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SKEL 3742

FAKULTI KEJURUTERAAN ELEKTRIK
UNIVERSITI TEKNOLOGI MALAYSIA
SKUDAI, JOHOR

DIGITAL COMMUNICATION LABORATORY

BPSK Modulation and Demodulation

Disediakan oleh	:	Disahkan oleh	: Head of Department
Nama	: Dr. Kamaludin Mohamad Yusof	Nama	: Prof. Madya Dr. Norazan Bin Mohd Kassim
Tandatangan	:	Tandatangan	:
Cop	:	Cop	:
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Introduction:

Traditionally, local communication was done over wires, as this presented a cost-effective way of ensuring a reliable transfer of information. However, for long-distance communications, transmission of information over radio waves was needed. Although this was convenient from a hardware standpoint, radio-waves transmission raised doubts about the corruption of the information; transmission was often dependent on high-power transmitters to overcome weather conditions, large buildings, and interference from other sources of electromagnetics.

The various modulation techniques offered different solutions in terms of cost-effectiveness and quality of received signals but until recently were still largely analog. Frequency modulation and phase modulation presented a certain immunity to noise, whereas amplitude modulation was simpler to demodulate. However, more recently with the advent of low-cost microcontrollers and the introduction of domestic mobile telephones and satellite communications, digital modulation has gained in popularity. With digital modulation techniques come all the advantages that traditional microprocessor circuits have over their analog counterparts. Any shortfalls in the communications link can be eradicated using software. Information can now be encrypted, error correction can ensure more confidence in received data, and the use of DSP can reduce the limited bandwidth allocated to each service.

Modulation is the process of facilitating the transfer of information over o medium. Voice cannot be sent very far by screaming. To extend the range of sound, we need to modulate it with the carrier before transmit it through a medium. Recalls that ASK uses the digital data's 1s and 0s to switch a carrier between two amplitudes. FSK uses the 1s and 0s to switch a carrier between two frequencies. An alternative to these two methods is to use the data stream's 1s and 0s to switch the carrier between two phases. This is called Binary Phase Shift Keying (BPSK).

Simulation

Download the file BPSK folder from the website and run it. The simulation is very straightforward by using BPSK_TX.grc and BPSK_RX.grc over two USRPs. The simulation uses direct connection via cable. However in this simulation, the codes are not been tested over wireless transmission.

Open-ended Design Problem: Over the Air (OTA)/Wireless Transmission

Multipath propagation occurs when radio frequency (RF) signal takes different paths when propagating from a source to a destination node. While the signal is en route, walls, chairs, desks, and other items get in the way and cause the signal to bounce in different directions. A portion of the signal may go directly to the destination, and another part may bounce from a chair to the ceiling, and then to the destination. As a result, some of the signal will encounter delay and travel longer paths to the receiver.

Multipath delay causes the information symbols represented in a received signal to overlap, which confuses the receiver. This is often referred to as intersymbol interferences (ISI). Because the shape of the signal conveys the information being transmitted, the receiver will make mistakes when demodulating the signal's information. If the delays are great enough, bit errors in the packet will occur. The receiver won't be able to distinguish the symbols and interpret the corresponding bits correctly. Therefore the received signal cannot be demodulated correctly.

In this section you are going to use the simulation gnuradio codes (same as in simulation section) to implement a digital communication system over wireless channel. Since the codes are

been tested over wireless channel, there is possibility an error occurred during transmission. As a group of researcher, you need to identify the cause of the problem. In the end, you need to able transmit and received “recorded sound” from end to end using two USRPs.

Objectives:

(i) Understanding the basic concept of digital communication system
(ii) Understanding the time-domain and frequency-domain analysis.
(iii) Understanding the effect of the noise over the digital communication system
(iv) Understanding the signal representation by observing In-phase and Quadrature data/signal
(v) Understanding the use of Constellation Diagram