Parallel OCT Hardware Algorithm

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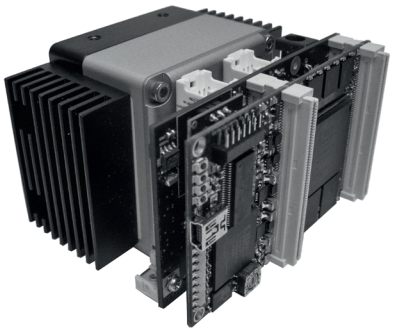
Optical Coherence Tomography (OCT) is an interferometric optical signal acquisition and processing method used in application with micrometer resolutions. The so called frequency-domain OCT provides advantages in signal-to-noise ratio. Using high-speed signal processing hardware, volumetric images can be captured and processed with real-time constraints. OCT can be used in diverse applications, art conservation, diagnostic medicine like ophthalmology and others, where images with high resolution are needed.

Vision

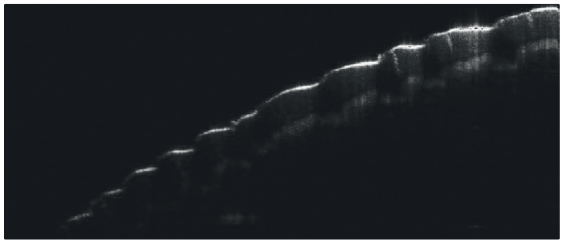
OCT equipment is still very costly nowadays. A new parallelization technique allows us to increase the hardware processing speed by factors. With this technique a complete high-speed OCT system including software and hardware using optics from HuCE-optoLab was developed.

OCTopus System

The system is named after the sea animal octopus, who with its eight arms can do a lot in parallel. Following the sea animal, the developed OCTopus optical coherence tomography system features parallel execution of our hardware algorithms.



High-Speed Camera and Low-Cost OCT Hardware



OCT Image of a Finger Tip (from CTI project 11668.1)

OCTopus is a complete OCT system including a graphical user interface, optics and a high-speed hardware. The system meets a framerate of 70 000 lines/s (A-Scans/s) with 2048 pixels each. This throughput of 215 MB/s leads to a processing time of 15 ms for a B-Scan (2048 x 1024 Pixels) resp. 3.7 seconds for a C-Scan (2048 x 512 x 512 Voxels). Thus our OCT systems positions itself in the market of very high-speed and real-time systems.

QT GUI

A QT based graphical user interface allows to display processed OCT-images at a framerate of about 20 B-Scans/s. It provides a simple interface to configure the high-speed algorithm.

High-Speed Algorithm

The high-speed algorithm runs on a low-cost Xilinx Spartan3 FPGA platform and computes 160 MSamples/s, 12 bit wide each, on four parallel channels. It is configurable through an RS-232 interface connected to the computer. The output representation can be chosen between linear or logarithmic and raw data or processed data. Further important processing steps as background(-light) removal, remap vector insertion or windowing can be configured.

Optics

A compact custom made optical delivering system provided by BFH-TI s optoLab is used to generate the optical interference signal to be captured by our line-camera.

Pascal Kesselring