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The influence of constant-envelope signals in coherent-detection optical OFDM systems

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The resilience towards fiber dispersion is the main attractive feature of orthogonal frequency division multiplexing (OFDM) signal processing in optical communications systems. Coherent-detection optical OFDM (CO-OFDM) posses many benefits that are critical for high data rate fiber transmission systems. It is extremely robust against chromatic and polarization mode dispersions at the same time that it improves spectral efficiency eliminating the need for a guard band between the optical carrier and the information-bearing signal. Furthermore, adaptive data rates with different subcarrier mapping levels can be supported using software-defined solutions. However, large peak-to-average power ratio (PAPR) of the inherent multicarrier signals is one of the main drawbacks in CO-OFDM systems, as it not only limits the resolution of digital-to-analog converters and power amplifiers, but also reduces the tolerance to the nonlinearities introduced by Mach-Zehnder (MZM) optical modulators and optical fibers. Several PAPR reduction techniques such as coding, tone reservation, clipping, peak windowing and partial transmit sequence, have been proposed in the literature. These distinctly techniques provide different degrees of effectiveness and tradeoffs that may include increased complexity, reduced spectral efficiency and performance degradation. Recently, we proposed a PAPR reduction scheme based on constant envelope (CE) signals to improve the tolerance towards MZM modulators and fiber nonlinearities in direct-detection optical OFDM systems. As a power efficient technique, it reduced the PAPR to 3 dB using electrical phase modulation (PM). After a successful experimental demonstration in direct-detection optical systems, this CE-OFDM technique was introduced in coherent detection systems as a suitable solution to the aforementioned problems. Unlike the approaches evaluated in the literature, the intermediate electrical constant-envelope signals of this solution were used to modulate the continuous wave laser source, employing a conventional one-branch MZM modulator. The influence of the electrical phase modulation index h in the performance of CE-OFDM in coherent detection optical systems was treated analytically and its range of validity examined by simulations. A compromise between h and subcarrier mapping was identified according to differences in sensitivity related to non-linearities inserted by the MZM. We showed that the proposed scheme outperforms conventional coherent detection OFDM systems.

Biography

Jair Adriano Lima Silva received his BS, MS and PhD degrees in Electrical Engineering from the Federal University of Esp´ rito Santo (UFES), Vitória, Brazil in 2003, 2006 and 2011 respectively. In 2012, he joined the Department of Electrical Engineering of UFES. His research interest include optical fiber communication, radio-over-fiber, orthogonal frequency division multiplexing, passive optical communication network, visible light and powerline communiactions.

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