A Systolic-Array Implementation of Maximum-likelihood Soft-Decision Sequential Decoding

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Abstract

Viterbi algorithm is a maximum-likelihood-decoding algorithm, but it can only be implemented in short constraint length. Sequential decoding is independent of constraint length but the decoding result is not always a maximum-likelihood decision. The MLSDA proposed by Han and Chen has the advantage of sequential decoding and it is also a maximum-likelihood-decoding algorithm. According to MLSDA, we implement a new convolutional code decoder using stacks.

The tranditional method for sorting the nodes serached in the sequential decoding is using a RAM to model a stack memory, and the sorting time is not a constant duration. In order to fix this shortage, we modify the priority queue algorithms (PESPQ) to implement MLSDA. Although the priority queue module is more complex than the stack memory, it can deliver the best node in a constant duration.

All 1/2 convolutional codes may be treated as an equivalent 2/4 (3/6) codes during the decoding phase if we combine two (three) input bits as one unit. Consequently, we might have some advantage in VLSI implementation such as decoding speed; however, the gate counts of decoder will be increased. In order to reduce the number of gate counts we modify a multiple-inputs systolic queue algorithm to implement MLSDA for 2/4 (3/6) codes. As the simulation shown, the decoding speed may be double faster for (2/4) while the gate counts increase half.