

## 3-D Laser Triangulation

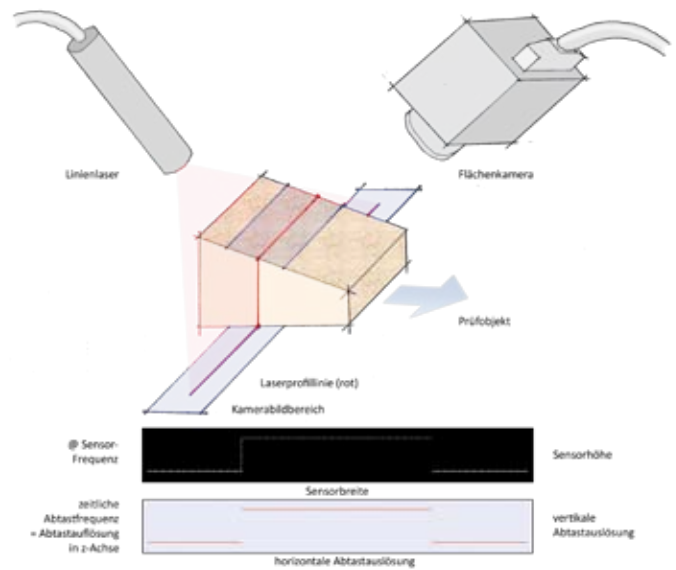
### 3D measurement on FPGA processors with high accuracy and high performance by Peak Detector and Center-of-Gravity method

The acquisition of geometrical data of an object with high accuracy is one of the major challenges in Machine Vision. The range of applications, which are using the 3D capture, is broad. It reaches from quality inspection over robotics to non-industrial applications.

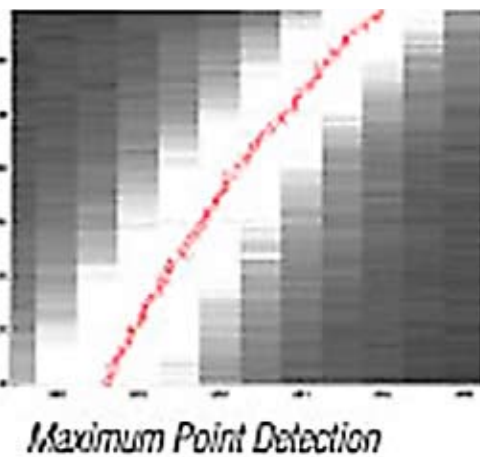
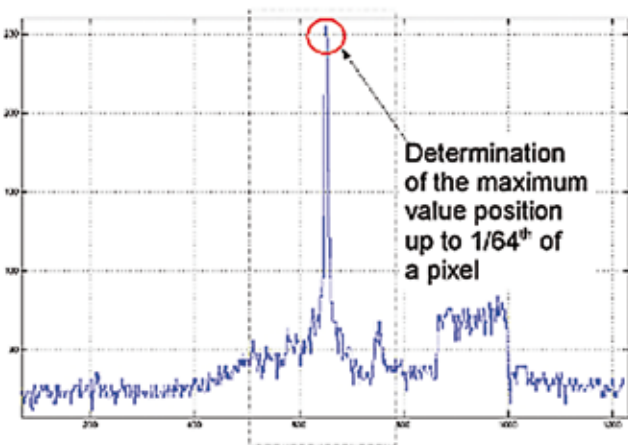
Since years, the number of optical, non-contact measurement methods increases. Most often used techniques are stereo vision, measurement with structured light, light section method, and use of time-of-flight cameras. All methods have its specific strengths and weaknesses.

Laser triangulation is one of the major measurement methods for the geometrical processing of 3D objects. The measurement method is based on a light section by a laser line on an object. A camera, which is aligned in a certain angle, acquires images of the projected laser line as light profile. The high density depends on the movement speed of the object and the frame rate of the acquisition. The information from the profile lines is processed in a 3D cloud of points, which represents the 3D geometry of the object.

Before the last step can be processed, the most accurate coordinates have to be calculated from the laser line profiles. There are various algorithmic methods available. The properties of the surface and material, and even the beam of the laser and its disturbances at the edges can influence the quality of the measurements. To respect these difficulties, the "center of gravity" method and "Peak Detector" algorithm of Aqsense is used, which is well-known being very



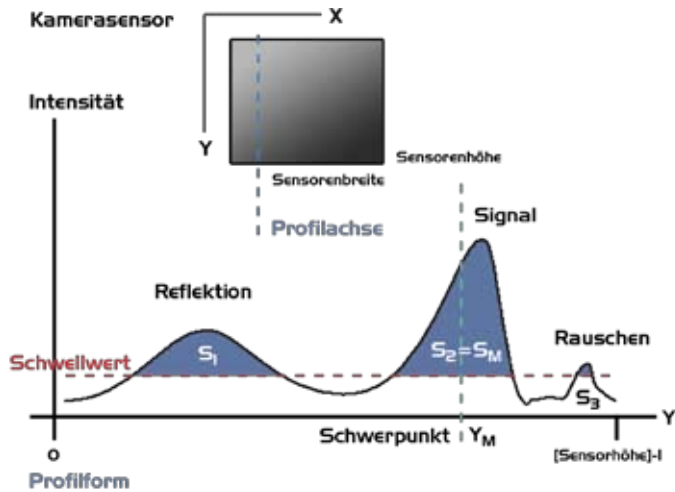
Setup of an application with 3D laser triangulation measurement



Accuracy features of Peak Detector in SmartApplets 3D family, © Copyright of images by Aqsense.

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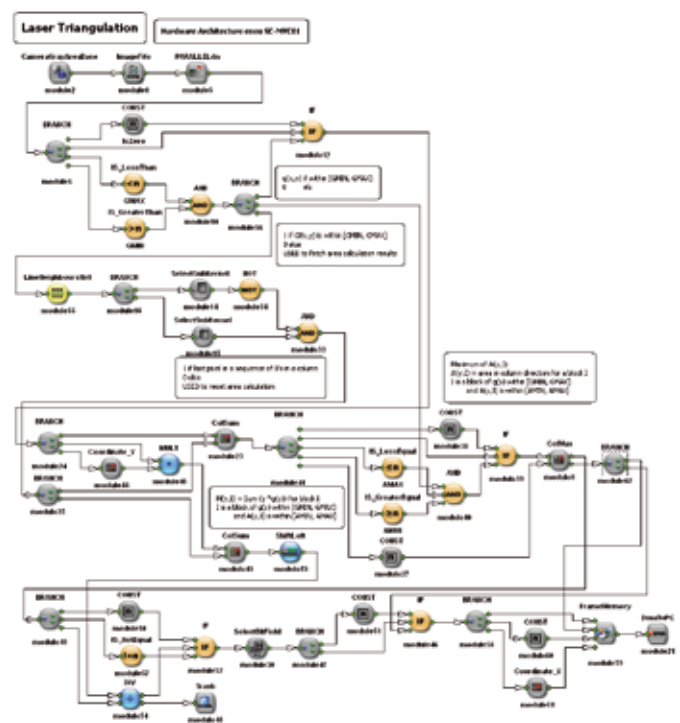
Implementation of Center-of-Gravity method in VisualApplets.

Alternative 3D laser triangulation programming on VisualApplets:

Besides the use of functional off-the-shelves feature sets (hardware applet) by SmartApplets, individual algorithms can be developed and loaded as a real-time code on the FPGA hardware. Exemplary designs of a 3D laser triangulation are included in the delivery of VisualApplets. These designs can be modified to meet individual requirements. The hardware code runs on the frame grabber highly parallelized without load of the host-CPU. A convenient access onto the registers of the hardware is realized by SDK functions to change or adjust the parameters during runtime. The ease of use of VisualApplets also allows software engineers to start programming hardware for Machine Vision application very quickly and successful.


stable and robust methods for most setups, materials and applications.

Silicon Software has implemented both methods for the coordinate processing in its new SmartApplets 3D family. The "center-of-gravity" as well as "peak detector" are available as hardware core for the on-board FPGA processor of the microEnable IV V-series frame grabbers. The quality of implementation is realized in a highly sophisticated way that respects additional pre-processing for image enhancements. The implementations support even the bandwidth of the fastest Camera Link cameras available on the market.



Example in VisualApplets for Center-of-Gravity implementation.

Available or planned 3D measurement products:

Standard / Product	Description
3-D Laser Triangulation	 
SmartApplets	SmartApplets 3D
VisualApplets	Graphical programming environment with 3D laser triangulation examples

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