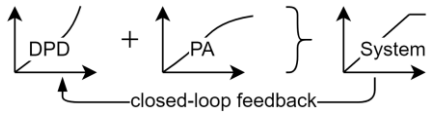
# Low-Complexity Feedback Data Compression for Closed-Loop Digital Predistortion

Arne Fischer-Bühner, Lauri Anttila, Vishnu Unnikrishnan, Manil Dev Gomony, and Mikko Valkama

## STATUS QUO




Digital predistortion (DPD) feedback architecture

- System output is observed using dedicated feedback receiver to adapt the DPD model

**Challenges**

- high oversampling ratio + high bit-resolution needed to capture the distortions
- long feedback sequence needs to be acquired to record all possible PA excitations

**Existing solutions**

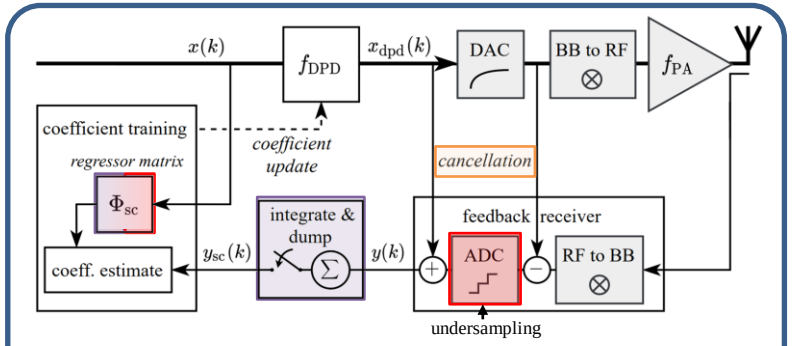
- ✓ histogram-based sample selection: extract a representative set of feedback samples
  - ✗ statistical properties of distortion need to be known and signals need to be analyzed first
  - ✗ **high complexity, low flexibility**

## NEW INSIGHTS

Low complexity method for feedback compression using "*sample combining*"

- ✓ condense feedback sample set
- ✓ extension of feedback undersampling
- ✓ irrespective of signal properties / PA excitation
  - high flexibility
- ✓ suitable for throughput-oriented, real-time, low complex implementation

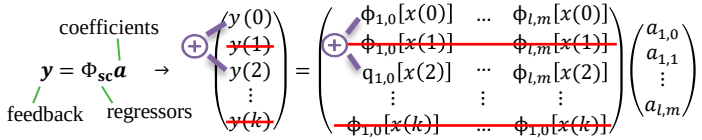
## DESCRIPTION




The proposed method uses three components:

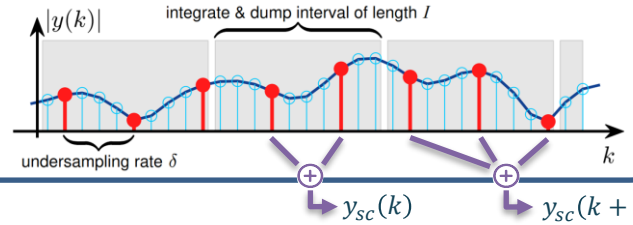
✓ undersampling ADC + ✓ integrate & dump + ✓cancellation

Any linear operation on the coefficient estimation is permitted if
1) <u>similarly applied to feedback and regressors</u> Φ
2) not systematically removing information (e.g. low-pass filter)




Combining rows/samples by integrate + dump yields condensed set of equations, information loss is avoided since

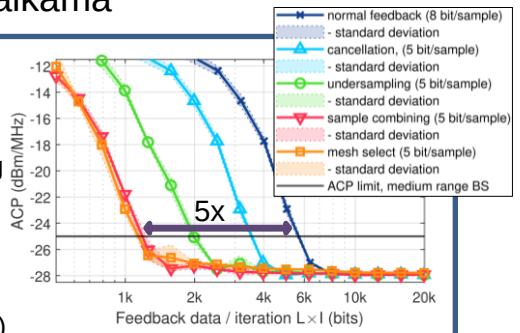
- most rows are highly-correlated
- undersampling spreads information in frequency domain and avoids low-pass removal of information




## QUANTITATIVE IMPACT

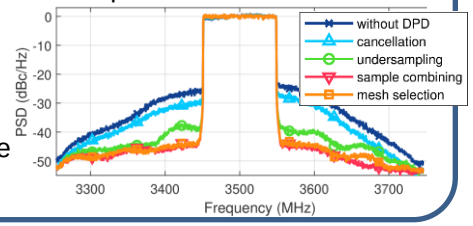
Evaluation with 100 MHz OFDM on 3.5 GHz GaN PA

- optimized learning rate
- 20 closed-loop training iterations
- assume low-bit quantization (5 bit)
- GMP DPD model




20 iterations with 300 feedback samples

- ✓ high linearity with 5x less data vs normal feedback
- ✓ same performance as reference




## PROPOSED CONCEPT GOALS

Proposed a simple & effective compression scheme for feedback sample reduction with

- ✓ low processing overhead
- ✓ competitive compression performance
- ✓ applicable together with low bit-resolution and undersampling ADC

Future work:

- demonstration in real-time system
- extension to DPD in multi-antenna systems

Funded by the European Union's Horizon 2020 research and innovation programme under grant No. 860921