

# Measurement setup for digital predistortion adaptation

Ali Soltani Tehrani, Thomas Eriksson, Christian Fager  
GigaHertz Centre, Chalmers University of Technology, SE-41296, Goteborg, Sweden

**Abstract**—This paper proposes a measurement setup to emulate adaptive predistortion of power amplifiers without real-time hardware circuitry. The method consists of utilizing repeated measurements in a manner that keeps the power amplifier in a state similar to the state it would be in using real-time adaptation hardware. This method provides a way to test and compare amplifier predistortion techniques without the need for expensive and complicated hardware in the feedback loop.

## I. INTRODUCTION

A growing trend in future wireless communication transmitters is to include feedback paths in the transmitter to adapt for changes in hardware characteristics. Specifically for power amplifiers (PAs), use of adaptive predistortion to cancel nonlinearities created by the PA has grown in importance [1], [2]. Aging, temperature changes, and bias mismatches are some of the reasons that require parameter adaptation.

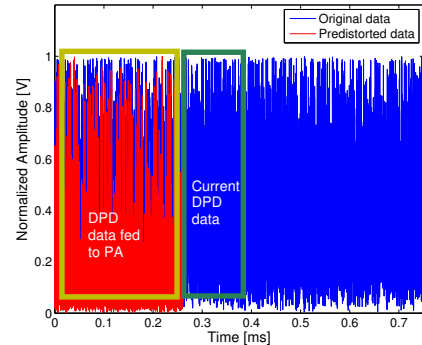
In order to analyze and compare adaptation techniques, it becomes necessary to construct an entire real-time feedback chain. In [1] a simple measurement setup for parameter adaptation of the predistorter is shown. In [2] this is accomplished by constructing a lookup table predistorter implemented in FPGA in the feedback loop. The resulting predistorter parameters converges relatively quickly. However, in these works the necessary hardware required to construct this feedback chain can be quite costly and complicated to construct.

In this work, a measurement setup is proposed that can emulate the behavior of a power amplifier in an adaptive environment without requiring the additional feedback chain hardware. This can help simplify the design and analysis stages of adaptation techniques and can be used as a test setup before the final phase of testing with the full real-time setup.

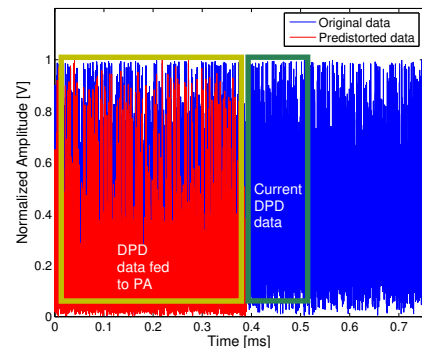
## II. PROPOSED MEASUREMENT SETUP

In a blocked based real-time adaptation of PA predistorter parameters, the input and output of PA are recorded by the feedback chain and used to update the predistorter parameters. The updated parameters are then used to predistort the next block of data to the PA. As the PA characteristics like temperature and bias change, or as the PA ages, the predistorter adapts to these changes. In order to emulate this behavior in a measurement setup without the real-time feedback loop hardware, it is necessary that the input signal and state (temperature variations, bias changes and etc.) of the PA remain similar for both methods.

In the proposed method iterations are used, where in each iteration, instead of the entire signal, only the predistorted



(a) Step  $k$



(b) Step  $k + 1$

Fig. 1. Outline of the measurement method proposed.

signal of the adaptation block is given to the PA. The input and output of the PA is recorded, and then offline the parameter update is applied to the next block of data and fed to the PA again. Figure 1(a) shows the predistorted input used for block  $k$  and the input data that will be predistorted with updated parameters. Figure 1(b) shows the results of predistorting the data of block  $k$  and the same procedure for block  $k + 1$ . This process is continued until the entire data set is predistorted by the PA. The predistortion signal found by this method will be similar to the predistortion signal of the real-time scheme.

## REFERENCES

- [1] J. Cavers, "Amplifier linearization using a digital predistorter with fast adaptation and low memory requirements," *IEEE Trans on Vehic. Tech.*, vol. 39, no. 4, pp. 374–382, nov 1990.
- [2] S. Boumaiza, J. Li, M. Jaidane-Saidane, and F. Ghannouchi, "Adaptive digital/RF predistortion using a nonuniform lut indexing function with built-in dependence on the amplifier nonlinearity," *Trans. Micro. Theory and Tech.*, vol. 52, no. 12, pp. 2670–2677, dec. 2004.