

IMPLEMENTATION OF RECURSIVE DIGITAL SINUSOIDAL SIGNAL GENERATOR of 5k Hz

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Abstract: - The sinusoidal 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 Barkhausen 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 sinusoidal 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 second-order 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 requires three full word-length multipliers for its hardware implementation.

II. DIFFERENCE EQUATION

A discrete, or differential, 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, $x(n)$ = impulse signal

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

$$a_0 = 1$$

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

$$a_2 = 1$$

$$\omega = \frac{2\pi f}{f_s}$$

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].

III. RECURSIVE DIFFERENCE EQUATION BASED 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.

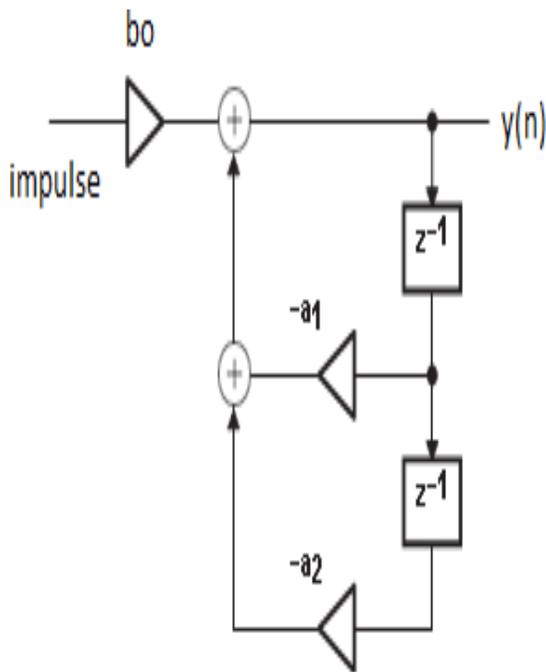


Fig.1.Realisation of Recursive difference equation

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

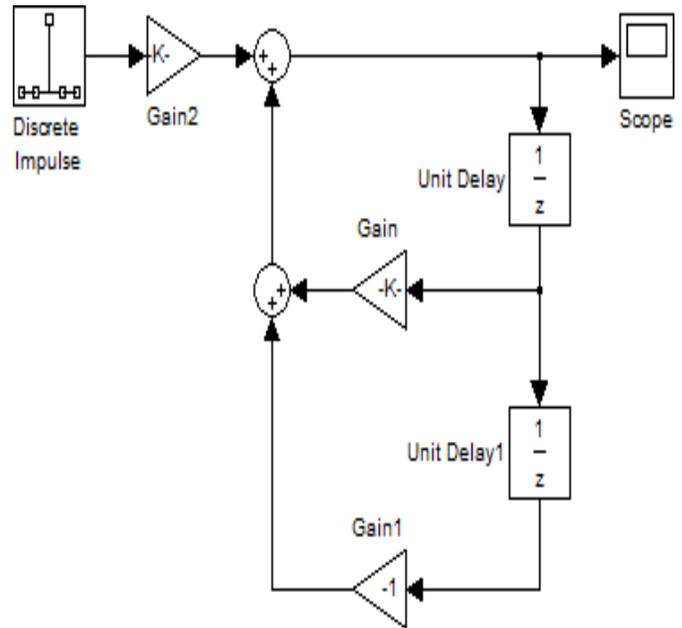


Fig.2.MATLAB Simulink Model

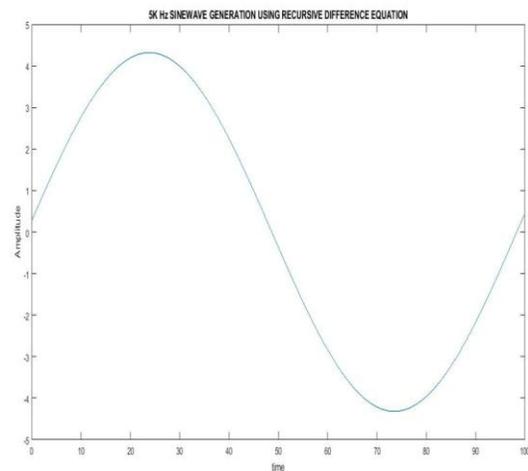


Fig 3: IMPLEMENTATION OF RECURSIVE DIGITAL SINUSOIDAL SIGNAL GENERATOR of 5k Hz

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.

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

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