Differential codebook for closed loop SU MIMO

Source:
   Bruno Clerckx, David Mazzarese,   E-mail: bruno.clerckx@samsung.com, d.mazzarese@samsung.com
   Jerry Pi, Hokyu Choi, Heewon Kang
   Samsung Electronics

Venue:
   RE: Call for comments on DL MIMO SDD text
Base Contribution:
   IEEE C80216m-08_850
Purpose:
   Adoption of the proposed text for the 802.16m SDD.

Contents

- Background

- Basic Principle

- Performance of differential codebook in SU-MIMO

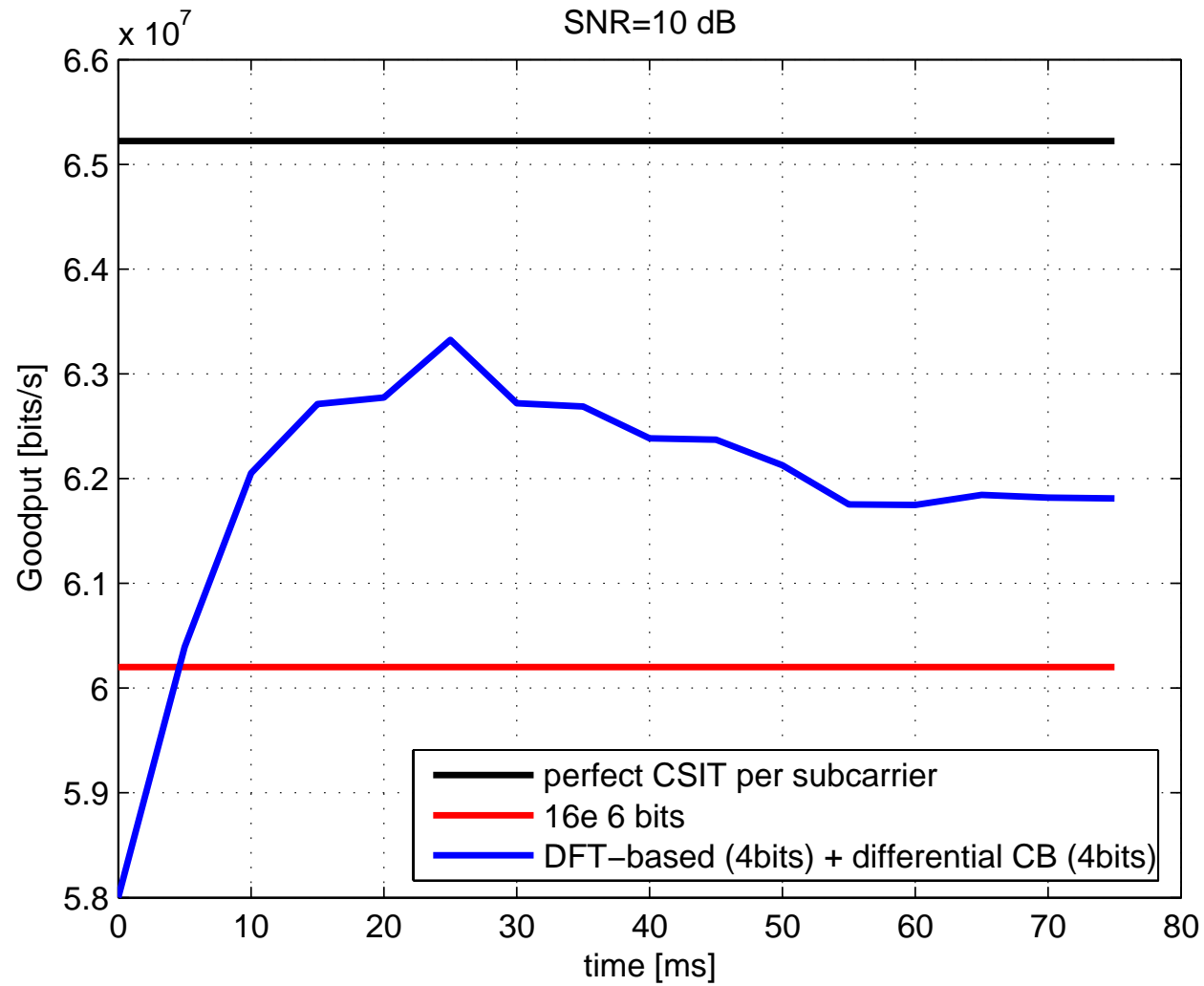- Text proposal

Background

- Some proposals to 802.16m suggest to use large codebooks to improve the accuracy of the channel state information at the BS.

- CONS of this approach:
  - feedback overhead increased
  - Exponential increasing computational burden incurred at the MS

- Our preference is to use a differential codebook which can readily reuse the feedback channel of the initial codebook.

Basic Principle

- Differential feedback scheme:
  - At time instant t=0, choose the appropriate precoder and rank from the standard SU MIMO codebook (e.g. a DFT-based codebook). Denote this precoder as $\mathbf{F}_0$
  - For time instant t>0, differentially rotate the previous codeword $\mathbf{F}_\tau = \tilde{\boldsymbol{\Theta}}_i \mathbf{F}_{\tau-1}$ with a rotation matrix $\tilde{\boldsymbol{\Theta}}_i$.

    This rotation matrix $\tilde{\boldsymbol{\Theta}}_i$ is an element of a rotation codebook.

    The mobile feeds back the index of the preferred rotation matrix in the rotation codebook
  - At time t=Tmax+1, the process is reset and t is fixed to 0 again.

- The Base station and the mobile station have knowledge of two codebooks: the standard codebook and the rotation codebook.

Performance of differential codebook in SU MIMO

Text proposal

1.1.x.2.1.3. Feedback for SU-MIMO

In FDD systems and TDD systems, a mobile station may feedback the following information in SU-MIMO mode:

- Rank (Wideband or sub-band)
- Sub-band selection
- CQI (Wideband or sub-band, per CW or per user)
- PMI (Wideband or sub-band)

[To remove from current text: For codebook based precoding, the feedback from a mobile station shall be based on the same codebook as used by base station for transmission.]

[To add to current text:

For codebook based precoding, two different feedback modes for the PMI shall be supported:

The standard mode: the feedback from a mobile station shall be based on the same codebook as used by base station for transmission, and it shall be sufficient for the base station to determine the new precoder

The differential mode: the feedback from a mobile station provides a differential knowledge which represents information that shall be used along with the other feedback information known at the base station for determining the new precoder.]