Volume: 07 Issue: 01 | Jan 2020

www.irjet.net

e-ISSN: 2395-0056 p-ISSN: 2395-0072

IMPLEMENTATION OF RECURSIVE DIGITAL SINUSOIDAL SIGNAL **GENERATOR of 5k Hz**

BANDARI SHUBHAKER¹, DUDA PRASAD², B. THEJA³

^{1,2,3}Assistant Professor, Dept of ECE, St. Martin's Engineering College, Hyderabad, Telangana, India.

Abstract: - The sinusodial wave has found its usage in various applications, including factory testing for connectivity. One method of sine-wave generation is predicated on a regeneration system that employs the principle of oscillation. Oscillation can only be attained if the system assures the Bakhausen Criterion. Following the principles of an analog oscillator, a digital oscillator is implemented using a special two-pole band pass filter which is modeled with a recursive difference equation to generate fixed frequency sinusoidal wave.

Key words: sinusoidal wave generator, digital filter, positive feedback, recursive difference equation, digital oscillator.

I. INTRODUCTION

The signal generator is strictly what its name implies: a generator of signals used as a stimulus for electronic measurements [1]. Most circuits require some sort of input whose amplitude varies over time. The signal could also be a real bipolar AC signal (with peaks oscillating above and below a ground reference point) or may vary over wide spread of DC offset voltages, either positive or negative. May be a sinusodial wave or other analog function, a digital pulse, a binary pattern or a purely arbitrary wave form [2]. The signal generator can provide ideal waveforms or it's going to add known, repeatable amounts and kinds of distortion (or errors) to the signal it delivers [3]. This characteristic is one among the signal generators greatest virtues, since it's often impossible to make predictable distortion exactly when and where its needed using only the circuit itself.

Digital sinusoidal oscillators are essential elements in many applications. They are used in communications, music synthesis, control, radar, and digital signal processing [4]. These digital oscillators exhibit the advantages of digital techniques, namely, stability, flexibility, and low cost. Moreover, the parameters of a digitally generated sinusoid are easy to control [5]. The conventional digital sinusoidal oscillator utilizes look-up-table in which the samples of a complete cycle of a sine wave are stored and read at appropriate time intervals [6].

Digital sinusoidal signals can be generated using a secondorder recursive digital filter with poles on the unit circle in the complex Z-plane [7]. Finite word-length constraints appear in the practical implementation of all recursive digital oscillators. Accordingly, the multiplier coefficient and the outputs of arithmetic operations must be quantized to fit in the allocated word-length [8].

The result is a distortion which affects both frequency and amplitude of the generated sinusoidal signals. A digital sinusoidal oscillator with low and uniform frequency spacing was represented finally as a response. The oscillator structure in requires three full word-length multipliers for its hardware implementation.

II. DIFFERENCE EQUATION

A discrete, or differencial, equation expresses a correlation between the elements of a succession, y(n) is

$$y(n) = -\frac{a_1}{a_0}y(n-1) - \frac{a_2}{a_0}y(n-2) + b_0x(n)$$

$$here, x(n) = \text{ impuse signal}$$

$$b_0 = A\sin(w)$$

$$a_0 = 1$$

$$a_1 = -2\cos(w)$$

$$a_2 = 1$$

$$w = \frac{2\pi f}{f_0}$$

Which, means that the sequence y(n) may be any constant sequence. Numerous mathematical models are posed in the form of discrete equations. Discrete equations also arise when solving continuous models using numerical methods, a necessary task for all but the simplest models [9]. Computers can only work with discrete data, so continuous equations must be discretized before they can be solved numerically [10].

Volume: 07 Issue: 01 | Jan 2020

www.irjet.net

III. RECURSIVE DIFFERENCE EQUATION BASEI MODEL

The sine wave can be used in many applications, transmitting data in the form of signals those signals are represented in the form of sine wave. Here, generating sine wave using second order recursive difference equation. Sine wave can be generated for minimum second order systems.

Oscillation can only be achieved by placing poles on the imaginary axis, for that we have chosen coefficients for second order systems.

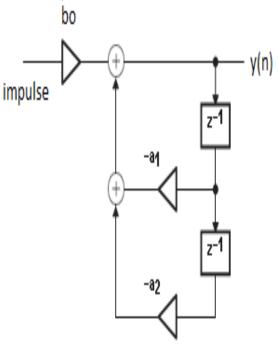


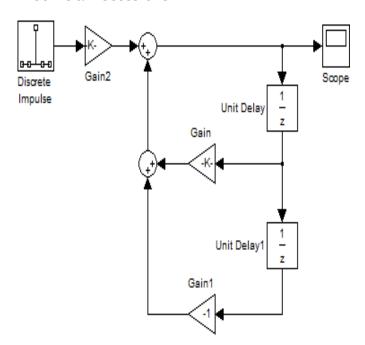
Fig.1.Realisation of Recursive difference equation

IV. IMPLEMENTATION USING MATLAB SIMULINK

Using the above model designing a sinusoidal generator with frequency f_0 =5k hz, f_s =10 hz amplitude A=5 v, we get following coefficients, assuming zero initial conditions

$$B_0 = 0.273$$
, $a_0 = 1$, $a_1 = -1.996$, $a_2 = 1$, $\omega = 3.14$, $A = 5$

V. RESULTS & DISCUSSIONS



e-ISSN: 2395-0056

p-ISSN: 2395-0072

Fig.2.MATLAB Simulink Model

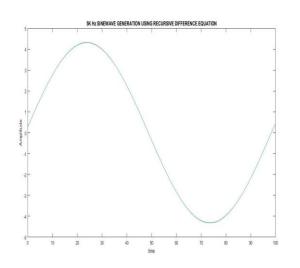


Fig 3: IMPLEMENTATION OF RECURSIVE DIGITAL SINUSOIDAL SIGNAL GENERATOR of 5k Hz

On simulation of above Simulink model a sinusoid of 5 k hz frequency and approximate peak to peak of 5v generated as per implementation done using MATLAB simulink Model as shown in fig:2 in section IV by using Recursive Difference Equation Based Model.



Volume: 07 Issue: 01 | Jan 2020 www.irjet.net e-ISSN: 2395-0056 p-ISSN: 2395-0072

VI. CONCLUSION:

The recursive oscillator has good frequency stability, but the essential circuit has high output distortion. Nonlinear feedback offers the simplest performance over the mid- and upper-frequency ranges. The decreasing cost of digital devices and components has reduced the popularity analog oscillators. The hitch is that the low amplitude, which may be increased using a further gain stage, but with the penalty of greatly reduced bandwidth

VII. REFERENCES

- 1. Archer, Stephen T., and Benjamin D. Pless. "Stimulation signal generator for an implantable device." U.S. Patent No. 6,690,974. 10 Feb. 2004.
- 2. Jefferson, William T. "Digital sine wave generator." U.S. Patent No. 3,657,657. 18 Apr. 1972.
- 3. Kleijn, W. Bastiaan. "Encoding speech using prototype waveforms." IEEE transactions on speech and audio processing 1.4 (1993): 386-399.
- 4. Al-Ibrahim, M. M. "A simple recursive digital sinusoidal oscillator with uniform frequency spacing." ISCAS 2001. The 2001 International Symposium on Circuits and Systems (Cat. No. 01CH37196). Vol. 2. IEEE, 2001.
- 5. Fukuda, Shoji, and Takehito Yoda. "A novel current-tracking method for active filters based on a sinusoidal internal model [for PWM invertors]." IEEE transactions on industry applications 37.3 (2001): 888-895.
- Hiasat, Ahmad A., and Abedulah M. Al-Khateeb. "New high-resolution digital sinusoidal oscillator structure with extremely low frequency and sensitivity." international Journal Electronics 86.3 (1999): 287-296.
- 7. Fliege, Norbert J., and Jög Wintermantel. "Complex digital oscillators and modulators." IEEE Transactions on signal processing 40.2 (1992): 333-342.
- Lagadec, Roger, and Henry O. Kunz. "Process and apparatus for translating the sampling rate of a sampling sequence." U.S. Patent No. 4,748,578. 31 May 1988.
- 9. Barton, Paul I., and Constantinos C. Pantelides. combined "Modeling discrete/continuousprocesses." AIChE journal 40.6 (1994): 966-979.
- 10. Hansen, Per Christian. "Numerical tools for analysis and solution of Fredholm integral equations of the first kind." Inverse problems 8.6 (1992): 849.
- 11. Arabi, Karim, and Bozena Kaminska. "Oscillationtest methodology for low-cost testing of active

filters." IEEE analog transactions on Instrumentation and Measurement 48.4 (1999): 798-806.