Rate-Adaptive Distributed Source Coding using Low-Density Parity-Check Codes

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Outline

- Slepian-Wolf coding
- LDPC codes for Slepian-Wolf coding
- Rate-adaptive Slepian-Wolf coding
- Extension of LDPC codes
- LDPC Accumulate (LDPCA) codes
- Sum LDPC Accumulate (SLDPCA) codes
Distributed Source Coding Example

\[ T_X = 68F \]

\[ T_Y = 71F \]

\[ |T_X - T_Y| < 5 \]
Slepian-Wolf Coding

X can be compressed losslessly at $R > H(X|Y)$.

[Slepian, Wolf, 1973]
LDPC Codes for Slepian-Wolf Coding

Perform within 5-10% of Slepian-Wolf bound

[Liveris, Xiong, Georghiades, 2002]
If the encoder does not know $H(X|Y)$, an incremental rate scheme can find a sufficient $R$. This requires feedback and good rate-adaptive codes.
Below the full rate, the LDPC decoding algorithm is severely degraded and performance is poor.
LDPC Accumulate (LDPC-A) Codes

For all rates, the LDPC decoding algorithm is effective and performance is near the Slepian-Wolf bound.
Performance is also near the Slepian-Wolf bound for all rates. LDPC and BCJR decoding algorithms are used jointly.
Simulation Results

X is binary iid, unbiased
Binary symmetric correlation btw X and Y
Length 6336 bits
75 trials per point
Turbo codes from [Aaron, Girod, 2002]
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Binary symmetric correlation btw X and Y
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Turbo codes from [Aaron, Girod, 2002]
Conclusions

- Extension of LDPC syndrome codes to rate-adaptive distributed source coding is ineffective
- LDPCA and SLDPCA codes are proposed
- Outperform punctured turbo codes
- Perform within 5% and 10% of the Slepian-Wolf bound at high and moderate rates
- Perform well for different source statistics