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On Turbo Encoded BICM

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Abstract

The superior performance of the binary Turbo codes has stimulated vigorous efforts in generating bandwidth efficient modulation schemes adhering to these codes. Several approaches for the integration of Turbo coding and modulation have emerged in recent years but none seem to dominate.

In our work the Bit Interleaved Coded Modulation (BICM) scheme is used to achieve high bandwidth and power efficiency, while separating coding and modulation. As is now well known, the BICM scheme achieves capacity remarkably close to the

constellation channel capacity. The Turbo-BICM scheme enjoys high coding diversity (well suited for fading channels), high flexibility as well as design and

implementation simplicity, while maintaining good power efficiency.

The system comprises one standard Turbo code, an interleaver, a mapper and a modulator at the transmitter, corresponding to a demodulator, a de-interleaver and a Turbo decoder at the receiver.

A modified system, which improves on performance by incorporating the demodulation in the iterative decoding procedure, is investigated, and some performance gain is demonstrated, especially for low rate codes. Information theoretic arguments for the somewhat minor potential improvement in performance are detailed. The preferred mapper and interleaver for this system are considered.

Extending previous works, for higher level modulations, we analyze a system including a convolutional code, an interleaver, a Differential Encoder (DE), a mapper and a modulator at the transmitter. As for the BPSK modulation, the serial concatenation of a convolutional code with DE outperforms the single convolutional code. The serial concatenation with DE approach is analyzed also for a Turbo code, where it is found to fail in achieving performance improvement. Several structures for the serial concatenation with DE are examined. These results are substantiated through the 'spectral thinning' phenomena of the weight distribution of the convolutional and Turbo codes.