**Introduction**

We present a polar code construction that supports both local and global decoding. Local decoding allows random access to subblocks of the full code block.

1KB | 1KB | 1KB | 1KB
---|---|---|---
4KB

When local decoding performance is insufficient, global decoding provides improved data reliability. This local-global construction is motivated by practical applications where reduced-latency recovery of subblocks of the coded information is required:

- Advanced multilevel flash memory
- Low-latency wireless communication

A local-global polar decoding architecture is proposed.

- Inner polar codes coupled through a systematic auxiliary polar code. [1]
- Split permutation maps specific systematic message bits to each inner code.

**Local-Global LDPC Code [2]**

Sub-blocked Tanner graph with 3 subblocks of length 6.

Local check nodes L and joint (global) check nodes J.

**Enhanced BP Decoding [3]**

Auxiliary code to protect intermediate quality (semi-polarized) bit-channels. Enhanced belief-propagation (EBP) decoding on extended factor graph.

**Flexible Length Polar Codes [4]**

Augmented polar code with auxiliary polar code. Enhanced BP decoding on extended factor graph. Flexible length polar code via coupling through auxiliary polar code:

- \( R_1 = \frac{K_1}{N_1} \); \( R_2 = \frac{K_2 + N_2}{N_2} \); \( R_3 = \frac{K_3 + N_3}{N_3} \)
- \( R_{\text{total}} = \frac{K}{N} = \frac{K_1 + K_2 + K_3 + N_2 + N_3}{N_2 + N_3} \)

**Local-Global Polar Codes**

Encoder architecture for local-global polar code.

- Systematic auxiliary code.
- Split permutation respects inner code assignments of \( K_{a1}, K_{a2}, ..., K_{a32} \)

Factor graph for local-global polar decoding.

- Enhanced BP decoding.
- Early stopping rule for coupled codes.

**Simulation: Local-Global Decoding with 2,4 Inner Codes**

- \( R_{\text{eff}} = 0.5 \).
- Inner codes \( C_{j}, j = 1, 2 \)
  - Code \( C_j \) message size:
    - \( M_j = K_{aj} + K_{bj} = 32 + 480 = 512 \)
    - Code \( C_j \) unfrozen frame size:
      - \( K_j = K_{aj} + P_{aj} = 512 + 32 = 544 \)
    - Code \( C_j \) total frame size:
      - \( N_j = K_j + F_j = 544 + 480 = 1024 \)
  - Systematic auxiliary code \( C_0 \)
    - Code \( C_0 \) rate:
      - \( R_0 = K_a/(K_a + F_0) = 64/128 = 0.5 \)

- \( R_{\text{eff}} = 0.5 \).
- Inner codes \( C_{j}, j = 1, 2, 3, 4 \)
  - Code \( C_j \) message size:
    - \( M_j = K_{aj} + K_{bj} = 64 + 448 = 512 \)
    - Code \( C_j \) unfrozen frame size:
      - \( K_j = M_j + P_{aj} = 512 + 64 = 576 \)
    - Code \( C_j \) total frame size:
      - \( N_j = K_j + F_j = 576 + 448 = 1024 \)
  - Systematic auxiliary code \( C_0 \)
    - Code \( C_0 \) rate:
      - \( R_0 = K_a/(K_a + F_0) = 256/512 = 0.5 \)

**References**