Abstract

This masters by research dissertation contributes to research in the field of Telecommunications, with a focus on forward error correction and improving an iterative Reed-Solomon decoder known as the Parity-check Transformation Algorithm (PTA). Previous work in this field has focused on improving the runtime parameters and stopping conditions of the algorithm in order to reduce its computational complexity. In this dissertation, a different approach is taken by modifying the algorithm to more effectively utilise the soft-decision channel information provided by the demodulator. Modifications drawing inspiration from the Belief Propagation (BP) algorithm used to decode Low-Density Parity-Check (LDPC) codes are successfully implemented and tested. In addition to the selection of potential codeword symbols, these changes make use of soft channel information to calculate dynamic weighting values. These dynamic weights are further used to modify the intrinsic reliability of the selected symbols after each iteration.

Improvements to both the Symbol Error Rate (SER) performance and the rate of convergence of the decoder are quantified using computer simulations implemented in MATLAB and GNU Octave. A deterministic framework for executing these simulations is created and utilised to ensure that all results are reproducible and can be easily audited. Comparative simulations are performed between the modified algorithm and the PTA in its most effective known configuration (with $\delta = 0.001$). Results of simulations decoding half-rate RS(15,7) codewords over a 16-QAM AWGN channel show a more than 50-fold reduction in the number of operations required by the modified algorithm to converge on a valid codeword. This is achieved while simultaneously observing a coding gain of 1dB for symbol error rates between 10^{-2} and 10^{-4}.