DIGITAL PREDISTORTION WITH LOW-PRECISION ADCS



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Motivation

Spectrum scarcity is leading to more frequency-agile standards

- -Non-contiguous transmission
- -Carrier Aggregation (CA) in LTE-Advanced
- –Cognitive radio
- -5G New Radio (NR) cellular

Non-contiguous carriers intermodulate

- -Caused by nonlinearities in power amplifiers (PAs)
- Undesired spurious emissions (spurs) and spectral regrowth
- -Could interfere with nearby channels
- –Self-interference to own receiver when using FDD

• DPD requires extra hardware

- -Extra RX chains with fast sampling rates
- Larger area
- More power
- Need computationally and hardware efficient way to linearize for this scenario

Main Idea

• Use a lower precision ADC for DPD on a UE device

- -Reduce the necessary area
- –Reduce the power
- Reduce the cost
- -Reduce the computational complexity by using shorter word lengths
- -Increase sampling rates

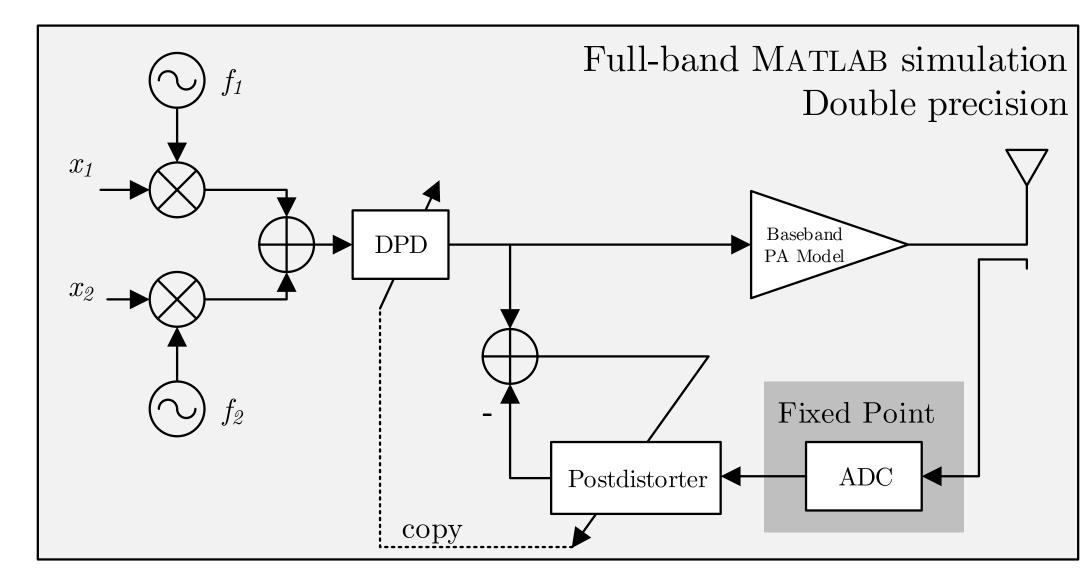
MATLAB Simulator

LTE-Advanced CA Scenario

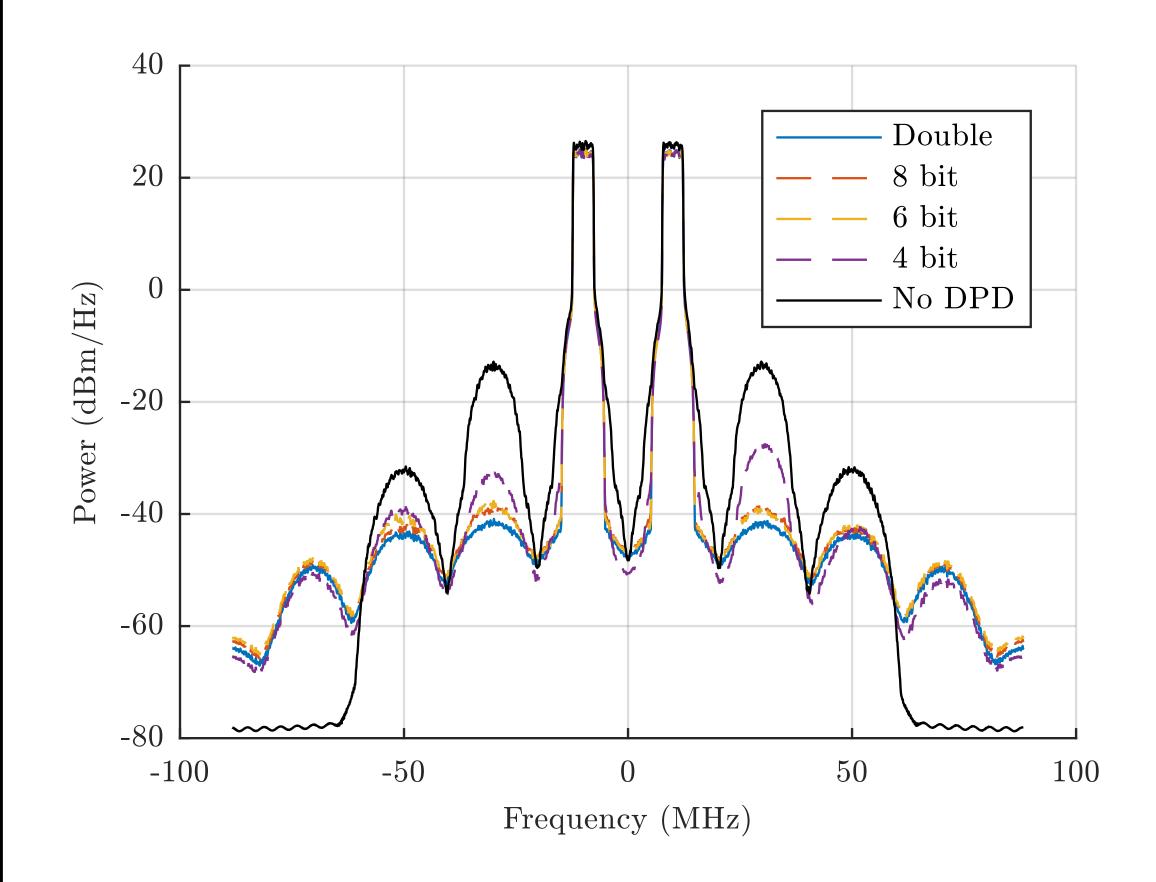
- -Two, 5 MHz component carriers
- -5th order, parallel Hammerstein PA model
- -Fixed point toolbox to emulate ADC

Full-band DPD Simulations

Simulation Architecture



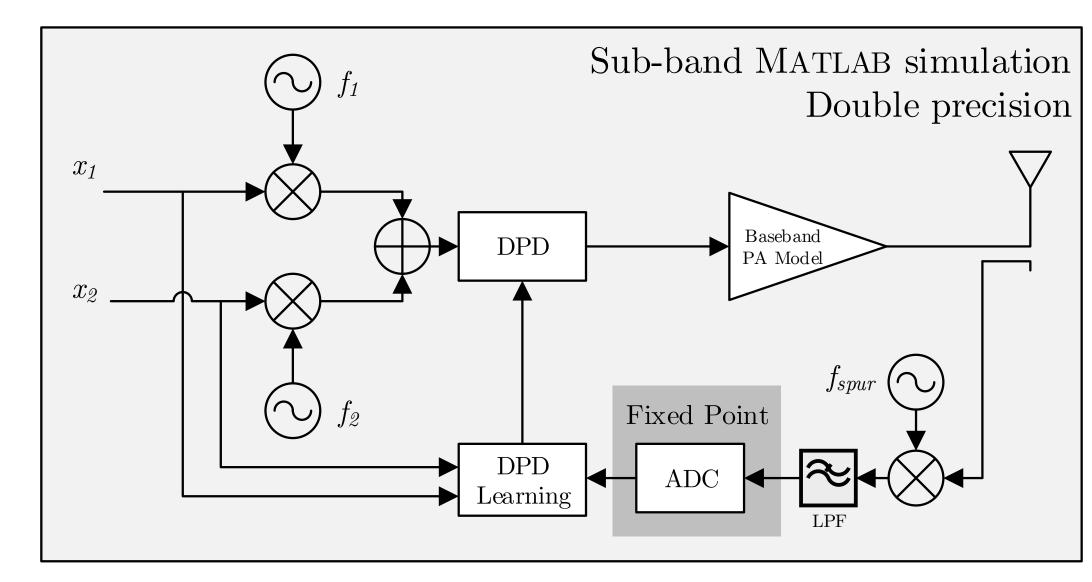
- -Traditional, indirect-learning DPD
- Suppression Results:



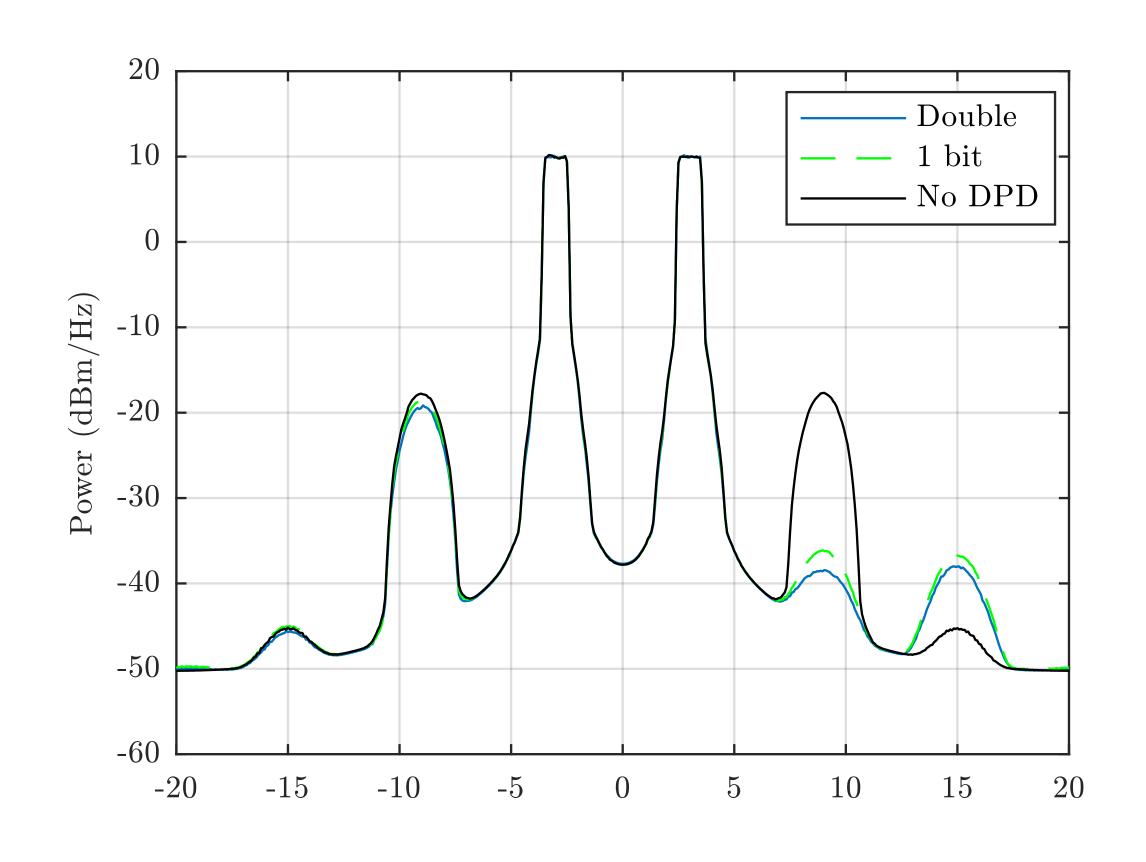
-Near ideal performance for as low as 6 bits

Sub-band DPD Simulations

Simulation Architecture



- Uses LMS adaptive training to learn inverse of PA nonlinearities
- Suppression Results:



- -Near ideal performance for as low as 1 bit
- By targeting a single spur, gain can be set to get better resolution of the signal
- –Main carriers no longer likely to saturate the ADC

Future Work

- Computational complexity analysis
- Multi sub-band, single-bit DPD solution
- Hardware testing with a real PA using the WARP SDR platform