

IMPLEMENTATION OF DATA TRANSMISSION USING GMSK MODULATION ON SDR PLATFORM

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Abstract

The requirement for transmission systems which use software and hardware hybrid arrangement, recognized as Software Defined Radio (SDR), rises because of restricted channel capacity in wireless communication. The focus of this paper is to understand the basic methods for real time file transmission in an open source, flexible and platform of low cost – Universal Software Radio Peripheral (USRP) along with GNU radio. SDR is a technology in which software is changed without varying the implementation of essential hardware aspect used in various communication applications. The GNU (not UNIX) Radio along with USRP has a low cost, fast processing ability of the platform called as SDR. It is a freeware easily available source software supporting SDR platform and USRP acts as the hardware for GNU Radio. The main focus of this paper is on the implementation of PSK modulator & demodulator and evaluates the working & results of a file transfer using PSK modulation technique. The real time file signal transmission and reception is performed using USRP and GNU Radio.

Keywords—PSK, GNU Radio, SDR, FPGA, USRP.

I. INTRODUCTION

Wireless communication is one of the interesting areas of research at the moment. But our conventional hardware based wireless communication systems are not able to adapt with the advancements in the wireless field. There is a need to develop such systems that can use the voice transmission channels to transfer data, images, videos etc, on the same medium. For this, there will be a need for an additional capacity for the existing systems and might require modifications in the infrastructure/hardware. There are some other challenges like scarcity of frequency resources, competitive standards, etc. The advent of SDR lead to the third revolution of wireless communication as it helped in providing greater flexibility because the changes are done at software level, instead at hardware. It is a flexible, reliable, upgradable, low cost and reconfigurable and reusable platform. SDR (SoftwareDefinedRadio) is a wireless system that handles the air traffic, interfaces and applications. In the SDR experimental toolkit, USRP is used as hardware set-up and GRC (GNU Radio companion) is used as software set-up.

In SDR system, GRC is used to perform different functions and modules. The GRC platform is a powerful Graphical user interface (GUI), which helps in performing SDR modules in effective way. GUI model providing practical exposure to wireless communication concepts like multiplexing, digital and considered as strongest technique in the area of wireless communication due to its ability to reduce the sideband power and provide better spectral efficiency.

This paper focuses on transmission of real time file signal through the PSK modulator and demodulator. This paper is organized as follows: Section II briefly explains the SDR system which includes USRP and GRC. Section III demonstrates the system model of this experiment i.e. real time file transmission using PSK modulation and demodulation. Section IV represents the results of the experiment. Section V presents the conclusions drawn and finally section VI is about the references.

II. SDR

1. Software Part- GNU Radio

The GNU Radio is open source free software that was designed by the Eric Blossom with the help of GNU radio general public license. In this paper, GNU Radio [5] acts as the programming part for the performance of SDR which is accessed. It is freely available online software. It is a very well suited programming tool that can be used to design various wireless performing applications. This software is varied, compiled and performed on personal computers and uses several operating systems, such as Window XP, Linux and various others. Ubuntu is the operating system used in this paper.

GNU Radio applications are created using Python or C++. It is full of two important portions: 'flow graph' and 'Block'. A block is signal processing unit for programming which is easily available in GNU Radio. C++ has higher proficiency, because thus usage is there for programming of processing of signal using block system. There are large varieties of signal blocks exceeding 100 signal processing blocks available in GRC, like mathematical calculation, convolutional code, different filters, frequency modulations etc. Also, it is easy to put into work a new signal processing block using the programming in GNU Radio. Therefore new blocks can be easily added according to the requirement. 'Flow graph' is the signal data graph used to achieve the tasks of different standards of communication. Because of Python's easier programming and flexibility, it is validating to further enhance the program code in the 'flow graph'. To enhance the programming speed it uses additional category of block which is written in Python programming code known as 'hierblock' which contains some processing signal blocks. There are some advanced version blocks like GMSK (Gaussian filtered Minimum Shift Keying) used for performing the function of modifying and reconvert using flowchart System.

In GNU Radio, there is a beneficial toolkit specified as Simplified Wrapper and Interface Generator (SWIG) which is used to change the Complex code of C++ class base model into the simpler function through which classes can also be programmed using Python. Using of this SWIG toolkit, GNU Radio is efficient of getting together combinable using the essential benefits of both codes of Python and C++ [7]. The basic function diagram of the GNU Radio is shown in Figure. 1

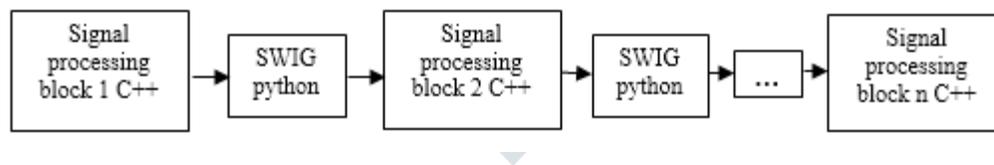


Fig. 1: Structure of GNU Radio

2. Hardware Part- USRP

USRP goes about as equipment part for SDR. It is the most significant equipment accomplice of GNU Radio as it gives RF front end to continuous correspondence. It design the product radio with the accessible RF condition. USRP not very costly and clients can download all structure archives and circuits and the code simulation of FPGA through the Ettus Research site. USRP essentially comprise of daughterboard and one main processing unit.

A USRP hardware board is appeared in Figure. 2 [6]. The motherboard changes over advanced sign to simple sign and the other way around and some different elements of motherboard are computerized up/down transformation, the change between baseband sign and middle of the road recurrence sign, interjection and pulverization signal preparing process. It additionally comprises of two ADCs and furthermore has a FPGA

which is significant piece of USRP. It executes high transfer speed numerical figurings and diminish the speed of information so it very well may be effectively broadcasted through USB 2.0.

USRP can be interconnected to the PC through USB 2.0. In particular, the information spilled over the USB 2.0 interface is as I/Q tests. There have been reports in regards to the USB 2.0 interface supporting information rates around 32MS/s and an inexact transmission capacity of about 6MHz of I/Q information and 12MHz of genuine information. There are four spaces in one motherboard, so simultaneously it tends to be associated with all things considered four daughterboard in which two are utilized as transmitting daughterboard and others two utilized as accepting daughterboard.

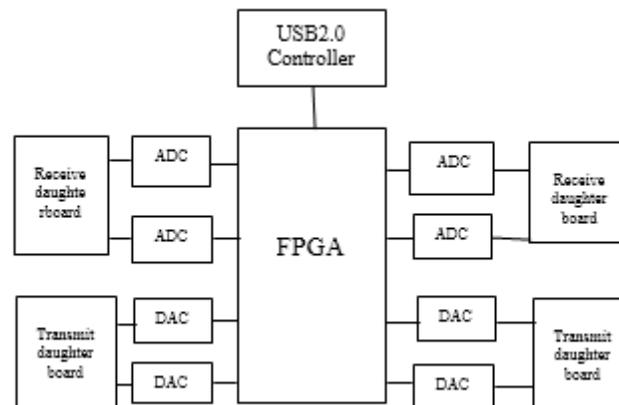


Fig. 2: USRP block diagram

3. Gaussian Minimum Shift Keying

Gaussian Minimum Shift Keying (GMSK) is similar to standard minimum phase shift keying modulation technique with the difference that the digital data stream is first shaped with the help of Gaussian filter and then it is applied to a frequency modulator. It is a type of continuous-phase FSK in which a constant envelope is provided by phase change between the symbols. Using this technique, packetized video is modulated using GMSK modulation and because of the flexibility of the GNU Radio tool, video transmission parameters such as video size, rate and gain of transmission can be reconfigured.

III. EXPERIMENT SET-UPS

In this paper, system model is divided into two parts. Transmitter side implementation is the first part and second part is the receiver side implementation of the GNU Radio software. The system input is a real time file signal which is processed by the GNU Radio software. The python language is used behind the blocks of GNU Radio. The real time file signal is transmitted wirelessly by dipole antennas. These antennas operate between 0.4 GHz to 4 GHz frequency range. At both transmitter and receiver side, these antennas are connected to the USRP device.

1. Transmitter end implementations

Using keyboard buttons ALT+CTRL + T, the terminal window will open and at the prompt type of this terminal: gnu radio companion. An untitled GRC window is appearing. File source, PSK modulator and other parts containing different codes are connected to each other to lineup the transmitting section of the PSK modulator which is shown in Figure 3.

In hybrid structure, antenna is constructed using various combination of geometries in the shape of fractal which further decreases the area and fabrication cost of antenna. By using different fractal configurations such as Sierpinski, Koch-Minkowski, Cantor sets, Hilbert and antennas free from fractal geometrical configuration with fractal or non fractal geometries provide an structure or flowchart for manufacturing of hybrid fractal geometrical antenna.

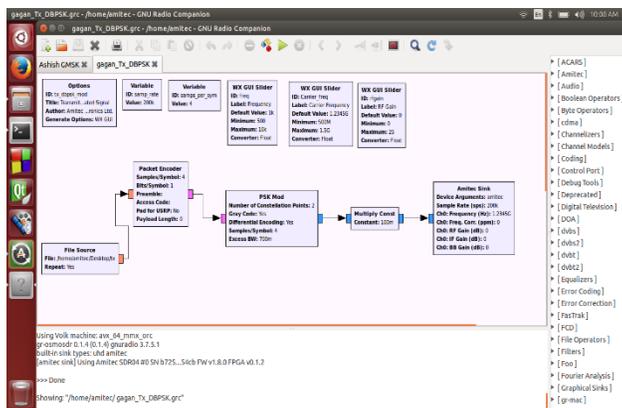


Fig. 3: PSK modulation System in GNU System

The Excess bandwidth=350m which is the bandwidth and the duration of bit period of PSK modulated signal . Sampling frequency used along with the symbol rate is equal to value 4 and Amitec sink called as (USRP) is used which works at 1.2345 GHZ channel frequency. The transmitted file tx shown in Figure 4.

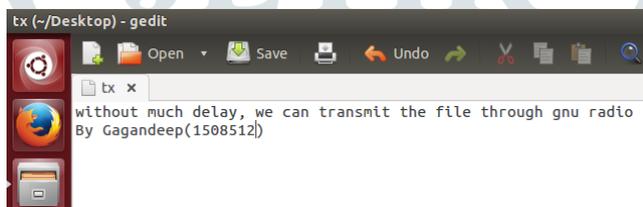


Fig. 4: Transmitted file Tx.

2. Receiver Side Implementations

Firstly, a blank file named “rx” is created at the home folder and then open the GRC window which is same as the transmitter side window. After this connect the low pass filter and PSK modulator to other blocks. The Figure 5 Show the complete flow graph of PSK demodulator.

The cut-off frequency of the low pass filter is 50 KHZ and it used the hamming window. The Amitec source which is USRP device used 1.2345 GHZ frequency.

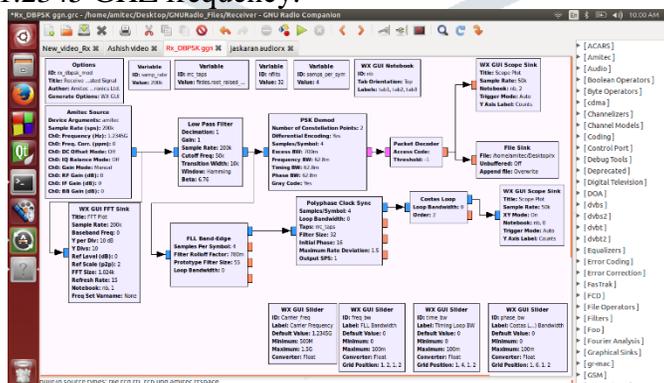


Fig. 5: PSK Demodulation system in GNU Radio

IV. RESULTS

In this paper PSK modulation is used to transmit real time file signal via GNU Radio and USRP. The Figure 6 shows the transmitted file signal from GNU Radio.

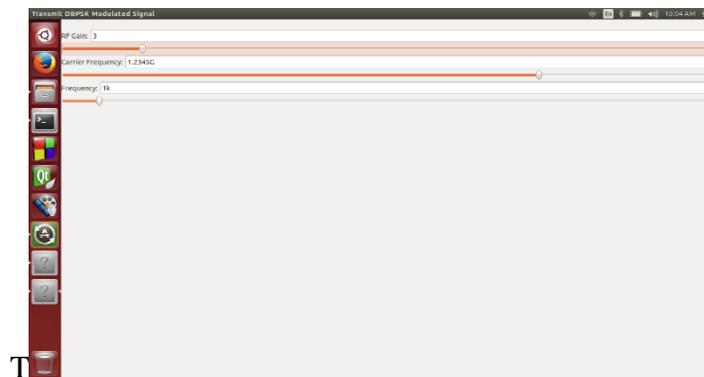


Fig. 6: Transmitted file signal from GNU Radio

The received file signal from GNU Radio shown in Figure 7.

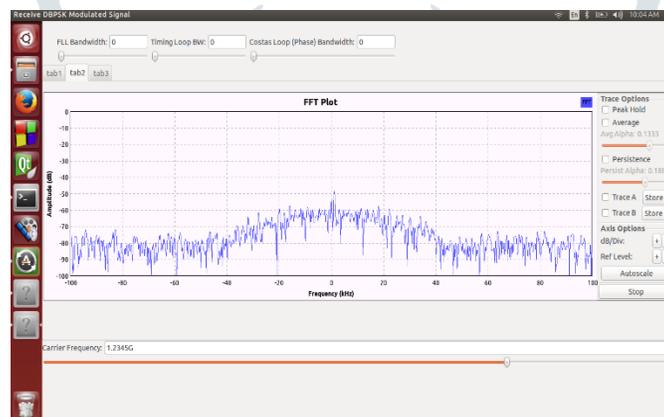


Fig. 7: Received file signal from GNU Radio

The constellation display represents the possible symbols that selected by the PSK modulation shown in Figure 8.

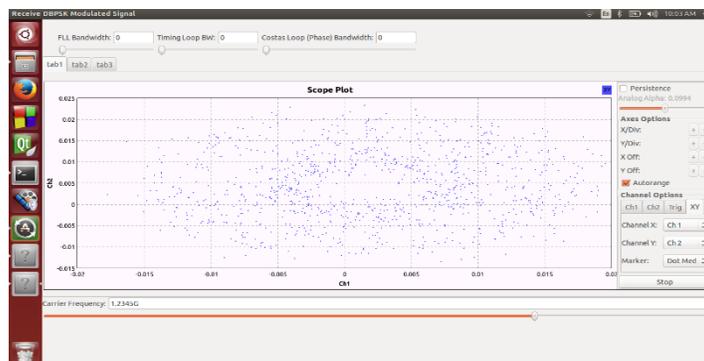


Fig. 8: Constellation display of file signal

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