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Michael V. Pishko, Dean, College of Engineering and Applied Science

Student, Iman A., An Obfuscated Analysis and Exposition of Really Cool Things That Only I Understand and You Do Not, M.S., Department of Electrical and Computer Engineering, May, 2025.

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AN OBFUSCATED ANALYSIS AND EXPOSITION OF REALLY COOL THINGS THAT ONLY I UNDERSTAND AND YOU DO NOT

by

Iman A. Student, B.S.E.E.

A thesis submitted to the
Department of Electrical and Computer Engineering
and the
University of Wyoming
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE
in
ELECTRICAL ENGINEERING

Laramie, Wyoming
May 2025

I dedicate this to my parents, who had the good fortune to have me in their lives, and to my dog Spot who helped proof-read this document.. . .

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Acknowledgments

This is where you write any paragraphs you want to show up on the Acknowledgments page. Traditionally, you use this space to thank your committee members for their help, any funding sources such as an NSF grant that helped you, and so on. This section is up to you (no page or word limit, but exercise restraint) as long as it is written in a professional manner. Be careful you don't end up with a messy page break, such as when the automatic insertion of your name, the university name, and the month and date at the end of this environment is the only thing that shows up on the next page. Write more or less text here to fix it!

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IMAN A. STUDENT

University of Wyoming

May 2025

Abbreviations, Acronyms, and Symbols

This is a partial list of abbreviations, acronyms, and symbols used in the text, provided in the hope that it will be helpful to some readers.

Symbols

( )	used for a continuous function.
[ ]	used for a discrete function.

Greek Letters

α	feedback coefficient for simple IIR filters, such as those used for a type of echo generation for guitar special effects.
λ	wavelength.
π	ratio of a circle circumference to diameter, 3.1415926535897932...
τ	time constant.
ω	radian frequency.

A

a	filter coefficient associated with an output term, y. When used in a transfer function, the a coefficients are associated with the denominator of the transfer function.
A	vector or array containing all of the a terms.
ADC	analog-to-digital converter.
AIC	analog interface circuit (see codec).

AGC automatic gain control.

AM amplitude modulation.

ARM Advanced RISC Machine, a 32-bit reduced instruction set computer (RISC) instruction set architecture (ISA) developed by ARM Holdings.

AWGN additive white Gaussian noise.

B

b filter coefficient associated with an input term, x. When used in a transfer function, the b coefficients are associated with the numerator of the transfer function.

B vector or array containing all of the b terms.

BW bandwidth of a bandpass signal.

BP bandpass.

BPF bandpass filter.

BPSK binary phase shift keying.

C

C value of capacitance.

CD-ROM Compact disk read-only memory.

CISC complex instruction set computer.

codec coder-decoder. An integrated circuit that contains both an ADC and a DAC.

CPU central processing unit.

D

DAC digital-to-analog converter.

D.C. direct current (0 Hz).

DDS direct digital synthesizer or direct digital synthesis.

DF-I direct form I.

DF-II direct form II.

DFT discrete Fourier transform.

DMA direct memory access.

DSK DSP starter kit.

DSP digital signal processing or digital signal processor.

DTFT discrete-time Fourier transform.

DTMF dual-tone, multiple-frequency signals as defined by telephone companies.

E

EDMA enhanced direct memory access.

F

FCC Federal Communications Commission.

FIR finite impulse response.

FFT fast Fourier transform.

FT Fourier transform.

$\mathcal{F}$ Fourier transform.

$\mathcal{F}^{-1}$ inverse Fourier transform.

f_h highest or maximum frequency that is present in a signal.

F_s sample frequency (samples/second) $= 1/T_s$.

G

GPP general purpose processor.

GPU graphics processing unit.

H

$H(e^{j\omega})$ discrete-time frequency response.

$H(j\omega)$ continuous-time frequency response.

$h[n]$ discrete-time impulse response or unit sample response.

$h[t]$ continuous-time impulse response.

$H(s)$ continuous-time transfer or system function.

$H(z)$ discrete-time transfer or system function.

HDTV high-definition television.

HP highpass.

HPF highpass filter.

HPI host port interface.

Hz hertz (cycles per second).

I

IF intermediate frequency.

IFFT inverse fast Fourier transform.

IIR infinite impulse response.

ISA instruction set architecture.

ISR interrupt service routine.

J

j $\sqrt{-1}$; identifies the imaginary part of a complex number. Some authors use i instead of j.

JTAG Joint Test Action Group, commonly used as the name of a debugging interface for printed circuit boards and IC chips. Formalized as IEEE Std 1149.1 in 1990.

L

$\mathcal{L}$ Laplace transform.

$\mathcal{L}^{-1}$ inverse Laplace transform.

L value of inductance.

LFSR linear feedback shift register.

LP lowpass.

LPF lowpass filter.

LSB lower sideband, also used for least significant bit.

M

M the number of bands in a graphic equalizer.

MA moving average.

McASP multi-channel audio serial port.

McBSP multi-channel buffer serial port.

ML maximum likelihood.

N

n index or sample number.

N often used as filter order; in other contexts, it is used for the length of a sequence, or for the length of an FFT.

NCO numerically controlled oscillator.

O

OMAP Open Multimedia Application Platform, a family of proprietary multi-core system on chips (SoCs) by Texas Instruments.

P

PC personal computer.

PCM pulse code modulation.

PLL phase-locked loop.

PN pseudonoise.

PSK phase shift keying.

Q

Q quality factor. Q = bandwidth of a BP filter divided by its center frequency. The higher the value of Q, the more selective the BP filter is.

QAM quadrature amplitude modulation.

QPSK quadrature phase shift keying.

R

r magnitude of a pole. This is a measure of how far the pole is from the origin.

R value of resistance.

RC resistor-capacitor.

RISC reduced instruction set computer.

RF radio frequency.

S

s the Laplace transform independent variable, $s = \sigma + j\omega$.

SoC system on chip.

T

τ a dummy variable often used in convolution.

t time.

T period of a signal or function.

TED timing error detector.

T_s sample period $= 1/F_s$.

TI Texas Instruments.

U

$u[n]$ discrete-time unit step function.

$u(t)$ unit step function.

U.S. United States (of America).

USB upper sideband; also used for Universal Serial Bus.

V

V voltage in Volts.

V_{in} input voltage.

V_{out} output voltage.

VLIW very long instruction word; this is a type of architecture for DSPs.

W

winDSK original Windows-based program for the C31 DSK, created by Mike Morrow.

winDSK6 Windows-based program, the follow-on to winDSK, for the C6x DSK series. It was created by Mike Morrow.

winDSK8 Windows-based program, the follow-on to winDSK6, for the OMAP-L138 multi-core board). It was created by Mike Morrow.

X

$X(j\omega)$ result of the Fourier transform $\mathcal{F}\{x(t)\}$; it shows the frequency content of $x(t)$.

$x[n]$ a discrete-time input signal.

$x(t)$ a continuous-time input signal.

Y

$Y(j\omega)$ result of the Fourier transform $\mathcal{F}\{y(t)\}$; it shows the frequency content of $y(t)$.

$y[n]$ a discrete-time output signal.

$y(t)$ a continuous-time output signal.

Z

z the independent transform variable for discrete-time signals and systems.

z^{-1} a delay of 1 sample.

Z_c impedance of a capacitor.

$\mathcal{Z}$ z-transform.

$\mathcal{Z}^{-1}$ inverse z-transform.

Chapter 1

Introduction

1.1 The Need for This Research

There are many good reference sources to help you make the most out of using LaTeX, both on the Internet and as books. There is also a huge worldwide group of users who willingly share their expertise as needed. Take a look at the web page for the TeX Users Group (TUG) at `www.tug.org`.

A blank line starts a new paragraph. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such.

1.2 Previous Research

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1.3 Dissertation Overview and Organization

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Chapter 2

Theoretical Background

2.1 My First Section

This first work theoretical in this area was performed by Golomb [1]. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such.

2.1.1 A Subsection

Bringing this work to practical fruition has been attributed to Dixon [2]. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such.

2.1.2 Another Subsection

Let's try out an equation. The expression for a double-sideband (with carrier) AM signal is

$$s_{\mathrm{AM}}(t) = A_c[1 + m(t)]\cos(\omega_c t) \tag{2.1}$$

where A_c is the amplitude of the carrier, $m(t)$ is the message signal (with amplitude always ≤ 1 to prevent overmodulation), and ω_c is the carrier frequency expressed in radians/sec [3]. In order to recover the message signal from (2.1), it is necessary to extract the envelope of

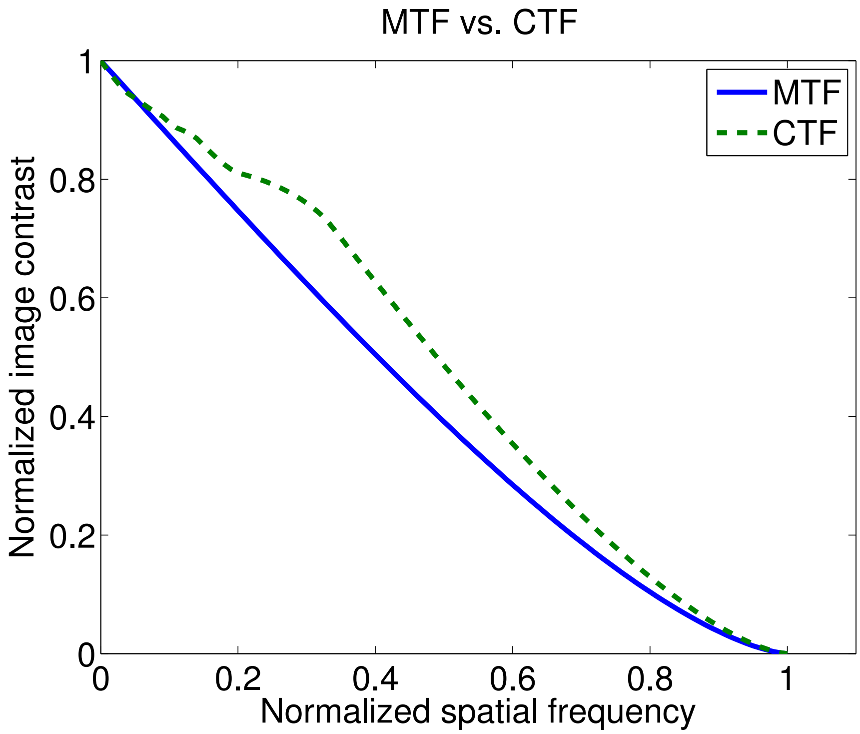


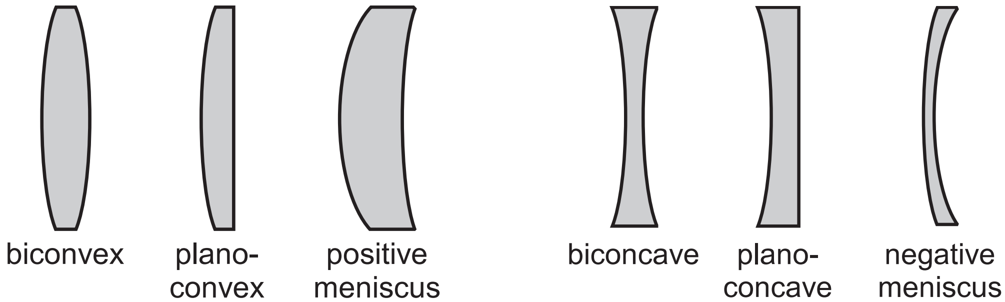
Figure 2.1: A comparison of the modulation transfer function and the contrast transfer function.

the signal $A_c[1 + m(t)]$. Once the envelope is obtained, the DC component can be removed with a DC blocking filter, leaving $A_c m(t)$, which is a scaled version of the original message signal. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such. This is meaningless text used only to test the margins and such.

2.2 My Second Section

Let's see how a floating figure is formatted. As we see in Figure 2.1, the optical measures of MTF and CTF are not equal [4]. Note that for a figure environment, the caption comes *after* the definition of the figure itself.

Sometimes you want to combine two subfigures into one main figure. The `subfig` package, loaded automatically with the UW thesis and dissertation files, can easily do this.



(a) Positive (converging) lenses. (b) Negative (diverging) lenses.

Figure 2.2: Common types of lenses.

You just use the `\subfloat` command as shown in the TeX source file below (it won't show up in the PDF file, of course, only the result of the command shows up there).

Some common shapes for individual positive and negative lenses, and their associated names, are shown in Fig. 2.2.

How about listings of computer programs? The main program (`main.c`) is very basic, as shown below. Note that unless your advisor objects, program listings should be single-spaced, which can be controlled with the `\spacing` command as shown. If you have longer and/or many program listings, it's usually better to place them in an appendix.

Listing 2.1: Main program for simple frame-based processing using ISRs.

```c
#include "..\Common_Code\DSK_Config.h"
#include "frames.h"

int main() {
    // initialize all buffers to 0
    ZeroBuffers();

    // initialize DSK for selected codec
    DSK_Init(CodecType, TimerDivider);

    // main loop here, process buffer when ready
    while(1) {
        if(IsBufferReady()) // process buffers in background
            ProcessBuffer();
    }
}
```

Wasn't that a nice program?

How about some MATLAB code? Note you have to specify the language since MATLAB wasn't the default language in the "listings" setup.

Listing 2.2: Simple MATLAB FIR filter example.

```
%  This m-file is used to convolve x[n] and B[n]
%
%  Assumes that both x[n] and B[n] start at n = 0
%
%  written by Dr. Thad B. Welch, PE {t.b.welch@ieee.org}
%  copyright 2001
%  completed on 13 December 2001 revision 1.0

% Simulation inputs
x = [1 2 3 0 1 -3 4 1];                % input vector x[n]
B = [0.25 0.25 0.25 0.25];             % FIR filter coefficients B[n]

% Calculated terms
PaddedX = [x zeros(1,length(B)-1)]; % zeros pads x[n] to flush the
   [+] filter
n = 0:(length(x) + length(B) - 2);  % plotting index for the
   [+]output
y = filter(B, 1, PaddedX);             % performs the convolution

% Simulation outputs
stem(n, y)                             % output plot generation
ylabel('output values')
xlabel('sample number')
```

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Table 2.1: Results of the third experiment, showing Euclidean distance to nearest eigenspace model point. Smaller numbers represent "better" recognition. This experiment tested for recognition of occluded objects.

	Occluded F4	Occluded F14	Occluded Tornado
Tornado	13.8922	6.4154	**68.9262**
P51	6.7955	3.7622	53.9320
F4	**5.7648**	5.5956	48.3343
F14	6.9371	**3.9662**	48.2957
F22	4.8605	5.6179	45.3576

2.3 My Third Section

Now let's see how a table is formatted. The minimum distance to a nearest cluster point is given in Table 2.1. Note that for a table environment, the caption comes *before* the definition of the table itself.

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Appendix A

Supporting Topics

A.1 My First Section

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A.1.1 A Subsection

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Appendix B

Equipment and Setup

B.1 My First Section

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B.1.1 A Subsection

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B.3.1 A Subsection

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