Wavelet-Coding for Radio over Fibre

As the fifth generation of mobile communication technology is developed and implemented, worldwide solutions propose the use of much greater spectrum allocations, including the millimetre-wave frequency band. Radio-over-fiber (RoF) links allow straightforward integration of the mobile front end and backhaul with deployed optical distribution networks, while readily offering the utilization of extremely large bandwidths. Such a requirement imposes critical demands for broadband wireless links, implying high-bit-rate transmissions that are loudly subjected to channel impairments. Current challenges for enhancing capacity and reach of wideband RoF communications involve overcoming severe linear and non-linear distortions caused by inevitable signal impairments within such hybrid links that lead to considerable reduction of receiver sensitivity and dynamic range. Combining theoretical analysis, simulation and experimental results, this thesis is a compilation of investigations on how to efficiently design RoF systems operating in the W-band region of the mm-wave spectrum. For the first time in literature, wavelet channel coding (WCC) is considered for RoF applications, showing considerable resilience against the effects of Doppler-induced time selectivity, which indicates that this is an effective approach for increasing robustness of short-to-medium range digital wireless communication links where there is some level of shadowing and relative motion between the antennas. In addition, a new solution for providing frequency diversity to wideband digital communication systems without any waste of spectrum resources is proposed and experimentally demonstrated, confirming not only the Tzannes' idea for WCC, but also the Silveira's strategy for implementing WCC in power-limited systems. Altogether with link analysis and deploying strategies developed herein, this thesis composes an enabling path for digitally and physically overcoming disruptive channel effects over broadband digital communication systems operating in mm-wave frequencies, most specifically at the W-band.