

Warsaw University of Technology

FACULTY OF
ELECTRONICS AND INFORMATION TECHNOLOGY



Institute of Electronic Systems

Master's diploma thesis

in the field of study Electronics
and specialisation Microsystems and electronic systems

Compact embedded camera and evaluation of high speed interfaces for
hyper-spectral imaging applications

Piotr Zdunek

student record book number 229417

Dr inż. Grzegorz Kasprowicz

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Abstract

Text of the Abstract.

Keywords: Camera, High-speed, Hyper-Spectral, Zynq, SDI, CoaXPress, PCIe, Aurora



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.....
miejscowość i data
place and date

Piotr Zdunek
imię i nazwisko studenta
name and surname of the student

229417
numer albumu
student record book number

Elektronika
kierunek studiów
field of study

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Chapter 1

Introduction

In this Master Thesis a design of an embedded camera and an evaluation of high speed interfaces is presented. The project is a part of a research project carried out by Center of space research in Warsaw. In this chapter a genesis of the project is presented as well as camera's main requirements. Additionally a literature review is shown together with market review. At the end of the chapter a thesis statement is presented.

1.1 Project genesis

In this master thesis a design of a compact embedded camera as well as an evaluation of high speed interfaces for aerial hyper-spectral imaging application is presented. The project was completed at Photonics and Web Engineering Group at the Institute of Electronics Systems which has a significant contribution in scientific camera development. [1]. Having a scientific cooperation with Institute of Space Research, there was a need to develop hardware, firmware and evaluate the use of different high-speed interfaces for novel hyperspectral camera.

Specifically, a camera is needed inside of hyperspectral imaging camera for high speed data sensor acquisition, filtering and transmission. Additionally the camera, needs to support different sensor types which have different parameters in order to evaluate their usefulness in the hyper-spectral application. On top of that, the system is planned to be used in aerial vehicles (such as planes or drones) it needs to exhibit optimal SWAP factor and have interfaces who are highly reliable in this conditions.

1.1.1 Motivation

1.2 Requirements

1.2.1 Literature review

1.2.2 Market review

1.3 Thesis statement

Chapter 2

Concept of design

In this chapter a concept of the design of the camera is presented. First of all, main camera requirements are shown and juxtaposed with possible solutions. Afterwards the specification of the design is described in detail.

2.1 Main requirements

- Framerate at 100 fps at 2048 x 2048 resolution
- High speed interface
- Processing capability
- Possible IMU integration

2.2 Specification

- Framerate at 180 fps at 2048 x 2048 resolution for CMV4000 and 100 fps for CIS1910F
- 6.25 Gbps interfaces: SDI, CoaXPress, Aurora, PCIe
- FPGA fabric for processing ability
- RS485 for communication with IMU and master controller

Chapter 3

Camera design

In this chapter a design of the camera is presented . First of all, an electrical design is shown of the processor board as well as of the sensor board. Next, the hardware design is presented together with SI/PI simulation. At the end of the chapter, measurements of physical characteristics of the boards are presented.

3.1 Processor board

3.1.1 Architecture

3.1.2 Zynq 7Z015 - Main processing unit

3.1.3 High speed interfaces

SDI

CoaXPress

PCIe/Aurora

3.1.4 Sensor connection

CMV4000

CIS1910F

3.1.5 Control - RS485

3.1.6 PCB Layout

3.1.7 Power Supply

3.1.8 SI/PI simulations

3.2 Sensor board

3.2.1 CIS1910F

3.2.2 CMV4000

3.3 Software

3.4 Digital system design

Chapter 4

Evaluation of high speed interfaces for aerial hyper-spectral camera

In this chapter an evaluation of high speed interfaces for aerial hyper-spectral application is presented. Firstly, the hypothesis of the evaluation is stated, then two high speed interfaces are used for hypothesis testing. At the end the results of the study are presented.

Chapter 5

Summary

In this chapter the summary of the master thesis is presented. Firstly the thesis objectives are contrasted with the final results. Then the main aspects of the work are shown with the description of possible future work. At the end the final summary is shown.

5.1 Thesis objectives and results

5.2 Future work

5.3 Final summary

formula

Bibliography

- [1] Krzysztof Pozniak Ryszard Romaniuk Grzegorz Wrochna Maciej Kwiatkowski, Grzegorz Kasprowicz. Advanced camera image data acquisition system for pi-of-the-sky, 2008.

Glossary

formula A mathematical expression

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Appendices

Appendix A

Electrical characteristics

The contents...

Appendix B

Test

The contents...