

# INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS.....

## Digital Signal Processing Applications: Digital Communications

M. A. Hassan<sup>1</sup>, N. M. Z. Hashim<sup>2</sup>, N. M. Saad<sup>3</sup>  
N. A. A. Hadi<sup>4</sup>, A. Salleh<sup>5</sup>, A. S. Ja'afar<sup>6</sup>

<sup>1, 2, 3, 4, 5, 6</sup> Centre for Telecommunication Research and Innovation (CeTRI)

Faculty of Electronic and Computer Engineering  
Universiti Teknikal Malaysia Melaka

76100 Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia.

<sup>1</sup>khs\_aliff@yahoo.com, <sup>2</sup>nikzarifie@utem.edu.my

**Abstract:** The purpose of the discussed paper is about the Digital Signal Applications which is Digital Communications. Nowadays, the needs of getting faster information become very high. People are demanding to get the information quickly. Therefore, digital communications fields require rapidly revolutions in order to fulfill the demand. This paper consists of fundamental theories and various concepts of digital communications. There are including elements of digital communication system, processes and techniques, modern data communication, digital communication applications and recent advancement in digital communications technology.

**Keywords:** Digital Communications, Recent technology of Communication, Elements of Digital Communication, Application of Digital Communication.

### 1. INTRODUCTION

Generally, communication is the interaction between human and human, machines and machines through any medium as long as both can interact with each other. Usually communication can be grouped into one way communication and two way communications.

Digital communications is the process of transfer data or information. Data is transmitted from transmitter to receiver through medium. The examples of mediums are optical fibers, wireless medium and storage media. Data in digital communication is in form of electromagnetic signal. The examples of signal are electrical voltage, radio wave and infrared signal. While, analog communication is the transmission of signal over an analog medium. The data is in form of sequence of pulses known as base band transmission or by a limited set of continuously varying wave known as pass band transmission. Both baseband and pass band signals represent the bit streams can be refer as transmission of digital. Literature Review

#### 1.1 Digital Communication Technology and Advancements [1]

This paper explains about the elements of digital communication system, processes and techniques and recent advancement in digital communications technology. Elements of digital communication system is shown below.

Information Source → Source Encoder → Channel Encoder → Digital  
Modulator → Channel Digital → Demodulator → Channel Decoder  
Source Decoder → Output Transducer → Output

**Figure 1:** Digital Communication System

Processes and techniques consist of sampling theorem, analog to digital conversion, modulation and error control. Sampling theorem is to convert the continuous time signal to discrete time signal. Then, digital and analog conversion required Pulse Code Modulation for the conversion. Meanwhile, before the signal can be converted, it must be processed within the specific range. Modulation is take place on signal that going to be transmitted to ensure the signal in the acceptable condition. The examples of digital modulation techniques are Amplitude Shift Keying and Phase Shift Keying. Error control also the part of digital communication system. Error control consists of Forward Error Correction and Auto Repeat Correction. FEC can be define as process of decoding that is applied on the received sequence to detect the position of error. ARQ apply a simple error detection code to the received sequence. If errors happen, ARQ sent back the signal after sequence of free error is achieved.

This paper shows some of the recent advancement in digital communication world. The use of Graphene modulators to enhance the speed of digital communications advances in underwater acoustic communication and the development using Phase Shift Keying on high frequency. Scientist of University California, Berkely demonstrates Graphene which can exceed the current speed limit. A team of researcher lead by Professor Xiang Zhang produce small optical device that use Graphene to switch light on and off. As a result, Graphene makes it possible to build a better modulator than previous one.

Moreover, Graphene based modulator enable large amount of data packets. Therefore, instead of broadband, in the near future, extreme band can be achieved. For the advances in underwater acoustic communication, by apply the phase coherent modulation will lead to achieve more or less the

# INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS.....

increase in magnitude of data throughput.

## ***1.2 Building Technology Platform Aimed to Development Service Robot with Embedded Personality and Enhanced Communication with Social Environment [2]***

This paper is discussed about the prototyping of technology platform to develop ambient aware human centric indoor service robot. The development of robot prototyping is one of the applications of digital communications. The robot is consists of wheel based mobile platform with spinal torso, head of robot and bi manual system with multi finger robot hands. The robot is expected to see, hear, speak and use its interface to communicate with humans. Furthermore, this paper also states that personal devices is widely accepted and available to majority and were recognized in the recent decades as future technology of modern world.

The prototype robot is capable of demonstrating its affective and social behavior by using audio and video interface as well as body movement. Robot also is equipped with advanced system based on sensor system which including laser range finder, ultrasonic distances sensors and proximity detectors. Plus, to enable the communication between the interface and environment it also equipped with inertial sensor, stereo vision system, two wide range microphones and loudspeaker.

## ***1.3 Modern Data Communications: Analog and Digital Signals, Compression, Data Integrity [3]***

This paper explains about four main specific element involve in digital communications. There are to increase the level of understanding of analog and digital signals, codes and encoding, compressions and error detection. This paper also lists out the factors which determine transmission process. The factors are connection cost, bit rate, channel usage, logistics, requirements of data connection and mobility.

Communication standard require communication device to send and represent information in readable and suitable ways. Analog and digital signals are the alternatives ways to transfer data. Through digital signals, data is represented either electronically or optically. While through analog signals, data is represented in continuous voltages levels.

This paper suggests reducing number of bits but still keeping enough information. By following the compression theory, not important data is eliminated and keep the important one. The data compression methods are lossless and lossy. Lossy compression includes Discrete Cosine Transform, Vector Quantization and Huffman coding. While lossless compression techniques include Run Length Encoding, String table compression and Lempel Ziff Welch.

There are two types of error in digital data transmission which is single bit error and bust error. Single bit error occurs when one bit in the data has changed. While in burst error there are more than 1 bit data that changed. There are three types of redundancy check which is parity checks, checksum and cyclic redundancy check.

## ***1.4 Reaching Real Time Moving Targets: The Use of Digital Communications to Inform and Mobilize College Students [4]***

This paper shows the idea of the faculty to continually find the effective method to deliver information freely to students. To achieve the objective, a new establishes Center of Civic Engagement (CCE) gather facts to identify the benefits of recent methods of digital communication and find out the problem that might occur. From the facts gathered, the strategy of new social media is develop. As results, CCE win the marketing and social networking initiatives awards. This paper display the problem occurs during the earliest period of CCE being launched and making its activities known to student body, faculty and university personnel. The research found out the audience has different needs of information, interest and motivation. This fact requires proper alternatives which is important to reach the students.

## ***1.5 The Future of Digital Communications: Technical Perspective [5]***

This paper explains about the problems occur during the phase of increasing the broadband capacity and the new demands of the internet users which gives a big impact towards the digital communications. The problems occur during the phase of increasing broadband capacity involve the series of broadband which consists wire line and wireless access. Broadband and bandwidth have become very important. This paper also focuses on technical details of broadband and bandwidth.

Shannon's Law states that there are two fundamental alternatives to increase the communication medium capacity. There are to increase the amount of bandwidth assign to the medium or to increase the received signal level relative to the noise and interference. Bandwidth increases is due to the technical characteristics of the transmission medium. The principle transmission media commonly used are fiber optic cable, coaxial cable and wireless link.

Wireless broadband has become the trend that involves wireless as a technology platform of broadband service. The technological difference between wireless and wire line technology must be considered. Both trends actually give effect towards the bandwidth. On the same time, wireless technology is predicted to growth faster and become the priority of technology in the near future. Wireless technology is facing the limitation which is different from the limitation faced by wire line technology. Wireless technology is subject to bandwidth constraints. This is because for bandwidth, wireless provider has to share bandwidth. The chance of traffic is higher than wire line service.

## ***1.6 The Digital Communications Revolution [6]***

This journal discussed the purpose for digitization and analysis of the latest path of producing communication and the criteria of digital communication products. In the end of this journal,

# INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

*WINGS TO YOUR THOUGHTS.....*

analysis is done which include the technology used and the complexity knowledge that are fundamental of constructing Theory of Digital Communication (TDC).

Currently, the media telecommunication and information technology are undergoing rapid changes. Digital communications has overpowered all the communication and media fields. There are more ways to communicate compare to earlier generations. Everyone is communicating using communication platform such as Facebook, Twitter and YouTube.

Evolution is commonly happen in technology business. Future digital devices or tools change the limit of broadcasting logic area to digital visual information processing. Communication involve almost in each part of human daily life. This future digital media have been invaded human pockets in form of camera equipped hand phones and PDAs.

Hypermedia is act as a thinking tool to organize and facilitate access to personal and known information and also be a medium used by user to access information. As hypermedia become more popular, the technology innovation will focus on making interface of their device more transparent which leads to touch screen.

## ***1.7 Application Of Digital Communication Techniques To Plastic Extrusion Process [7]***

This paper discussed about the contribution of digital communication methods to process of plastic extrusion. Previously, by not using digital communication techniques lead to some problem during the process. Therefore, this paper will explained the latest technology used in extrusion process which improve the operation and produce a quality product.

Generally, extrusion machine which is extruder is widely used in wire and cable insulation sheath production. The theme for the production of wire and cable insulation sheath is the core technology in the whole wire and cable generating process. Thus, the accuracy and the reliability of the extruder are very important. This is because the used of PLC, Programmable Logic Controller leads to convenient in programming and combining. The used of PLC also are reliable and working fast.

Unfortunately, most of extruders with PLC controller using analog control. Analog control is one of the control techniques with some disadvantages which is low accuracy, less reliability, not stable and difficult to troubleshoot and repair when problem occur. The extruder itself has delay factors which cause ordinary regulator cannot control process efficiently.

Extrusion process which consists of molten plastic onto wire and other shapes require close control of many variables to ensure consistency quality of product. This paper suggests, in order to get a good or greater quality of product, hardware and software of extruder must be fully digital control. The system must consist of integrated control mode of computer and PLC.

## ***1.8 5G Technology of Mobile Communication: A Survey [8]***

The paper is discussed about the research of 5G technology of mobile communication as one of digital communications applications. Previous generation which widely used now is 4G and 3G. 4G technologies consist of several standards similar to 3G.

The benefits of this research are the early development of 5G technology which assumed as customer oriented. 5G technology offer utmost priority to user compare to 3G and 4G. 5G technology is to make use of mobile phones within very high bandwidth. Plus, the technology also include all types of advanced features which make 5G technology most dominant technology in near future. This paper also describes the problems occur in migration from 4G and 3G. There are challenges in security, challenges in network infrastructure and Qos Support, charging and billing, data encryption and jamming and spoofing.

After overcome or reduce the challenge this paper suggest several key points of 5G technology. Firstly, 5G is completed wireless communication with almost no limitation and also been called as real wireless world. Secondly, data can be transfer much faster than 3G and 4G. Thirdly, 5G introduce almost perfect real world wireless which called as WWW: Worlds Wide Wireless Web. Fourthly, real wireless world with no more limitation to access and zone issue can be achieved. Last but not least, wearable device with artificial intelligent capabilities can be achieved.

## ***1.9 Digital Communications For Relay Protection [9]***

This paper also explains about the applications of digital communication in power system protection. This paper consists of 2 parts. For part 1, theory and configuration that can be applied to existing and new protection systems, digital characteristics and transport system applicable and not applicable for protection, future digital communication technologies of interest to the protection engineer and the requirement for future benchmarks. For Part 2, this paper discussed about the current analog communications relay schemes.

The example of digital communication that applied for relay protection is through point to point system. It is the simplest design for digital communication systems. The channel is exist between only two nodes. Point to point system is famous network examples. The channel switching is provided by separate switching equipment. Other examples stated in this paper are Star, linear drop and insert and Sonet ring.

## ***1.10 Fundamental of Satellite Communications Part 3: Modulation Techniques used in Satellite Communication [10]***

This paper explained about the technique used in satellite

# INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

*WINGS TO YOUR THOUGHTS.....*

communication which is one of the application and revolution of digital communications. Early communication stages consists of continuously transfer many signals, modulation types, digital modulation which including data quantization, techniques of digital modulations, recovering packet errors and Amplitude and Phase Shift Keying (ASK).

Besides, for early digital wireless communications, the researcher and developer focus more on communication objectives, speed, accuracy, selection of a suitable carrier of smoke or light or electromagnetic radiation and check the path loss and distortion.

Frequency Division Multiplexing (FDM) satellite carriers play important role in satellite communications. The carriers have assign frequency and bandwidth. Frequency converter in FDM places their carrier in assigned slot and their guard bands prevent the adjacent carrier disturbances. For FDM Carriers, frequency spectrum is limited natural resource. Maximum utilization of the allotted frequency is good for busy channel.

## 2. CONCLUSION

As conclusions, this paper review is the summarization of 10 previous researches done by previous people. This paper will increase the understanding and knowledge on the digital communication applications and its newest technology. The purpose of digital communication which is to connect the human's interaction and giving benefits to human is clearly explained in this paper reviewed.

## Acknowledgement

We are grateful to Centre for Telecommunication Research and Innovation (CeTRI) and Universiti Teknikal Malaysia Melaka (UTeM) through PJP/2013/FKEKK (29C)/S01215 for their kind and help for supporting financially and supplying the electronic components and giving their laboratory facility to complete this study.

## References

- [1] Stuti Ramola, "Digital Communication Technology and Advancements", Advance in Electronic and Electric Engineering, Research India Publications, Vol. 2, 2014.
- [2] Aleksandar Rodica, Miloš Jovanovica, Ilija Stevanovica, Branko Karanb, Veljko Potkonjakk,"Building Technology Platform Aimed to Development Service Robot with Embedded Personality and Enhanced Communication with Social Environment", Digital Communications and Networks, 2015.
- [3] Cristian S. Calude , "Modern Data Communications: Analog and Digital Signals, Compression, Data Integrity", Modern Data Communication, August 2012.
- [4] Dr. Allison F. Alden, Anthony G. Naglieri, "Reaching Real Time Moving Targets: The Use of Digital Communications to Inform and Mobilize College Students", CSPA-NYS Journal of Student Affairs Vol. 12, Issue 1, 2012.
- [5] Fernando Laguarda, "The Future of Digital Communications: Technical Perspective", External Affairs and Policy Counselor Time Warner Cable.
- [6] Vineet Kaul, "The Digital Communications Revolution", Online Journal of Communication and Media Technologies, Vol. 2, Issue 3, July 2012.
- [7] Jin Zhao, Xiaofeng Wu, "Application Of Digital Communication Techniques To Plastic Extrusion Process", The Ninth International Conference on Electronic Measurement & Instruments ICEMI, 2009.
- [8] Asvin Gohil, Hardik Modi, Shobhit K Patel, "5G Technology of Mobile Communication: A Survey", International Conference on Intelligent Systems and Signal Processing (ISSP), 2013.
- [9] Gary Michel, Greg Pleinka,"Digital Communications For Relay Protection", Working Group of IEEE Power System Relaying Committee.
- [10] Howard Hausman, "Fundamental of Satellite Communications Part 3: Modulation Techniques used in Satellite Communication", MITEQ, Dec 2009.Salam, Azuki Abdul, and Nik Azran Ab Hadi. "Fuzzy logic controller for shunt Active Power Filter." Engineering Technology and Technopreneuship (ICE2T), 2014 4th International Conference on. IEEE, 2014.