

Multi-user coded cooperative communication scheme for relay channel using Fountain codes

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COOPERATIVE COMMUNICATION

Relay channel

- Broadcast channel + Multiple Access Channel
- Cooperative communication
 - Achieves the transmit diversity
- Multi-user cooperative communication

 Multi-user cooperative communication via network coding









COOPERATIVE COMMUNICATION

Coded cooperative communication

- Cooperative communication using channel coding
- The effective scheme is needed
 - Network coding helps to improve the throughput
 - Channel coding is essential to guarantee the performance
 - Network coding and channel coding should be processed jointly not separately



RELATED WORKS

100000100000

Using convolutional codes

- Source-relay channel is protected by only the convolutional code
- This yields the performance degradation



RELATED WORKS

Using bilayer LDPC codes

 The relay generates additional parity by Density Evolution which optimizes the degree of overall LDPC code





PROPOSED SCHEME

Block diagram for the proposed scheme

• For simplicity, 2 users are assumed to cooperate





PROPOSED SCHEME

Each source node

- Encodes the information with LDPC code
- So that the (S-R) channel is protected by LDPC code

The relay node

- Decodes the received blocks separately
- And then encodes the recovered blocks jointly with LT code

The destination node

Decodes all information block using overall graph





FOUNTAIN CODES

Fountain code

- Rate-less codes
- Any number of input symbols can be applied
- Infinitely many output symbols are available
 - This makes the code to be effective for various channel condition
- Simple and fast encoding is possible (linear time)

But



FOUNTAIN CODES

In the proposed scheme

 If the source-dest. channel is available then the intermediate nodes of fountain code are received at the destination

The situation that a meaningless value is obtained do not occur Therefore Fast decoding is possible

 If the source-dest. channel is not available then the same decoding process is performed



DISCUSSION

Compared to the scheme based on convolutional code

• Better performance

Compared to the scheme based on bilayer LDPC code

- Low complexity
- High flexibility
- The rate-less property
 - Makes the system works adaptively
 - If the channel condition is good, the relay transmits only the small number of symbols
 - if the channel condition is not good, the relay can generate and transmit more symbols until the decoding is succeed
 - Makes any number of source nodes can cooperate



SIMULATION



• All links are assumed to be AWGN channel with the same SNR

✓ user-relay, user-destination and relay-destination

LDPC used for each user is assumed to be the same

Rate 2/3, block length 576

- Fixed-rate LT code is assumed for simplicity
 - The number of output symbols generated are 576
- BP decoding and not global iteration is assumed at dest.

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SIMULATION RESULT



