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Effects of Predistortion on Linearized Transmitter Design for Videoconferencing Channel

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ABSTRACT: In this paper usingPredistortion technique for reducing distortion in the Videoconferencing channel. QPSK modulation is widely used technique in communication system whenever any data travelling through the channel it gets the AM/AM and AM/PM distortions .Predistortion is the technique in which if we know the channel response then We can create the inverse response of it and applying before the nonlinear PA in the transmitter side combining both response and travelling through the channel we can get good linearity and better performance at the receiver side. Earlier Predistortion is designed by using the Active Circuit and It can be made using passive circuit. For Pulse Shaping requirement Raised Cosine filter which is more suitable and adjustable shaping curve sharpness by changing roll off factor which nullify the effect of ISI .Non-linear Saleh Model is used for reducing AM/AM and AM/PM distortion. For Simulink purpose The channel is Distorted the Eye of it is Closed in the Eye diagram but after applying the Predistortion technique when we see the Eye Diagram of it Open Eye Which introduce the less ISI .

Keywords: Power Amplifier(PA),Intersymbol Interference(ISI),Quadrature Phase Shift Keying (QPSK),Raised Cosine Filter(RRC),Amplitude modulation to Amplitude Modulation (AM-AM),Amplitude Modulation to Phase Modulation(AM-PM).

I INTRODUCTION

Videoconferencing is an Interactive method of communication that combines the use of audio signal, video signal, and computing technologies to allow people in different locations to meet face to face to conduct a conference in real time .Video conferencing is maximum connection speed of 384kbps. Linearization has become an important technology in modern communications systems .The most powerful and efficient linearization technique is digital predistortion in that technique if we know the channel response how it degrades its performance then by using that knowledge we can anticipate that response of that channel and apply it before HPA nonlinear amplifier.Predistorters are employed to preprocess the baseband signal to cancel out the nonlinearities of the PA. Predistortion is widely done basis of the mathematical calculation.power amplifiers (PAs) in the system should be highly efficient as well as highly linear to reduce size and cost of the systemThe fluctuations lead to AM-AM (amplitude modulation to amplitude modulation) fluctuations and AM-PM (amplitude modulation to phase modulation) fluctuations of the overall predistortion system, ultimately degrading the linearization performance. PA amplifier is operated in nonlinear region to minimize the AM/AM and AM/PM Distortion. For videoconferencing channel modulated purpose used QPSK modulation technique which is widely used techniques. For Pulse shaping requirement widely used Raised Cosine Filter used.RRC filter which reduce the ISI effect by changing the value of alpha parameter between 0 to1.So system will become more linear and by using predistortion and reduces the non-linearity of the Power amplifier. In this paper described Predistortion technique can be used by using Lump component instead of Active circuit.By changing the order of the filter and making suitable amplitude and phase response of we can anticipate the distorted signal by adding in to the original signal.

II FUNDAMENTAL OF PREDISTORTION TECHNIQUE

Predistortion is widely used technique. The concept of predistortion is to insertion of nonlinear module between the input signal and power amplifier. If we know how a signal will be distorted during the transmission, we can anticipate this distortion when we creating the signal at the transmitter.Here we can see in the figure that response of the amplifier is show in that and also Predistorters which generated the inverse response of it. Now when we combined both the

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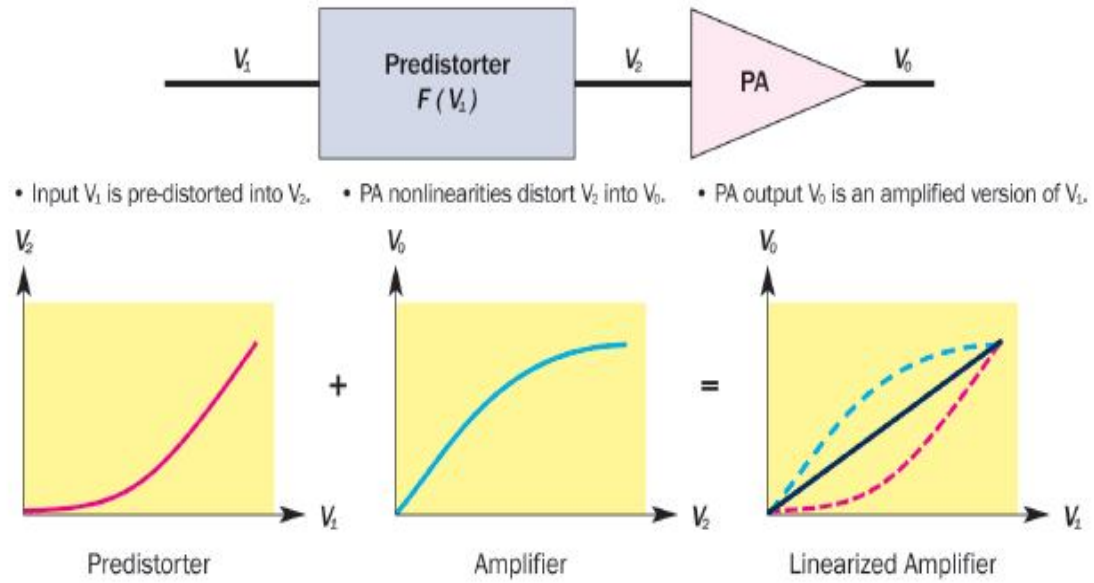
result we can see that it output response will become the linear. So system will become more linear and by using predistortion



III SYSTEM MODEL

For videoconferencing channel as input random data sequence is applied to QPSK modulator. ForPulse Shaping requirement Raised cosine filter is due to changing the value of alpha between 0 to 1 to make response more sharpen and also estimate the effect of ISI.Predistortion module is applied in between the input signal and Nonlinear Power amplifier which cause the AM/AM and AM/PM distortion. Based on the idea of channel simulator response curve applied inverse response of that channel is applied before nonlinear Memory less saleh Model and minimize the channel distortion at the transmitting side. And passing through the AWGN channel at the receiver side better performance can be achieved

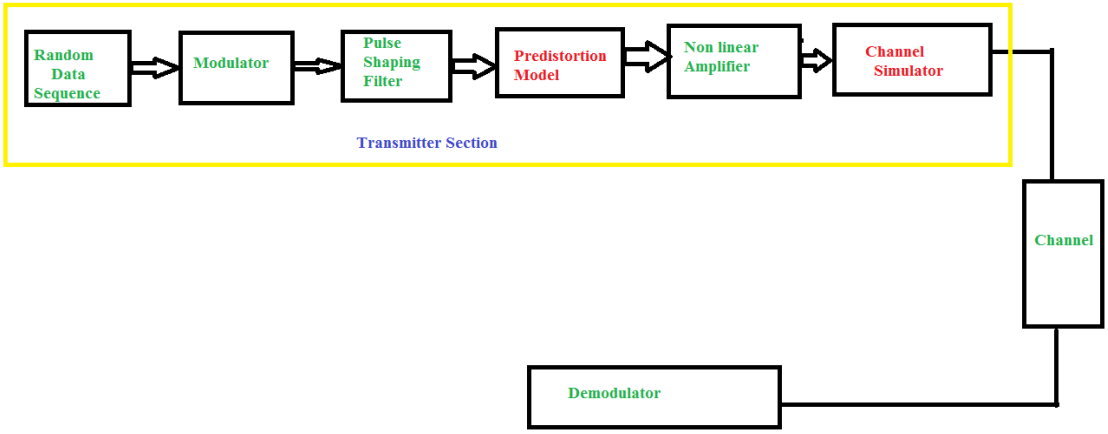


Figure: Basic Model of Videoconferncing channel using Predistortion Circuit

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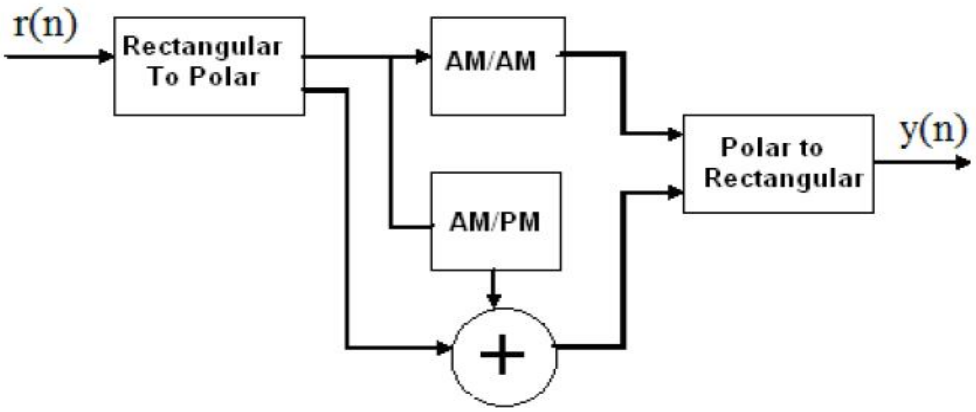
IV.HPA MODEL

Various HPA models have been developed for theoreticalanalysis in the past decades. They can be generally classified into two categories: memoryless and memory HPA models.Saleh and Rapp model are the typical memorylessHPA model for Traveling Wave Tube Amplifier (TWTA) and Solid State Power Amplifier (SSPA), respectively.The below figure shows the Saleh Model.



The AM/AM parameters, alpha and beta, are used to compute the amplitude gain for an input signal using the following function:

$$g(r(n)) = \frac{\alpha_a r(n)}{[1+\beta_a] r(n)^2}$$

$$f(r(n)) = \frac{\alpha_\varphi r(n)^2}{[1+\beta_\varphi] r(n)^2}$$

Where $\alpha_a, \beta_a, \alpha_\varphi$ and β_φ are the model's parameters.

The AM/PM parameters, alpha and beta, are used to compute the phase change for an input signal using the following functionsignal.AM/AM Parameters are alpha =2.1587 and beta=1.1517, AM/PM Parameters are alpha =4.0033, beta 9.0140

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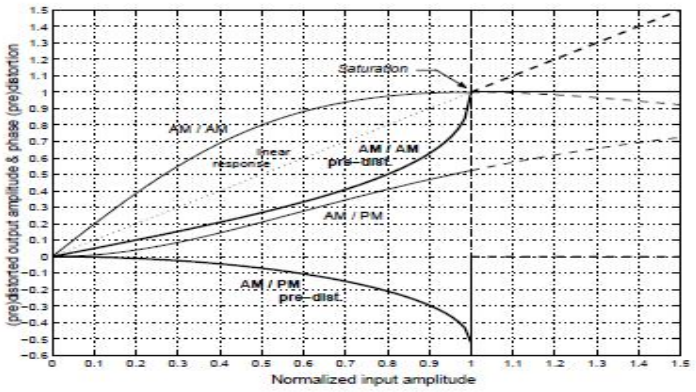


AM-AM and AM-PM Predistortion theoretical Concept

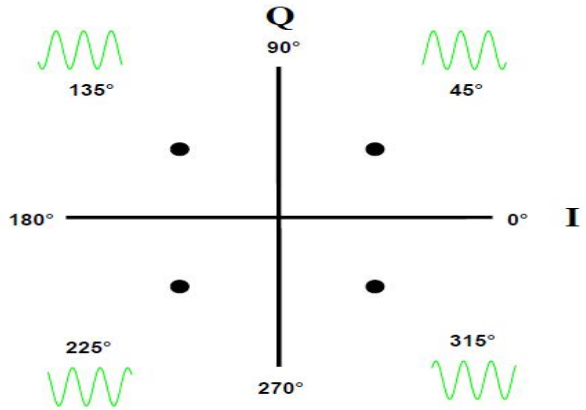
V.QPSK MODULATOR

In QPSK, two bits are transmitted in a single modulation symbol. The phase of the carrier takes on one of four equally spaced values such as 0, n/2, n and 3n/2, where each value of phase corresponds to a unique pair of message bits. A QPSK signal can be defined as

$$s(t) = \sqrt{\frac{2E_s}{T_s}} \cos\left[2\pi f_c t + (i-1)\frac{\pi}{2}\right], \qquad i = 1,2,3,4$$

where T symbol duration (equal to twice the bit duration Tb).Each channel modulates a carrier The two carrier frequencies are the same, but their phase is offset by 90 degrees (that is, they are “in quadrature”).The two carriers are combined and transmitted Four states because $2^2 = 4$.Theoretical bandwidth efficiency is two bits/second/Hz

Symbol Transmitted	Carrier Phase	Carrier Amplitude
00	225°	1.0
01	135°	1.0
10	315°	1.0
11	45°	1.0



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VI. RAISED COSINE FILTER

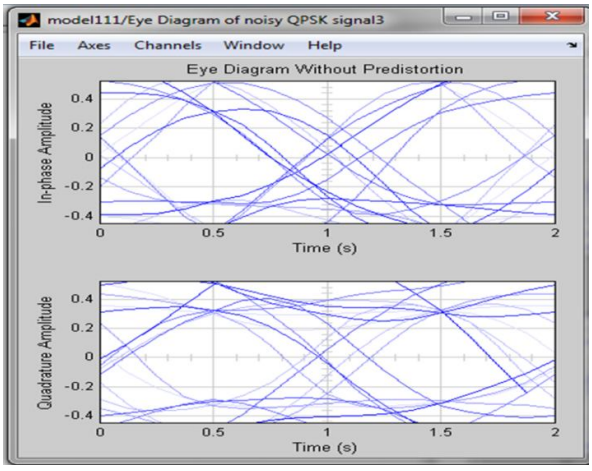
By taking the Root RC filter Frequency response gives the Equation:

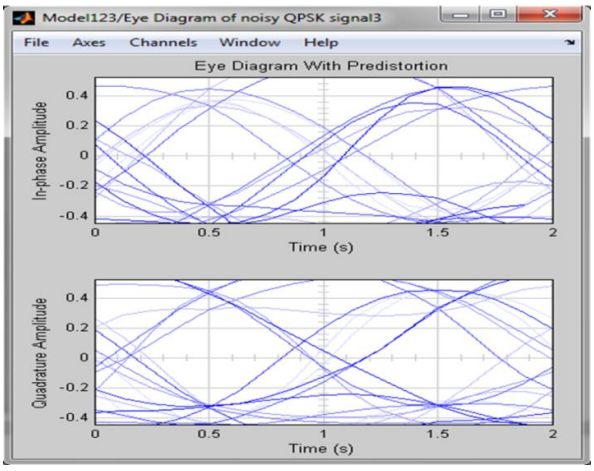
$$H(f)=\begin{cases}\sqrt{T} & \left(0\le|f|\le\dfrac{1-\beta}{2T}\right)\\ \sqrt{\dfrac{T}{2}\left\{1+\cos\left[\dfrac{\pi T}{\beta}\left(|f|-\dfrac{1-\beta}{2T}\right)\right]\right.} & \left(\dfrac{1-\beta}{2T}\le|f|\le\dfrac{1+\beta}{2T}\right)\\ 0 & \left(|f|>\dfrac{1+\beta}{2T}\right)\end{cases}$$

RRC theoretically has infinite number of taps so it has infinite attenuation in the stop band. However, in implementation its length should be reduced to a finite value. Decreasing the number of samples (filter delay) reduces the stop band attenuation. The roll off factor is a measure of the excess bandwidth of the filter, i.e., the bandwidth occupied beyond the Nyquist bandwidth of 1/2T, where 1/T is symbol rate. As roll off increases eye in the eye diagram opens up. This means that if there were no bandwidth restrictions it would be easier on the receiver if one used a large roll off. (However, for bandwidth efficiency roll off should be smaller.)Smaller roll off gives narrower bandwidth. However, its side lobes increase so attenuation in stop band is reduced.RRC filters are implemented in the base band as a digital filter. Since implementing narrow (high Q) filters in the RF bands is difficult. Roll off factor value in between 0 to 1.

VII. SIMULATION RESULT

In the Simulink result below using eye diagram here we can see that in the figure without predistortion and with using predistortion videoconferencing channel .In the figure without Predistortion and with Predistortion the eye of both channel is inverse now combining both response before the transmitting side and passing through the channel at the receiver side performance of the system response is more linear and improved the performance





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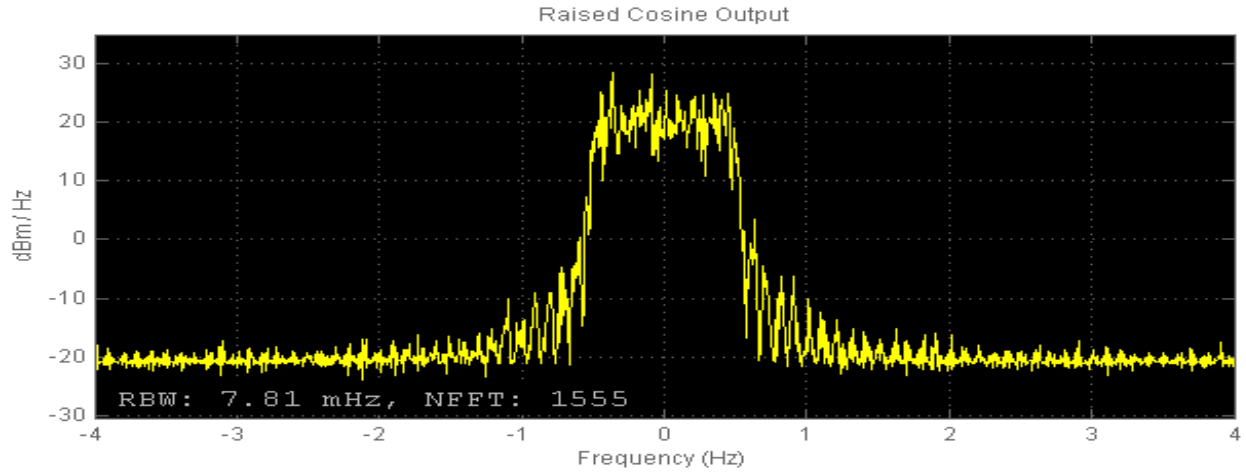
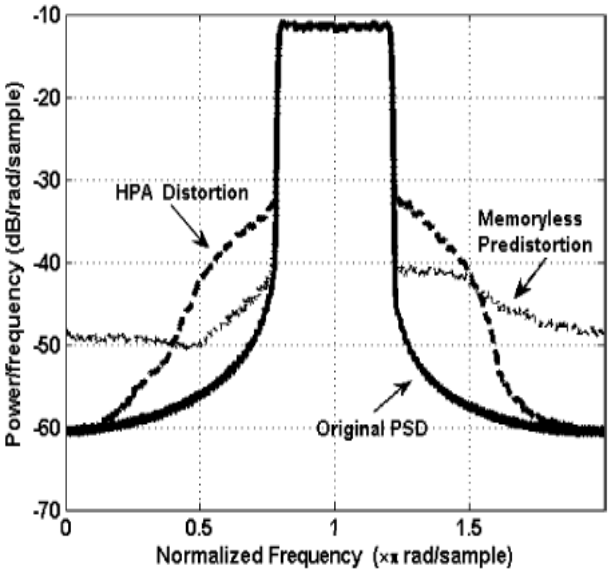
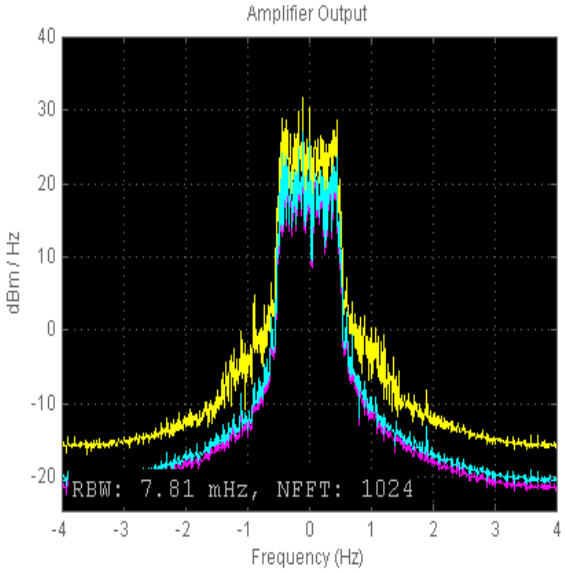


When Digitally Modulated QPSK has side lobes after Filtering Side lobes are removed. But this introduces Amplitude variations. When this signal is passed through nonlinear amplifier these causes distortion in amplitude and phase hence the performance of the signal is degraded. This can be seen from the eye diagram however if we do predistortion this will be degraded before amplifier but will improved after nonlinear amplifier.





VIII CONCLUSION

It can be simulated the Transmission Communication Link including Modulation, Filtering, Amplification, Noise Addition and verify the Performance by Using Standard Demodulator. In the communication link Including the Distortion due to Non-Linear Amplifier and Channel Simulator and it can observed that before transmission due to Predistortion Eye Diagram is degraded

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