Sudan University of Science and Technology

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Study and Evaluation Mobile Digital Video Broadcasting - Second Generation Terrestrial TV Tuner

A Research Submitted in Partial fulfillment for the Requirements of

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الاستـهلال

قال تعالى :

((فَفَهَّمْنَاهَا سُلَيْمَانَ ۚ وَكُلًّا آتَيْنَا حُكْمًا وَعِلْمًا ۚ وَسَخَّرْنَا مَعَ دَاوُودَ الْجِبَالَ يُسَبِّحْنَ وَالطَّيْرَ ۚ وَكُنَّا فَاعِلِينَ))

صدق الله العظيم

سورة الأنبياءالآية (79)

DEDICATION

We are very grateful to Almighty Allah for helping us through this long journey, May He continues to bless, help and guide us to the right path.

We dedicate this project to all those that helped us toward this success, specially our mothers, our fathers, our family, our teachers and our colleagues.

Thank you all…

ACKNOWLEGEMENT

Our completion of this project could not have been accomplished without the support of our family and colleagues.

We would like to express our gratitude and appreciation to all those who gave us the possibility to complete this project. A special thanks to our final year project supervisor **Dr. Rashid A.Saeed,** who help us, stimulating suggestions and encouragement, help gratitude to coordinate our project especially in writing this report.

ABSTRACT

Nowadays the Digital Video Broadcasting techniques has become the spread among the other broadcasting techniques, one of them is the Digital Video Broadcasting Terrestrial (DVB-T2) which is going to be the subject of our project. In this project our work will focus on the study of the effect of motion on receiving Digital Video Broadcasting on the moving vehicles. MATLAB-SIMULINK have been used to simulate the model that consists of number of blocks each of them has a special functionality in processing the transmitted signal until it reaches the receiver or the final destination. the model has been implemented and tested and the results are recorded for the future study.

المستخلص

في الآونة الأخيرة أصبحت تقنيات بث الفيديو الرقمي هي الأكثر إنتشاراً ضمن تقنيات البث، أحد تقنيات البث هذه هي تقنية البث الأرضي للفيديو الرقمي التي أصبحت مُتبناة في أكثر من 80 دولة حول العالم. في هذا المشروع سيكون مجال العمل هو دراسة تأثير الحركة على إستقبال البث الأرضي للفيديو الرقمي في المركبات المتحركة .حيث تم إستخدام أداة (الماتلاب) لمحاكاة النموذج المتكون من عدد من (الصناديق) لكل واحد منها وظيفة محددة في معالجة الإشارة المُرسلة حتى تصل إلى المستقبل أو الوجهة النهائية ، حيث يضم النموذج كل من المُرسل و المُستقبل. تم تطبيق النموذج وإختباره لحظياً. كل النتائج سُجلت بغرض الدراسة المستقبلية.

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ABBREVIATIONS

DVB-T2	Digital Video Broadcasting – Second Generation Terrestrial
ETSI	European Telecommunication Standard Institute
MTVT	Mobile Television Tuner
BER	Bit Error Rate
DVB-S	Digital Video Broadcasting- Satellite
DVB-C	Digital Video Broadcasting- Cable
OFDM	Orthogonal Frequency Division Multiplexing
PLP,s	Physical Layer Pipes
QPSK	Quadrature Phase Shift Keying
QAM	Quadrature Amplitude
LDPC	Low Density Parity Check
MISO	Multiple-Input Single-Output
DVR	Digital Video Recorder
MIMO	Multiple Input Multiple Output
TFS	Team foundation server
VHS	Video Home System
TU6	Tangle wood Ukulele
DVB-NGH	Next Generation Handheld

SSD	Signal Space Diversity
CFR	Channel Frequency Response
AWGN	Additive White Gaussian Noise

CHAPTER ONE

INTRODUCTION

1.1 Preface:

Digital Video Broadcasting – Second Generation Terrestrial (DVB-T2) it is the extension of the television standard Digital Video Broadcasting – Terrestrial (DVB-T), issued by the consortium Digital Video Broadcasting (DVB), devised for the broadcast transmission of digital terrestrial television. DVB has been standardized by European Telecommunication Standard Institute (ETSI).

Over the past 10 years, DVB-T has become the most widely adopted and deployed terrestrial digital video standard. It is now well established and the prices of DVB receivers have dropped over time as the technology has matured. Due to its successful development and deployment, DVB-T has come to serve as a sort of benchmark for the development of other terrestrial digital video standards.

Due to increasing scarcity of spectrum and requirements for high transmission capacity in recent years, an updated standard with more spectral efficiency is required to replace DVB-T. The DVB-T2 system is capable of meeting these requirements, due to its increased capacity, robustness, and the ability to reuse existing reception antennas. The regions which previously adopted DVB-T systems, primarily countries in Europe and Asia, will be migrating to DVB-T2, while many new countries and regions began the process of adopting DVB-T2 directly since the first version of the standard was published in 2009.

1.2 Problem Statement:

The need of reception of DVB-T signals on a moving targets such as cars, trains, even a walking person. Also the need of receiving digital television signal on an analog TV.

1.3 Proposed Solution:

A mobile DVB-T tuner to be used in car to receive digital television broadcasting while the car is moving.

1.4 Aim and Objectives:

The aim of this thesis is to design and study mobile DVB-T tuner to receive the second generation of digital terrestrial television.

The objectives of this thesis are:

- To study the Mobile Television Tuner(MTVT) with various speed and propagation model,
- To implement the MTVT in Simulink and adjust the parameters.

1.5 Methodology:

The matlab Simulink will be used to design a DVB-T model with the effect of motion on the received signal. The motion effect has been added by adding the Multipath Rayleigh Fading Channel. The transmitted signal will be tracked from the transmitter through the channel until it reaches the receiver. After that the transmitted signal will be compared with the received signal and then the Bit Error Rate (BER) will be calculated by the Error Rate Calculation block so that we can compare the (BER) in the case of fixed reception and the case of moving.

1.6 Thesis Outlines:

Chapter One explain preface, Problem Statement, Proposed Solution, Aim and the method used.

Chapter Two is a theoretical background and related works in a field of car DVB-T TV tuner.

Chapter Three describes the model used and simulation.

Chapter Four discusses the results of simulation for the thesis.

Chapter Five explain the conclusion and the future ideas that can be performed.

CHAPTER TWO

LITERATURE REVIEW

2.1 Technical background:

2.1.1 Digital television (DTV):

DTV is the transmission of television signals, including the sound channel, using digital encoding, in contrast to the earlier television technology, analog television, in which the video and audio are carried by analog signals. It is an innovative service that represents the first significant evolution in television technology since color television in the 1950. Digital TV can transmit multiple channels in the same bandwidth occupied by a single channel of analog television. A switchover from analog to digital broadcasting began around 2006 in some countries, and many industrial countries have now completed the changeover, while other countries are in various stages of adaptation.

2.1.2 Digital Video Broadcasting (DVB):

DVB is a suite of internationally accepted open standards for digital television.

The DVB standards specify the delivery mechanism for a wide range of applications, including satellite TV (DVB-S), cable systems (DVB-C), terrestrial transmissions (DVB-T) and handheld terminals (DVBH). The physical layer of each of these standards is optimized for the transmission channel being used. The DVB-T specification was initially created for the purpose of providing digital television over the air, mostly for fixed reception as it was done with analog television. The main issue to solve was to provide arobust modulation scheme against echoes created by reflections against buildings, hills, and other terrestrial obstacles. (OFDM) was proposed as the optimal scheme against these problems. DVB is a transmission scheme based on the Moving Picture Expert Group(MPEG-2) standard, as a method for point to multipoint delivery of high quality compressed digital audio and video. It is an enhanced replacement of the analogue television broadcast standard. The single carrier transmission method is, however, unsuitable for terrestrial transmissions as multipath severely degrades the performance of high-speed single carrier transmissions. For this reason, OFDM was used for the terrestrial transmission standard for DVB. The use of higher modulation schemes will achieve a higher data throughput.

2.1.2.1 *Digital Video Broadcasting – Terrestrial (DVB-T):*

DVB-T is the DVB European-based consortium standard for the broadcast transmission of digital terrestrial television that was first published in 1997 and first broadcast in the UK in 1998. This system transmits compressed digital audio, digital video and other data in an MPEG transport stream, using coded orthogonal frequency-division multiplexing (COFDM or OFDM) modulation. It is also the format widely used worldwide (including North America) for Electronic News Gathering for transmission of video and audio from a mobile newsgathering vehicle to a central receive point. Figure 2.1 shows digital video broadcasting-terrestrial.

2.1.2.2 Digital Video Broadcasting - Second Generation Terrestrial (DVB-T2):

DVB-T2 is the extension of the television standard DVB-T, issued by the consortium DVB, devised for the broadcast transmission of digital terrestrial television.

This system transmits compressed digital audio, video, and other data in "physical layer pipes" (PLPs), using OFDM modulation with concatenated channel coding and interleaving. The higher offered bit rate, with respect to its predecessor DVB-T, makes it a system suited for carrying HDTV signals on the terrestrial TV channel (though many broadcasters still use plain DVB-T for this purpose). Table 2.1 comparison between DVB-T and DVB-T2.

The following characteristics have been devised for the T2 standard:

- COFDM modulation with QPSK, 16-QAM, 64-QAM, or 256-QAM constellations.
- OFDM modes are 1k, 2k, 4k, 8k, 16k, and 32k. The symbol length for 32k mode is about 4ms.
- Guard intervals are 1/128, 1/32, 1/16, 19/256, 1/8, 19/128, and 1/4. (For 32k mode, the maximum is 1/8.)
- FEC is concatenated LDPC and BCH codes (as in DVB-S2 and DVB-C2), with rates 1/2, 3/5, 2/3, 3/4, 4/5, and 5/6.
- There are fewer pilots, in 8 different pilot-patterns, and equalization can be based also on the RAI CD3 system.
- In the 32k mode, a larger part of the standard 8 MHz channel can be used, adding about 2% extra capacity.
- DVB-T2 is specified for 1.7, 5, 6, 7, 8, and 10 MHz channel bandwidth.
- MISO (Multiple-Input Single-Output) may be used (Alamouti scheme), but MIMO will not be used. Diversity receivers can be used (as they are with DVB-T).
- Multiple PLPs to enable service-specific robustness at a particular bit rate.
- Bundling of more channels into a Super MUX (called TFS) is not in the standard.

Table 2.1 comparison between DVB-T and DVB-T2:

	DVB-T	DVB-T2
Input Interface	Single Transport Stream(TS)	Multiple Transport Stream and Generic Stream Encapsulation (GSE)
Modes	Constant Coding& Modulation	Variable Coding & Modulation
Forward Error Correction(FEC)	Convolutional Coding + Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LDPC+BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modulation	OFDM	OFDM
Modulation Schemes	QPSK,16QAM,64QAM	QPSK, 16QAM, 64QAM, 256QAM
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Discrete Fourier transform(DFT) size	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered Pilots	8% of total	1%, 2%, 4%, 8% of total
Continual Pilots	2.6% of total	0.35% of total
PLPs	No	Yes

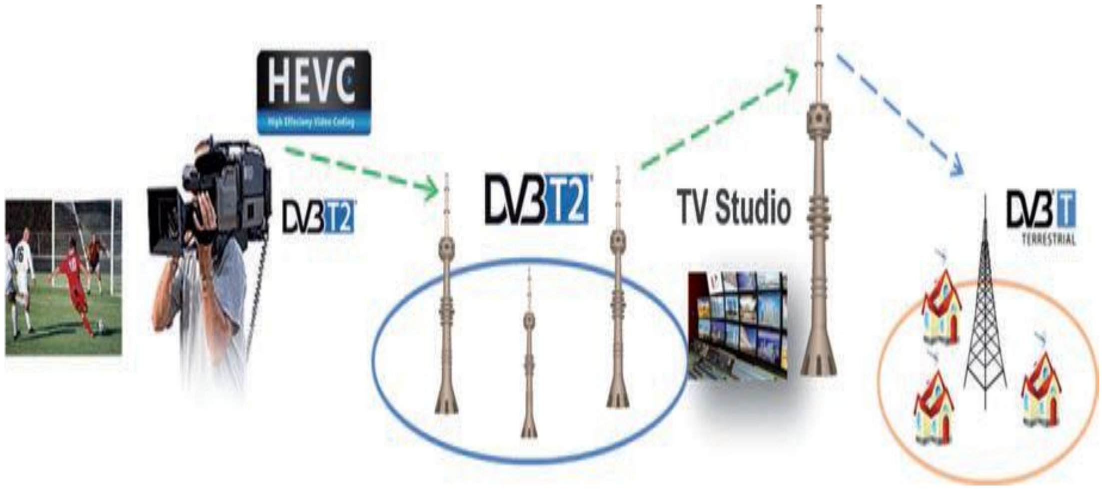

Figure 2.1:digital video broadcasting-terrestrial

2.1.3 TV tuner:

A TV tuner card is a kind of television tuner that allows television signals to be received by a computer. Most TV tuners also function as video capture cards, allowing them to record television programs onto a hard disk much like the digital video recorder (DVR) does.

There are currently two kinds of tuner are used:

2.1.3.1 Hybrid tuners:

A hybrid tuner has one tuner that can be configured to act as an analog tuner or a digital tuner. Switching between the systems is fairly easy, but cannot be done immediately. The card operates as a digital tuner or an analog tuner until reconfigured.

2.1.3.2 Combo tuners:

This is similar to a hybrid tuner, except there are two separate tuners on the card. One can watch analog while recording digital, or vice versa. The card operates as an analog tuner and a digital tuner simultaneously. The advantages over two separate cards are cost and utilization of expansion slots in the computer. As many regions around the world convert from analog to digital broadcasts, these tuners are gaining popularity.

Like the analog cards, the Hybrid and Combo tuners can have specialized chips on the tuner card to perform the encoding, or leave this task to the CPU. The tuner cards with this 'hardware encoding' are generally thought of as being higher quality. Small USB tuner sticks have become more popular in 2006 and 2007 and are expected to increase in popularity. These small tuners generally do not have hardware encoding due to size and heat constraints.

2.1.3.3 Mobile TV adapter:

External TV tuner card attachments are available for mobile phone handsets like the iPhone, for watching mobile TV, via TV stations on 1seg in Japan (Soft Bank), and for soon for the proprietary subscription-based Media FLO in the U.S. (Qualcomm). There is also a "converter" for watching DVB-H in Europe and elsewhere via Wi-Fi streaming video(Packet Video).

2.1.3.4 Video capture:

Video capture cards are a class of video capture devices designed to plug directly into expansion slots in personal computers and servers. Models from many manufacturers are available; all comply with one of the popular host bus standards including PCI, newer PCI Express (PCI) or AGP bus interfaces.

These cards typically include one or more software drivers to expose the cards' features, via various operating systems, to software applications that further process the video for specific purposes. As a class, the cards are used to capture baseband analog composite video, S-Video, and, in models equipped with tuners, RF modulated video. Some specialized cards support digital video via digital video delivery standards including Serial Digital Interface (SDI) and, more recently, the emerging HDMI standard. These models often support both standard definition (SD) and high definition (HD) variants.

While most PCI and PCI-Express capture devices are dedicated to that purpose, AGP capture devices are usually included with the graphics adapted on the board as an all-in-one package. Unlike video editing cards, these cards tend to not have dedicated hardware for processing video beyond the analog-to-digital conversion. Most, but not all, video capture cards also support one or more channels of audio. New technologies allow PCI-Express and HD-SDI to be implemented on video capture cards at lower costs than before.

There are many applications for video capture cards like EasyCap including converting a live analog source into some type of analog or digital media, (such as a VHS tape to a DVD), archiving, video editing, scheduled recording (such as a DVR), television tuning, or video surveillance. The cards may have significantly different designs to optimally support each of these functions. Capture cards can be used for recording a video gamelongplay (LP) so gamers can make walkthrough game play videos.

One of the most popular applications for video capture cards is to capture video and audio for live Internet video streaming. The live stream can also be simultaneously archived and formatted for video on demand. The capture cards used for this purpose are typically purchased, installed, and configured in host PC systems by hobbyists or systems integrators. Some care is required to select suitable host systems for video encoding, particularly HD applications which are more affected by CPU performance, number of CPU cores, and certain motherboard characteristics that heavily influence capture performance.

2.1.4 Mobile TV:

The mobile TV applications such as DVH-H/T, T-DMB/DAB, ISDB-T are recently emerging all over the world. To support various applications, the multi standard and multiband mobile TV RF tuner is developed as a cost-effective and size-effective solution.

2.2 Related Work:

Digital video broadcasting-terrestrial (DVB-T) is the name of the terrestrial transmission system which was developed by the DVB Thesis. DVB-T is in It describes its capabilities with a special emphasis on mobile reception. In order to analyze how an MPEG transport stream at the input of a DVB-T modulator is turned into a DVB-T signal, we consider the channel coding and modulation used. Network planning issues, antenna diversity concepts for mobile receivers, and handover procedures will be considered. the introduction of DVB-of. In contrast to various other countries Germany decided to offer DVB-T as a means of providing the "anywhere TV" experience. This implies that DVB-T signals can be received with mobile and portable receivers. In regions with DVB-T coverage analogue terrestrial TV services were discontinued just a few months after the launch of DVB-T [1].

A baseband receiver for DVB-T OFDM with variable number of subcarriers. The proposed receiver consists of a blind mode detector, time and frequency synchronizer, and channel estimator. The blind mode detector uses a novel algorithm to detect the number of OFDM subcarriers in the received signal. Time and frequency synchronization is performed after the transmission mode is detected, channel estimation is performed using ID or 2D interpolation. Simulation results show that the proposed mode detection and synchronization algorithms are close to ideal, and good overall performance is achievable [2].

DVB-T2 implements tradeoffs in terms of time diversity, latency and power saving. we study in detail these tradeoffs in the context of mobile reception. Together with time diversity, we also investigate the impact of reduced time de-interleaving memory and Alamouti-based MISO in the mobile reception of DVB-T2 services. In addition, we propose the utilization of upper layer FEC protection in order to overcome the limitations of the DVB-T2 physical layer for the provision of long time interleaving, and enable fast zapping. The performance is evaluated by means of simulations in mobile channels that include the presence of fast fading and shadowing in the received signal [3].

They present detailed experimental performance results of classical mobile channel (TU6) for DVB-T2. These evaluations are given for different Doppler frequencies in a classical SFN (Single Frequency Network) compared to distributed MISO. Laboratory and field measurements are presented. With the receiver used for our experiments, the results show clearly the quality degradation of received signals for distributed MISO compared to classic SFN. These results are useful for the study and the determination of the current mobile performance of DVB-T2 and network design and may also be useful for upcoming standards such as DVB-NGH (Next Generation Handheld) [4].

A number of technical innovations have been included in DVB-T2 to boost throughput and ruggedness, enhance single-frequency network coverage, and ease both transmitter and receiver implementation. the new standard and then surveys the key technologies behind DVB-T2, including the LDPC/BCH forward error correction scheme, transmission scheduling, orthogonal frequency-division multiplexing with huge block size, multiple-antenna transmissions, and synchronization techniques. A comparison with the current DVB-T standard is also provided, showing that DVB-T2 is able to increase the payload throughput and allows HDTV transmission with current network planning [5].

The exploring of the DVB-T/T2 transmission performance in advanced mobile television channel models. For the analysis and simulation there were used advanced mobile fading channel models called Vehicular Urban and Motorway Rural that respects fast moving receiver in a car and Doppler shift. Detailed dependences of the bit error ratio before and after channel decoding and according modulation error ratio on the carrier-to-noise ratio are the main results of this work. Applications for the exploring of DVB-T/T2 performance were completely created in MATLAB. In advance, the results of the simulations were completely verified on real measurement data to be sure about their validity [6].

The frequency bands are presented. It is designed to be integrated in a monitor-equipped device, and exhibits reduced electrical size with respect to similar PIFA configurations. A reflection coefficient less than -6 dB and -10 dB was obtained in the 470-862 MHz (59% percentage bandwidth) DVB-T and the 2400-2484 MHz (2.7% percentage bandwidth) WLAN bands, respectively. An antenna gains of almost 3 dB and 4.5 dB, with more than 95% radiation efficiency, was obtained in the two frequency bands of interest. The PIFA fills an overall volume of 217 × 12 × 8 mm^3 and can be realized by a properly cut and fold single metal sheet. Measurements on prototypes have shown that the proposed layout is robust in terms of the impedance matching detuning that can be caused by the presence of metal parts nearby the antenna [7].

The proposed antenna consists of a grating patch and a concave rectangular ground plane with defected ground plane. The added part in the ground plane is used to enable the antenna height reduction for fixed ranges of operating frequency. The proposed antenna can operate from 470 MHz to 870 MHz frequency range corresponding to 60 % of impedance bandwidth for |S11| better than -7.5 dB. This covers the working frequency band (470-862 MHz) of DVB-T system. The radiation pattern of the proposed antenna is omnidirectional across the desired operating frequency band [8].

An important research effort is undertaken by main industry actors to face the multidimensional (transport technology, session signaling, and QoS provisioning) heterogeneity in the Next Generation Network (NGN). The per-session service adaptation is crucial to accommodate terminal and network heterogeneity experienced by different mobile users. we investigate an intermediate architecture based on interconnection of DVB-T and 802.11 WLAN networks. The 802.11 WLAN is considered today as the "de-facto" wireless access network for the last miles connection. Both its per-service cost-effectiveness and wide acceptation by users make it an ideal candidate to bridge existing broadcast TV services toward the end-users. We propose a seamless cross-layer inter-working between broadcasting network (i.e. DVBT) and 802.11 WLAN network for adaptive and interactive mobile TV service delivery. We use a specific Adaptation Gateway (AG) at each Access Network to perform media adaptations. AG features a joint channel and video bit-rate awareness to tackle link degradations (signal strength quality, packet loss, etc.). Performance evaluations using an experimental test-bed are conducted and they show that our proposed cross-layer adaptation gateway reduces considerably packet losses and enhances the perceived quality of the TV service. it is possible to address network and terminal heterogeneity and to offer interactive and personalized service to the end users [9].

proposes several novel designs to reduce the synchronization latency and hardware complexity. The carrier and clock synchronization loops are fully digitalized schemes. The scattered pilots synchronization adopts a two stages scheme to reduce the detection latency. In addition, the pre-filling scheme reduces the latency of channel estimation. The design result shows that the equivalent gate count is about 810 K gates including 102.8 KB memory [10].

We propose an efficient algorithm for adaptation to time varying channels of the second filter. The method is applied to the Terrestrial Digital Video Broadcasting System (DVB-T), which was originally specified for fixed receivers and which is in the process of being extended for mobile reception. The results are shown after inner decoding. Depending on the channel conditions, the signal-to-noise ratio gain can be up to 1.6 dB. The method provides a compatible improvement to DVB-T receivers [11].

Signal space diversity (SSD) has been lately adopted into the second generation of the terrestrial digital video broadcasting standard DVB-T2. While spectrally efficient, SSD improves the performance of QAM constellations over fading channels thanks to an increased diversity. In this paper, flexible mapper and demapper architectures for DVB-T2 standard are detailed. A detection based on the decomposition of the constellation into two-dimensional sub-regions in signal space associated to an algorithmic simplification constitute the main novelty of this work. They enable to strongly decrease the complexity of the demapper. The design and the FPGA prototyping of the resultant architecture are then described. Low architecture complexity and measured performance demonstrate the efficiency of the detection method [12].

The performing channel estimation and equalization normally so-called frequency domain pilots are employed. As pilots are known information to the receiver, they do not carry any information and are thus overhead. Therefore, DVB-T2 also allows for a mode with nearly no frequency domain pilots, whereby the channel estimation is based on the data itself. This paper shows the high performance and throughput benefits of this pilot-free transmission and blind channel estimation technique while proposing an optimized algorithm [13].

Signal space diversity (SSD). While spectrally efficient, SSD improves the performance of QAM constellations over fading channels thanks to an increased diversity. flexible mapper and demapper architectures for DVB-T2 standard are detailed. A detection based on the decomposition of the constellation into two-dimensional sub-regions in signal space associated to an algorithmic simplification constitute the main novelty of this work. They enable to strongly decrease the complexity of the demapper. The design and the FPGA prototyping of the resultant architecture are then described. Low architecture complexity and measured performance demonstrate the efficiency of the detection method [14].

The new terrestrial digital video broadcasting standard DVB-T2 provides a specific symbol - called P1-symbol - for the initial time and frequency synchronization. the maximum likelihood (ML) time and carrier frequency offset (CFO) synchronization scheme, which exploits the structure of the P1 symbol in both time and frequency domains is derived. Two lower-complexity solutions are then proposed: (1) a ML estimator that only exploits the time structure of the P1 symbol and (2) a pseudo ML (PML) scheme that resorts to a suboptimal CFO estimator while still performing ML time synchronization. The proposed schemes are compared in terms of both synchronization capabilities and implementation complexity. The Cramèr-Rao bounds for the CFO estimators are also evaluated. Simulation results in a typical DVB-T2 scenario show that both ML and PML schemes have a very close performance while significantly outperforming existing schemes [15].

The feasibility of software implementation of DVB-T2 receiver with DTG-106 [1] mode using the coarse-grained reconfigurable array (CGRA) based processor. This paper focuses mainly on DVB-T2 system design and implementation of major software functions of DVB-T2 demodulator: FFT, frequency interpolation, multi-level de-interleaving, and soft-demapper. By implementing the full chain DVB-T2 software and measuring the cycle performance, we demonstrate the software implantation of DVB-T2 on dual core CGRA processor running at 400 MHz [16].

The parameters can be perfectly optimized for each reception scenario, ranging from stationary reception with roof-top aerials, up to portable or mobile reception. However, all countries that have already introduced DVB-T2 mainly focus on stationary reception. In contrast, stationary reception is no relevant option for a potential introduction of DVB-T2 in Germany. Instead, a potential roll-out would focus on the benefits of terrestrial broadcasting compared to satellite and cable, i.e., mobility. Within an extensive field trial in northern Germany, the performance of the different parameter configurations and new algorithms offered by DVB-T2 were analyzed in detail, e.g., multiple physical layer pipes, rotated constellations, and multiple-input single-output. the trial network and the obtained measurement results, which are based on thousands of individual measurements. Moreover, the document gives recommendations for an optimal parameter configuration.

DVB-NGH enabled Handheld receivers are going to work with the existing DVB infrastructure. we model the link budget deficits of the Handheld DVB receivers as additional power losses for a typical fixed roof-top DVB-T2 receiver. Because of those additional losses Handhelds get a reduced coverage. The attrition in coverage is especially dramatic for the indoor Handheld receivers. We analyze coverage for two different models of the Population density, i.e. Clark's and Smeed's [17].

The performance of a pilot aided channel estimator and equalizer for DVB-T2 for the 8 different pilot patterns are explore. In addition to, develop a system that adopts the pilot pattern that provides the best bit error rate (BER) performance for the certain radio environment in which the receiver operates. This scheme will enhance the performance of current DVB-T2 transmission system. We test our system using different types of channel estimation scheme with increasing levels of computation complexity namely: Linear interpolation (Step), Linear Interpolation Order 0(Line0), Linear Interpolation Order 1 (Line1) and Spline Least Squares Best Fit estimators; which have been proposed to estimate the Channel Frequency Response (CFR) between the pilots' location. In this paper, the performance results for SISO by producing BER against SNR graphs is analyzed and presented for different configurations such as QAM modulation orders, number of sub-carriers and type of pilot patterns for different radio environments [18].

DVB-T2 uses orthogonal frequency division multiplexing (OFDM) as modulation scheme. For performing channel estimation and equalization normally so-called frequency domain pilots are employed. As pilots are known information to the receiver, they do not carry any information and are thus overhead. Therefore, DVB-T2 also allows for a mode with nearly no frequency domain pilots, whereby the channel estimation is based on the data itself. This paper shows the high performance and throughput benefits of this pilot-free transmission and blind channel estimation technique while proposing an optimized algorithm [19].

passive radar systems that use analyze the ambiguity function and make explicit its features in delay and Doppler in terms of the underlying structure of the DVB-T signal. Ambiguities will be managed via the development of a set of mismatched filter weights that will be applied to the reference signal prior to range-Doppler map formation. The development of the mis-matched filter is based on previous work with an extended improvement for ambiguity peak reduction a wider variety of DVB-T signals [20].

high-level system simulations have been performed, followed by the construction of a prototype DVB-T receiver using a custom20-GHz bipolar technology, show an overall third-order input referred intercept point of 116 dB/spl mu/V, a noise figure of 14 dB and an automatic gain control range of 71.4 dB, drawing 250 mA at a 5-V supply [21]. designed analog ASIC which integrates all analog tuner blocks (including channel filtering) on one chip. Measured results from this chip, implemented in a

CHAPTER THREE

SYSTEM DESIGN AND IMPLEMENTATION

3.1 General description of the DVB-T model:

3.1.1 Random Integer Generator block: Generate random integer numbers.

3.1.2 Integer-Input RS Encoder block:

The Integer-Input RS Encoder block creates a Reed-Solomon code with message length and code word length number of punctures.

3.1.3 OFDM Modulator Baseband block:

The OFDM Modulator Baseband block applies OFDM modulation to an incoming data signal. The block accepts one or two inputs depending on the state of the Pilot input port.

3.1.4 OFDM Demodulator Baseband block:

The Orthogonal Frequency Division Modulation (OFDM) Demodulator Baseband block demodulates an OFDM input signal. The block accepts a single input and has one or two output ports, depending on the status of Pilot output port.

3.1.5 Integer-Output RS Decoder block:

The Integer-Output RS Decoder block recovers a message vector from a Reed-Solomon code word vector. For proper decoding, the parameter values in this block must match those in the corresponding Integer-Input RS Encoder block.

3.1.6 Integer to Bit Converter block:

The Integer to Bit Converter block maps each integer (or fixed-point value) in the input vector to a group of bits in the output vector.

The block maps each integer value (or stored integer when you use a fixed point input) to a group of bits, using the selection for the Output bit order to determine the most significant bit. The resulting output vector length is times the input vector length.

3.1.7 Error Rate Calculation block:

The Error Rate Calculation block compares input data from a transmitter with input data from a receiver. It calculates the error rate as a running statistic, by dividing the total number of unequal pairs of data elements by the total number of input data elements from one source.

Use this block to compute either symbol or bit error rate, because it does not consider the magnitude of the difference between input data elements. If the inputs are bits, then the block computes the bit error rate If the inputs are symbols, then it computes the symbol error rate.

3.1.8 Spectrum Analyzer Block:

The Spectrum Analyzer block, referred to here as the scope, displays frequency spectra of signals. The Spectrum Analyzer block accepts input signals, through one or more input ports, with the following characteristics:

- Discrete sample time.
- Real- or complex-valued.
- Fixed number of channels of variable length.
- Floating- or fixed-point data type.

3.1.9 Display: Shows value of input.

3.1.10 The Additive White Gaussian Noise (AWGN) Channel:

The Additive White Gaussian Noise (AWGN) is the easiest and omnipresent. The model does not include nonlinearity, frequency selective, interference and fading. The figure 3.1.10 shows the continues model of AWGN channel where is signal transmitter and is the signal receiver waveform.

Generally, the *W(t)* is known as thermal noise. Random motion of electrons in electrical device causes to generate the thermal noise.

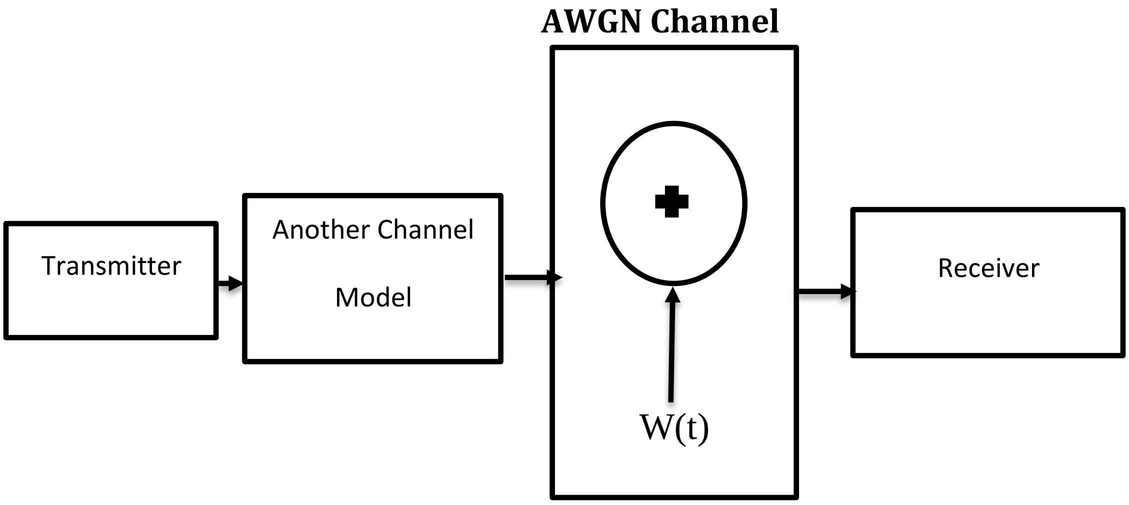

Figure 3.1.10: Communication System Model with AWGN and Another Channel.

3.1.11 Scatter Function Block:

Multipath fading and user mobility lead to a time and frequency dependent channel. The Transfer function of a particular sample channel does not necessarily provide enough details about the stochastic behavior of the radio channel. Such stochastic properties are captured in the scatter function. The scatter function combines information about

- Doppler spread (which relate to angles of arrival).
- path delays.

3.1.12 DVB-T 64-Quadrature Amplitude Modulaton QAM Demapper Block:

A 64-QAM demapper that makes soft decisions, producing a set of six real numbers for each complex number in its input. These six numbers represent soft decisions on the real and imaginary components' first bit, second bit, and third bit. The Viterbi Decoder subsystem interprets the soft-decision numbers and uses them to decode the punctured convolutional code properly.

3.1.13 Outer Interleaver(Convolutional Interleaver) Block:

The data obtained from the output of RS is applied to a convolutional Interleaver having the standard parameters. A Convolutional interleaver rearranges the transport stream to increase the efficiency of the RS decoder.

3.1.14 DVB-T Inner Interleaver Block:

The last process of these error protection techniques is the inner interleaver. Inner interleaver has two separate processes. Bit interleaver and symbol interleaver.

3.1.15 Multipath Rayleigh Fading Channel block:

The Multipath Rayleigh Fading Channel block implements a baseband simulation of a multipath Rayleigh fading propagation channel. This block accepts a scalar value or column vector input signal. The block inherits sample time from the input signal. The input signal must have a discrete sample time greater than 0.

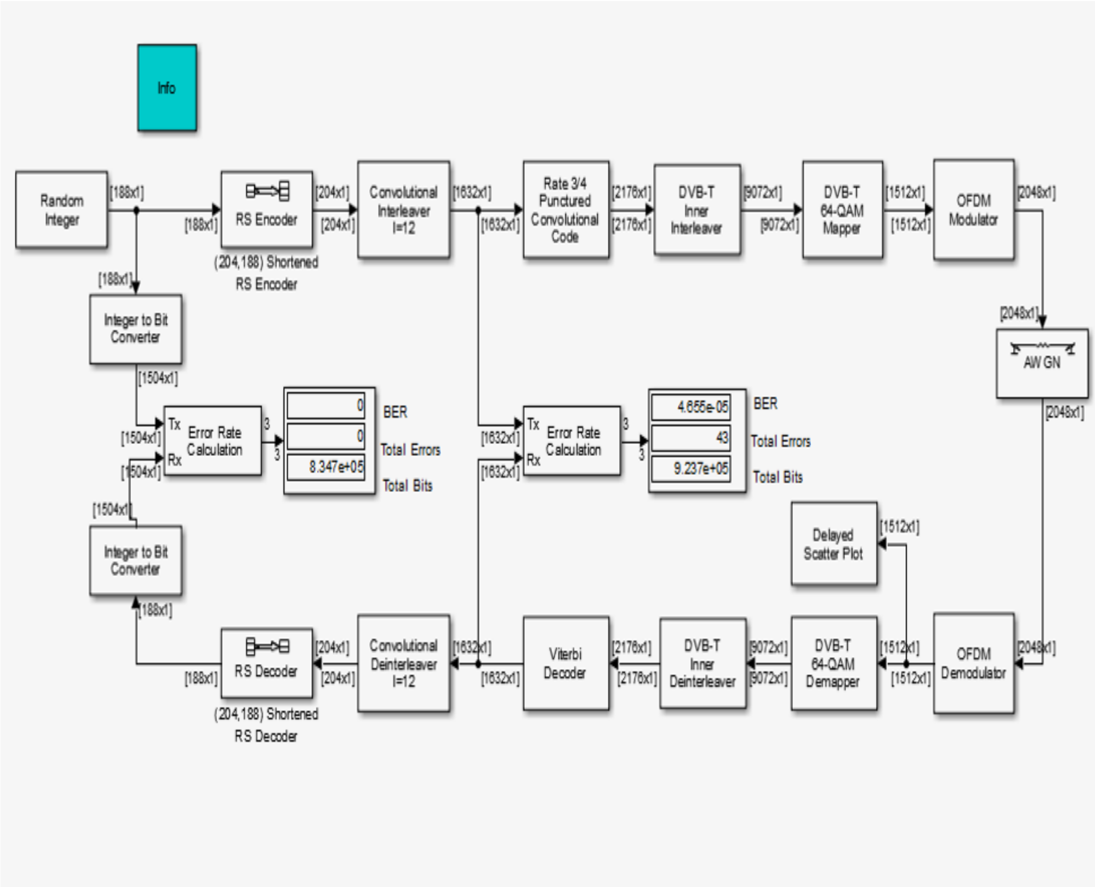

Figure 3.2: model of DVB-T block diagram

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Overview:

This chapter covers the results obtained from the simulation.

4.2 simulation result:

Figure 4.1 shows the output signal of the OFDM modulator which represent the transmitted signal with the following parameters:

FFT=2048

Number of guard bands = [268 268]

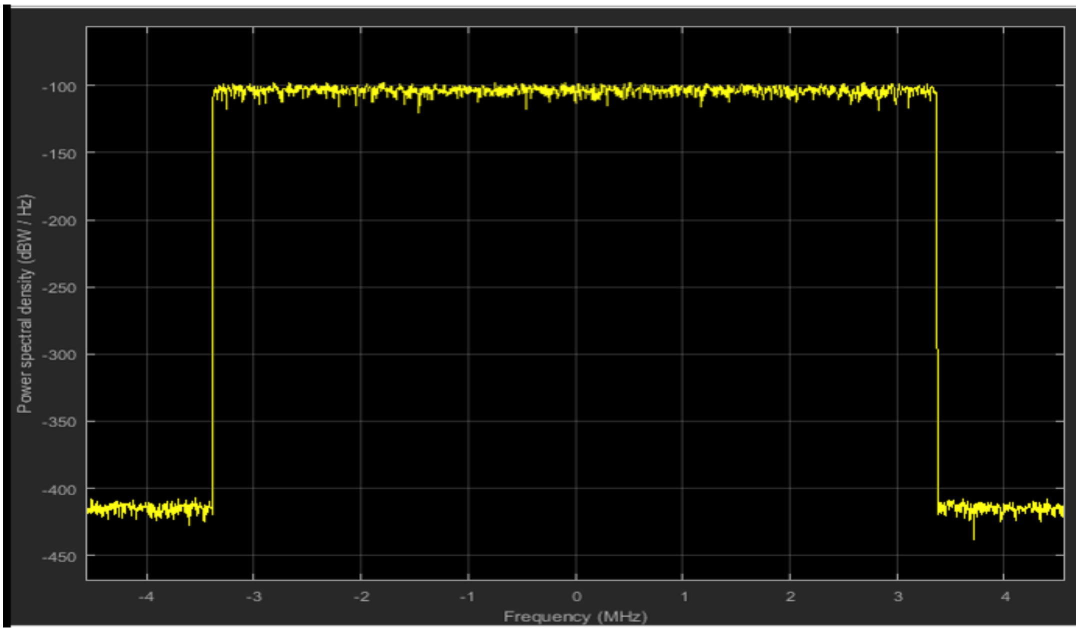

Figure 4.1: the transmitted signal

Figure 4.2 shows the signal of the AWGN channel with the parameters:

SNR=18.5 db

Input signal power = 1\2048

We notice that the signal has become very noisy because of the effect of the AGWN channel.

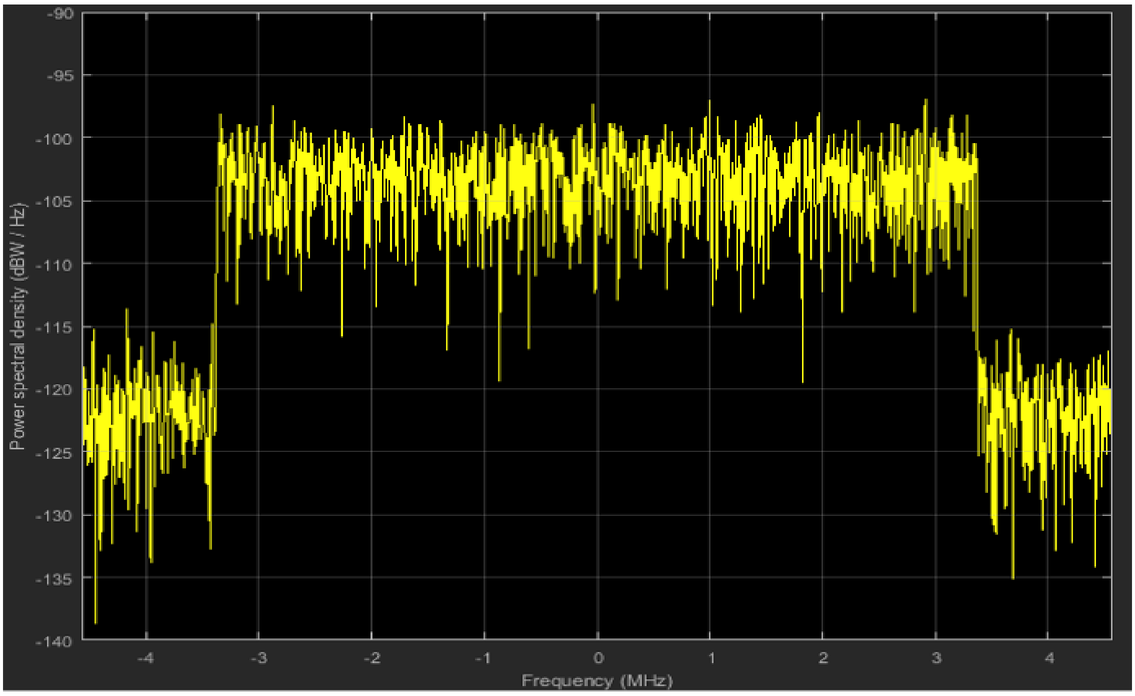

Figure 4.2: signal of the AWNG channel

Figure (4.31) shows the output signal of OFDM demodulator with the following parameters which is similar to the transmitted signal before modulation.

FFT=2048

Number of guard bands = [268 268]

figure 4.32 shows the signal Bit Error Rate (BER) before adding the multipath Rayleigh fading channel

BER=0

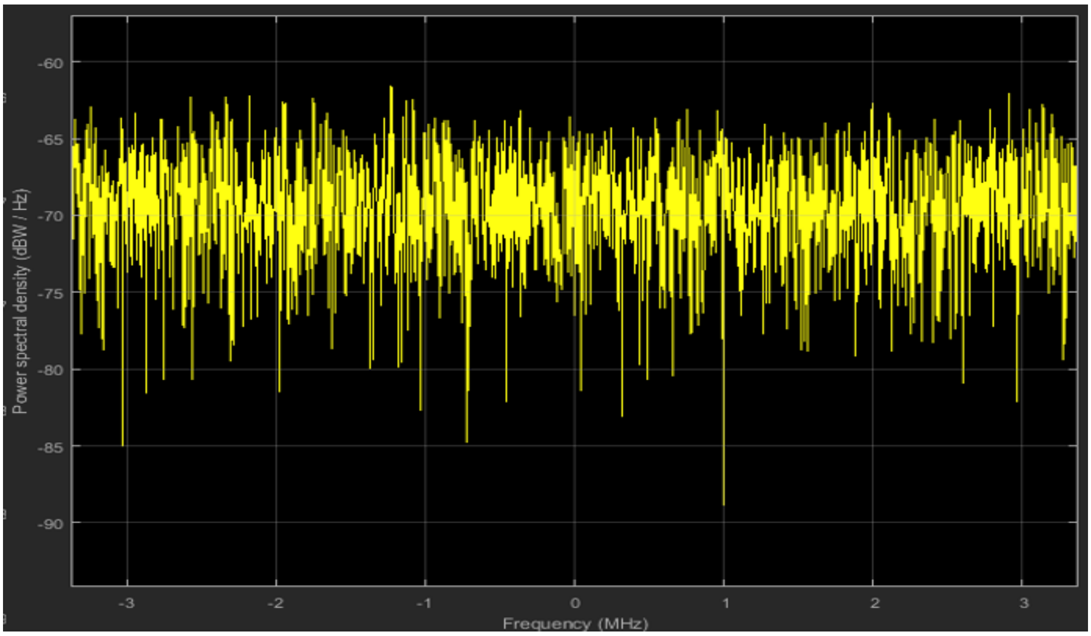

Figure 4.31 : signal of OFDM demodulator

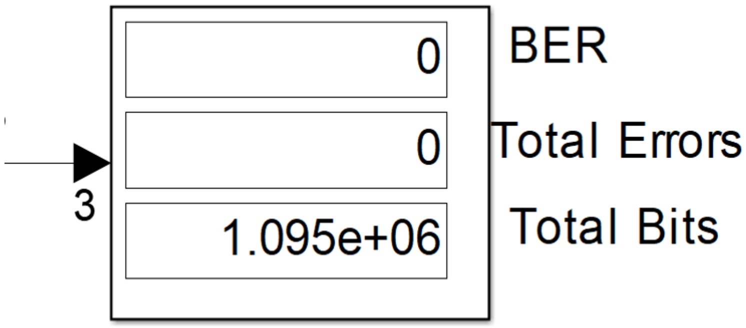

Figure 4.32 : The Bit Error Rate

The signal from the Rayleigh fading channel showed in figure 4.41 with the following parameters:

THD=-1.15 db

SNR=-20.10DB

SNAD=-20.13 db

SFDR=0.19 db

After we add the Rayleigh fading channel the bit error rate has become.

BER=0.504 as shown in figure 4.42

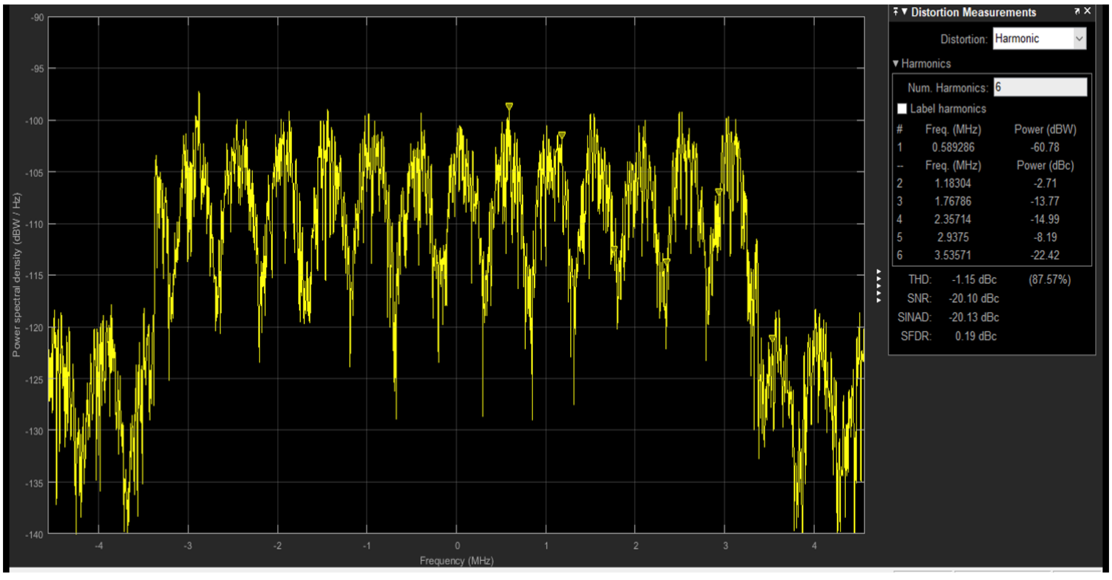

Figure 4.41 signal from Rayleigh Fading Channel

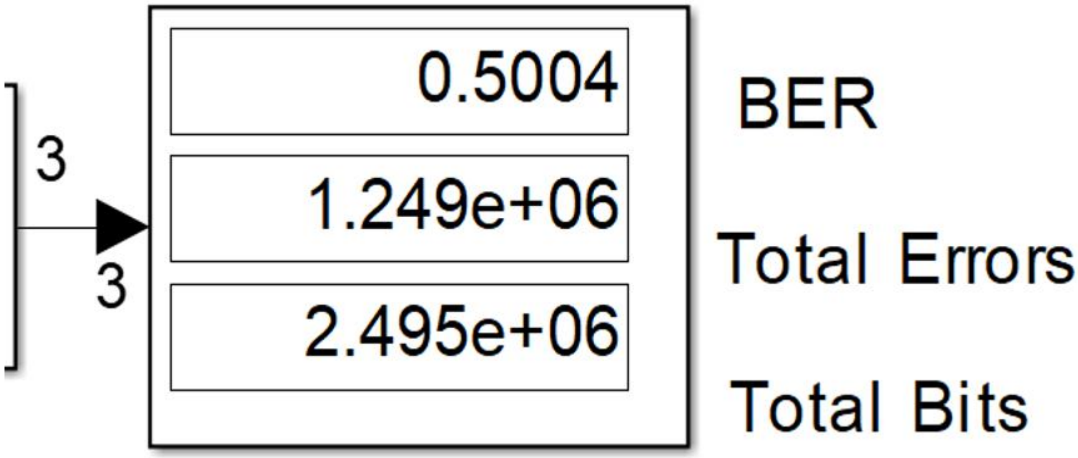

Figure 4.42 the Bit Error Rate

Figure 4.5 shows the signal at the last stage which represent the received signal after we add the equalizer block to adjust the Bit Error Rate (BER).

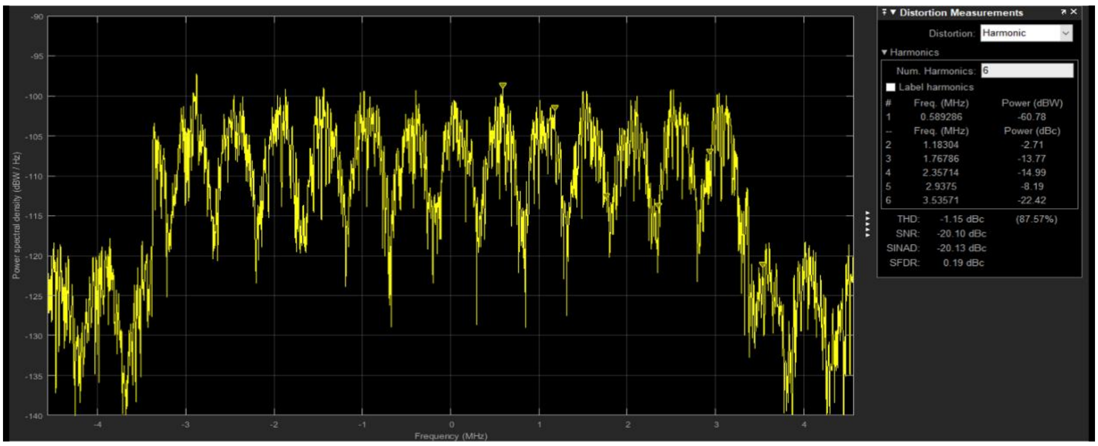

Figure 4.5: the received signal

Figure 4.6 shows the signal after the Error rate calculation.

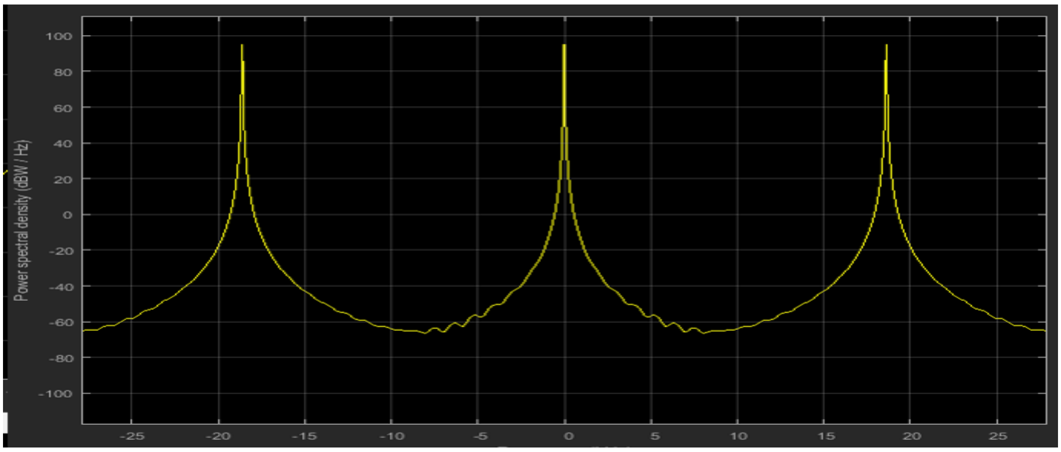

Figure 4.6: signal after Error Rate Calculation

Figure 4.7 shows the signal from the OFDM receiver which represent the quadrature amplitude of the received signal.

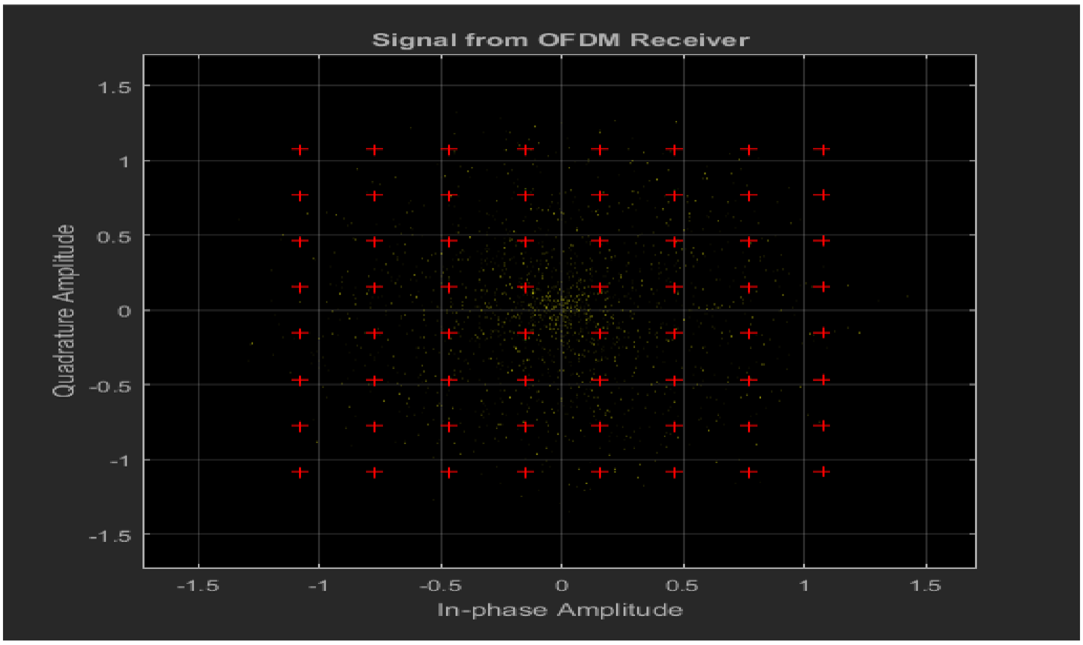

Figure 4.7: QAM for the received signal.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion:

In this Thesis a successful simulation of DVB-T model has been done which represent the effect of motion. The overall model consists of transmission stage and reception stage with a channel between them. The all Thesis is about receiving digital video broadcasting on a moving vehicle so that we add the multipath Rayleigh fading channel to simulate the motion of the vehicle.

The Thesis is done using MATLAB SIMULINK simulation tool and it work properly when the signal is transmitted through the channel to the receiver and the problem of the Bit Error Rate produced from. The motion has been avoided by adding the equalizer block to the model.

By achieving that the system can provide reception of digital TV on a moving car.

5.2 Recommendation:

This Thesis can be improved to more advanced Thesiss using DVT-T2 by improving the performance of the receiver so that we recommend to:

- Work on the problem of the noise produced by the effect of the motion.
- Hardware implementation of the model.
- Improve the model into Digital Video Broadcasting - Second Generation Terrestrial standard.