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Power amplifier wireless communications and WLAN using adaptive polynomial

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Abstract:

In order to linearize power amplifiers, this study introduces a novel adaptive pre-distortion technique that may be used with non-constant envelope modulations like QAM and OFDM. The polynomial system is used before distortion. The goal is to minimize the Mean Square Error between the optimally amplified signal and the baseband-equivalent of the actual amplifier's output. How the gradient is expressedanalytically2.Methodologybehindthesuggestedapproach.
Here, z(n) is the complex baseband signal, zI(n) and zQ(n) are its cartesian coordinates, and z(n) is the complex envelope of the modulated signal. A function known as f is used to do polynomial pre-distortion. The function [3] of |z(n)|2 is a complex polynomial. With z(n) as the input, the pre-distortionsystemproduceszp(n)=z(n)f(|z(n)|2).
of the standard has been determined. This analytical statement is used to apply a stochastic gradient technique.The output One way to speed up the convergence process is to apply a particular normalization to the coefficients of the polynomial predistortion. A class AB power amplifier with a baseband signal matching filtered QPSK and OFDM modulations has been used to test the approach.

Keywords: Digital mobile communications, feedback signal, general-purpose solid-state amplifiers..

Introduction:

The autonomy of mobile terminals is directly affected by the design of extremely efficient Power Amplifiers (PA), making it a key concern for mobile communications. The output signal is distorted in both amplitude and phase due to the non-linearities that are inherent in efficient PA. The AM-PM and AM-AM curves are used to describe these aberrations [1]. They cause the demodulation error rate to rise, as well as spectrum regrowth in neighboring channels and constellation distortion (an increase in the EVM) in digital mobile communications equipment. These distortions To minimize a criteria J, the complex coefficients fk are adaptively adjusted. The suggested criteria J is a Mean Squared Error criterion, with the error signal being the disparity between the ideal amplified signal G0z(n) and the demodulated output zp-a(n) rendered by the predistorter and Non Linear PA cascade:
are dependent on the modulation's envelope dynamics. Compared to non-constant envelope modulations like QAM or OFDM, they are much less disruptive for constant envelope modulations like GMSK. There have been several methods suggested [2] for

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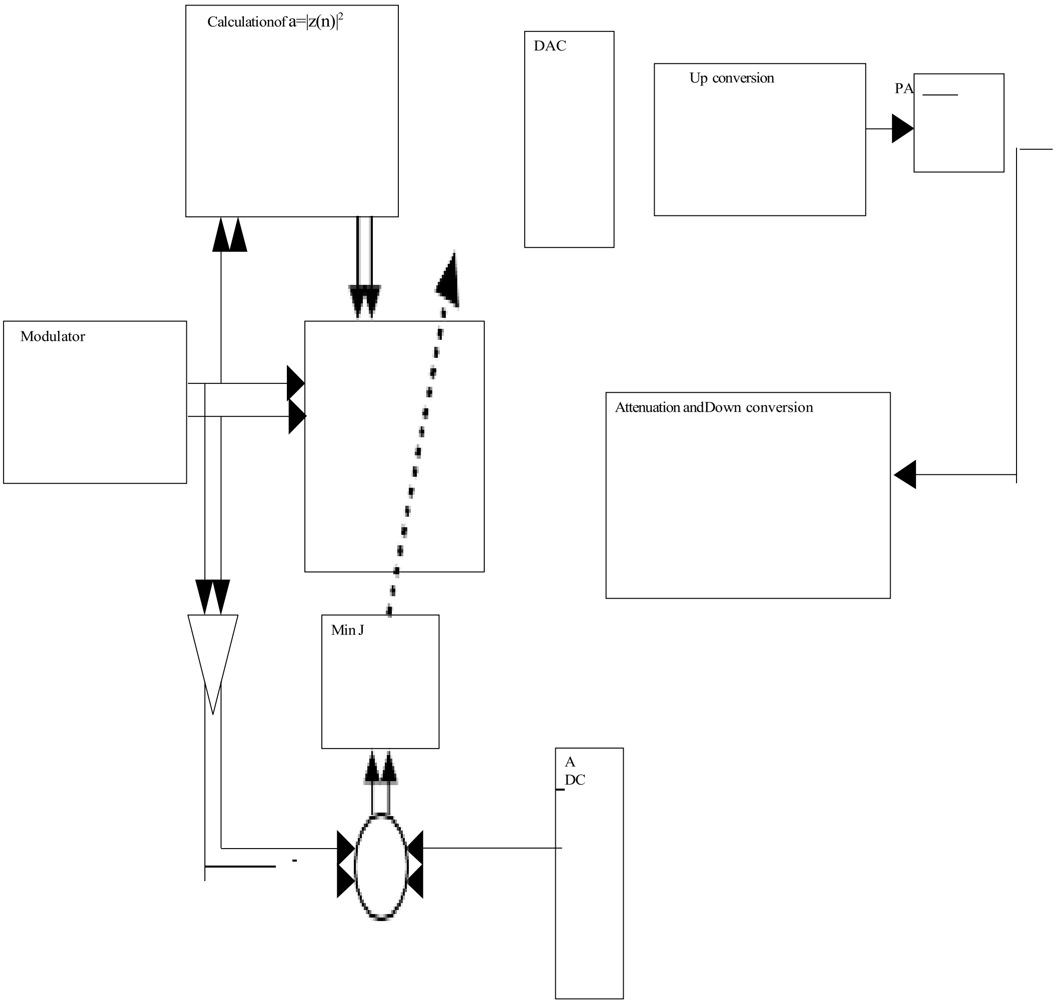

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address these non-linearities by using adaptive pre-distortion techniques, feedback or feedforward analog methods, etc. A novel baseband polynomial pre-distortion approach, tailored to the EDGE modulation scenario, was recently developed by us [4]. It makes use of an EVM criteria. This study examines the stochastic gradient and gradient characteristics for polynomial identification and extends the concept to various kinds of modulations.Image 1: Schematic of the mechanism used to prevent distortion

The corresponding baseband model has been used in the simulations, which assume that the output distorted signal is narrow-band relative to the carrier frequency. We have also done baseband simulations of the amplifier.

The squared envelope of the amplifier's input signal a determines its complex gain. The AM-PM and AM-AM measured curves provide its value.

exactly 5 decibels. The OFDM modulation envelope displays a Rayleigh density of probability when the number of carriers is sufficiently large. MMR is 10 decibels.

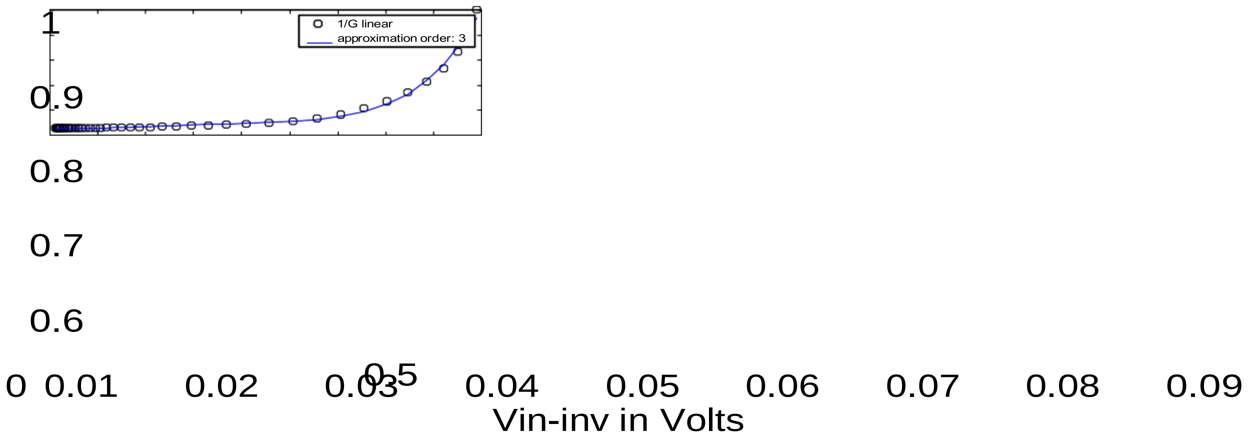
The normalized gradient technique converges the coefficients of polynomials (Figure 4).

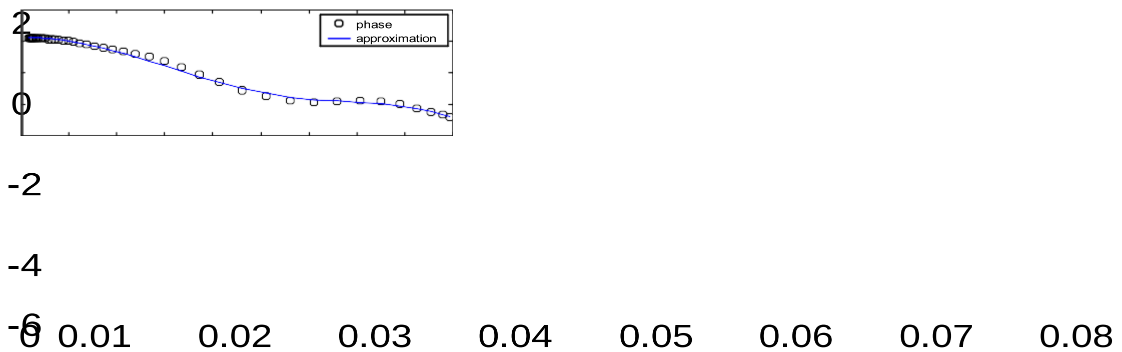
Unpredictable gradient method Then, using the updating equation as a guide, we tested a normalized stochastic algorithm: If S(n) is defined as xn2(i+j+1))/E(x2(i+1))/E(x2j), then ν(n+1) is equal to ν(n) + μ0.*(s(n)-S(n)ν(n) with s(n) being defined as y x (2i+1))/E(x2(i+1)). The results are shown in Fig 5.

, which shows the constellation at the emitter's output both with and without a linear power amplifier. The NLA's impact on the power spectral densities of the OFDM and QPSK modulations are seen in Figures 10 and 11, respectively.

5.3. Fixed predistortion

We have first calculated a fixed predistortion. This fixed predistortion is obtained by fitting a 3rd order polynomial to the inverse curve of the complex gain of the amplifier. Figure 9 shows the inverse curve of the gain and its approximation by a polynomial curve.





0.09

Figure 9: Inverse complex Gain and its Polynomial Approximation. The results obtained for the power spectral densities,
with the fixed pre-distortion, are given Figure 10 and 11.

5.4. Adaptive predistortion

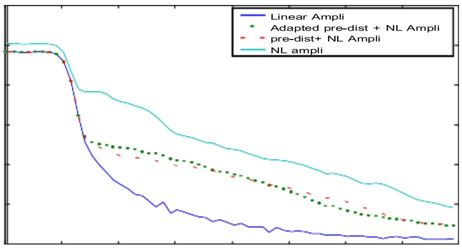
We have then adapted a 3th order pre-distortion system with a neutral initialization (f(|z²|)=1).

The adaptation has been done for different values of the PBO. After a few thousands iterations we obtain a system which gives the following results expressed in terms of EVM and power spectral densities performances.

EVM minimization: for QPSK signals the EVM falls from .089 to .0032.

-40
0 0.5 1 1.5 2 2.5 3 3.5 4
frequency f/Fs

Figure 10: Power Spectral Densities before and after pre-distortion



40
20
0
-20
-40
-60
-80
0 0.5 1 1.5 2 2.5 3 3.5 4
frequency f/Fs

Figure 11: Power Spectral Densities before and after pre-distortion

We can notice that the shape of the power spectral density (psd) has been drastically improved

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whereas it was not the direct criterion. The adaptive pre-distortion performs almost as good as the fixed one.

Conclusion

A non-linear amplifier with adaptive baseband polynomial pre-distortion based on Mean Square Error criteria has been created by us. Our research shows that an adaptation step tailored to the degree of each polynomial coefficient is crucial for convergence.

References

Artech House, Boston, 99. S.C. Cripps, "RF Power Amplifiers for Wireless Communications." 2. "Linearised RF Amplifier and Transmitter Techniques" by P. B. Kenington, published in 1998 by Wireless SystemInternational(http://.www.wsil.com).
"An adaptive predistorter for a power amplifier based on adjacent channel emissions" (IEEE Trans. On Vehicle Technology, Vol. VT-41, n°1, pages 49-56, Feb. 1992) was written by S. P. Stapelton and F. C. Costescu.
Presented at the Proc. of ECWT'2000 in Paris in October 2000, G. Baudoin and P. Jardin presented "A new adaptive baseband pre-distortion algorithm for linearization of power amplifiers, application to EDGE-GSM transmitters" (pp. 163-166).