Title of Dissertation

Subtitle

Presented by:
Your Name

Prepared for:
Your Supervisor(s)
Dept. of Electrical and Electronic Engineering
University of Cape Town

Submitted to the Department of Electrical Engineering at the University of Cape Town in partial fulfilment of the academic requirements for a Bachelor of Science degree in Electrical and Computer Engineering.

November 2020

Key words:
Some keywords relating to your research

I know the meaning of plagiarism and declare that all of the work in the dissertation, save for that which is properly acknowledged, is my own.

.....

Your Name

Abstract

The abstract should be a one or two paragraph summary of your paper. It is meant to sell your paper to interested buyers.

Contents

List of Figures and Listings

List of Tables

Nomenclature

1 Acronyms

A ..... Amperes
AC ..... Alternating Current
ADC ..... Analogue to Digital Converter
API ..... Application Programmer's Interface
ARM ..... Advanced RISC Machine
ASIC ..... Application Specific Integrated Circuit
AXI ..... Advanced Extensible Interface

BAR ..... Base Address Register
BCD ..... Binary-Coded Decimal
Bd ..... Baud, in symbols per second

CFAR ..... Constant False Alarm Rate
CMOS ..... Complimentary Metal-Oxide Semiconductor
CPLD ..... Complex Programmable Logic Device

dBm ..... Deci-Bell, relative to 1 mW
DC ..... Direct Current
DDC ..... Digital Down Converter
DDS ..... Direct Digital Synthesis
DMA ..... Direct Memory Access
DSP ..... Digital Signal Processor (or processing)

EDA ..... Electronic Design Automation

FIFO ..... First-in, First-out (queue)
FIR ..... Finite Impulse Response
FMC ..... FPGA Mezzanine Card
FPGA ..... Field Programmable Gate Array
FSM ..... Finite State Machine

GUI ..... Graphical User Interface

HDL ..... Hardware Description Language
HPS ..... Hard Processor System
HSTL ..... High Speed Transfer Logic

I/O ..... Inputs/Outputs
I^2C ..... Inter-IC
IC ..... Integrated Circuit
IDE ..... Integrated Development Environment

LE ..... Logic Element
LSb ..... Least Significant Bit
LSB ..... Least Significant Byte
LUT ..... Look-Up Table
LVCMOS ..... Low Voltage Complementary Metal Oxide Semiconductor
LVDS ..... Low Voltage Differential Signalling
LVPECL ..... Low Voltage Positive Emitter Coupled Logic
LVTTL ..... Low Voltage Transistor-Transistor Logic

MIMO ..... Multiple Input Multiple Output
MISO ..... Master Input / Slave Output
MOSI ..... Master Output / Slave Input
MSb ..... Most Significant Bit
MSB ..... Most Significant Byte
MSI ..... Message Signalled Interrupt

NCO ..... Numerically Controlled Oscillator
NTP ..... Network Time Protocol

PC ..... Personal Computer

PCB ..... Printed Circuit Board
PCI ..... Peripheral Component Interconnect
PCIe ..... PCI Express
PLL ..... Phase Locked Loop
PPDS ..... Point-to-Point Differential Signalling
PRF ..... Pulse Repetition Frequency
PRI ..... Pulse Repetition Interval
PSU ..... Power Supply Unit

RADAR ..... Radio-Assisted Direction and Ranging
REST ..... Representational State Transfer
RF ..... Radio Frequency
RISC ..... Reduced Instruction Set Computer
RMS ..... Root Mean Square
RPM ..... Revolutions per Minute
RSDS ..... Reduced Swing Differential Signalling

SI ..... Système International d'Unités
SoC ..... System On Chip
SPI ..... Serial Peripheral Interface
SSTL ..... Stub Series Terminated Logic

TCP ..... Transmission Control Protocol
TTL ..... Transistor-Transistor Logic

UART ..... Universal Asynchronous Receiver Transmitter
UDP ..... User Datagram Protocol
UFM ..... User Flash Memory
URL ..... Uniform Resource Locator

V ..... Voltage
VHDL ..... VLSI HDL
VLSI ..... Very Large-Scale Integration

XML ..... eXtensible Markup Language

2 Terminology

Developer	FPGA firmware developer, using any firmware development tool.
Device	The specific target FPGA.
Megafunction	A target-specific module, typically generated from within the vendor IDE, after the Altera nomenclature.
Module	Akin to a Verilog module; i.e. unit of digital circuit that has ports to the outside world and can exist at any level of the design hierarchy.
Object file	An intermediary file used in the ALCHA compilation process. It is the reult of compiling a single translation unit and describes a collection of objects.
Peripheral	Any device, external to the FPGA, that interfaces directly with the FPGA.
Platform	The platform that the ALCHA compiler runs on, including operating system and computer hardware.
Target	The platform ALCHA is compiling to, including FPGA, PCB, peripherals and vendor IDE.
Translation unit	Akin to a C language translation unit, i.e. a collection of source files and headers that translate to a single object file
User	The developer who is using ALCHA to develop FPGA firmware.
Vendor	The FPGA manufacturer.

Chapter 1

Introduction

If you are new to LaTeX, I would suggest reading [1]. If you want to use Microsoft Word (or one of its many clones), you can download the official IEEE conference template from [2]. The TA and tutors can provide LaTeX support. Use Word at your own risk.

The introduction is where you set the scene. Here you reference other, related work, as well as a summary relating to how you improve upon said work [3]. In the sense of the practical reports, the introduction will summarise the experiment the practical is all about.

As a general rule of thumb, keep the introduction to the first column and don't put any sub-sections into it.

Remember that, for bibliography citations to work, you have to include running BibTeX in the compile chain. My TeXstudio [4] compile chain for "Build & View" is

```
txs:///bibtex | txs:///pdflatex |
txs:///bibtex | txs:///pdflatex |
txs:///view-pdf-internal
```

1.1 Drafting Markup

When the template is in draft mode, you can use various helper macros, as illustrated below:

This is old text that should be removed. *This is a note about something to remember, or comments from the proof-reader.* **This is something that still needs doing.** When compiled with `\Draftfalse`, the content of these macros are removed from the output, *except something that needs to be rephrased.*

Chapter 2

Literature Review

Chapter 3

Methodology

In this section you should describe the method of the experiment.

3.1 Hardware

Include detail such as the hardware used. It's generally a good idea to include a block diagram at this point, such as the one presented in Fig. 3.1. This figure was drawn in InkScape [5]. When you want to import an InkScape figure (SVG format) into LaTeX, simply save it to PDF (use the drawing extents as the media box area) and include the figure.

3.2 Implementation

Also mention the implementation source code:

```
# You can include inline Matlab / Octave code
x = linspace(0, 2*pi, 1000);
y = sin(x);
plot(x, y); grid on;
```

or you could turn it into a float: see listing 3.1. Floats are tables, figures and listings that appear at a different place than in the source code. This template is set up to put floats at the top of the next column, as prescribed by the IEEE article specification.

Only list what is relevant. Don't give too much detail - just enough to show what you've done. This template supports the following languages:

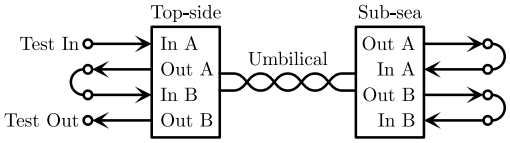

Fig. 3.1. Test setup used to test the implementation [6].

```
__kernel void Multiply(
  __global float* A, // Global input buffer
  __global float* B, // Global input buffer
  __global float* Y, // Global output buffer
    const  int    N  // Global uniform
){
  const int i = get_global_id(0); // 1st dimension index
  const int j = get_global_id(1); // 2nd dimension index

  // Private variables
  int   k;
  float f = 0.0;

  // Kernel body
  for(k = 0; k < N; k++) f += A[i*N + k] * B[k*N + j];
  Y[i*N + j] = f;
}
```

Listing 3.1. OpenCL kernel to perform matrix multiplication

- Matlab (Octave)
- GLSL
- OpenCL
- Verilog
- VHDL
- TCL
- Python
- C++ (use the name 'Cpp')

3.3 Experiment Procedure

Furthermore, include detail relating to the experiment itself: what did you do, in what order was this done, why was this done, etc. What are you trying to prove / disprove? You can include hypotheses, such as presented in Hypothesis H0 below.

Hypothesis H0: All scientific papers contain hypotheses. An hypothesis is generally not longer than a single paragraph, but the command does support multiple paragraphs if required.

Chapter 4

Design

Chapter 5

Experimentation

Chapter 6

Results

The results section is for presenting and discussing your findings. You can split it into subsections if the experiment has multiple sections or stages.

6.1 Figures

Include good quality graphs (see Fig. 6.1). These were produced by the Octave code presented in listings 6.1 and 6.2. You can play around with the `PaperSize` and `PaperPosition` variables to change the aspect ratio. An easy way to obtain more space on a paper is to use wide, flat figures, such as Fig. 6.2.

Always remember to include axes text, units and a meaningful caption in your graphs. When typing units, a µ sign has a tail! The letter "u" is not a valid unit prefix. When typing resistor values, use the Ω symbol.

6.2 Tables

Tables are often a convenient means by which to specify lists of parameters. An example table is presented in table 6.1. You can use Tablesgenerator to make your LaTeX tables.

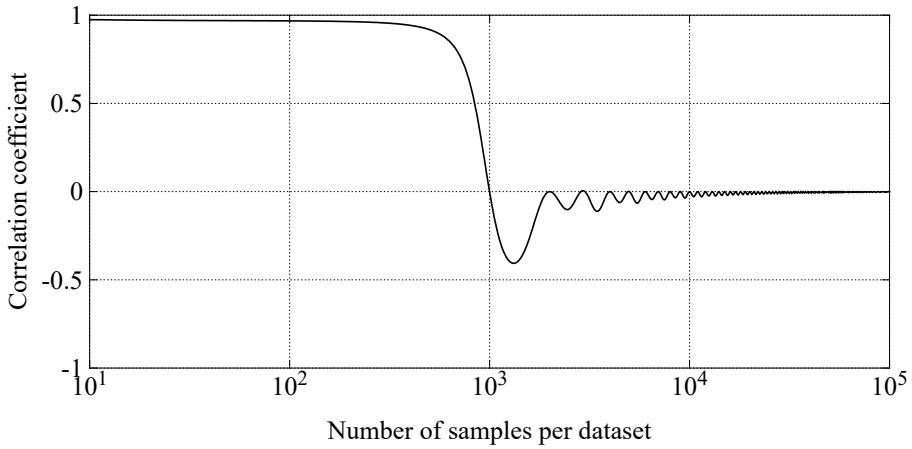

Fig. 6.1. The correlation coefficient as a function of sample count.

```
function FormatFig(X, Y, File);
  set(gcf, 'PaperUnits'      , 'inches');
  set(gcf, 'PaperOrientation', 'landscape');
  set(gcf, 'PaperSize'       ,       [8, 4]);
  set(gcf, 'PaperPosition'   , [0, 0, 8, 4]);

  set(gca, 'FontName', 'Times New Roman');
  set(gca, 'Position', [0.1 0.2 0.85 0.75]);

  xlabel(["\n" X]);
  ylabel([Y "\n\n"]);

  setenv("GSC", "GSC"); # Eliminates stupid warning
  print(...
    [File '.pdf'],...
    '-dpdf'...
  );
end
```

Listing 6.1. Octave function to format a figure and save it to a high quality PDF graph

```
figure;                                 # Create a new figure
# Some code to calculate the various variables to plot...
plot(N, r, 'k', 'linewidth', 4); grid on; # Plot the data
xlim([0 360]);                          # Limit the x range
ylim([-1 1]);                           # Limit the y range
set(gca, 'xtick', [0 90 180 270 360]);  # Set the x labels

FormatFig(...                           # Call the function with:
  'Phase shift [\circ]',...                    # The x title
  'Correlation coefficient',...                # The y title
  ['r_vs_N;_f=' num2str(f) ';_P=' num2str(P)]... # Format the file name
);
close all;                              # Close all open figures
```

Listing 6.2. Example of how to use the FormatFig function

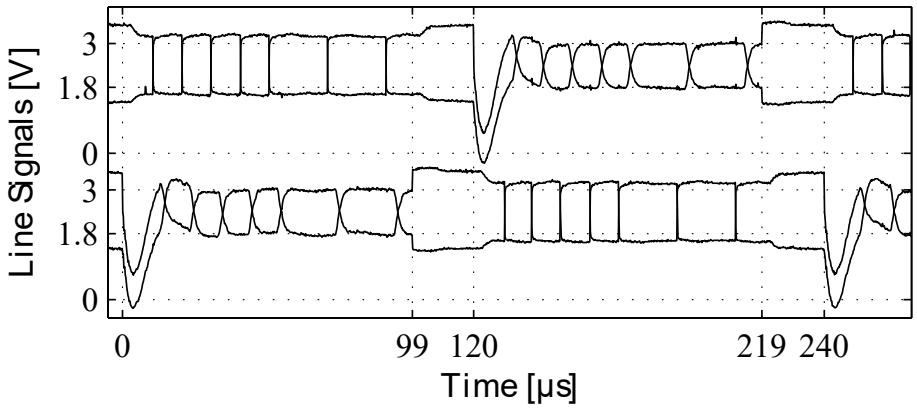

Fig. 6.2. Oscilloscope measurement showing physical line signals on both ends of a transmission line during master switch-over [6].

TABLE 6.1
MY INFORMATIVE TABLE

Heading 1	Heading 2	Heading 3
Data	123	321
Data	456	654
Data	789	987

6.3 Pictures and Screen-shots

When you include screen-shots, pdfLaTeX supports JPG and PNG file formats. PNG is preferred for screen-shots, as it is a loss-less format. JPG is preferred for photos, as it results in a smaller file size. It's generally a good idea to resize photos (not screen-shots) to be no more that 300 dpi, in order to reduce file size. For 2-column article format papers, this translates to a maximum width of 1024. **Never change the aspect ratio of screen-shots and pictures!**

It is highly recommended to make use of the `\Figure` macro for figures. It puts all the formatting tweaks in one place, so that you don't need to update all the individual figure inclusion points when you want to do a styling update. The file name is used for the LaTeX label, such as "Fig. 6.3".

Make sure to always use the best quality image possible. Use JPEG for photos, PNG for screen-shots and PDF (scalable vector graphics) for everything else. JPEG is lossy, but good for photos, whereas PNG is lossless and good for images with large areas of solid colour, as

Fig. 6.3. An example image with custom scaling

can be seen in Fig. 6.4.

6.4 Maths

LaTeX has a very sophisticated maths rendering engine, as illustrated by equation 6.1. When talking about approximate answers, never use ± 54 V, as this implies "positive or negative 54 V". Use ≈ 54 V or ~ 54 V instead.

$$y = \int_0^\infty e^{x^2} \mathrm{dx} \tag{6.1}$$

(a) JPEG (b) PNG (c) SVG

Fig. 6.4. Comparison of various image format qualities

Chapter 7

Conclusion

The conclusion should provide a summary of your findings. Many people only read the introduction and conclusion of a paper. They sometimes scan the tables and figures. If the conclusion hints at interesting findings, only then will they bother to read the whole paper.

You can also include work that you intend to do in future, such as ideas for further improvements, or to make the solution more accessible to the general user-base, etc.

Publishers often charge "overlength article charges" [7], so keep within the page limit. In EEE4084F we will simulate overlength fees by means of a mark reduction at 10% per page. Late submissions will be charged at 10% per day, or part thereof.

Bibliography

[1] J. Taylor and J. G. Hoole, "Robust Protocol for Sending Synchronisation Pulse and RS-232 Communication over Single Low Quality Twisted Pair Cable," in *Proceeding of ICIT*. Taiwan: IEEE, Mar. 2016.

[2] T. Oetiker, H. Partl, I. Hyna, and E. Schlegl, "The Not So Short Introduction to LaTeX 2_ε," https://tobi.oetiker.ch/lshort/lshort.pdf, Jul. 2015, version 5.05.

[3] "IEEE Conference Paper Templates," http://www.ieee.org/conferences_events/conferences/publishing/templates.html.

[4] A. Baboon, B. Charles, D. Ester, and F. Generalson, "An Amazing Title," Their Not-so-awesome University, Technical Report, Apr. 1492.

[5] B. van der Zander, J. Sundermeyer, and T. Hoffmann, "TeXstudio – A LaTeX Editor," https://www.texstudio.org/.

[6] "InkScape Website," http://www.inkscape.org/.

[7] "Voluntary Page and Overlength Article Charges," http://www.ieee.org/advertisement/2012vpcopc.pdf, 2014.

Appendix A

Item 1

Appendix B

Item 2