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Abstract— **An iterative decoding scheme for woven convolutional codes is presented. It is called pipeline decoding and operates in a window sliding over the received sequence. This exploits the nature of convolutional codes as sequences and suits the concept of convolutional encoding and decoding as a continuous process. The pipeline decoder is analyzed in terms of decoding delay and decoding complexity.**

Additional interleaving for woven convolutional constructions is introduced by employing a convolutional scrambler. It is shown that some types of interleaving preserve the lower bound on the free distance of the original woven construction.

Simulation results for woven convolutional codes are presented.

I. Introduction

In [1, 2] three related woven constructions were introduced, viz.,

- woven convolutional codes with *outer* warp $(l_o, 1)$,
- woven convolutional codes with *inner* warp $(1, l_i)$,
- the *twill* (l_o, l_i),

where the (l_o, l_i) denotes the number of encoders in the outer and inner warps, respectively. The encoder for a woven convolutional code is represented by a serial concatenation of two warps both consisting of a set of parallel convolutional encoders, see Fig. 1. If l_o and l_i are relatively prime and large enough, the free distance of the woven convolutional code satisfies

$$d^{w}_{\text{free}} \geq d^{o}_{\text{free}} d^{i}_{\text{free}}, \tag{1}$$

where d^{o}_{free} and d^{i}_{free} denote the free distances of the outer and inner component code, respectively.

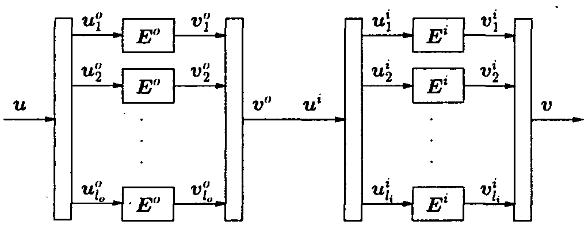

Fig. 1: Encoder for the twill.

II. Iterative Decoding

In contrast to the well known iterative decoding scheme of serially concatenated truncated convolutional codes [3, 4], the presented decoding scheme, called *pipeline decoding*, operates with a sliding window technique over the received sequence. For the symbol–by–symbol *a posteriori* decoding of the inner and outer component codes a sliding window version of the BCJR algorithm [5] is employed. The window is separated into one decision window of size w_d and one delay window of size w_b. Based on the sizes of these windows we analyze the decoding delay and the decoding complexity of the W–BCJR, as well as that of the pipeline decoder. Simulation results for the pipeline decoder are presented.

III. Additional Interleaving

Additional interleaving can significantly improve the bit error performance at low signal to noise ratios. To preserve the convolutional code structure of the overall code, we use convolutional scramblers for interleaving.

It is shown, that the woven construction can apply additional random interleaving without violating the lower bound on the free distance of the original construction (1). Furthermore, additional interleaving can be applied to reduce the number of encoders, l_o and l_i, while the lower bound (1) still holds.

IV. Simulation Results

Simulation results show that terminated woven convolutional codes are attractive alternatives to both parallel and serial concatenation of convolutional codes, e.g., Turbo codes.

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