first candidate codeword of 4 Tx. That is, the first candidate codeword of 4 Tx is determined based on the downlink precoding codebook of 4 Tx.

[0061] Similarly, a precoding codebook of 2 Tx for the uplink MIMO transmission can be determined. The first candidate codeword of 2 Tx is determined based on the uplink precoding codebook of 2 Tx. Alternatively, a precoding codebook of 2 Tx for the downlink MIMO transmission can be determined. The first candidate codeword of 2 Tx is determined based on the downlink precoding codebook of 2 Tx.

[0062] Optionally, the first candidate codeword, the second candidate codeword, and the third candidate codeword of 4 Tx and/or the first candidate codeword, the second candidate codeword, and the third candidate codeword of 2 Tx may be pre-configured.

[0063] At S202, a first codeword for the antenna partial coherence transmission and/or a second codeword for the antenna non-coherence transmission of 8 Tx L-layer for the uplink MIMO transmission is determined based on the candidate codeword.

[0064] L indicates the maximum number of transmission layers for the uplink MIMO transmission supported by the terminal, in which L is taken as a positive integer, and L is less than or equal to 8.

[0065] Since the partial coherence transmission involves that transmission layers corresponding to partial antenna ports are mutually orthogonal, it is necessary to group all the antenna ports to realize that data transmitted by partial layers is only mapped to one antenna port group. The 8 antenna ports can be divided into a plurality of antenna port groups, each group corresponds to only partial antenna ports and the layers corresponding to the antenna ports within the group are mutually orthogonal.

[0066] For example, 8 antenna ports are divided into 2 groups, each group includes 4 antenna ports, and corresponds to 4 uplink transmission layers. In this case, it is required that the 4 uplink transmission layers within each group are mutually orthogonal, but there is no need to enable the uplink transmission layers between different groups to be mutually orthogonal. That is, the data transmitted by some layers is only mapped to one antenna port group, and the data transmitted by other layers is only mapped to other antenna port groups. Each of partial transmission layer has a one-to-one correspondence with each antenna port group.

[0067] In an embodiment of the disclosure, 8 Tx can be divided into K antenna port groups, in which K is a positive integer less than 8. For example, the 8 antenna ports may be grouped into 2 or 4 antenna port groups, in which all the antenna ports can be used for the full coherence transmission.

[0068] Optionally, the 8 antenna ports may be evenly assigned, or the 8 antenna ports may be unevenly assigned. Optionally, the 8 antenna ports can be sequentially or cyclically assigned to 2 or 4 antenna port groups; or a transmission coherence between the 8 antenna ports can be determined and the 8 antenna

methods, the third codeword and the fourth codeword may be determined based on the above implementations, and the elements in the codewords may be further spliced to the corresponding antenna ports.

[0172] For example, when the antenna ports are grouped as {0,4},{1,5},{2,6},{3,7}, the first codeword for the antenna partial coherence transmission of 8 Tx 8-layer is

$$W_{8,8}=\begin{bmatrix}1&1&0&0&0&0&0&0\\0&0&-1&-1&0&0&0&0\\0&0&0&0&j&j&0&0\\0&0&0&0&0&0&-j&-j\\1&-1&0&0&0&0&0&0\\0&0&-1&1&0&0&0&0\\0&0&0&0&j&-j&0&0\\0&0&0&0&0&0&-j&j\end{bmatrix}.$$

[0173] Referring to FIG. 10, FIG. 10 is a flow chart illustrating a method for determining an uplink MIMO transmission codeword according to an embodiment of the disclosure. As shown in FIG. 10, the method may include, but is not limited to, the following steps.

[0174] At S1001, a candidate codeword of 2 Tx for uplink MIMO transmission is determined.

[0175] At S1002, 8 Tx are divided into 4 antenna port groups.

[0176] Regarding the detailed description of steps S1001 to S1002, reference can be made to the relevant contents described in the above embodiments, which will not be repeated here.

[0177] At S1003, a third codeword is determined from a second candidate codeword of 4 Tx, and a fourth codeword corresponding to the third codeword is determined.

[0178] At S1004, a first codeword is obtained by splicing, based on the antenna port groups and a co-phasing coefficient, the third codeword and the fourth codeword.

[0179] In an embodiment of the disclosure, the first codeword for the antenna partial coherence transmission of 8 Tx L-layer may be determined based on the second candidate codeword for the antenna partial coherence transmission of 4 Tx. It should be noted that in the case that the first codeword of 8 Tx L-layer is determined based on the second candidate codeword of 4 Tx, a sparse matrix corresponding to a transmission codeword of 8 Tx of the antenna port groups is composed of a sparse matrix corresponding to a codeword for the antenna partial coherence transmission of 4 Tx. For example, if the first antenna port group consists of {0, 2}, the second antenna port group consists of {1, 3}, the third antenna port group consists of {4, 6}, and the fourth antenna port group consists of {5, 7}, then the sparse matrix

CLAIMS

1. A method for determining an uplink multiple input multiple output (MIMO) transmission codeword, comprising:

determining a candidate codeword of 4 transmit antenna ports (Tx) and/or 2 Tx for uplink MIMO transmission, wherein the candidate codeword comprises at least one of a first candidate codeword for antenna full coherence transmission, a second candidate codeword for antenna partial coherence transmission, or a third candidate codeword for antenna non-coherence transmission;

dividing 8 Tx into K antenna port groups, wherein K is a positive integer less than 8;

determining a third codeword from the candidate codeword, and determining a fourth codeword corresponding to the third codeword; and

obtaining a first codeword for the antenna partial coherence transmission of 8 Tx L-layer for the uplink MIMO transmission by splicing, based on the antenna port groups and a co-phasing coefficient, the third codeword and the fourth codeword, wherein L is less than or equal to 8.

2. The method according to claim 1, wherein obtaining the first codeword, by splicing, based on the antenna port groups and the co-phasing coefficient, the third codeword and the fourth codeword comprises:

determining a co-phasing coefficient matrix;

generating a first spliced codeword by splicing the third codeword and a first set zero-element matrix in a row dimension;

generating a second spliced codeword by splicing the fourth codeword and a second set zero-element matrix in the row dimension;

generating a third spliced codeword by splicing the first spliced codeword and the second spliced codeword in a column dimension; and

generating the first codeword by performing a matrix dot product operation on the co-phasing coefficient matrix and the third spliced codeword, wherein coefficients in the co-phasing coefficient matrix are multiplied with a block matrix at a corresponding position in the third spliced codeword.

3. The method according to claim 1 or 2, wherein K=2, and determining the third codeword from the candidate codeword, and determining the fourth codeword corresponding to the third codeword comprises:

determining the third codeword from the first candidate codeword of 4 Tx, and determining the fourth codeword corresponding to the third codeword.

4. The method according to claim 1, wherein determining the third codeword from the first candidate codeword, and determining the fourth codeword corresponding to the third codeword comprises:

determining a first candidate codeword as the third codeword according to a number L of transmission layers; and

determining another first candidate codeword as the fourth codeword according to the number L of transmission layers.

5. The method according to claim 1, wherein K=2, and the method further comprises:

determining two or more codewords from the first candidate codeword of 4 Tx; and

determining a splice position of the two or more codewords, and generating the first codeword of 8 Tx L-layer by splicing the two or more codewords based on the splice position.

6. The method according to claim 1 or 2, wherein K=4, and determining the third codeword from the candidate codeword, and determining the fourth codeword corresponding to the third codeword further comprises:

determining a first candidate codeword of 2 Tx 2-layer as the third codeword; and

determining a first candidate codeword of 2 Tx 1-layer as the fourth codeword.

7. The method according to claim 6, wherein a number of the third codewords is L-4; and a number of the fourth codewords is 8-L.

8. The method according to claim 1, wherein K=2, and determining the second codeword of 8 Tx L-layer comprises:

determining a third candidate codeword of 4 Tx P-layer as the third codeword;

determining a third candidate codeword of 4 Tx Q-layer as the fourth codeword; and

generating the second codeword of 8 Tx L-layer by splicing the third codeword and the fourth codeword, wherein a sum of P and Q is L.

9. The method according to any of claims 1-8, further comprising:

determining, based on a phase angle supported by a communication device, the co-phasing coefficient.

10. The method according to any of claims 1-9, further comprising:

determining a normalization coefficient of any codeword, and performing energy normalization on any codeword based on the normalization coefficient.

11. An apparatus for communication, comprising:

a processing module, configured to determine a candidate codeword of 4 transmit antenna ports (Tx) and/or 2 Tx for uplink MIMO transmission, wherein the candidate codeword comprises at least one of a first candidate codeword for antenna full coherence transmission, a second

candidate codeword for antenna partial coherence transmission, or a third candidate codeword for antenna non-coherence transmission; divide 8 Tx into K antenna port groups, wherein K is a positive integer less than 8; determine a third codeword from the candidate codeword, and determining a fourth codeword corresponding to the third codeword; and obtain a first codeword for the antenna partial coherence transmission of 8 Tx L-layer for the uplink MIMO transmission by splicing, based on the antenna port groups and a co-phasing coefficient, the third codeword and the fourth codeword, wherein L is less than or equal to 8.

12. A communication apparatus, comprising a processor and a memory wherein the memory stores a computer program, and when the computer program is executed by the processor, the method of any one of claims 1 to 10 is implemented.

13. A computer-readable storage medium, configured to store instructions, wherein when the instructions are executed, the method of any one of claims 1 to 10 is implemented.