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Rising to the Challenge

The Creation of a New Camera

After having supplied imaging technologies for aerial acquisition for many years, less than two years ago, Phase One introduced the iXA camera, a dedicated medium format camera for aerial photography. The camera was built from the ground up as a dedicated aerial camera and contained features not found in off-the-shelf cameras that are adapted for aerial use. The camera quickly became popular among a wide range of users and is becoming a standard for medium format aerial photography.

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Introduction

With the recent explosive demand for quality aerial imagery, Phase One chose to add more cameras to its range of products. The large demand for camera that is easily integrated into light aircraft as well as the growth of arrays of cameras for oblique photography sent Phase One on a course to develop another camera. Dov Kalinski, General Manager of Phase One Industrial set the challenge to the research and development department. He asked for, "a totally new medium format platform based on a 50 MP CMOS sensor that offers more flexibility than a DSLR. It must have a fast capture rate with high sensitivity, while consuming very little power. It has to be small and light and the entire camera has to weigh less than 750 grams, excluding a lens. The new sensor must offer users direct connectivity to controllers, GPS/IMU and storage."

Camera specifications

Tasks were divided between mechanical and electrical engineers working around the world, each team working within their specialty and sharing progress to coordinate strategy for the next steps. Moving from CCD technology to CMOS meant creating new electronics and firmware to meet the increased capture speed of the CMOS sensor. Phase One R&D worked closely with the sensor vendor to integrate the new CMOS sensor into Phase One plat-

forms. The new sensor, with 8,280 cross track coverage, is the highest resolution CMOS sensor in the commercial aerial market, and opens up a completely new range of possibilities for those involved in aerial data acquisition. As the 50 MP CMOS sensor offers quality imaging across its range of 100 to 6400 ISO, flights under low light conditions are possible by increasing the ISO while maintaining the highest image quality. With the growing demand for faster data delivery or "on the spot" information, the capability to fly even under conditions standard cameras can't tolerate prove to be a valuable component in the lineup of cameras that a company will own.

A second advantage of the Phase One iXU 150 is the fact that CMOS sensors have a fast image cycle, which allows a capture rate of less than one second per frame (0.8 frame/second). This enables flying faster while still keeping the required overlap. To keep up with the fast frame rate, the camera uses Schneider-Kreuznach lenses



Phase One iXU 150 integrated digital medium format aerial camera.

(ranging from 28 mm up to 240 mm), with central leaf shutters, enabling users to shoot at speeds up to 1/1600 second. The central leaf shutters offer a distinct advantage over focal plane shutters in DSLRs enabling higher metric accuracy, which is essential in applications such as mapping and 3D modeling.

Dealing with heat

With a camera capturing images as fast as the iXU 150, special attention had to be paid to design a system that dissipated heat quickly to maintain the image quality Phase One has been known to deliver. The CMOS sensor employed in the iXU 150 and its driving electronics uses less than half the power of a comparable CCD sensor platform, enabling smaller and lighter camera design.

The reduction of power was important, but additional steps were required to move any remaining heat outside of the camera chassis. By understanding the induction qualities of the metals used and the position of the components, a design was made employing heat pipes to convey heat to the outside of the camera in a way that did not add to the overall weight. The heat that is generated is quickly dissipated, enabling the sensor to stay cool and work efficiently throughout the entire mission.

Weight

The new camera had to be super light but also rugged, so traditional aircraft grade 6061 aluminum alloy was compared to magnesium alloy and even carbon fiber. Although carbon fiber is a very light material, it was determined that it could not handle the strict mechanical tolerances needed to support the lens under flight conditions. Magnesium alloy, which is 30 percent lighter than aluminum, was chosen to be used to make chassis of the camera. The camera's chassis is barely wider than the diameter of its lens and the entire camera weighs in at 750 grams excluding a lens.

Lenses

Both the iXU and iXA cameras use the Schneider-Kreuznach FS lenses. They also share the same electrical interface, power inputs and image workflows making them totally compatible with each other in an array of two or more cameras for imaging/LiDAR use, NIR and RGB, or a nadir/oblique setup. The cameras can be mixed and matched or used separately according to the needs of the user. Users who start with an iXU can upgrade to an iXA at a later point and keep on using the Schneider-Kreuznach FS lenses.

CMOS sensors can also be used to capture either RGB (visual light) or Near Infra-Red (NIR) up to a wavelength of approximately 1000 nm. With a single camera this cannot be done simultaneously, but using different lenses and filters by a simple lens exchange the same camera can be used for both wave lengths. As UAVs are being used more and more for agricultural missions, NIR is becoming more important.

Airborne applications

When looking at airborne applications, Phase One sees a high potential for the iXU 150 in the applications that utilize a light aircraft, where



Cross section schematic looking down from the top of the Phase One iXU 150

weight and size is a factor, especially since the camera has independent self-storage of images in addition to a USB 3.0 interface. The camera will likely be popular with users who do forestry, agriculture and especially mapping applications. Also, projects that require immediate take off, despite inclement light conditions, are natural projects for medium format CMOS-based cameras. A direct take off of a light aircraft can be used to minimize the flight time. This is a distinct advantage in inspection projects

such as power line poles, pipelines, and oil rigs.

Because of the small size and the ability to synchronize the capture of iXU 150 cameras, it is also suited for building multi-head camera systems. The cameras have direct connectivity to external GPS/IMU and FMS systems and can incorporate position and time values into Phase One raw files. An array with multiple cameras in an oblique angle can easily fit into standard gyro stabilized mounts. An array of iXU 150 cameras with its low weight and small camera body make integration much easier and still offer the quality that users needing high resolution images are expecting. The oblique camera market is growing rapidly and the iXU is expected to play a major role in this field because of its unique specifications.

A terrestrial industrial field that requires high resolution and compact cameras is homeland security. The live view capability of the iXU makes this camera a perfect tool for security applications, where personnel can view a scene with High Definition video quality and when required, capture a high resolution image for immediate analyses. The image can be used to judge if action is needed or not or saved for later analysis or evidence. This enables increased security in venues such as locations for sport events, public events or at sensitive locations like airports or train stations. Other terrestrial applications can be found in quality control during production processes, packing or inspection. A remote camera in a dangerous environment such as a nuclear power plant or chemical factory enables monitoring of situations without risking the safety of humans. The high resolution live view and the option to shoot high resolution images enables new possibilities, which can secure a situation or deliver more information and contributing to a better understanding of a situation to minimize risks.

Conclusion

The Phase One iXU 150 challenge was indeed met and the resulting camera, with its 50 MP CMOS sensor is currently the smallest and lightest integrated digital medium format camera on the market. The camera will find its way into many existing and new applications and with its high resolution, light weight and compact design, offer all the functionalities of a perfect tool for a growing demand for quality images that we face today.

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