

COMPREHENSIVE STUDY ON THE INFLUENCE OF LED LOW-
LEVEL MODULATION TOWARD ITS NONLINEARITY WITHIN
VLC SYSTEM

WONG YONG XIANG

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**COMPREHENSIVE STUDY ON THE INFLUENCE OF LED
LOW-LEVEL MODULATION TOWARD ITS NONLINEARITY
WITHIN VLC SYSTEM**

WONG YONG XIANG

**This report is submitted in partial fulfilment of the requirements for
the degree of Bachelor of Electronic Engineering with Honours**

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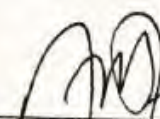
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Alamat Tetap: S13 KAMPUNG
MERBAU 32400
AYER TAWAR
PERAK

Tarikh : 23 MAY 2018


Disahkan oleh:


(COP DAN TANDATANGAN PENYELIA)
DR. ZAITON BT ABDUL MUTALIP
Pensyarah Kanan
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Karung Berkunci No 1752
Pejabat Pos Durian Tunggal
76100 Durian Tunggal, Melaka

Tarikh : 23 MAY 2018

DECLARATION

I declare that this report entitled “COMPREHENSIVE STUDY ON THE INFLUENCE OF LED LOW-LEVEL MODULATION TOWARD ITS NONLINEARITY WITHIN VLC SYSTEM” is the result of my own work except for quotes as cited in the references.

Signature :	
Author :	WONG YONI XIAN
Date :	25/5/18

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

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DEDICATION

I dedicate this report to my beloved university, my supervisor, my family and my friends.

ABSTRACT

The degree project involved with implementation of the low-level modulation techniques toward the Visible Light Communication System (VLC) in order to investigate the effect of it toward the LED non-linearity effect. Two types of low-level modulation implemented in this work, the analogue low-level modulation and the digital low-level modulation. For analogue, amplitude modulation is used while for digital the amplitude shift key are used. Both techniques will be implement in the VLC system and comparison will be done between both modulation system and the normal VLC system. Three systems are designed and build. There are several experiments carried on these systems including the bright and dark test (environment test), distance test, angle test, current test and the power test. The environment test referring to the surrounding where the aim is to test the suitable environment for transmission. The distance test and angle test are used to test the coverage area of the system. The current and power test are used to test the non-linearity characteristics of the LED and result will be recorded and graph are plotted. For the bright and dark test, three systems are less disrupted by noise when it tested in dark surrounding. This is because during bright surrounding the surrounding light are creating noises that are affecting the system output. The range of the distance of the three systems are between 1 to 3 metres

where the modulated systems are having longer distance. For transmission angle all three systems achieved 180 degrees. Lastly for the nonlinearity effect graph, digital and analogue modulation system are having a more linear graph than the normal VLC system. Generally, both digital and analogue modulation system are enhancing the transmission process but overall digital modulation are better because amplitude modulation are having more noise due to its characteristics.

ABSTRAK

Projek ini melibatkan pengaplikasi teknik modulasi tahap rendah terhadap system komunikasi cahaya nyata demi untuk mengkaji impaknya terhadap kesan ketaklelurusan dalam diod pemancar cahaya (LED). Terdapat dua jenis teknik modulasi yang akan digunakan dalam kajian ini dan dua teknik tersebut adalah teknik modulasi secara analog dan teknik modulasi secara digital. Dalam teknik modulasi secara analog, Teknik modulasi secara amplitud akan diaplikasikan manakala untuk teknik modulasi secara digital modulasi ASK akan digunakan. Kedua-dua Teknik ini akan diaplikasikan dalam sistem komunikasi cahaya nyata dan perbandingan akan dilaksanakan antara kedua-dua sistem dan sistem komunikasi cahaya nyata yang biasa. Terdapat beberapa kajian yang telah dilaksanakan dan kajian-kajian tersebut meliputi kajian dalam kawasan terang dan gelap, jarak, sudut, penghantaran arus serta kuasa. Kajian suasana adalah menguji kesesuaian suasana terhadap sistem komunikasi cahaya nyata. Kajian jarak dan sudut pula menguji ruang perliputan penghantaran data dan isyarat. Kajian arus dan kuasa adalah digunakan untuk menguji kesan ketaklelurusan dalam diod pemancar cahaya (LED) dalam system komunikasi cahaya nyata. Kaedah graf akan digunakan dalam pencatatan data untuk kajian ini. Dalam kajian suasana, telah nyata dilihat bahawa ketiga-tiga sistem adalah kurang

dipengaruhi oleh isyarat yang tidak diperlukan. Ini adalah kerana dalam keadaan terang, cahaya nyata dalam suasana tersebut akan mengganggu dan tercampur dalam penghantaran isyarat. Dalam kajian jarak dan sudut, jarak yang dapat dicapai oleh tiga sistem tersebut adalah antara 1-3 meter manakala bagi aspek sudut, ketiga-tiga sistem dapat menghantar isyarat dari 0 darjah ke 180 darjah. Akhir sekali dalam kajian arus dan kuasa, keputusan menunjukkan bahawa kesan ketaklelurusan sistem yang mengaplikasikan teknik modulasi adalah lebih rendah berbanding dengan sistem biasa. Tetapi secara keseluruhan, sistem modulasi secara digital adalah lebih baik kerana modulasi secara amplitud lebih mudah terdedah kepada isyarat yang tidak diperlukan atas ciri-cirinya.

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LIST OF SYMBOLS AND ABBREVIATIONS

VLC	:	Visible Light Communication
LED	:	Light Emitting Diode
AM	:	Amplitude Modulation
ASK	:	Amplitude Shift Key
PAM	:	Pulse Amplitude Modulation
PWM	:	Pulse Width Modulation
OOK	:	On Off Keying
PPM	:	Pulse Position Modulation
FSK	:	Frequency Shift Key
RF	:	Radio Frequency
IR 4.0	:	Industrial Revolution 4.0
TOV	:	Turn On Voltage

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CHAPTER 1

INTRODUCTION

1.1 General Overview & Background

There had been a rapid growth on the global technology which proven by the coming of the industrial revolution 4.0. The technology of world had growth from depending on animal and labor, to mechanical world, then the electrical world and finally reach now the electronic world. These had shown how fast the technology of the world had changed and how important for us the community and society must do to merge and involve in this big and historical revolution. With the coming of IR4.0, there are needs of improvement and enhancement in different types of technology, devices and methodology in order to be able to follow the trend of global toward a better tomorrow. One of the biggest part of the revolution are about the communication or data transmission. Communication is all about the process of delivering the desired or wanted messages between one and other. With the growth of the human population

and communication technology, the demand for getting more desired or more effective communication platform and method are frustrated needed for the community nowadays. Before this, people had figure out the solution of using the radio frequency (RF) communication which are using the radio frequency as a medium to deliver the data to the users. However, as mention early due to the rapid growth of the human population, the limited bandwidth of the RF will soon unable to fulfill the needs and desires from the large amount of human population toward communication. Hence, in order to follow the trend of industry revolution 4.0, the upcoming wireless communication system must be able to offer high speed of data transmission, channel with higher capacity which use to support the variety of broad band services and the ability to merge in the technology of real time. Therefore, there are few types of new communication technology and systems came out. For example, radio over fiber and optical wireless communication. These communication systems have both their Pros and Cons, for the radio based communication, although it has outstanding performances in data communication however it still having some issues needed to be clear. Those issues are like security, health, cost and congested spectrum. Next, the optical communication system, the optical wireless communication system also had its strengths and weakness. However, if comparing optical communication system with the more conventional communication like the two above, the optical communication system had advantages toward them in some aspect. For example, lower cost, high data transfer rate, less complexity and unregulated and unbounded license of free spectrum. With these advantages, these will definitely help in improving mankind advancement.