

Optical Coherence Tomography (OCT) Using Basler runner GigE and Basler sprint Camera Link Cameras

Customer

- Location: Germany
- Industry: Photonic Technology

Thorlabs is a US-based corporate group with offices and subdivisions all over the world. Thorlabs is a supplier of optics, optoelectronics, and optomechanics for laboratory needs, providing more than 15,000 different components.

Founded in 1989 as a “basement” company dealing with laser and fiber optic components, Thorlabs has expanded continuously with their product portfolio becoming wider and more complex.

A subsidiary company, Thorlabs GmbH, joined the family in 1997. It is located near Munich and is responsible for the European market. Thorlabs GmbH provides technology excellence in optical measurement and control systems.

A subdivision of Thorlabs GmbH is located in Lübeck, Germany. They develop camera-based measurement systems, and they are the contact point for Basler.

Application

The specific application using Basler cameras is Optical Coherence Tomography (OCT). This is a relatively new technique that uses the interference of scattered light and reference light with well-known properties to allow depth resolved measurements.

Using this technique, it is possible to create non-contact volumetric measurements of highly scattering or transparent media such as plastics, glass, biologic tissue, semiconductor material, or any other media that is at least partly permeable to light in the wavelength range used by the system. The use of light allows resolution down to a few microns and an imaging depth of some millimeters. These properties fill the gap between ultrasound and confocal microscopy.

OCT is an established non-contact medical imaging technique. The contact-free operational principle is the key benefit of this technique. OCT is widely used in ophthalmology to obtain high resolution 3D images of the anterior portion of the human eye and also the posterior part, e.g. the retina.



Detail of the Camera Integration in the System

The alternative for a doctor is to simply look at the back of the eye using white light. Because near infrared (NIR) light is used with OCT, there is no reflex from the iris and therefore the patient's eye requires no preparation for the examination. NIR can also penetrate deeper into the tissue than white light. For this application, being a non-contact measurement with micron scale resolution is a major bonus and makes this approach unique.

Over the years, the market has started to mature and several companies around the world are building a variety of applications with most centered on the field of medical imaging.

Solution and Benefits

To deploy a high quality camera-based OCT system, it is crucial to use a reliable, fast line scan or area scan camera meeting the core specifications required for OCT.

These are:

- High responsivity

Imaging using the OCT method is based on weak light signals. Therefore the use of a high responsivity light detector or sensor in the system is critical.

- Low dark current

This value is a key parameter for the dynamic range. It quantifies the lowest usable signal level.

- High full well capacity

This parameter defines the absolute maximum number of electrons that can be collected in a single pixel. For a variety of technical reasons, the pixels do not behave in a linear fashion when approaching their full well capacity.

- Saturation capacity

Due to the non-linear effects near to the full well capacity, an artificial limitation on the full well capacity may be set. This is called the saturation capacity.

- Dynamic range

The ratio between full well capacity (or saturation capacity) and the dark current is defined as the dynamic range.

- Very high line scan rate

The acquisition of volumetric image information is only possible within a reasonable time frame when all parts of the system are operating at high speed.

- Low cross talk

Cross talk quantifies the unwanted impact of the charge content of a pixel on all of its neighbors. With low cross talk, the separation between pixels is better and will yield a sharper (and better) image.

- Reliable, standardized driver family architecture

This property is important for easy integration into custom software applications and the system environment.

- Standardized mechanical profile

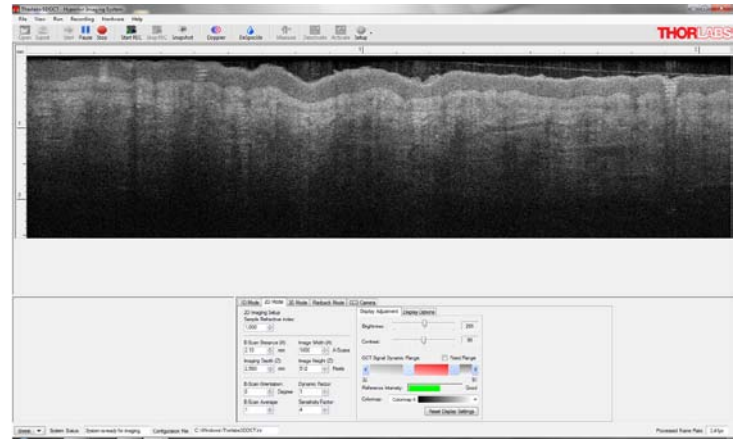
This property helps to meet various customer requirements based on their technical platform, i.e., helps customers more easily select the appropriate camera for their system.

- No unwanted secondary reflections

As a developer of OCT systems, the Lübeck branch of Thorlabs GmbH is faced with a wide variety of customer requirements. To be able to provide mature solutions for various situations, Thorlabs offers products based on different cameras.

Basler was able to offer cameras that could be exchanged without affecting Thorlabs mechanical and software design while maintaining state of the art specifications. Basler was also able to support the special requests of Thorlabs' customers in terms of sensor design.

With a maximum line scan frequency of 140 kHz, the Basler sprint 4k line scan camera in particular allows the performance of online volumetric image acquisition with reduced movement artifacts and the capability of supporting Doppler measurements.



Software Screenshot of Measurement

Technologies Used

Fast line scan cameras can be used to capture the images generated by OCT. Because the signal received is in the form of a striped pattern, the camera technology must have low noise with no background stripes or wavy patterning. Cameras used in OCT must be high quality and sensitive. The faster they are, the less time the procedure takes, which improves patient comfort.

Basler Technology used for OCT:

- Basler ruL2048-30gm runner GigE glassless line scan cameras and Basler spL4096-140km sprint Camera Link cameras. Based on speed, resolution and cost requirements, these two line scan camera models have proven to be advantageous for various OCT applications.
- pylon Driver Package – This powerful application programming interface has made the camera features very easy to use.

More Information

More information regarding Thorlabs, their product range, and their special applications can be found at:

www.thorlabs.com



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