Joint LDPC Codes for Multi-User Relay Channel

연세대학교 부호 및 암호 연구실
김정현, 박선영, 김주영, 김영준, 송홍엽
{jh.kim06, sy.park, jy.kim, yj.kim, hysong} @yonsei.ac.kr
Bilayer LDPC codes for relay channel

: BS  : FRS  : MS

Joint LDPC Codes for Multi-User Relay Channel
Bilayer LDPC codes for relay channel

: BS  : FRS  : MS
Joint LDPC codes for multiuser relay channel

- BS: Base Station
- FRS: Femto-Relay Station
- MS: Mobile Station
Joint LDPC codes for multiuser relay channel

Overall code graph

Single user code graph
Optimization of Joint LDPC codes

By density evolution for Joint LDPC codes

\[
\max_{\lambda_{i,j}} \quad R = 1 - \frac{\sum_{u \geq 1} \sum_{i \geq 2} \rho_i(u)/i(u)}{\sum_{u \geq 1} \sum_{i \geq 2} \lambda_i(u)/i(u)},
\]

\[
\text{s.t.} \quad \sum_{i \geq 2, j \geq 0} \lambda_{i,j}(i, j) \left( \frac{i}{i+j} e^{1}_{i,j}(p^l, q^l) + \frac{j}{i+j} e^{2}_{i,j}(p^l, q^l) \right) < \mu_h (\eta p + (1-\eta)q),
\]

\[
\sum_{i(u) \geq 2} \lambda_i(u) e_i(u)(p) < \mu_h p,
\]

where \( \lambda_i(u) = \frac{1}{\eta(u)} \sum_{j(u) \geq 0} \frac{i(u) \cdot \lambda_i(u), j(u)}{i(u) + j(u)} \),

\[err_{l_{\max}}(u) \leq err_{th},\]
## Performance of Joint LDPC codes

### Simulation environment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>AWGN</td>
</tr>
<tr>
<td>Number of Users</td>
<td>12</td>
</tr>
<tr>
<td>Overall Code Length</td>
<td>2304</td>
</tr>
<tr>
<td>Single User Code Length</td>
<td>96</td>
</tr>
<tr>
<td>Code Rate</td>
<td>$R_{SR\ or\ SD}=2/3, \quad R_{RD}=1/2$</td>
</tr>
<tr>
<td>Maximum iteration</td>
<td>8</td>
</tr>
</tbody>
</table>
Performance of Joint LDPC codes

FER comparison of Joint LDPC code vs. Bilayer LDPC code
Performance of Joint LDPC codes

BER comparison of Joint LDPC code vs. Bilayer LDPC code
Conclusion

Merits:

Joint LDPC codes bring remarkable performance gain by user cooperation
Joint LDPC codes guarantee achieved service quality by controlling the degree distribution

Demerits:

The relay must be much more intelligent than before
Overall code length decoded simultaneously at the destination becomes much larger than before
Thank you!

{jh.kim06, sy.park, jj.kim, jj.kim, hysong} @yonsei.ac.kr