**Channel Coding Project**

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The Incremental Redundancy H-ARQ

for Convolutional Coding

1. **Introduction**

The basic idea of Incremental Redundancy (IR) based H-ARQ is taking the puncture pattern into account, and for each retransmission the coded block is not the same. Different puncture patterns are used to create the retransmission FEC block. The puncture patterns are predefined or can be easily deducted from the original pattern, and can be selected based on retransmission number.

At the receiver, the received signals are depunctured according to its specific puncture pattern, which is decided by the current retransmission number, then the combination is performed at bit metrics level. The pros of this scheme are:

1. The combined version becomes a low rate code instead of a punctured code because of the puncture pattern change. The additional coding gain can be obtained. Our simulation results show nearly 1 dB addition gain over conventional Chase Combining (CC) in both AWGN and Rayleigh fading channel.

2. The retransmission block length can be flexible by choosing the puncture pattern with different puncture length.

3. The decoding complexity is almost the same as CC.

4. Compatible with conventional chase combining.

5. Only minor modification is needed.

**2-Definition**

**Hybrid automatic repeat request** (**hybrid ARQ** or **HARQ**) is a combination of high-rate [forward error-correcting coding](http://en.wikipedia.org/wiki/Forward_error_correction) and [ARQ](http://en.wikipedia.org/wiki/Automatic_repeat-request) error-control. In standard ARQ, redundant bits are added to data to be transmitted using an [error-detecting (ED) code](http://en.wikipedia.org/wiki/Error-detecting_code) such as a [cyclic redundancy check](http://en.wikipedia.org/wiki/Cyclic_redundancy_check) (CRC). Receivers detecting a corrupted message will request the message anew from the sender. In Hybrid ARQ, the original data is encoded with a [forward error correction](http://en.wikipedia.org/wiki/Forward_error_correction) (FEC) code, and the parity bits are either immediately sent along with the message or only transmitted upon request when a receiver detects an erroneous message. The ED code may be omitted when a code is used that can perform both [forward error correction](http://en.wikipedia.org/wiki/Forward_error_correction) (FEC) in addition to error detection, such as a [Reed-Solomon code](http://en.wikipedia.org/wiki/Reed-Solomon_code). The FEC code is chosen to correct an expected subset of all errors that may occur, while the ARQ method is used as a fall-back to correct errors that are uncorrectable using only the redundancy sent in the initial transmission. As a result, hybrid ARQ performs better than ordinary ARQ in poor signal conditions, but in its simplest form this comes at the expense of significantly lower throughput in good signal conditions. There is typically a signal quality cross-over point below which simple hybrid ARQ is better, and above which basic ARQ is better.

**3- Simulation results**

This IR H-ARQ scheme is evaluated over both AWGN and uncorrelated Rayleigh fading channel. The modulation is QPSK. The channel coding scheme is \_ punctured convolutional code, which is a puncture version from \_ mother code is. In the simulation, 3 retransmissions are allowed. The puncture pattern for the n-th retransmission is generated by cyclically shifting n columns based on the original puncture pattern in the current standard.

**4-CC Incremental Redundancy HARQ**

When Convolutional Coding (CC) Incremental Redundancy (IR) is enabled for particular SS, the HARQ\_MAP will be used to signal the allocation and the HARQ Control IE will use the “CC IR” allocation format. The encoding of the companded sub channel field is identical to Generic Chase HARQ and is defined in Table BBB. Concatenation rules for each respective coding mode are applied as defined for non-HARQ transmissions.