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COMPARISON BETWEEN GENERATION OF ANALOG AND DIGITAL QPSK MODULATION FOR SATELLITES COMMUNICATION SYSTEMS

Abstract

Most of the satellite communication systems are using Quadrature Phase Shifting Key (QPSK) as their modulation technique, because this modulation technique achieves the requirements of these systems of high data rate and low power consumption. In this paper, a comparison between two proposed VHDL implementation methods of QPSK modulation are described; first one will generate Analog QPSK modulation signal using Numerical Controlled Oscillator (NCO). The second will generate digital QPSK modulation signal using ring counter. The comparison will focus on the utilization and power consumption after implement the two methods on Kintex-7 Kit. The implementation and simulation results are done using Xilinx Vivado-2015.2 tool. In recent years, Quadrature Phase Shift Keying (QPSK) modulation technique is widely used in communication systems such as mobile and satellite systems. To achieve the requirements of efficient power and bandwidth especially for satellite payload data transfer and satellite communication, two modulation schemes, QPSK and 8-PSK, are implemented with different methods using different combination of Direct Digital Frequency Synthesis (DDFS) and COrdinate Rotation Digital Computer (CORDIC). for both satellite and ground station to reduce the antenna size and save power consumption for generate sine and cosine signal A QPSK modulation system is implemented using stored sine and cosine data in RAM instead of generate them using Numerical Controlled Oscillator (NCO). To generate high throughput QPSK modulator, two methods are proposed to implement QPSK modulator using BOOTH algorithm and storing the QPSK data into ROM. The digital QPSK modulation has many advantages than Analog QPSK modulation because it is less complex, more efficient in error detection and correction in high speed data communication systems which lead to satisfy the demand for high data rate and low power consumption in many satellite communication systems. To increasing the transmission rate of communication system, QPSK modulator is implemented using Direct Digital Synthesis (DDS) principle and for demodulator a Finite Impulse Response filter (FIR) is used to remove high frequency component. In this paper, two different QPSK modulation methods are implemented to generate analog and digital QPSK modulation signal, the result will show the resource utilization and power consumption for each method. The implementation, The results and simulations are confirmed on Kintex-7 FPGA kit using VHDL through Vivado 2015.2. This paper proposed two methods to generate QPSK modulation signal and from the simulation and results, the method that generate digital QPSK modulation signal achieve low resources utilization and power consumption.