HARQ ACK Channel and Retransmission Dummy Pattern Performance Comparison

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Purpose:
Performance comparison of HARQ ACK/NAK channels and re-transmission dummy pattern

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Background

- Several ACK/NCK channels schemes are proposed for MR system.
  - Performance and overhead tradeoff should be compared

- Several re-transmission dummy patterns are proposed for MR system
  - Performance should be compared and optimized

- This draft serves a placeholder for reporting the simulation results to the HARQ ad-hoc
  - Simulations working is running
CQICH Coding

- Assume $x_{ij}$ as the transmit symbol at data tone $j$ of the tile $i$, where $i = 0, 1, \ldots, 5$, and $j = 0, 1, \ldots, 7$.
- $X=[x_{ij}]$ is selected from the codebook $P$.
  - $p=[p_{ij}]$ is a codeword of the codebook $P$ containing 64 different codewords.
  - $p_{ij}$ is selected from a QPSK constellation.
  - Each codeword represents a 6-bit binary number.
- Assume $y_{ijk}$ as the received symbol at the receive antenna number $k$. 
Coherent Detector

- $h_{ijk}^\wedge$ represents estimated channel between transmit antenna and the $k$th receive antenna for the data tone $j$ and tile $i$.
  - Channel is estimated based on the received pilots per each tile.
  - The best channel estimation method is to average the 4 pilots over a uplink tile.
- Coherent detection is defined as follows:

$$\hat{p} = \arg \max_{p = [p_{ij}] \in P} \text{Re} \left( \sum_{i,j,k} \hat{h}_{ijk}^\wedge p_{ij}^\wedge y_{ijk}^\wedge \right)$$
Non-coherent Detector

- No channel estimation
- Non-coherent detection is defined as follows:

\[ \hat{p} = \arg \max_p \sum_i \left( \sum_j p_{ij} |y_{ijk}|^2 \right) \quad p = [p_{ij}] \in P_{i,k} \]
Pilot Overhead

- Coherent detection needs pilot for channel estimation.
- Pilot overhead for uplink tile is $10\log_{10}(12/8) \sim 1.7$ dB assuming no pilot power boost.
- Benefit of non-coherent detection is that there is no need to transmit pilots.
  - Null pilot tones
  - 1.7 dB power saving in comparison to coherent detection
Coherent: Perfect CSI
Coherent: Channel Estimation
Non-Coherent: Same Data Tone Power As Coherent
Non-Coherent: Same Average Tx Power As Coherent
Coherent: Perfect CSI
Coherent: Channel Estimation
Non-Coherent: Same Data Tone Power As Coherent
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