Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

Master 2013

Khalil Ahmed Rashid

Evaluation of FPGA based Image Acquisition Systems for High Speed Position Detection.

ABSTRACT - Masterthesis

Characterization of optical devices by experimental ray-tracing gives valuable information not only about shape and form, but especially about functionality of the optical devices. The measuring principle realized in i3m detects intensity distribution of light passing DUT by CMOS image sensor, transmits image data via camera link and calculates centroid position in PC. With this setup, maximum acquisition rate of about 80 fps is possible which limits the speed of measurement.

In this work, the factors limiting frame rate and measurement speed are figured out and different approaches to achieve data rates up to 120 fps are evaluated. These solutions includes TI CCTV system, Labview based FPGA solution, Matrox Frame Grabber, Terassic FPGA with CLR solution and Microtronix hardware plus cameralink IP. The most promising solution based on CLR-HSMC card and Altera FPGA is realized. A camera link interface IP is developed using VHDL to capture pixel data from CMOS camera. From this pixel data, centroid positions are calculated and transmitted over UART interface for further processing.

With this realized setup, practical frame rate up to 136 fps has been achieved and still with some more modification in existing hardware, frame rate up to 180 fps could be achieved, which ultimately helps to speed up the measurement process and will also reduce overall system cost.

Keywords: Ray-tracer, Basler Camera, CLR-HSMC Daughter Card, DE2 Development Board, Centroid algorithm, Camera Link Interface, Frame Rate Calculator, Basler Pylon API, Easy Precision, Frame Grabbers.