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(54) **METHOD AND DEVICE FOR PROCESSING CODEBOOK SUBSET RESTRICTION**

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(57) **ABSTRACT**

The present invention discloses a method and device for processing codebook subset restriction, which includes: the codebooks for every rank of N antenna ports are grouped, wherein N is a natural number; after grouping, the status of each group is identified as restricted or unrestricted by using one bit. The present invention can reduce the signaling overhead needed for codebook subset restriction.

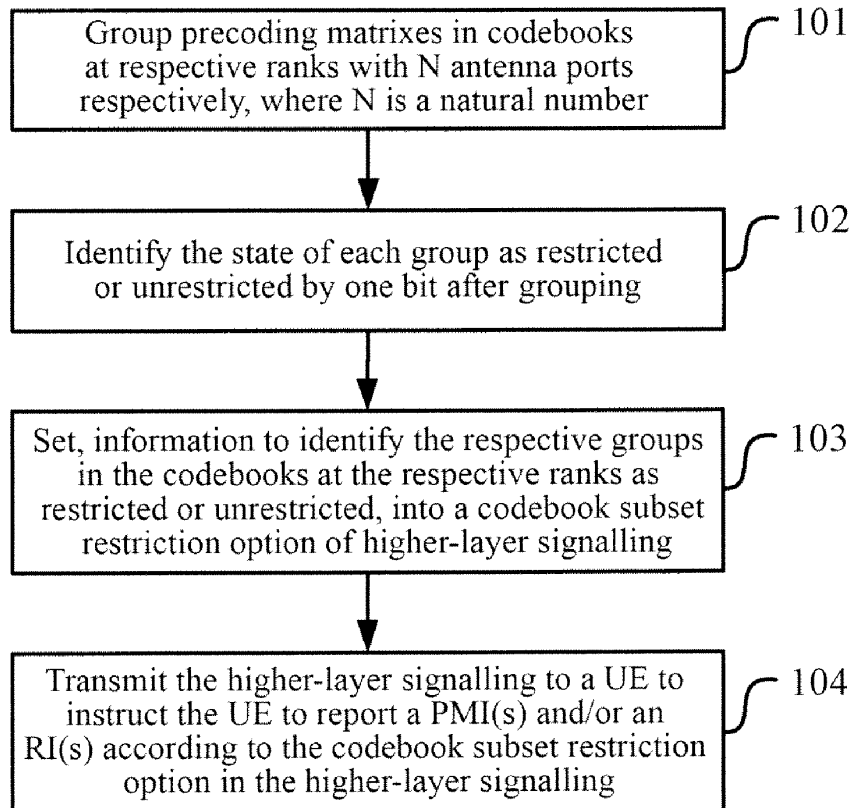
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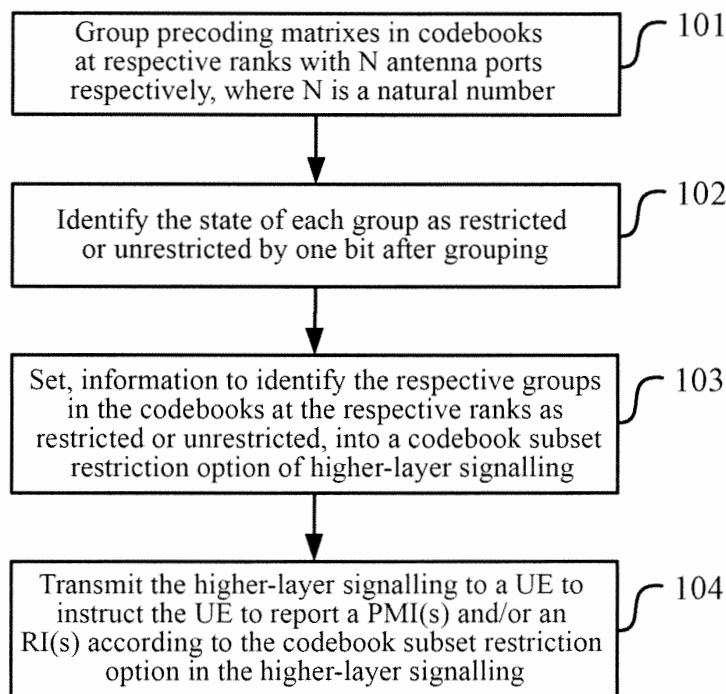


Fig. 1

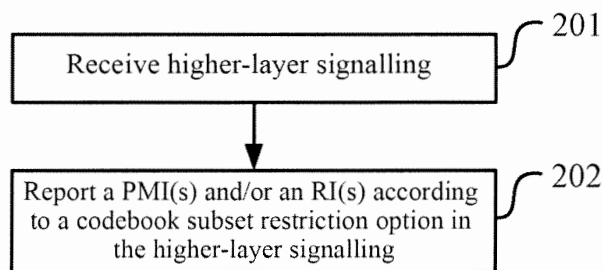


Fig. 2

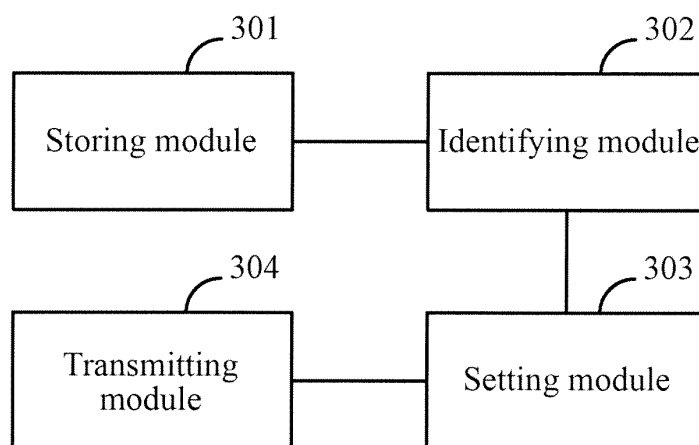


Fig. 3

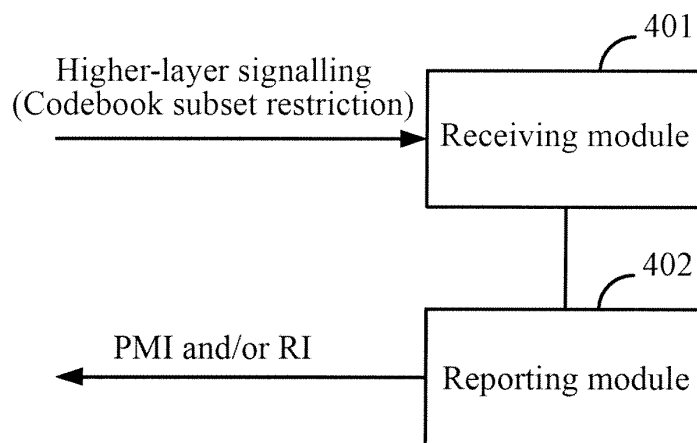


Fig. 4

METHOD AND DEVICE FOR PROCESSING CODEBOOK SUBSET RESTRICTION

[0001] This application claims the benefit of Chinese Patent Application No. 201010285420.0, filed with the Chinese Patent Office on Sep. 16, 2010 and entitled “Method and device for processing codebook subset restriction”, which is hereby incorporated by reference in its entirety.

FIELD

[0002] The present invention relates to the field of wireless communication and particularly to a method and device for processing a codebook subset restriction.

BACKGROUND

[0003] A Multiple Input Multiple Output (MIMO) system adopts a plurality of transmit and receive antennas and utilizes joint processing of a signal in the space, time and frequency domains for velocity, diversity and array gains. In the MIMO system, if a transmitter can know channel information somehow, then it can optimize a transmission signal according to a channel characteristic to improve the quality of reception and to lower a requirement on the complexity of a receiver. In general, a Time Division Duplex (TDD) system can obtain channel information due to channel reciprocity, but a Frequency Division Duplex (FDD), or the TDD system in some special cases, has to require channel information to be fed back from a receiver. Quantified channel information is typically fed back in a real system to lower a feedback overhead and a feedback delay. Channel information can be quantified for a channel matrix and a statistic thereof or for a preprocessing parameter recommended by the receiver. The quantified channel information is mapped into a set constituted of a limited number of elements, which is referred to as a codebook.

[0004] In order to stabilize mutual interference between cells for the sake of improving the accuracy of a Channel Quality Indicator (CQI) reporting by a User Equipment (UE), a method for restricting a codebook subset by higher-layer signalling to signal a codebook subset restriction has been defined in the Release 8 (Rel-8), and the signalling is referred to as codebookSubsetRestriction in the Rel-8. Specifically a Precoding Matrix Indicator(s) (PMI) and/or a Rank Indicator (s) (RI) reported from the UE are/is restricted by codebook-SubsetRestriction configured in higher-layer signalling. For a specific precoding codebook and a relevant transmission mode, whether respective precoding matrixes in all the codebooks are available is specified in a bitmap approach to thereby indicate a codebook subset available to the UE. A codebook subset restriction may be applied to open loop and closed loop multiplexing, multi-user MIMO and precoding of a closed loop with an RI=1. A specific correspondence relationship is as depicted in Table 1.

TABLE 1

| The number of bits of codebook subset restriction for different transmission modes | Number of bits A_c | |
|--|----------------------|-----------------|
| | 2 antenna ports | 4 antenna ports |
| | Transmission mode 3 | 2 |
| Transmission mode 4 | 6 | 64 |

TABLE 1-continued

| The number of bits of codebook subset restriction for different transmission modes | Number of bits A_c | |
|--|----------------------|-----------------|
| | 2 antenna ports | 4 antenna ports |
| | Transmission mode 5 | 4 |
| Transmission mode 6 | 4 | 16 |
| Transmission mode 8 | 6 | 32 |

Where A_c represents the number of bits included in codebookSubsetRestriction and corresponds to the number of all the available precoding matrixes in a corresponding transmission mode.

[0005] A new transmission mode is added to the Rel-10 as a transmission mode 9. In the case that a PMI feedback is configured, a channel is measured and fed back based upon a Channel-State Information Reference Signal (CSI-RS) and a signal is demodulated based upon a UE-specific Reference Signal (UE-RS) in the transmission mode 9. Channel measurement and feedback via at most 8 CSI-RS ports is supported. A restriction of a codebook subset will also be supported in the Rel-10, and the number of bits of a codebook subset restriction corresponding to 8 antenna ports has not yet been defined so far.

[0006] Codebook subset restrictions in the existing Long Term Evolution-Advanced (LTE) Rel-8/9 are defined for 2 and 4 antenna ports, and the size of a codebook is not vary large with 2 and 4 antenna ports. With 4 antenna ports, for example, the size of a codebook at each rank is 4 bits, and then 64 bits in total are required for a codebook subset at 4 ranks. However a dual-codebook feedback mechanism including a codebook C1 reflecting bandwidth/long-term information and a codebook C2 reflecting frequency selectivity/short-term information is adopted in the Rel-10, where the C1 and the C2 are finally integrated into a codebook C. The currently accepted sizes of codebooks with 8 antenna ports are as depicted in Table 2:

TABLE 2

| | The sizes of C1 and C2 and integrated codebook C with 8 antenna ports (the number of precoding matrixes) | | |
|-------|--|----|----------------------|
| | C1 | C2 | C |
| Rank1 | 16 | 16 | $16 \times 16 = 256$ |
| Rank2 | 16 | 16 | $16 \times 16 = 256$ |
| Rank3 | 4 | 16 | $4 \times 16 = 64$ |
| Rank4 | 4 | 8 | $4 \times 8 = 32$ |
| Rank5 | 4 | 1 | $4 \times 1 = 4$ |
| Rank6 | 4 | 1 | $4 \times 1 = 4$ |
| Rank7 | 4 | 1 | $4 \times 1 = 4$ |
| Rank8 | 1 | 1 | $1 \times 1 = 1$ |
| Total | 53 | 60 | 621 |

[0007] Specifically an 8-antenna port codebook in the Rel-10 is represented as a two-dimension table where a row index i_1 corresponds to an index in the codebook C1 and is represented as a first PMI in a feedback and a column index i_2 corresponds to an index in the codebook C2 and is represented as a second PMI in a feedback

[0008] A drawback of the prior art lies in that if each precoding matrix is mapped to 1-bit information as in the bitmap approach in the Rel-8, then 621 bits are required for the

signalling codebookSubsetRestriction, thus resulting in a considerable signalling overhead.

SUMMARY

[0009] An aspect of the invention is to provide a method and device for processing a codebook subset restriction so as to address the related problem(s) of restricting a codebook subset in the case of multiple antenna ports.

[0010] There is a method for processing a codebook subset restriction in an embodiment of the invention, which includes the operations of:

[0011] grouping precoding matrixes in codebooks at respective ranks with N antenna ports respectively, where N is a natural number; and

[0012] identifying the state of each group as restricted or unrestricted by one bit after grouping.

[0013] Preferably grouping the precoding matrixes in the codebooks at respective ranks respectively includes any one of:

[0014] grouping per row to take each row of precoding matrixes in the codebooks as a group;

[0015] grouping per column to take each column of precoding matrixes in the codebooks as a group;

[0016] grouping respectively per row and column to take each row of precoding matrixes and each column of precoding matrixes in the codebooks respectively as groups and to identify a precoding matrix as restricted if a row or column, to which the precoding matrix belongs, is restricted after grouping;

[0017] grouping per identical precoding matrix to take identical precoding matrixes in the codebooks as a group;

[0018] grouping per same beam direction to take precoding matrixes in the same beam direction in the codebooks as a group; and

[0019] grouping per precoding matrix element to take precoding matrixes with identical precoding matrix elements in the codebooks as a group.

[0020] Particularly the codebooks at different ranks can be grouped in the same or different ways.

[0021] Preferably the method further includes:

[0022] setting, information to identify the respective groups in the codebooks as restricted or unrestricted, into a codebook subset restriction option of higher-layer signalling.

[0023] Preferably the method further includes:

[0024] transmitting the higher-layer signalling to a UE to instruct the UE to report a Precoding Matrix Indicator(s), PMI, and/or a Rank Indicator, RI(s), according to the codebook subset restriction option in the higher-layer signalling.

[0025] There is a method for reporting channel information in an embodiment of the invention, which includes the operations of:

[0026] receiving higher-layer signalling; and

[0027] reporting a PMI(s) and/or an RI(s) according to a codebook subset restriction option in the higher-layer signalling.

[0028] There is a device for processing a codebook subset restriction in an embodiment of the invention, which includes:

[0029] a storing module configured to store a grouping rule under which precoding matrixes in codebooks at respective ranks are grouped; and

[0030] an identifying module configured to identify the state of each group as restricted or unrestricted by one bit after the precoding matrixes in the codebooks at the respective

ranks with N antenna ports are grouped respectively under the grouping rule, where N is a natural number.

[0031] Preferably the storing module includes any one or combination of the following units:

[0032] a row grouping unit configured to store the grouping rule under which each row of precoding matrixes in the codebooks is taken as a group;

[0033] a column grouping unit configured to store the grouping rule under which each column of precoding matrixes in the codebooks is taken as a group;

[0034] a row and column grouping unit configured to store the grouping rule under which each row of precoding matrixes and each column of precoding matrixes in the codebooks are taken respectively as groups and to identify a precoding matrix as restricted if it is both restricted and unrestricted after grouping;

[0035] a precoding matrix grouping unit configured to store the grouping rule under which identical precoding matrixes in the codebooks are taken as a group;

[0036] a beam grouping unit configured to store the grouping rule under which precoding matrixes in the same beam direction in the codebooks are taken as a group; and

[0037] an element grouping unit configured to store the grouping rule under which precoding matrixes with identical precoding matrix elements in the codebooks are taken as a group.

[0038] Particularly the codebooks at the respective ranks can have the same or different grouping rules.

[0039] Preferably the device further includes:

[0040] a setting module configured to set, information to identify the respective groups in the codebooks at the respective ranks as restricted or unrestricted, into a codebook subset restriction option of higher-layer signalling.

[0041] Preferably the device further includes:

[0042] a transmitting module configured to transmit the higher-layer signalling to a UE to instruct the UE to report a PMI(s) and/or an RI(s) according to the codebook subset restriction option in the higher-layer signalling.

[0043] There is a device for reporting channel information in an embodiment of the invention, which includes:

[0044] a receiving module configured to receive higher-layer signalling; and

[0045] a reporting module configured to report a PMI(s) and/or an RI(s) according to a codebook subset restriction option in the higher-layer signalling.

[0046] An advantageous effect of the invention are as follows:

[0047] In the technical solution according to the embodiments of the invention, an overhead of signalling required for a codebook subset restriction can be reduced as a result of firstly grouping and then performing a restriction process on codebooks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] FIG. 1 is a schematic diagram of a method for processing a codebook subset restriction according to an embodiment of the invention;

[0049] FIG. 2 is a schematic diagram of a method for reporting channel information according to an embodiment of the invention;

[0050] FIG. 3 is a schematic structural diagram of a device for processing a codebook subset restriction according to an embodiment of the invention; and

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