

# Project Title

A Project Report submitted to the  
Department of Computer Science and Engineering, Jahangirnagar University  
in partial fulfillment of the requirements for the degree of  
B.Sc. in Computer Science and Engineering

By

Name....

Exam Roll: 122112

Registration No: 2342334

Session: 2011 - 2012

Supervised by

Name of Teacher

Designation



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING  
JAHANGIRNAGAR UNIVERSITY

DECEMBER 2015

# Abstract

Write your abstract here.....

# Declaration

The research work entitled “**PROJECT TITLE**” has been carried out in the Department of Computer Science and Engineering, Jahangirnagar University is original and conforms the regulations of this University.

I understand the University’s policy on plagiarism and declare that no part of this project has been copied from other sources or been previously submitted elsewhere for the award of any degree or diploma.

---

(Candidate)

**Counter Signed by**

---

(Supervisor)

# Acknowledgement

Write your acknowledgement here.....

# CONTENTS

<b>Abstract</b>	<b>ii</b>
<b>Declaration</b>	<b>iii</b>
<b>Acknowledgement</b>	<b>iv</b>
<b>List of Figures</b>	<b>vii</b>
<b>List of Tables</b>	<b>viii</b>
<b>List of Symbols</b>	<b>ix</b>
<b>List of Algorithms</b>	<b>x</b>
<b>1 Introduction</b> .....	<b>1</b>
1.1 Background and Motivation .....	1
1.2 Objective .....	2
1.3 Research Problem .....	2
1.4 Contribution .....	4
1.5 Thesis Organization .....	4
<b>2 Literature Review</b> .....	<b>6</b>
2.1 Multiple Input and Multiple Output (MIMO) System .....	6
2.2 Linear Block Code .....	10
2.2.1 Space Time Block Code.....	10
<b>3 System Model</b> .....	<b>28</b>
3.1 Derivation of the Trace of Complex Channel Matrix .....	28
3.1.1 Derivation of Expectation for Gaussian Fading Channel .....	33

<b>4 Experiments</b> .....	<b>36</b>
4.1 Low SNR Analysis of Gaussian Fading Channel.....	36
4.1.1 Gaussian Fading SM MIMO System.....	36
4.2 Low SNR Analysis of Weibull Fading Channel .....	40
<b>5 Conclusion</b> .....	<b>57</b>
1.1 Summary.....	1
1.2 Future Work.....	2
<b>References</b> .....	<b>58</b>

# LIST OF FIGURES

1.1: Performance of wireless channel under awgn environment taking service time as a parameter .....	1
2.2: Space Time Block Code (Matrix Format) .....	10
2.3: Multiple Input Single Output (MISO) for 2 antennal case .....	11
3.1: Block diagram of Alamouti Scheme .....	12
4.1: Two way Space Time Block Code .....	12

# LIST OF TABLES

1.1: Units for Magnetic Properties .....	2
2.2: Summary of Parameters of Different Space-Time Block Codes .....	16
3.1: Moment of Four Fading Channels .....	52



# LIST OF SYMBOLS

<i>Symbol</i>	<i>Description</i>
$\mathbf{H}$	Random MIMO Channel Matrix
$E\{\cdot\}$	Expectation
$(\cdot)^+$	Hermitian Transposition
$E[\text{trace}(\mathbf{H}^+\mathbf{H})]$	Expectation of the trace of complex channel matrix $(\mathbf{H}^+\mathbf{H})$
$E[\text{trace}\{(\mathbf{H}^+\mathbf{H})^2\}]$	Expectation of the trace of complex channel matrix $(\mathbf{H}^+\mathbf{H})^2$
$E[x^k]$	$k^{\text{th}}$ Moment of the MIMO Channel
$\frac{E_b}{N_0 \text{ min}}$	Minimum Normalized Transmit Energy per Information Bit
$\frac{E_b}{N_0}$	Normalized Transmit Energy per Information Bit
$S_0$	Wideband Slope
$R_c$	Code Rate in bits/s/Hz
$C\left(\frac{E_b}{N_0}\right)$	Shannon's capacity function with respect to $E_b/N_0$
$\mu$	Mean of Gaussian random variable
$\sigma$	Standard deviation
$\lambda$	Scale Parameter
$m$	Shape Parameter
$\Gamma(x)$	Gamma function
$\gamma_{av}$	Ratio of shape and spread parameter
$k$	Constant

# LIST OF ALGORITHMS

2.1: Algorithm_Name .....	11
2.2: Algorithm_Name .....	16
3.1: Algorithm_Name .....	52



# Chapter 1

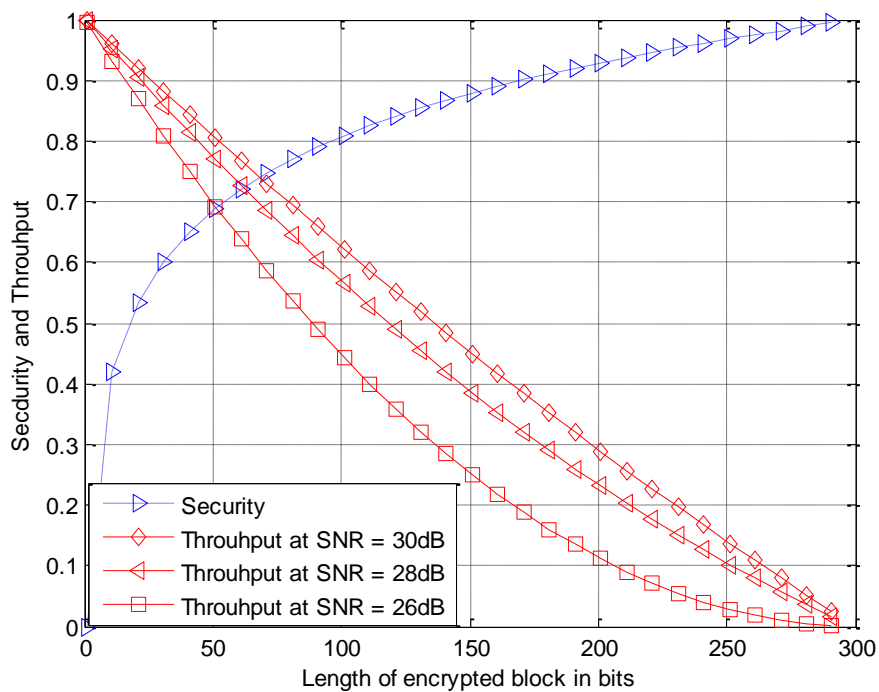
## Introduction

Write intro here [1]. Write intro here.

### 1.1 Testing

#### 1.1.1 Testing

Each figure must be referred in literature like ‘fig. 1.1.’. All figures and graph must be in gray scale except some special cases.



**Fig. 1.1** Performance of wireless channel under awgn environment taking service time as a parameter

The figure must be numbered like above with title. The figure should be referred in literature like, ‘the profile of throughput and security level is shown in fig.1.1’. All figures and graph must be in gray scale except some special cases.

TABLE 1.1  
UNITS FOR MAGNETIC PROPERTIES

SYMBOL	QUANTITY	CONVERSION FROM GAUSSIAN AND CGS EMU TO SI <sup>A</sup>
$\Phi$	magnetic flux	1 Mx $\rightarrow 10^{-8}$ Wb = $10^{-8}$ V·s
$B$	magnetic flux density, magnetic induction	1 G $\rightarrow 10^{-4}$ T = $10^{-4}$ Wb/m <sup>2</sup>
$H$	magnetic field strength	1 Oe $\rightarrow 10^3/(4\pi)$ A/m
$\mu_r$	relative permeability	$\mu \rightarrow \mu_r$
$w, W$	energy density	1 erg/cm <sup>3</sup> $\rightarrow 10^{-1}$ J/m <sup>3</sup>
$N, D$	demagnetizing factor	1 $\rightarrow 1/(4\pi)$

Table must have both number and title and must be mentioned in literature. All tables, graphs and figures must be centered.

The following Equations:

$$\int_0^{r_2} F(r, \varphi) dr d\varphi = [\sigma r_2 / (2\mu_0)] \quad (1.1)$$

All mathematical variables must be in italic, vectors and matrix in bold phase in the literature. Equations must be left aligned but their numbers must touch the right end of the lines. All characters in literature must be in Times New Romans 12 points font and subscripts/superscripts in 10 pints font.

# Chapter 2

## Literature Review

Write review here [1]. Write review here.

### **2.1 Testing**

#### **2.1.1 Testing**

# References

- [1] W. K. Chen. *Linear Networks and Systems*. Belmont, CA: Wadsworth, 1993, pp. 123-35.
- [2] J. E. Bourne. "Synthetic structure of industrial plastics," in *Plastics*, 2nd ed., vol. 3. J.Peters, Ed. New York: McGraw-Hill, 1964, pp.15-67.
- [3] G. Pevere. "Infrared Nation." *The International Journal of Infrared Design*, vol. 33, pp. 56 - 99, Jan. 1979.
- [4] D. B. Payne and H. G. Gunhold. "Digital sundials and broadband technology," in *Proc. IOOC-ECOC*, 1986, pp. 557-998.
- [5] B. Brandli and M. Dick. "Engineering names and concepts," presented at the 2<sup>nd</sup> Int.Conf. Engineering Education, Frankfurt, Germany, 1999.
- [6] M. Duncan. "Engineering Concepts on Ice. Available online: [www.iceengg.edu/staff.html](http://www.iceengg.edu/staff.html), Accessed on Oct. 25, 2000.
- [7] S. Mack. "Desperate Optimism." M.A. thesis, University of Calgary, Canada, 2000.