A Study on Adaptive Thresholds for Reduced Complexity Bit-Flip Decoding

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Abstract—Low-density parity-check (LDPC) codes are capacity approaching codes that have rapidly been adopted in modern systems such as the IEEE 802.11n and long term evolution advanced (LTE-A) communications standards. The decoders based on the iterative belief propagation offer exceedingly high performance but unfortunately have high computational complexity. Therefore significant research has focused on lower complexity architectures based on the family of so-called bit-flipping algorithms. In the basic bit-flipping algorithm the number of failed parity checks for each bit is calculated and the sign of the bit with the maximum failed checks is inverted. Inverting bits above a certain threshold removes the complexity of calculating a maximum function and adaptive thresholds on each bit further simplifies the design. The choice of threshold updates directly affects the error and convergence performances. Here we describe a simple architecture that has two decoders with different scaling factors and select the branch with the lowest syndrome sum. It is shown that the addition of a random uniform perturbation to the threshold can reduce the average iteration count further by providing an escape from stuck decoding states.