution of GO greatly exceed those of the next biggest project, the U.S. Geological Survey's NAIP (National Agriculture Imagery Programme). The first GO imagery was produced in August 2010, and to date 46% of the land area has been captured and around 278 blocks, equalling 2.21km2 have been published. The entire project is scheduled for completion by June 2012, to be immediately followed by a three-year refresh cycle that will involve re-acquiring about 50% of the original coverage, with priority given to the most populated and rapidly changing areas. Ultimately, Microsoft would like to acquire imagery for the whole planet.

Aims and Objectives

Users fall into three categories: consumers, who will get access through the Bing Maps website; government and business users of enterprise mapping applications that leverage the Bing Maps platform; and government and business users that purchase the imagery from DigitalGlobe for off-line usage. The GO project aims to populate Bing Maps with a consistent set of imagery rather than having to quilt this together from various sources t of which data would vary widely in age, specification and resolution. Mapping at this scale was previously done only by government agencies, whose needs differ from those of consumers. For example, local government may want to know the location of every manhole cover and what crops are growing in rural areas, while consumers typically want imagery that allows them to see their favourite fishing spot or the farm where their grandparents lived.

This dataset will also be very helpful for state and federal governments, energy and transportation sectors, and environmental protection. GO is very technically challenging because of its broad scope. The project is acquiring about 1,500 cells, each about 9,000km2 in size, or six to nine times larger than a typical county-wide aerial mapping project.

UltraCamG

The UltraCamG was developed to carry out the GO project; G standing for ‘Giant', because it has about 50% more pixels across the flight line than any other digital aerial-camera system. The UltraCamG leverages technology developments from the UltraCam commercial product line, comprising the UltraCamXp, the UltraCamXp Wide Angle, the UltraCamLp, and the recently announced UltraCam Eagle (see below). However, the company does not sell the UltraCamG, nor disclose its specifications.

In most areas the UltraCamG is operated at a height of 5,000m (15,000 feet) or higher to fully utilise its wide field of view. This also reduces flying costs because each aerial survey requires fewer flight lines. The UltraCamG can collect gigabytes of pictures every few seconds; it also includes very large data storage units that allow for more efficient data collection thanks to uninterrupted image collection and minimal ground time. It can be flown as long as sunlight and weather permit. In addition to the red, green, and blue bands, the UltraCamG also acquires an infrared and a panchromatic band which are used to classify land coverage and to extract elevation models. The integrated GNSS receiver and inertial measurement unit (IMU) collect the camera's position and orientation, so that each pixel can be easily geo-referenced.

UltraCam Eagle

The UltraCam Eagle is a technological cousin of the UltraCamG, launched as a commercial offering in May 2011 (Figure 1). Although the specifications of the UltraCamG are concealed, the specifications of the Eagle are made public. The camera's 3.7-gigabyte per second image collection allows for 80% forward overlap. It supports new, exchangeable lenses with two different focal lengths, a pan-sharpen ratio of 1:3, new filters with curved characteristics to flatten out vignetting, a radiometric bit depth of 14 bits, and a panchromatic image size of 20,010 x 13,080 pixels. All system components are integrated into the sensor head, including UltraNav, a flight management and georeferencing system featuring GNSS-inertial technology, pilot displays, and flight planning software.

The advantages of this camera system include large-scale mapping with minimal occlusions; very sharp colour and colour infrared (CIR) images and dynamic radiometric range; accurate stitching and superior elevation accuracy for large-scale mapping; savings due to fewer flight lines, less flight time, less weight and less fuel consumption; unlimited storage capacity; and smaller size.

Survey Partners

While Microsoft produces the camera systems and software and processes the imagery, partners carry out the actual aerial surveys, making Microsoft both a customer and a vendor in the aerial photography community. Partners mount the UltraCamG on the underside of plane fuselage to capture vertical images; the stabilised mount compensates for vibration and small bumps in the air.

The partners plan and execute the aerial survey and perform all image post-processing, as they have traditionally done with the UltraCamX or UltraCamD or any other of the sensors. However, the UltraCamG's wider swath width and slightly higher operating altitude enables capture of 10,000km2 per flying mission. Microsoft makes the imagery available online to consumers and business, while DigitalGlobe sells it to government and businesses for offline use. This partnership allows DigitalGlobe, a leading provider of satellite imagery, to expand its offerings to include aerial imagery.

Post-processing

Image capture is entirely digital and relies on the highly automated UltraMap photogrammetric workflow software. Since it is always the same type of camera being used, the imagery can be processed very quickly with very little manual intervention. After acquisition by partners, the images are downloaded, processed, quality controlled; bundled and sent to the Bing Imagery Technologies facility in Boulder, Colorado (USA), where a staff of only about twenty software developers and twenty production technicians put the imagery into a 37-petabyte storage facility and run some additional quality-control checks.

The images then go through a thorough standard photogrammetric workflow, starting with aerial triangulation using UltraMap, then georeferencing and next orthophotos production.

A series of radiometric and geometric transformations are conducted and the orthophotos mosaicked into the final product. Finally, they undergo a series of quality-control steps to ensure that the quality of the imagery meets requirements. Corrections are made when necessary. At this point the data is sent to DigitalGlobe to sell for offline usage, and to Bing Maps for inclusion in its web services. The UltraCam family of cameras is set up to capture redundant imagery, which Microsoft uses to drive its workflow. The huge amount of computer processing power available to this company enables it to automate many processes that are normally done manually, because it is quite willing to trade 1,000 core hours of processing for one hour of labour.

Concluding Remarks

From a business perspective, the GO programme enables corporate clients such as insurance and real-estate companies to build a consistent experience for their end users. The user community is going to come up with new uses and new use-cases inconceivable before this sort of seamless imagery was available.