Therefore, when there are a lot of sub-bands, the quantization feedback on a channel matrix may bring a large CSI feedback overhead, but if only information about the amplitude or the phase of the weighting coefficients over the entire wideband is fed back, the high performance gain brought by this kind of codebook feedback cannot be fully exerted.

SUMMARY

CSI feedback and receiving methods, an apparatus, a device, and a storage medium provided by embodiments of the present disclosure can at least solve the problem in the related art that the CSI feedback overhead is large when the CSI is accurately fed back.

A first aspect of the present disclosure provides a CSI feedback method. The method includes steps described below.

A terminal determines precoding matrix indication information (PMI). The PMI includes first base vector information associated with first base vectors, second base vector information associated with second base vectors and second coefficient information, used to derive first coefficients and second coefficients, and the second coefficient information includes second coefficient amplitude information and second coefficient phase information; a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources; frequency domain resources in each of the plurality of frequency domain units of a same transmission layer correspond to a same precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and the first coefficients corresponding to a same first base vector define a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients. Precoding vectors corresponding to frequency domain resources in a preset frequency domain unit are the same, a precoding vector is a linear combination of first base vectors, and weighting coefficients used in the linear combination of the first base vectors are first coefficients. On multiple frequency

domain units contained in a CSI feedback band, a vector composed of first coefficients corresponding to a same first base vector is a linear combination of second base vectors, and weighting coefficients used in the linear combination of the second base vectors are second coefficients.

The terminal feeds back CSI containing the PMI to a base station, wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components and the two components comprise a first amplitude component and a second amplitude component.

A second aspect of the present disclosure further provides a CSI receiving method. The method includes steps described below.

A base station receives CSI containing PMI from a terminal.

The base station acquires first base vector information associated with first base vectors, second base vector information associated with second base vectors, and second coefficient information from the PMI, the second coefficient information being used to derive first coefficients and second coefficients. The second coefficient information includes second coefficient amplitude information and second coefficient phase information; a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources; frequency domain resources in each of the plurality of frequency domain units of a same transmission layer correspond to a same precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and the first coefficients corresponding to a same first base vector defines a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients, wherein receiving, by the base station, the CSI containing the PMI from the terminal includes receiving, by the base station, the CSI including two components of the second coefficient amplitude information and quantizing the two components to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components and the two components comprise a first amplitude component and a second amplitude component. Precoding vectors corresponding to frequency domain resources in a preset frequency domain unit are the same, a precoding vector is a linear combination of first base vectors, and weighting coefficients used in the linear combination of the first base vectors are first coefficients. On multiple frequency domain units contained in a CSI feedback band, a vector composed of first coefficients corresponding to a same first base vector is a linear combination of second base vectors, and weighting coefficients used in the linear combination of the second base vectors are second coefficients.

A third aspect of the present disclosure further provide a CSI feedback apparatus. The apparatus, applied to a terminal, includes at least one processor and a transmitter.

The at least one processor is configured to determine precoding matrix indication information (PMI). The PMI includes first base vector information associated with first base vectors, second base vector information associated with second base vectors, and second coefficient information, used to derive first coefficients and second coefficients, the second coefficient information includes second coefficient amplitude information and second coefficient phase information; a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources; frequency domain resources in each of the plurality of frequency domain units of a same transmission layer corresponds to a precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and the first coefficients corresponding to a same first base vector define a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients. Precoding vectors corresponding to frequency domain resources in a preset frequency domain unit are the same, a precoding vector is a linear combination of first base vectors, and weighting coefficients used in the linear combination of the first base vectors are first coefficients. On multiple frequency domain units contained in a CSI feedback band, a vector composed of first coefficients corresponding to a same first base vector is a linear combination of second base vectors, and weighting coefficients used in the linear combination of the second base vectors are second coefficients.

The transmitter is configured to feedback CSI containing the PMI to the base station, wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components, and the two components comprise a first amplitude component and a second amplitude component.

A fourth aspect of the present disclosure provides a base station, comprising: memory, storing at least one program; and at least one processor in communication with the memory and configured to execute the at least one program to perform the steps, comprising: receiving CSI containing

precoding matrix indication information (PMI) from a terminal; and acquiring first base vector information associated with first base vectors, second base vector information associated with second base vectors, and second coefficient information from the PMI, the second coefficient information being used to derive first coefficients and second coefficients, wherein: the second coefficient information comprises second coefficient amplitude information and second coefficient phase information; a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources; frequency domain resources in each of the plurality of frequency domain units of a same transmission layer correspond to a same precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and the first coefficients corresponding to a same first base vector define a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients, wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components, and the two components comprise a first amplitude component and a second amplitude component.

What is claimed is:

1. A channel state information (CSI) feedback method, comprising:

determining, by a terminal, precoding matrix indication information (PMI), wherein the PMI comprises:

first base vector information associated with first base vectors;

second base vector information associated with second base vectors; and

second coefficient information, used to derive first coefficients and second coefficients, the second coefficient information comprising second coefficient amplitude information and second coefficient phase information;

a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources;

frequency domain resources in each of the plurality of frequency domain units of a same transmission layer correspond to a same precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and

the first coefficients corresponding to a same first base vector define a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients; and

feeding back, by the terminal, CSI containing the PMI to a base station,

wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components and the two components comprise a first amplitude component and a second amplitude component.

2. The method of claim 1, wherein a frequency domain unit of the plurality of frequency domain units comprises at least one of: a sub-band or a first resource block (RB) set, wherein a number of RBs contained in the first RB set is less than a number of RBs contained in a sub-band of the CSI feedback band.

3. The method of claim 1, wherein the second base vectors comprise discrete Fourier transform (DFT) vectors.

4. The method of claim 1, wherein a dimension of each second base vector is equal to a number of frequency domain units contained in the CSI feedback band.

5. The method of claim 1, wherein the second base vectors belong to a second base vector candidate set, the second base vector candidate set is determined based on a parameter N, and the second base vector candidate set is $\{v_1, ..., v_N\}$ or a subset of $\{v_1, ..., v_N\}$, wherein N is a number of frequency domain units contained in the CSI feedback band.

6. The method of claim 5, wherein when the second base vector candidate set is the subset of $\{v_1, ..., v_N\}$, a method of determining the second base vector candidate set comprises:

determining the second base vector candidate set based on a starting position of the second base vector candidate set and a number of vectors in the second base vector candidate set.

7. The method of claim 1, wherein the second base vectors comprise K base vectors selected from X consecutive base vectors in a second base vector candidate set, and X and K are positive integers.

~~8. The method of claim 1, wherein the second coefficient amplitude information comprises:~~

~~two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components and the two components comprise a first amplitude component and a second amplitude component.~~

~~9~~8. The method of claim ~~8~~1, wherein feeding back, by the terminal, the CSI containing the PMI to the base station comprises at least one of:

feeding back a common second amplitude component for a plurality of pieces of second coefficient amplitude information corresponding to a common first base vector; or

feeding back a common second amplitude component for a plurality of pieces of second coefficient amplitude information corresponding to a common second base vector.

~~10~~9. A channel state information (CSI) receiving method, comprising:

receiving, by a base station, CSI containing precoding matrix indication information (PMI) from a terminal; and

acquiring, by the base station, first base vector information associated with first base vectors, second base vector information associated with second base vectors, and second coefficient information from the PMI, the second coefficient information being used to derive first coefficients and second coefficients, wherein:

the second coefficient information comprises second coefficient amplitude information and second coefficient phase information;

a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources;

frequency domain resources in each of the plurality of frequency domain units of a same transmission layer correspond to a same precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and

the first coefficients corresponding to a same first base vector defines a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients,

wherein receiving, by the base station, the CSI containing the PMI from the terminal includes receiving, by the base station, the CSI including two components of the second coefficient amplitude information and quantizing the two components to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components and the two components comprise a first amplitude component and a second amplitude component.

~~11~~10. The method of claim ~~10~~9, wherein the frequency domain unit comprises at least one of: a sub-band or a first resource block (RB) set, wherein a number of RBs contained in the first RB set is less than a number of RBs contained in a sub-band of the CSI feedback band.

~~12. The method of claim 10, wherein receiving, by the base station, the CSI containing the PMI from the terminal:~~

~~receiving, by the base station, the CSI including two components of the second coefficient amplitude information and quantizing the two components to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a~~

~~product of the two quantized components and the two components comprise a first amplitude component and a second amplitude component.~~

~~13~~11. A channel state information (CSI) feedback apparatus, applied to a terminal, comprising:

at least one processor, configured to determine precoding matrix indication information (PMI), wherein:

the PMI comprises first base vector information associated with first base vectors, second base vector information associated with second base vectors, and second coefficient information, used to derive first coefficients and second coefficients, the second coefficient information comprising second coefficient amplitude information and second coefficient phase information;

a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources;

frequency domain resources in each of the plurality of frequency domain units of a same transmission layer corresponds to a precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and

the first coefficients corresponding to a same first base vector define a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients; and

a transmitter in communication with a base satiation, configured to feedback CSI containing the PMI to the base station,

wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components, and the two components comprise a first amplitude component and a second amplitude component.

~~14~~12. A base station, comprising:

memory, storing at least one program; and

at least one processor in communication with the memory and configured to execute the at least one program to perform the steps, comprising:

receiving CSI containing precoding matrix indication information (PMI) from a terminal; and

acquiring first base vector information associated with first base vectors, second base vector information associated with second base vectors, and second coefficient information from the PMI, the second coefficient information being used to derive first coefficients and second coefficients, wherein:

the second coefficient information comprises second coefficient amplitude information and second coefficient phase information;

a CSI feedback band comprises a plurality of frequency domain units, each frequency domain unit having a plurality of frequency domain resources;

frequency domain resources in each of the plurality of frequency domain units of a same transmission layer correspond to a same precoding vector, each precoding vector being a linear combination of the first base vectors with weighting coefficients being the first coefficients; and

the first coefficients corresponding to a same first base vector define a first coefficient vector, the first coefficient vector being a linear combination of the second base vectors with weighting coefficients being the second coefficients,

wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components, and the two components comprise a first amplitude component and a second amplitude component.

~~15~~13. The method of claim 5, wherein a s^{th} vector of the second base vector candidate set is $\{1 \quad \exp\left(j\frac{s}{N}2\pi\right) \quad \cdots \quad \exp\left(j\frac{(N-1)s}{N}2\pi\right)\}$ being a positive integer.

~~16~~14. The CSI feedback apparatus of claim ~~13~~11, wherein a frequency domain unit of the plurality of frequency domain units comprises at least one of:

a sub-band; or

a first resource block (RB) set, wherein a number of RBs contained in the first RB set is less than a number of RBs contained in a sub-band of the CSI feedback band.

~~17~~15. The CSI feedback apparatus of claim ~~13~~11, wherein the second base vectors comprise discrete Fourier transform (DFT) vectors.

~~18~~16. The CSI feedback apparatus of claim ~~13~~11, wherein a dimension of each second base vector is equal to a number of frequency domain units contained in the CSI feedback band.

~~19~~17. The CSI feedback apparatus of claim ~~13~~11, wherein the second base vectors belong to a second base vector candidate set, the second base vector candidate set is determined based on a parameter N, and the second base vector candidate set is $\{v_1, ..., v_N\}$ or a subset of $\{v_1, ..., v_N\}$, wherein N is a number of frequency domain units contained in the CSI feedback band.

~~20~~18. The CSI feedback apparatus of claim ~~19~~17, wherein the at least one processor is further configured to determine the second base vector candidate set based on a starting position of the second base vector candidate set and a number of vectors in the second base vector candidate set.

~~21~~19. The CSI feedback apparatus of claim ~~19~~17, wherein a s^{th} vector of the second base vector candidate set is $\{1 \quad \exp\left(j\frac{s}{N}2\pi\right) \quad \cdots \quad \exp\left(j\frac{(N-1)s}{N}2\pi\right)\}$ being a positive integer.

~~22~~20. The CSI feedback apparatus of claim ~~13~~11, wherein the second base vectors comprise K base vectors selected from X consecutive base vectors in a second base vector candidate set, and X and K are positive integers.

~~23. The CSI feedback apparatus of claim 13, wherein the second coefficient amplitude information comprises two components to be quantized to be between 0 and 1 to generate two quantized components, wherein a coefficient amplitude used in the precoding vector is a product of the two quantized components, and the two components comprise a first amplitude component and a second amplitude component.~~

~~24~~21. The CSI feedback apparatus of claim ~~21~~19, to feedback the CSI containing the PMI to the base station, the transmitter is configured to perform at least one of the steps comprising:

feeding back a common second amplitude component for a plurality of pieces of second coefficient amplitude information corresponding to a common first base vector; or

feeding back a common second amplitude component for a plurality of pieces of second coefficient amplitude information corresponding to a common second base vector.