



UNIVERSITY OF CAPE TOWN

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This document is in draft format. It is known to be incomplet and incorrekt, and it has lots of bad fomatting. Drafting styles are defined as follows:

Text that is old and must be re-worked or removed

*Shorthand note that should be incorporated into the text later*

**Something that must be done**

*Something that must be rephrased*

Internal link

Citation link

External link

```
// Comment
normal text


```
pre-processor
class // Keyword
"String"
```


```

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.

.....

Author 1

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Author N

## **Abstract**

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

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# 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<sup>2</sup>C ..... 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

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

# Chapter 1

## Introduction

If you are new to L<sup>A</sup>T<sub>E</sub>X, I would suggest reading [2]. If you want to use Microsoft Word (or one of its many clones), you can download the official IEEE conference template from [3]. The TA and tutors can provide L<sup>A</sup>T<sub>E</sub>X 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 [4]. 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 BibT<sub>E</sub>X in the compile chain. My TeXstudio [5] 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.*

*You can also use cards, as follows:*

### **TODO**

This is a todo card.

It is a minipage environment, so you can have all sorts of stuff in it. It can be many paragraphs long, but don't make it too long, because L<sup>A</sup>T<sub>E</sub>X will force the whole card onto a single page.

### *NOTE*

This is a nested note card. You can nest cards of arbitrary types as deep as you like.



## 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](#) [6]. When you want to import an InkScape figure (SVG format) into L<sup>A</sup>T<sub>E</sub>X, simply save it to PDF (use the drawing extents as the media box area) and include the figure.

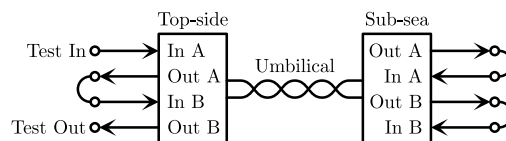


Fig. 3.1. Test setup used to test the implementation [1].

### 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.

```
__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

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:

- 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.

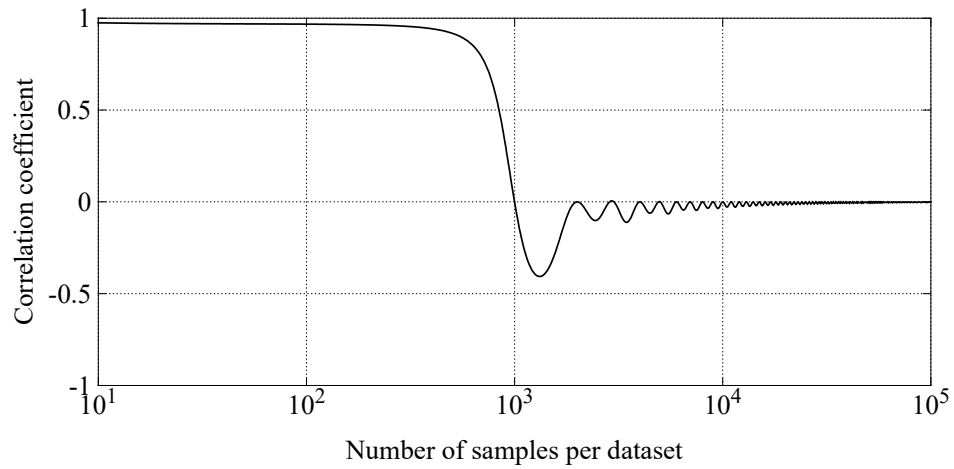


Fig. 6.1. The correlation coefficient as a function of sample count.

```
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

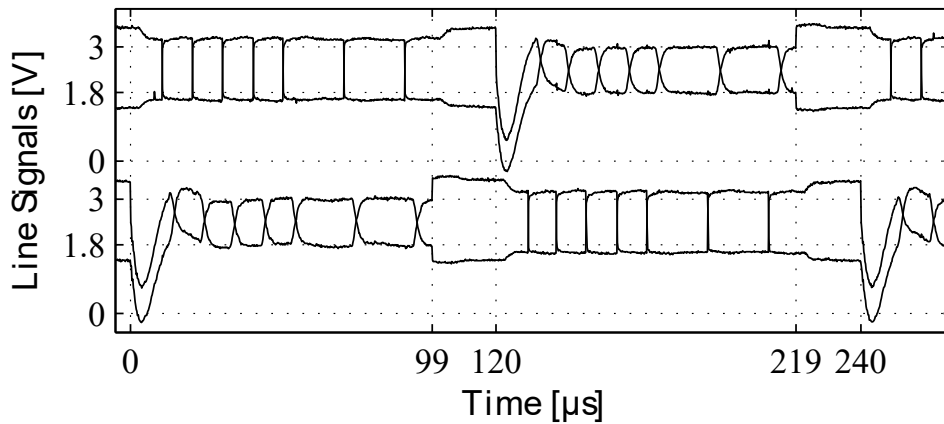


Fig. 6.2. Oscilloscope measurement showing physical line signals on both ends of a transmission line during master switch-over [1].

Always remember to include axes text, units and a meaningful caption in your graphs. When typing units, a  $\mu$  sign has a tail! The letter “u” is not a valid unit prefix. When typing resistor values, use the  $\Omega$  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 L<sup>A</sup>T<sub>E</sub>X tables.

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, pdfL<sup>A</sup>T<sub>E</sub>X 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 L<sup>A</sup>T<sub>E</sub>X label, such as “Fig. 6.3”.



Fig. 6.3. An example image with custom scaling

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 can be seen in Fig. 6.4.



Fig. 6.4. Comparison of various image format qualities

## 6.4 Maths

L<sup>A</sup>T<sub>E</sub>X has a very sophisticated maths rendering engine, as illustrated by equation 6.1. When talking about approximate answers, never use  $\pm 54$  V, as this implies “positive or negative 54 V”. Use  $\approx 54$  V or  $\sim 54$  V instead.

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

# 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 L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>,” <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](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 L<sup>A</sup>T<sub>E</sub>X Editor,” <https://www.texstudio.org/>.
- [6] “InkScape Website,” <http://www.inkscape.org/>.
- [7] “Voluntary Page and Overlength Article Charges,” <http://www.ieee.org/advertisement/2012vpcopec.pdf>, 2014.

# Appendix A

## Item 1

## Appendix B

### Item 2