INDOOR WIRELESS CHANNEL MODELING AND EQUALIZATION

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Wireless communications for home networking present a difficult fading and multipath environment that may cause sever signal distortions. While there are several circuit and algorithm components employed to combat the channel impairments, one of the most important elements in the receiver is the adaptive equalizer. The performance of an equalization algorithm can be measured in many ways. For the wireless home network, the main concerns are convergence-time and mean square error (MSE). The convergence rate is important, as it relates to the amount of time that service would be interrupted on the network during initialization, a change in the channel characteristics, or in the event that there is a significant interference in the channel being used. The MSE relates to the equalizer's ability to yield, upon convergence, the correct alphabets. This has a direct impact on both Quality of Service (QoS) and the maximum achievable data rate of the system. Adaptive equalization must, therefore, provide the best possible convergence-time without compromising MSE.

While the commonly used constant modulus algorithm (CMA) is one key candidate that could achieve desired convergence requirements, its respective cost function is only amplitude-dependent, and knowledge about the signal constellation is dismissed. The CMA and its different extensions are shown to keep large misadjustments for high-order QAM signals. Incorporating partial or full knowledge of signal constellations in the cost function of gradient-based adaptive blind equalization techniques should lead to improved receiver performance. One class of blind equalization algorithms uses dual-mode schemes, in which the CMA is applied for initializations. Equalization is then continued by minimizing a cost function that includes partial or full knowledge of signal constellations.

In this project, we propose a modified CMA (MCMA) for application to wireless networks employing QAM signals. In the MCMA, the cost function is constructed from two separate error terms, one is identical to the CMA case, and the other corresponds to a decision-directed (DD) mode, or any other constellation matched error (CME) term.

The CME term in the proposed MCMA is chosen by constructing a function of the equalizer output that satisfies a number of desirable properties, including uniformity and symmetry. These properties should serve to shape the cost function in a manner that is not biased towards any specific alphabet, and to alert the adaptive equalizer when high error values are produced. An even-power sinusoidal function is shown to satisfy the above conditions and yields a simple gradient update of the equalizer weights. The respective MCMA cost function, in the 16 and 64 QAM cases, leads to faster convergence and smaller MSE than those obtained using the CMA.