Performance of turbo equalized space-time coded signals with reduced complexity receiver using M algorithm

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ABSTRACT

Space-Time coding techniques, that employ transmit antenna diversity in addition to possible receive antenna diversity are rapidly becoming compulsory technologies in wireless communications to reduce the operating region of signal to noise ratios. With the ever increasing demand for data rate, these systems needs to be implementable under frequency selective conditions, sometimes subject to severe intersymbol interference (ISI). Therefore equalization of space-time coded signals is an important problem.

Equalizers based on the maximum *a posteriori* (MAP) algorithm which uses the BCJR algorithm or those based on the Viterbi algorithm that performs maximum likelihood sequence estimation are superior to linear or Decision Feedback Equalizers (DFE) in that they reap the benefits of multipath diversity and they do not suffer from noise enhancement or error propagation. Following the concepts behind Turbo codes, "Turbo Equalization" has been recently considered that combines the equalization and decoding processes through iteration. These equalizers that require a soft output algorithm like the BCJR show the best performance in receivers and, hence are natural candidates to be investigated for space-time coded systems.

Maximum Likelihood Sequence Estimation (MLSE) equalization and turbo equalization employing BCJR in the equalizer has been already investigated for space-time coded signals. But equalizers employing BCJR are prohibitively complex under moderate to severe ISI conditions. For a space-time coded system the complexity is much higher due to the higher cardinality of space-time symbols transmitted from multiple antennas.

Use of the M algorithm has been established as a reduced state approach for the application of the BCJR algorithm.

In this thesis, we consider the application of M-BCJR for turbo equalization of space-time coded signals. The proposed model is simulated for a 4PSK, 2 transmit antenna transmitter on a 3-tap channel; leading the equalizer to have 256 states. Even with the use of a simple block interleaver the system shows better performance than the case of quasistatic Rayleigh fading (under no ISI) when M is 64 and even better performance than optimal separate MAP equalization and decoding when M is 128, thus showing the effective reduction in receiver complexity.