Receiver Design for Nonlinearly Distorted OFDM Signals: Applications in Radio-over-Fiber Systems

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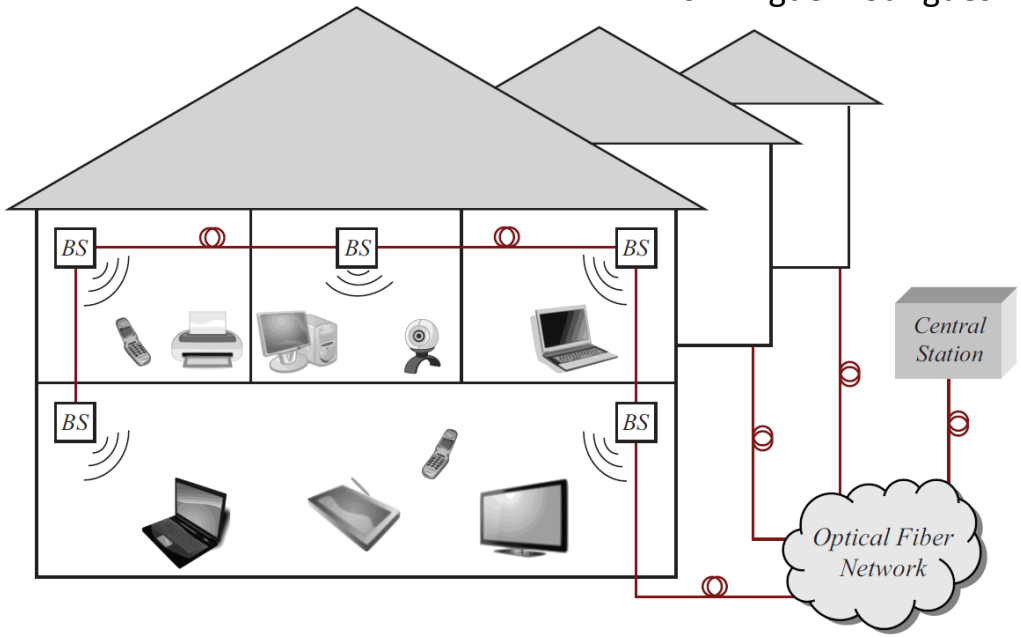
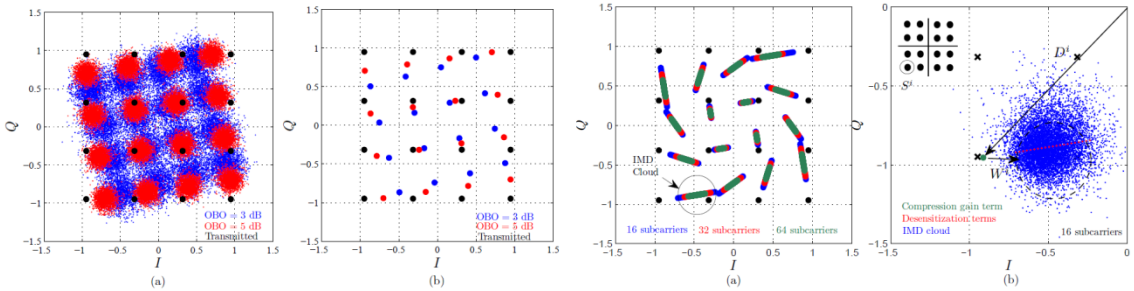
- Transmission of **OFDM** signals conveying M-PSK and M-QAM constellations;
- **Modelling**, study of the **impact** and **compensation** of:
  - **Nonlinear effects** from optical modulators;
  - **Carrier frequency and phase offsets** from local oscillators;
  - **Fading phenomena** from multipath channels;
  - **Additional noise sources** from antennas, photodiodes, receptors;
- Applications to optical communication systems:
  - Specifically the transmission of **WiFi** and **UWB** based signals in **Radio-over-Fiber (RoF) systems.**





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Abstract:

This thesis is concerned with the study and development of receiver structures based on post-compensation techniques in order to mitigate the effects of both nonlinear and linear dispersive phenomena associated with communications channels and devices as well as the result of their interaction in the transmission of OFDM signals. Although the work presented here can be applied to any OFDM memoryless nonlinear transmission system, it focus on intensity modulated/direct detection radio-over-fiber uplink systems.

The optimum receiver and an associated iterative receiver that compensates for nonlinear distortion and AWGN are proposed. Subsequently, a simpler linear receiver structure based on the minimization of the mean-squared error for nonlinearly distorted OFDM signals in the presence of AWGN is proposed and its structure is analytically derived.

The impact of both multipath and bandpass nonlinear channels on the performance of OFDM signals transmission is addressed. Moreover, both channel estimation operation and signal equalization are also a subject of study. A new channel frequency response estimator structure based on the minimization of the mean-squared error is proposed for both Rayleigh and Rician distributed fading channels. Additionally, an extension to the estimator which includes compensation of carrier frequency offset is also presented.

Finally, the techniques developed are applied to assess and improve the performance of intensity modulated/direct detection radio-over-fiber uplink systems. As impairments, we consider that the OFDM signal suffers from fading, antenna noise, nonlinearities from a Mach-Zehnder modulator, carrier frequency offset and noise from the photodiode. Several simulation results are presented and discussed for the transmission of two OFDM signals based on IEEE802.11g/n and ECMA-368 standards and the performances of the techniques are discussed.