

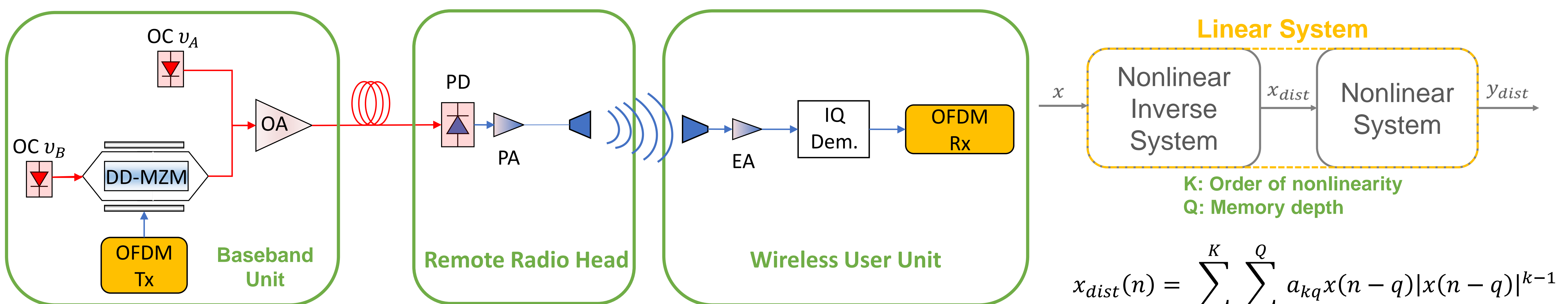
Mitigation of Nonlinear Distortions in a mm-Wave OFDM Photonic Link Employing Digital Signal Pre-Processing

Optical Communications

Motivation

- Next generation of wireless networks, 5th generation (5G), is expected to provide large bandwidths to support the emerging interactive services and multimedia. To prevent spectral congestion and to meet the 5G bandwidth requirements, these systems will eventually need to operate in the millimeter wave (mm-Wave) region.
- Optical generation of carriers introduces nonlinearities that degrade the system's performance. By applying digital predistortion based on Memory Polynomials, we can mitigate the nonlinearities.

Description



Modeling the inverse of the system:

$$\mathbf{a} = (\mathbf{Y}^H \mathbf{Y})^{-1} \mathbf{Y}^H \mathbf{x}$$

$$\mathbf{x}_{dist} = \mathbf{X} \times \mathbf{a}$$

Determine coefficients a_{kq} using Minimum Squares Method

$$\mathbf{Y} = [\mathbf{Y}_{10} \dots \mathbf{Y}_{K0}, \mathbf{Y}_{11} \dots \mathbf{Y}_{K1}, \dots, \mathbf{Y}_{1Q} \dots \mathbf{Y}_{KQ}]^T$$

$$\mathbf{Y}_{kq} = [y_{kq}(n) \ y_{kq}(n+1) \ \dots \ y_{kq}(n+N-1)]^T$$

$$y_{kq} = y(n-q)|y(n-q)|^{k-1}$$

$$x_{dist}(n) = \sum_{k=1}^K \sum_{q=1}^Q a_{kq} x(n-q) |x(n-q)|^{k-1}$$

A. Hekkala et al., "Predistortion of Radio Over Fiber Links: Algorithms, Implementation, and Measurements," vol. 59, no. 3, pp. 664-672, 2012.

Simulation Results

General System Parameters:

60 GHz, $f_{IF} = 5$ GHz, 5Gbit/s

Modulation Parameters:

OFDM, 64 carriers, 16-QAM, 25% cyclic prefix

Optical System Parameters:

CW laser with noise, $\lambda = 1552.5$ nm,

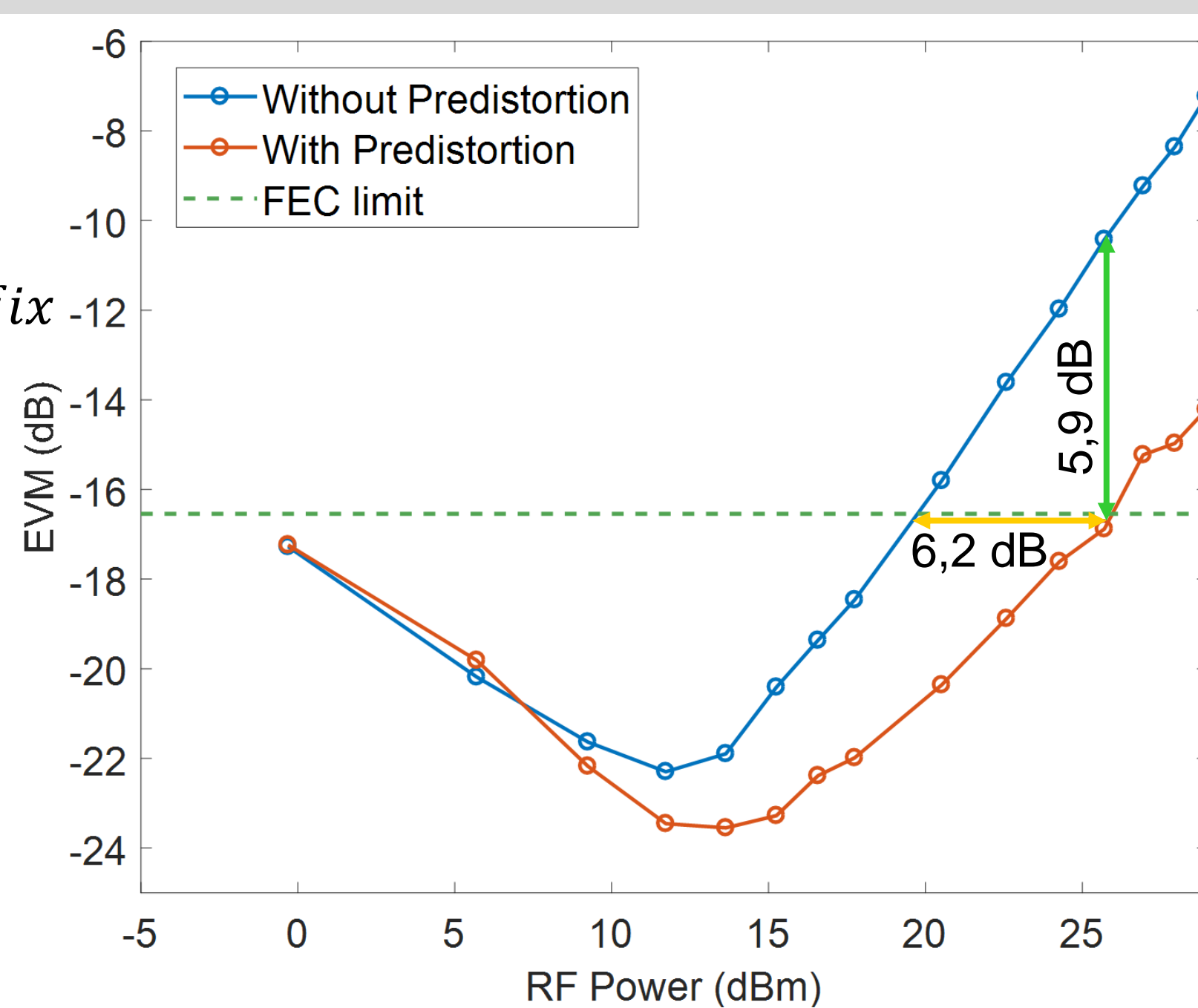
Dual-Drive Mach-Zehnder

with $V_{\pi} = 3.5$ V

Best Oral Presentation



B.M.Oliveira, et al "Mitigation of nonlinear distortions in a mm-Wave OFDM photonic link employing digital signal pre-processing", 20th International Conference on Transparent Optical Networks (ICTON), 2018. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8473711&isnumber=8473576>



Experimental Results

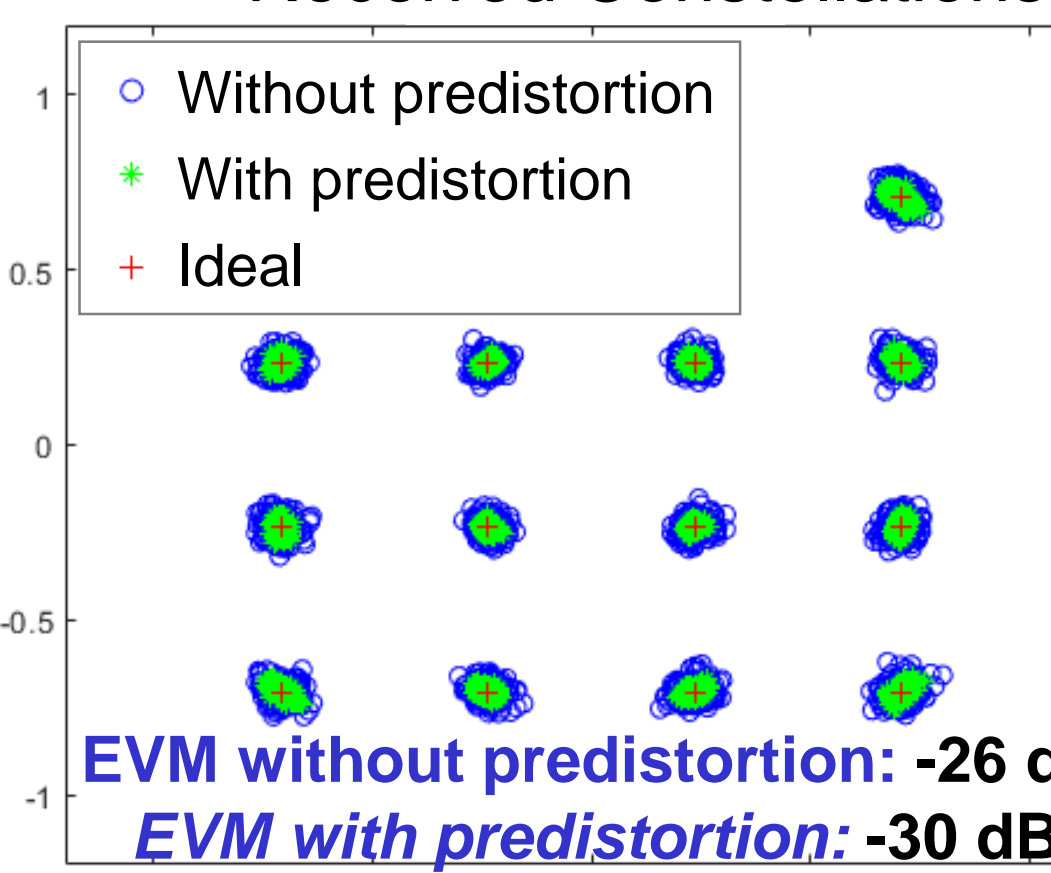
General System Parameters: $f_{IF} = 625$ MHz, 625 Mbit/s

Modulation Parameters: OFDM, 128 carriers, 16-QAM, 25% cyclic prefix

Optical System Parameters: CW laser, $\lambda = 1552.5$ nm, Dual-Drive Mach-Zehnder with $V_{\pi} = 4$ V

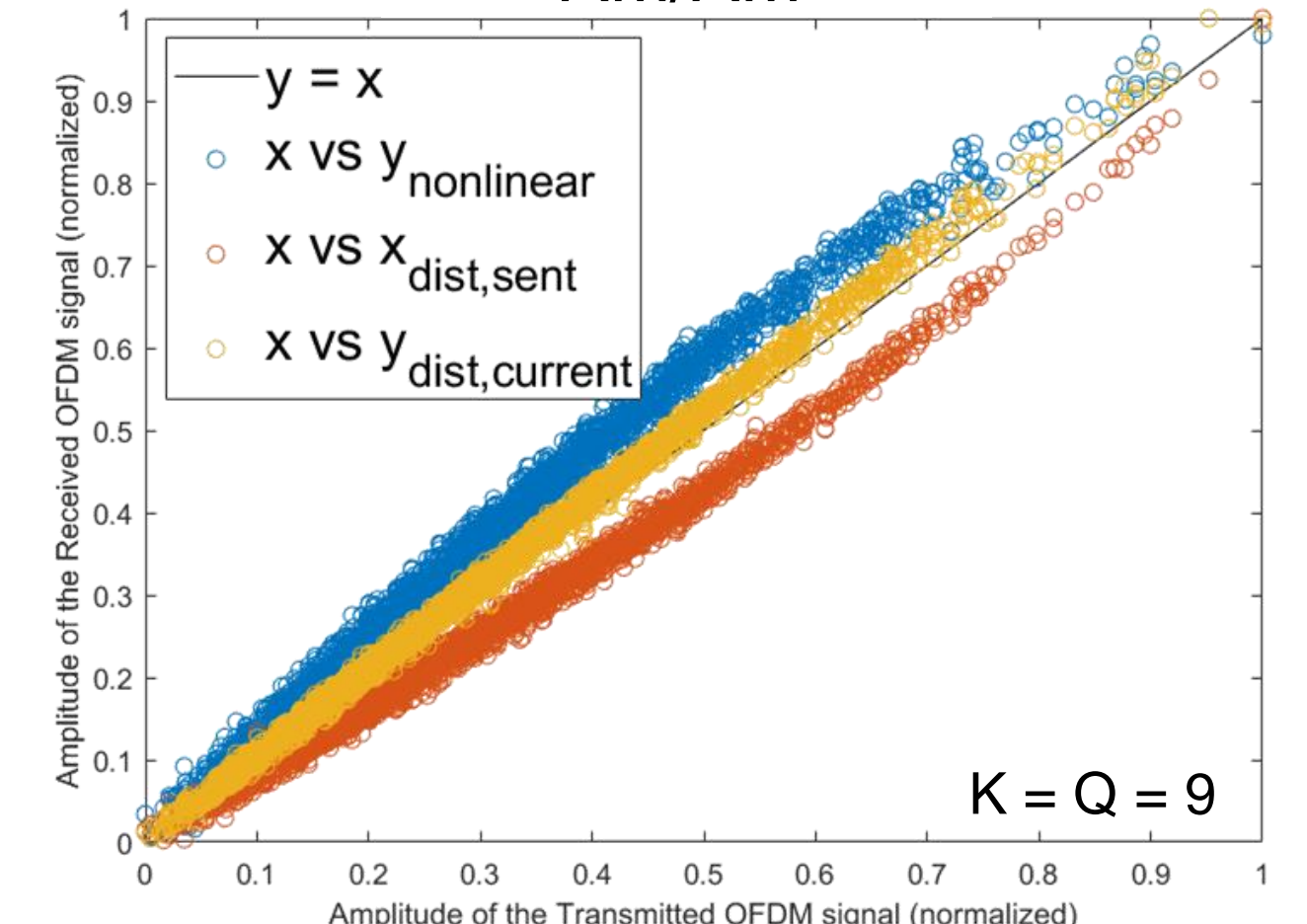
Number of samples = 3200; Number of iterations = 20;

Received Constellations



EVM without predistortion: -26 dB
EVM with predistortion: -30 dB

AM/AM



Achievements

- For the simulated system, the performance improvement has been analyzed in terms of EVM, showing 6 dB of improvement
- In the experimental setup, the performance improvement in EVM was 4 dB
- We have successfully demonstrated that memory polynomials can be applied to 5G

Future Work in this Topic

- Analyze the improvement in performance when using Memory Polynomials in different systems.
- Study of other distortion compensation techniques.