PHASEONE INDUSTRIAL

Case Study

GGS Oblique Camera System — Making 3D Oblique Systems Accessible and Affordable

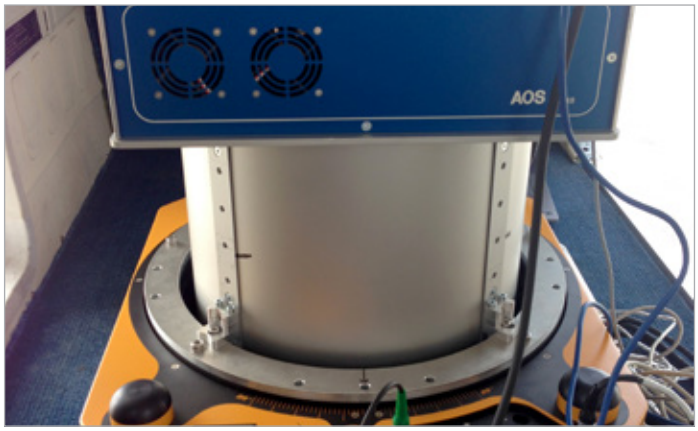
Introduction

Last year, Realworld Engineering Consultants Inc., a Taiwanese company, approached the Phase One Industrial partner in Taipei, LinkFast Technology Co., Ltd., and expressed an interest in using Phase One aerial cameras for a 3D oblique camera system. LinkFast discussed this request with Phase One Industrial, and was subsequently introduced to GGS GmbH from Germany. Besides being one of Phase One's integration partners, GGS has an excellent reputation for innovation and for integrating IMU/GNSS and FMS solutions.

Realworld had three requirements for the integration:

- Phase One aerial cameras had to be used.
- The complete oblique camera had to fit in their existing GSM 4000® (gyro mount) from SOMAG AG Jena.
- The array must work with their PosAV (GNSS/IMU) 510 from Applanix.

Based on these requirements, GGS did a full feasibility study for the customer and came up with a design for a new oblique camera. This proposal was accepted by Realworld and GGS received the go-ahead to build a complete oblique system with Phase One aerial cameras.



Development and Design

While the project may have appeared straightforward, the creation of the oblique system was a challenge for GGS. In order to tackle it, three major areas needed to be considered:

- Mechanical design — the mechanical design involved combining the five cameras together in a solid mount to fit into the limited space in the GSM 4000. In addition, the design required a stable orientation able to withstand vibrations.
- Electronic design — the electronic design needed to: supply power to each camera, the IMU, the embedded PC and the control unit.
- Data management — the design for the data management system needed to optimize the data transfer between the cameras, IMU/GNSS, FMS and the gyro mount.

Mechanical Design

GGS designed a solid metal frame, which holds the five cameras in their different positions. The bottom part of the frame contains the cameras and the upper part houses the IMU and PC as well as the other electronic components. The complete structure fits into a tubular sleeve, which is lowered into the opening of the GSM 4000. The sleeve protects the cameras and electronics against environmental conditions and makes it more convenient to move the complete system in and out the aircraft. The top housing has five slots for holding removable SSD hard drives.

Electronic Design

The electronic system needed to supply power to all of the cameras, the PC and other electronic components with stable power. It was essential that the components would not be affected by power peaks, which can be caused by the inconsistencies of the aircraft's power supply, so an internal unlimited power supply (UPS) was installed to deal with the fluctuations.

The cameras were daisy chained together using Phase One's multi-sync cables to ensure fast synchronization for the trigger signal. Then, all the components were connected to each other. The cameras were connected to the PC for data transfer via USB 3.0 and a separate connection to control the cameras. The IMU was connected to the PC and to a socket on the top of one of the cameras. All cables were shielded and had solid connections, in order to prevent them from loosening during a flight.

Data Management

A critical part of the final design was the data management. The system was required to manage four different systems that needed to communicate with each other:

- The FMS system triggers the cameras when flying over the snap circle. The cameras then send the event pulse to the IMU/GNSS system to mark the correct trigger point for post processing of the exterior orientation.
- The IMU communicates with the gyro mount, which sends the positioning information to the PC to store the position during the event as well. By having the IMU information and adding the gyro mount positioning, the customer can calculate the floating lever arms during the post processing, which increases the exterior position accuracy above the level of IMU/GNSS data.
- Cameras receive the IMU/GNSS information and write the data to the header of each image file.
- Images are written to the SSD drives.

To complete the system, GGS recommends Phase One's iX Capture software, a free control, capture and conversion software, which gives the operator complete control over the array of cameras. The operator sets the camera parameters and is able to monitor individual captures as they are made — even zooming into individual captures at 100 percent. The software makes controlling the cameras an easy task for the operator.

Calibration Flight

The camera was calibrated in Germany before being shipped to the client. During the calibration flight, 258 images were captured by each camera with the IMU/GNSS data written to each image. The five images from each exposure position were not overlapped, but in the final block each point was found in approximately 200 images. Each photo contained an average of 110 well-distributed, measured, tie points. Before the flight, a precise mission planning was done using the AeroTopoL software, which can also be used for full oblique mission planning.

The whole project was calculated with post processing software and the camera calibration was done in one step. During the iteration process, the camera calibration parameters for each camera head were determined. The oblique cameras were not used as co-registered sensors in relation to the nadir camera. All camera images were fed into the aerial triangulation (AT) process as single per-oriented data.

In addition to the calibration data, a bore sight calibration was performed using the nadir camera and the offsets for each oblique camera. This generated a highly accurate sensor model for the complete system and enabled a fully automated data extraction for further projects. After the success of the calibration flight, the camera was shipped to the customer in Taiwan and installed with support from GGS staff.

Takeaway

Gerhard Kemper, CEO of GGS said: "The Phase One aerial cameras are an excellent match for our products and are easily integrated into our systems. We started using Phase One aerial products from when they were first introduced and continue to cooperate with the company on new releases. We have integrated their cameras in several of our aerial solutions, which are used by customers around the world."

With this turnkey oblique camera solution, 3D city models and other projects requiring oblique imagery will become an easy task. As more clients request oblique images, oblique systems using Phase One cameras, such as the one designed by GGS, are becoming more accessible to users who can provide oblique aerial data to today's market.

About Phase One

Phase One A/S is based in Copenhagen with offices in New York, London, Cologne, Tel Aviv, Tokyo and Hong Kong. Phase One Industrial is a division of Phase One and is dedicated to research, development and manufacturing of advanced hardware and imaging software solutions that meet the unique requirements of aerial photography users.

To find out more about Phase One products, please visit http://industrial.phaseone.com and set up an appointment with one of our aerial photography experts for a demonstration.

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