Widely Linear Equalization for IQ Imbalance and Skew Compensation in Optical Coherent Receivers

In this paper, an alternative approach to design linear equalization algorithms for optical coherent receivers is introduced. Using widely linear complex analysis, a general analytical model is shown, where In-phase/quadrature (IQ) imbalances and IQ skew at the coherent receiver front-end are naturally included in channel equalization problem. Next, the problem of chromatic dispersion (CD) compensation after imbalanced and skewed coherent detection is analyzed. Based on the analytical models obtained it is demonstrated that, under the presence of such receiver front-end imperfections, the complexity of the channel equalization filter which is able to provide optimal performance, on the minimum mean square error (MMSE) sense, will scale proportionally to twice the complexity of CD compensation, if standard zero-forcing equalization of CD is applied as first equalization procedure. For the last, it is shown that, by applying the widely linear complex analysis, one can derive a complex-valued adaptive equalizer structure which is able to compensate for linear IQ-mixing effects at the receiver front-end. By extensive numerical simulations, the performance versus complexity of the proposed equalizer is shown to match the predictions of the analytical models derived.

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