Variable-to-Check Residual Belief Propagation for Informed Dynamic Scheduling of LDPC Codes

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INTRODUCTION

- Future system requires higher data throughput
  - Fast and accurate decoder (fast convergence, high performance)

![Diagram]

Standard BP (simultaneous scheduling) → Non-dynamic scheduling
Layered / Shuffled BP (serial scheduling)

Residual BP (Informed Dynamic Scheduling)
RBP FOR LDPC CODES

- Residual Belief Propagation [3], [4]

\[ r \left( m_{n_i \rightarrow n_j} \right) = \left\| m_{n_i \rightarrow n_j}^{\text{new}} - m_{n_i \rightarrow n_j}^{\text{old}} \right\| \]

\[ m_{c_a \rightarrow v_j} = \log \frac{P(E_{c_a} = 0 | v_j = 0, r)}{P(E_{c_a} = 0 | v_j = 1, r)} \]


The procedure of RBP decoding for LDPC codes

VCRBP FOR LDPC CODES (proposed)

- The Residual of RBP and VCRBP

\[
m_{c_a \rightarrow v_j} = \log \frac{P(E_{c_a} = 0|v_j = 0, r)}{P(E_{c_a} = 0|v_j = 1, r)}
\]

\[
m_{v_j \rightarrow c_i} = \log \frac{P(v_j = 0|r, \{E_{c_a} = 0, c_a \in N(v_j)\setminus c_i\})}{P(v_j = 1|r, \{E_{c_a} = 0, c_a \in N(v_j)\setminus c_i\})}
\]

The procedure of VCRBP decoding for LDPC codes

VCRBP FOR LDPC CODES (proposed)
HOW TO SOLVE THE TRAPPING SET - RBP
HOW TO SOLVE THE TRAPPING SET - VCRBP
The procedure of Node-wise RBP decoding for LDPC codes

N-VCRBP FOR LDPC CODES (proposed)

- The procedure of Node-wise VCRBP decoding for LDPC codes
SIMULATION RESULTS

- FER performance with IEEE 802.16e block length-576, code rate-1/2, maximum 8 iterations
**SIMULATION RESULTS**

- FER performance with IEEE 802.16e block length-576, code rate-1/2, up to maximum 50 iterations at 2.5dB

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**Frame Error Rate - IEEE 802.16e(576)(1/2)**

- BP
- LBP
- N-RBP
- RBP
- N-VCRBP
- VCRBP

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VCRBP for IDS of LDPC Codes  
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CONCLUSION

(1) VC-RBP makes LDPC decoding converge very fast in terms of the number of iterations.

(2) It guarantees better performance with lower decoding complexity than RBP in only 8 iterations.

(3) It performs similarly better after sufficiently many iterations.

(4) N-VCRBP has very close performance to VCRBP with significantly lower decoding complexity.