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Estimation and Design Techniques for Adaptive Delta Modulation Using Otas

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Abstract: This paper mainly studies a signal processing methodology of communication systems realized circuits of Adaptive Delta Modulation (ADM) using Operational Transconductance Amplifiers (OTAs). *Methodology*: This work suggests a design for adopting the quantization step size using feedback output quantize through adoptive delta modulation scheme using loss operation with Transconductance amplifier as loss OTAs integrator. Quantization step size is realized using integrators, rectifiers and amplifiers. The step over load is controlled by variable voltage gain (Av) of the Trans conductance. *Result:* was compared with conventional ADM using Op-Amp. According to the quantized output, the slope overload noise and granular noise are changed by controlling the variable voltage gain (Av) of OTAs. *Conclusion*: The paper suggests a design using feedback output quantize through ADM scheme by loss operation with Trans-conductance amplifier as loss OTAs integrator, the control is achieved by increasing or decreasing the step size from δmin to δmax in order to determine the quantization noise. Simulation power results improve the signal-to-noise ratio (SNR) and modulation quality at fs = 64 kHz. Moreover, the dynamic range of the modulator is also improved.

Keywords: Adaptive Delta Modulation, Operational Transconductance Amplifier, Step Size

1. Introduction

All the recent wired and wired and wireless technologies have already switched to digital. Therefore, digital storage devices and digital encoding methods have priority when developing any communications system, mostly in verbal communication, opportunities for encoders and decoders to play an important role as a signal. So analog-to-digital converters and digital-to-analog converters to encode and decode respectively must be designed with the required quality of service and availability of resources. For human speech, sample rate 8000 samples per second as the rate should be used for Pulse Code Modulation (PCM) with 256 quantization levels requires a minimum of 64 Kbps per second data transfer rate. It gets quite a lot of overhead for portable devices often used by low cost and low power. Thus engineers previously used the sensitivity of the human ear to reduce the number of bits needed for the transfer. But the dynamic range of the human ear on 40dB. Encoding may not provide good quality speech where whispers kind of speech

Is with high amplitude signals [1, 2]. The performance delta modulator can significantly improve by making step

Modulator size assumed time of different shapes. In particular during abrupt segment the input signal increases the step size. And vice versa when AC input step size is reduced slowly. Thus size adapts to the level of the input signal. The resulting method is called Adaptive Delta modulation (ADM). There are several types of ADM, depending on the type of the schema used for adjusting step size [3].

In the recent past researchers presented the methodology for the design of companders circuit, On the basis of delta modulator. This proposed circuit is a fully digital device. A new class system is proposed, which combines the traditional broad group of companders with adaptive filter is proposed in this work are the development of the methodology for the analog and digital circuits delta modulator and companders with plenty of OTAs and active element as a semiconductor diode. The results of the simulation of the circuit also reported, the design method enhancements the basis of the frequency of nonlinear connection circuits [4].

2. OTA Model

The operational amplifier is used as an active device in the vast majority of the active filter and a large number of the feedback are used to create a filter to obtain the substance regardless of the gain of the PO. Many practical filters projects have been developed after this approach. As it became clear, however, that the operational amplifier restrictions exclude the use of these filters in the high frequencies, attempts to integrate these filters have been unsuccessful with the exception of a few non demanding applications and convenient voltage or current management schemes for external adjustment filter performance does not exist. With the implementation of a BJT and MOSFET by its very nature the current and Transconductance amplifiers respectively, the question naturally arises [5, 6, 7] Can I get any better filter features, performance and flexibility by using one of the other major types of amplifiers for example, Transconductance, current or trans resistance instead of the voltage amplifier or specially operational amplifier many of the basic structures of the OTA on the basis of use only OTAs and capacitors and therefore are attractive for integration. The number of components of these structures is often very low (for example, second order error estimation and filters can be built with two OTAS and Two Capacitors) compared with the VCVS design. Convenient internal or external voltage or current control filter performance is achievable with these structures. They are attractive to the frequency of the links (e.g., master / slave) applications. Recently several groups have used the OTAs in monolithic filter continuous time structure. From a practical point of view the performance of the high frequency of discrete bipolar OTAs such as CA 3080, quite well. Transconductance profit, the GM can vary within a few decades, adjusting the current offset external DC J ABC. The basic limitations of existing OTAs is limited differential input voltage swings necessary to maintain the linearity For CA 3080 is limited to approximately 30 MV p-p for the maintenance of a reasonable degree of linearity. Although will be discussed the structure of the Feedback in which decreases the sensitivity of the filter parameters (as in the op amp on the basis of the filter design), the main emphasis will be placed on those structures in which the parameters of the standard filter interest in direct proportion to the GM OTA [8].

Design Of Operational Transconductance Amplifiers (OTAs)

Low voltage and low power amplifier design in low-voltage design, the main consideration is to maintain the output swing as higher as possible. This can be achieved when no cascading transistors can be used in the output stage. For minimum power consumption, the number of current branches should be minimized. So the current mirror amplifier is best suited for low-power low-voltage amplifier.

3. Delta Modulation Using Otas

ADM was later selected as the standard for all NASA communications between mission control and space-craft Adaptive delta modulation or [continuously variable slope delta modulation] (CVSD) is a modification of DM in which the step size is not fixed. Rather, when several consecutive bits have the same direction value, the encoder and decoder assume that slope overload is occurring, and the step size becomes progressively larger [9].

Otherwise, the step size becomes gradually smaller over time. ADM reduces slope error, at the expense of increasing quantizing error.

This error can be reduced by using a low-pass filter. ADM provides robust performance in the presence of bit errors meaning error detection and correction are not typically used in an ADM radio design, this allows for a reduction in host processor workload (allowing a low-cost processor to be used [10].

Adaptive delta modulation is widely used to perform analogue to digital conversion (ADC) using general adaptive delta modulator as shown in Figure (1). The difference between the present sample and the predicted value for the next sample is quantized [11]. This improve the dynamic range, The input signal X(t) is sampled, to the discreet time X(n) with sampling frequency.

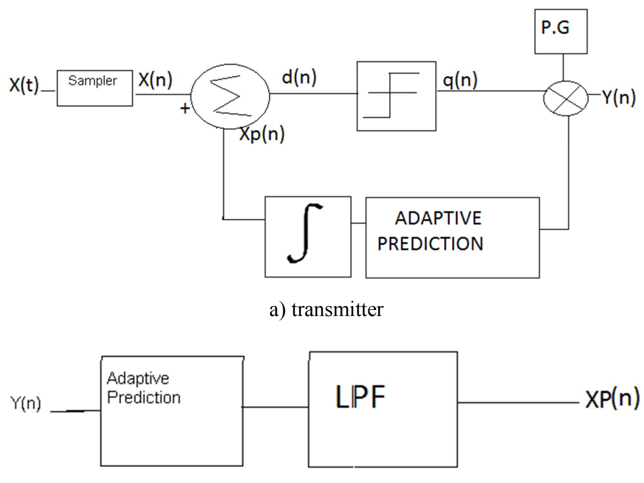
More large than twice F_m, to eliminate aliasing

$$f_s \geq 2 f_m \tag{1}$$

Where: f_s: sampling frequency, f_m: bandwidth of input signal, and the quantize converts the difference signal

$$d_n = x_{(n)} - x_{(p}(n) \tag{2}$$

where: X_n: is the input signal $X_p(n)$: is the prediction signal.



a) transmitter

b) Receiver.

Figure 1. *General adaptive delta modulation a) transmitter b) Receiver.*

Then the modulator converts the output of quantizer to the digital binary signal [y(n)].

$$Y_{(n)} = \sum_{nm-\infty}^{\infty} q(nts)\partial(t - nts \tag{3}$$

Where: q(nTS) the limited of d(n). $\partial(t - nTs)$: The pulse generator.

The reference predicted signal Xp(n) is generated by the adaptive prediction circuit, if the input sinusoidal signal is very small or constant, the output pulse is alternates sign, and the output dc magnitude value becomes small, which controls the variable gain of operational trans conductance amplifier [12, 13]. Consequently the step size of the output can be very small. as the input amplitude increase from zero, the step size of the output will increase and it's slope will continuously vary to match the slope of the input at zero crossing, therefore the output stair step approximation Xp(n) is

$$x_{p(n)} = \sum_{nm-\infty}^{\infty} q(nts)\int_{\tau} \partial(t(\lambda - nTs)dn \tag{4}$$

When slope over load occurs, the output pulses will have the same polarity over this period. Thus the magnitude of the rectifier circuit and filter minimize this effect by increasing the variable gain (Av), of operational trans conductance amplifier, and consequently an increase the step size. In addition, OTA integrator provide compensation for small in balances in positive and negative step size.

$$Q = \frac{qm\,4Ts}{2c2} \tag{5}$$

Where: Q is the height of the quantization interval.

4. Results and Discussion Analyses

The analysis show that the best approximation for the output prediction integrator (Xp) occurs when the sampling frequency is high, figure (2).

Assuming that the input audio signal is $X_{(t)}=A_{\sin}$ (2πfm). Where: A is the peak amplitude of the input signal. In general, slope overload occurs when the rate of change of the input exceeds the maximum rate of change that can be generated by the adaptation feedback loop. since the maximum rate of change in the adaptation feedback loop is merely the step size times the sampling rate, a slope overload condition occurs if

$$\left|\frac{qm\,4Ts}{2c2}\right| > qfs \tag{6}$$

Where q is the step size and fs is the sampling frequency then

$$\frac{d}{dt} A_{\sin} 2\pi fmt \left| A2\pi fm_{\cos}(2\pi fmt) \right| > qfs \tag{7}$$

In the design parameter we choose q<2A
the maximum slope is A2$A = \pi fm$

So to avoid the step size limiting and slope –overload, from equation (7)

$$A2\pi fm < \pi fm < qfs \tag{8}$$

$$A_{nd} .q < \frac{qfs}{2\pi fm} \tag{9}$$

Simulation using math cad show that the step size should be adjusted for highest frequency that will be required for transmission, if the input level 2KHZ test tone and the sampling frequency is fs=64khz, then the optimum step size is:

$$q \geq \frac{a2\pi fm}{fs} \geq \frac{1 * 2\pi * 2.10^3}{64.10^3} \geq 196mv \tag{10}$$

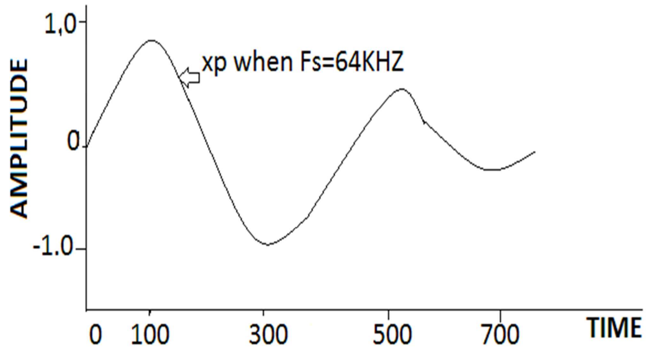


Figure 2. *Analog input signal and approximation output signal.*

The quantization noise is calculated as the slope of the predicted signal, this can be accomplished by adjusting the variable gain of the operational trans conductance amplifier, and integrator.

$$SNR(db) = 10long\left(\left(\left[x(n)\uparrow 2\right]\right) / \left\|(y(n)\right\|. - xp(n)\ \ ]] \uparrow 2] \tag{11}$$

Where: $x_{(n)}$ the input signal $xp_{(n)}$ is the reconstructed predicted signal, y(n) is decoded signal.

The experimental quantizing signal to noise ratio (SNR) versus sampling frequency Shown in figure 3

Where the (SNR) is improves with decreasing.

The input frequency and increasing the sampling frequency, also for adaptive DM using OTA the SNR performs better than the general first order DM.

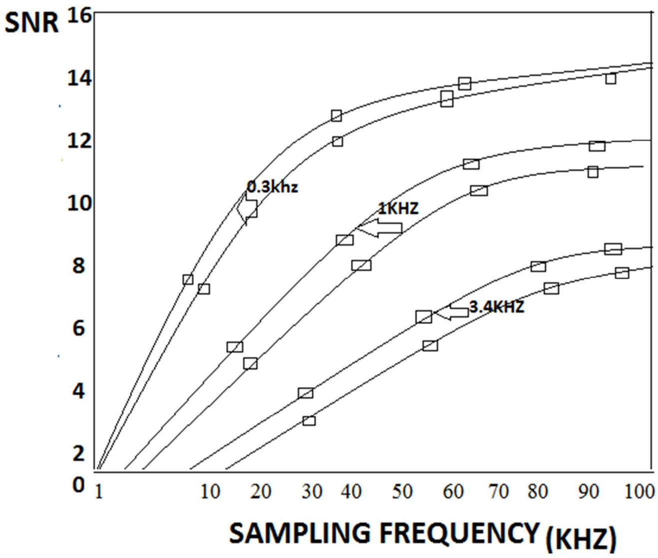


Figure 3. *Signal to noise ratio versus sampling frequency for difference input signal.*

5. Conclusions

The work presented is an improvement of the performance of the newly suggested methodology realizing ADM using OTAs amplifiers compared with systems using Op –Amp. The improvement is achieved by continuous estimation of the step size through control of the gain of OTAs. The results using this technique show some improvement of the performance compared with conventional methods using Op-Amp.

Main parameter that has to be taken care is the sampling frequency. Rates might not give expected results. Performance betters with good sampling frequencies due to highly correlated sample.

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