VLSI Implementation of Oqpsk for Biomedical Devices Applications

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***Abstract* - OQPSK is the one kind of improved QPSK. QPSK can produce the phase ambiguity in carrier recovery process. OQPSK eliminates the influence of phase ambiguity, on the correct decision. This design combines the VHDL language with CORDIC algorithm and produces the very strong versatility and the very good probability frequency and it is applicable for biomedical devices applications.**

***Keywords* - FPGA, OQPSK, CORDIC ALGORITHM, VHDL**

1. INTRODUCTION

Offset quadrature phase-shift keying (OQPSK) is a variant of phase-shift keying modulation using 4 different values of the phase to transmit. It is sometimes called staggered quadrature phase-shift keying (SQPSK).

Taking four values of the phase (two bits) at a time to construct a QPSK symbol can allow the phase of the signal to jump by as much as 180° at a time. When the signal is low-pass filtered (as is typical in a transmitter), these phase-shiftsresult in large amplitude fluctuations, an undesirable quality in communication systems. By offsetting the timing of the odd and even bits by one bit-period, or half a symbol-period, the in-phase and quadrature components will never change at the same time. This yields much lower amplitude fluctuations.

CORDIC (digit-by-digit method, Volder's algorithm) (for **CO**ordinate **R**otation **DI**gital **C**omputer) is a simple and efficient algorithm to calculate hyperbolic and trigonometric functions. It is commonly used when no hardware multiplier is available (e.g., simple microcontrollers and FPGAs) as the only operations it requires are addition, subtraction, bitshift and table lookup.

CORDIC is generally faster than other approaches when a hardware multiplier is unavailable (e.g., in a microcontroller based system), or when the number of gates required to implement the functions it supports should be minimized (e.g., in an FPGA).In recent years, CORDIC algorithm is used extensively for various biomedical applications, especially in FPGA implementations.

2. OFFSET QUADRATURE PHASE SHIFT KEYING

Offset quadrature phase-shift keying (OQPSK) is a variant of phase-shift keying modulation using 4 different values of the phase to transmit. It is sometimes called staggered quadrature phase-shift keying (SQPSK).

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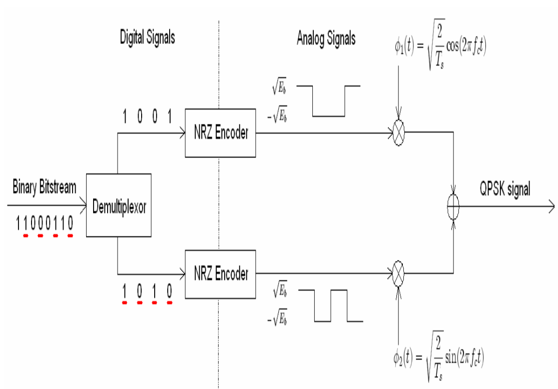


FIG: 1 block diagram of oqpsk signal

The input binary sequence is applied to demultiplexer and it divides into two separate bit streams of the odd numbered and even numbered bits. The first even bit occurs after the first odd bit. Therefore even numbered bit sequence starts with the delay of one bit period due to first odd bit. Thus first even bit is delayed by one bit period 'T_b ' with respect to first odd bit. This delay of T_b is called as offset. Hence the QPSK is named as OQPSK.

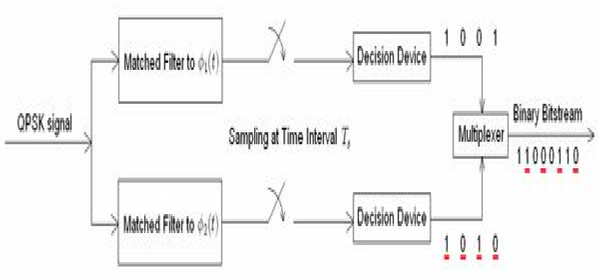


FIG: 2 Block Diagram of OQPSK Demodulator.

The OQPSK signal is passed to matched filter like band pass and it is centered around $4f_0$. This is divided by 4 and is gives to two decision device. Coherent quadrature carriers and synchronous demodulators are called as decision device.The coherent carriers cos(2π f_0 t) and sin(2π f_0 t) are applied to synchronous demodulators, it consist of multiplier and an integrator. The signal is multiplied and integrates the product signal and sampled. The outputs of two integrators are sampled at the offset of one bit period, T_b . Then the odd and even sequences are combined by multiplexer

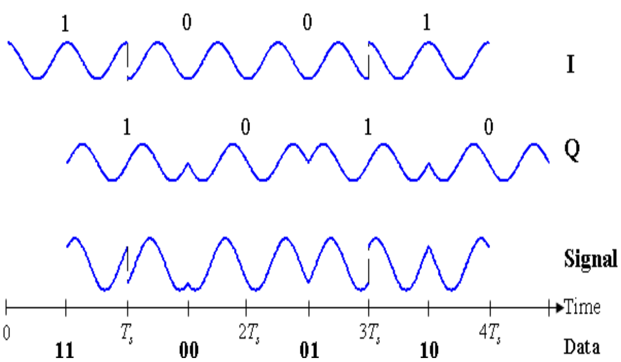


FIG: 3 Timing diagram

3. CORDIC ALGORITHM

The modern CORDIC algorithm was first described in 1959 by Jack E. Volder. It was developed at the aero electronics department of Convair to replace the analog resolver in the B-58 bomber's navigation computer.

Although CORDIC is similar to mathematical techniques published by Henry Briggs as early as 1624, it is optimized for low complexity finite state CPUs.

John Stephen Walther at Hewlett-Packard further generalized the algorithm, allowing it to calculate hyperbolic and exponential functions, logarithms, multiplications, divisions, and square roots.[2]

Originally, CORDIC was implemented using the binary numeral system. In the 1970s, decimal CORDIC became widely used in pocket calculators, most of which operate in binary-coded-decimal (BCD) rather than binary.

CORDIC is particularly well-suited for handheld calculators, an application for which cost (e.g., chip gate count has to be minimized) is much more important than is speed. Also the CORDIC subroutines for trigonometric and hyperbolic functions can share most of their code.

Mode of operation

CORDIC can be used to calculate a number of different functions. This explanation shows how to use CORDIC in rotation mode to calculate sine and cosine of an angle, and assumes the desired angle is given in radians and represented in a fixed point format. To determine the sine or cosine for an angle β, the y or x coordinate of a point on the unit circle corresponding to the desired angle must be found. Using CORDIC, we would start with the vector v_0:

$$v_0 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

In the first iteration, this vector would be rotated 45° counterclockwise to get the vector v_1. Successive iterations will rotate the vector in one or the other direction by size decreasing steps, until the desired angle has been achieved. Step i size is Artg($1/(2^{(i-1)})$) where i 1,2,3,….

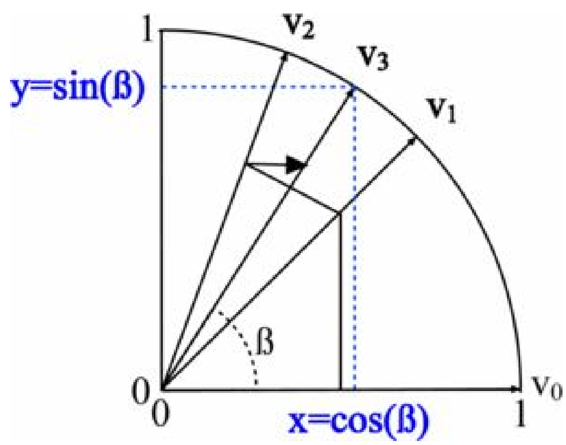


FIG: 4: CORDIC ALGORITHM

e formally, every iteration calculates a rotation, which is performed by multiplying the vector v_{i-1} with the rotation matrix R_i:

$$v_i = R_i v_{i-1}$$

The rotation matrix R is given by:

$$R_i = \begin{pmatrix} \cos\gamma_i & -\sin\gamma_i \\ \sin\gamma_i & \cos\gamma_i \end{pmatrix}$$

Using the following two trigonometric identities

$$\cos\alpha = \frac{1}{\sqrt{1+\tan^2\alpha}}$$

$$\sin\alpha = \frac{\tan\alpha}{\sqrt{1+\tan^2\alpha}}$$

the rotation matrix becomes:

$$R_i = \frac{1}{\sqrt{1+\tan^2\gamma_i}}\begin{pmatrix} 1 & -\tan\gamma_i \\ \tan\gamma_i & 1 \end{pmatrix}$$

The expression for the rotated vector $v_i = R_i v_{i-1}$ then becomes:

$$v_i = \frac{1}{\sqrt{1+\tan^2\gamma_i}}\begin{pmatrix} x_{i-1} & - & y_{i-1}\tan\gamma_i \\ x_{i-1}\tan\gamma_i & + & y_{i-1} \end{pmatrix}$$

where x_{i-1} and y_{i-1} are the components of v_{i-1}. Restricting the angles γ_i so that $\tan\gamma_i$ takes on the values $\pm 2^{-i}$ the multiplication with the tangent can be replaced by a division by a power of two, which is efficiently done in digital computer hardware using a bit shift.

Applications of cordic algorithm

CORDIC is generally faster than other approaches when a hardware multiplier is unavailable (e.g., in a microcontroller based system), or when the number of gates required to implement the functions it supports should be minimized (e.g., in an FPGA).

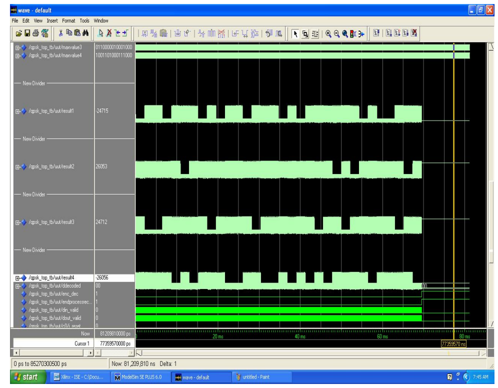
On the other hand, when a hardware multiplier is available (e.g., in a DSP microprocessor), table-lookup methods and power series are generally faster than CORDIC. In recent years, CORDIC algorithm.

4. CONCLUSION

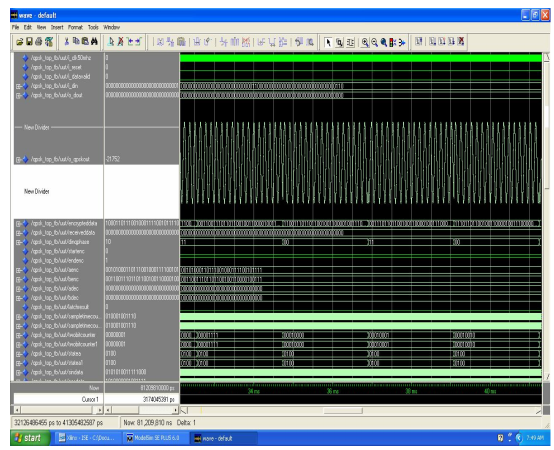
This paper has proposed the quite thorough analytical investigation to the OQPSK modulation method with the CORDIC algorithms in a hardware implementation is to avoid time-consuming complex multipliers. The computation of phase for a complex number can be easily implemented in a hardware description language. Fabrication techniques have steadily improved, and complex numbers can now be handled directly without too high a cost in time, power consumption, or excessive die space, so the use of OQPSK modulator using CORDIC techniques is is used extensively for various biomedical applications, especially in FPGA implementations.

5. RESULTS

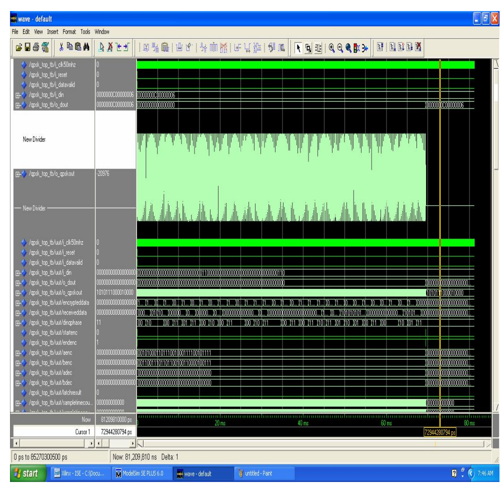
5.1 FOUR PHASES



5.2 ANALOG OUTPUT OF OQPSK MODULATION



5.3 ANALOG OUTPUT OF OQPSK DEMODULATION



6. REFERENCES

1. D. Munoz, D. Sanchez, C. Llanos, M. Ayala-Rincon, “Trafeoff of FPGA design of floating-point transcendental functions,” in Proc. IEEE Conf. Very Large Scale Integration, Oct. 2009.
2. A. M. El-Gabaly, B. R. Jackson and C. E. Saavedra, "An L-Band Direct-Digital QPSK Modulator in CMOS," IEEE International Symposium on Signals, Systems and Electronics, Montreal, Quebec, Canada, April 2007.
3. M.Kovac, J.kolouch “bpsk,qpsk modulator simulation moduel”2004.
4. Shen Yue-hong, Gao Yuan-yuan, Wei Yi-min Communication Theory [M].Beijing: Mechanical Industry Publishing House 2004
5. M. Ibne, S. Islam, and M. Sulaiman, “Pipeline floating point ALU design using VHDL,” in Proc. IEEE Int. Semiconductor Electronics, 2002.