

COMPUTER MODELING AND OPTIMIZATION OF COHERENT OPTICAL COMMUNICATIONS SYSTEMS

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Abstract

Coherent optical systems are promising candidates for multichannel transmission [1]. For the study of these systems, computer simulation was used in order to take into account the influence of different physical effects evolved [2]-[4]. However, due to the complexity of the problem, all the above works contain simplifying assumptions either on the evaluation of the system's performance [2],[3] or on the device modeling [4].

This paper presents an accurate computer model for the design of coherent optical communications systems. The model includes communications engineer-oriented subroutines simulating the physical impairments of the optical channel (nonuniform FM response, residual AM modulation, phase noise, fiber dispersion) and is assisted by a standard software package for CAD of analog and digital communication systems (TOPSIM,[5]). A highly accurate semi-analytical technique is used to evaluate low error probabilities ($\sim 10^{-9}$) [6], [7]. Intersymbol interference, phase noise filtering and shot noise correlation are for the first time simultaneously taken into account for the evaluation of the error probability.

The model is applied to the analysis and optimization of a coherent heterodyne CPFSK system with differential receiver operating at 1 Gb/s. It is possible to calculate with more precision than in [2]-[4] the sensitivity penalty due to the nonuniform FM response [7], the reduction of the error floor due to the phase noise filtering [8], and the optimal bandwidth of the IF filter used in differential CPFSK receivers [9]. In all these works, experiment is in good agreement with the theoretical results.

The proposed simulation model can also be a very efficient tool in order to define criteria for the device selection.