Digital Distortion with Low Precision ADCs

Chance Tarver and Joseph Cavallaro
Department of Electrical and Computer Engineering
Rice University, Houston, TX 77251
Email: tarver@rice.edu cavallar@rice.edu

***Abstract*—Digital Predistortion (DPD) is a popular technique for linearizing a power amplifier (PA) to help reduce the spurious emissions and spectral regrowth. DPD requires the learning of the inverse PA nonlinearities by training on the output of the PA. In practical systems, the analog output of the PA will have to go through an analog-to-digital converter (ADC) so that training can be done on a digital processor. The quantization degrades signal quality and may limit performance of a DPD learning algorithm. However, a lower resolution ADC may cost less and allow for less computational complexity in the digital processing. We study this tradeoff to try to find how much precision is needed in DPD systems.**

I. Introduction

The power amplifier (PA) is a component of wireless systems that has a nonlinear transfer function. The nonlinearities are undesirable in that they lead to distortions such as spectral regrowth around the main carriers and intermodulation distortions (IMDs) in scenarios with multiple, noncontiguous carriers. This is exacerbated with modern signals such as OFDM with high PAPR.

Digital predistortion (DPD) is a method for linearizing a power amplifier (PA). With DPD, the nonlinearities are estimated so that they can be corrected before the PA with their inverse. To do this, we must train our predistorter by observing the signal after the PA. In practical situations, we need a feedback bath after the PA that has a downconverter and an ADC. For wide bandwidth signals, the sampling rate of the ADC must be fast. In mobile applications where power and cost are a concern, one option for reducing the complexity of the system is to use a low precision ADC.

This is a common thing being explored in MMWave and massive MIMO

In this paper, we test the performance of our previous DPD solutions for varying ADC precision.

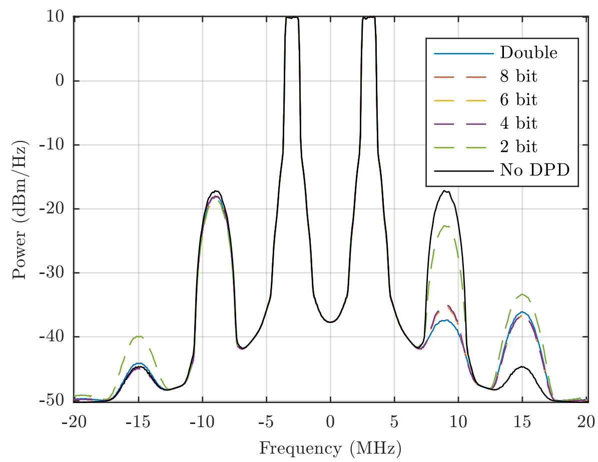

Fig. 1. PSD output when performing sub-band DPD with a low precision ADC feedback path. Here, performance for 8, 6, and 4 bit observations are similar with about 2 dB less IM3 suppression when compared to the double precision PA simulation.

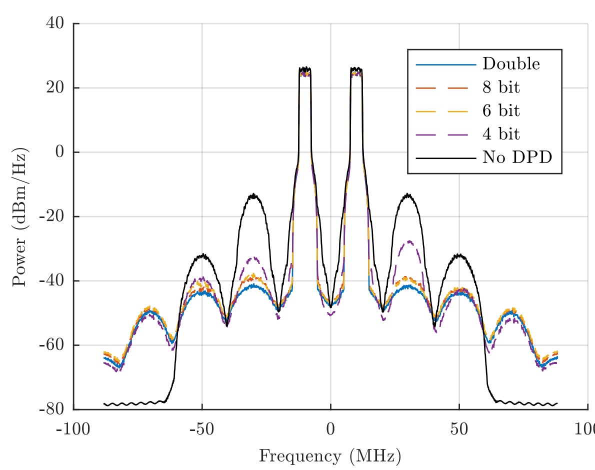

Fig. 2. PSD output when performing full-band DPD with a low precision ADC feedback path. Here, performance for the 8 bit and 6 bit ADCs are similar with about 2 dB less IM3 suppression when compared to the double precision PA simulation.

II. SubBand DPD

TEXT

III. FullBand DPD

IV. WARPLab Testing

V. Conclusion

The conclusion goes here.

References

[1] H. Kopka and P. W. Daly, *A Guide to LaTeX*, 3rd ed. Harlow, England: Addison-Wesley, 1999.