CLAIMS

What is claimed is:

1. A pilot information symbol sending method, applied to a transmit end and comprising:

determining, based on a discrete Fourier transform DFT matrix and a sensing matrix, a pilot information symbol corresponding to each antenna on each pilot resource; and

sending a corresponding pilot information symbol on each of the pilot resources for each of the antennas; wherein

the sensing matrix is determined through training of channel information.

2. The method according to claim 1, wherein the determining, based on a discrete Fourier transform DFT matrix and a sensing matrix, a pilot information symbol corresponding to each antenna on each pilot resource comprises:

determining, according to $F*W=A$, the pilot information symbol corresponding to each antenna on each pilot resource, wherein A is an observation matrix A formed by all pilot information symbols, W is the sensing matrix, F is an N-dimensional DFT matrix, and N is the number of the antennas.

3. The method according to claim 1, further comprising:

training the sensing matrix, wherein the training the sensing matrix comprises the following steps:

obtaining a plurality of groups of actual channel information that are obtained by performing channel estimation by a receive end based on a preset channel estimation algorithm and an approximate message passing AMP parameter; and

performing iterative training on a preset neural network model based on the channel estimation algorithm, the AMP parameter, the plurality of groups of actual channel information, and the DFT matrix, so as to obtain the sensing matrix.

4. The method according to claim 3, wherein the step of performing iterative training on a preset neural network model comprises:

during the L-th iteration, adjusting variables of the neural network model based on channel estimation information obtained in the L-th iteration and the L-th group of channel information corresponding to the L-th iteration, wherein the channel estimation information is obtained by performing channel estimation on a target result based on the channel estimation algorithm and the AMP parameter, and the target result is a result of multiplying an output of the neural network model by the DFT matrix and then by the L-th group of channel information corresponding to the L-th iteration, wherein L is a positive integer.

5. The method according to claim 1, wherein pilot information symbols sent on different antennas are different, and pilot information symbols sent by a same antenna on different pilot resources are different.

6. The method according to claim 1, wherein the number of antennas is greater than the number of pilot resources.

7. A channel estimation method, applied to a receive end and comprising:

receiving a pilot signal on each pilot resource, wherein the pilot signal comprises a pilot information symbol correspondingly sent on the pilot resource by each antenna of a transmit end; and

performing channel estimation based on a learned approximate message passing LAMP network and the pilot information symbols; wherein

the pilot information symbol is determined based on a discrete Fourier transform DFT matrix and a sensing matrix, the sensing matrix is determined through training of channel information, a LAMP parameter used for channel estimation by the LAMP network is obtained through training on a neural network that is expanded during an iterative solution process based on the sensing matrix and an AMP algorithm.

8. The method according to claim 7, wherein the pilot information symbol is determined according to $F*W=A$, wherein A is an observation matrix A formed by all pilot information symbols, W is a sensing matrix, F is an N-dimensional DFT matrix, and N is the number of the antennas.

9. The method according to claim 7, further comprising:

training the sensing matrix, wherein the training the sensing matrix comprises the following steps:

obtaining a plurality of groups of actual channel information that are obtained by performing channel estimation by the receive end based on a preset channel estimation algorithm and an approximate message passing AMP parameter; and

performing iterative training on a preset neural network model based on the channel estimation algorithm, the AMP parameter, the plurality of groups of actual channel information, and the DFT matrix, so as to obtain the sensing matrix.

10. The method according to claim 9, wherein the step of performing iterative training on a preset neural network model comprises:

during the L-th iteration, adjusting variables of the neural network model based on channel estimation information obtained in the L-th iteration and the L-th group of channel information corresponding to the L-th iteration, wherein the channel estimation information is obtained by performing channel estimation on a target result based on the channel estimation algorithm and the AMP parameter, and the target result is a result of multiplying an output of the neural network model by the DFT matrix and then by the L-th group of channel information corresponding to the L-th iteration, wherein L is a positive integer.

11. The method according to claim 7, wherein pilot information symbols sent on different antennas are different, and pilot information symbols sent by a same antenna on different pilot resources are different.

12. The method according to claim 7, wherein before the performing channel estimation based on a learned approximate message passing LAMP network and the pilot information symbols, the method further comprises:

determining a signal-to-noise ratio of the receive end; and

determining a LAMP parameter corresponding to a target signal-to-noise ratio range as the LAMP parameter used for channel estimation by the LAMP network, wherein the target signal-to-noise ratio range is a first signal-to-noise ratio range corresponding to the signal-to-noise ratio in at least two first signal-to-noise ratio ranges.

13. The method according to claim 12, wherein the first signal-to-noise ratio range is a signal-to-noise ratio range for obtaining the LAMP parameter through training, and the first signal-to-noise ratio range is in one-to-one correspondence to the LAMP parameter.

14. The method according to claim 13, wherein the at least two first signal-to-noise ratio ranges are comprised in a second signal-to-noise ratio range, and the second signal-to-noise ratio range is a signal-to-noise ratio range for obtaining the sensing matrix through training on channel information.

15. The method according to claim 7, wherein the number of antennas is greater than the number of pilot resources.

16. A communications device, wherein the communications device is a transmit end of a pilot information symbol and comprises:

a first determining module, configured to determine, based on a discrete Fourier transform DFT matrix and a sensing matrix, a pilot information symbol corresponding to each antenna on each pilot resource; and

a sending module, configured to send a corresponding pilot information symbol on each of the pilot resources for each of the antennas; wherein

the sensing matrix is determined through training of channel information.

17. The communications device according to claim 16, wherein the first determining module is specifically configured to: determine, according to $F*W=A$, the pilot information symbol corresponding to each antenna on each pilot resource, wherein A is an observation matrix A formed by all pilot information symbols, W is the sensing matrix, F is an N-dimensional DFT matrix, and N is the number of the antennas.

18. The communications device according to claim 16, wherein pilot information symbols sent on different antennas are different, and pilot information symbols sent by a same antenna on different pilot resources are different.

19. A communications device, wherein the communications device is a receive end of a pilot information symbol and comprises:

a receiving module, configured to receive a pilot signal on each pilot resource, wherein the pilot signal comprises a pilot information symbol correspondingly sent on the pilot resource by each antenna of a transmit end; and

a processing module, configured to perform channel estimation based on a learned approximate message passing LAMP network and the pilot information symbols; wherein

the pilot information symbol is determined based on a discrete Fourier transform DFT matrix and a sensing matrix, the sensing matrix is determined through training of channel information, a LAMP parameter used for channel estimation by the LAMP network is obtained through training on a neural network that is expanded during an iterative solution process based on the sensing matrix and an AMP algorithm.

~~20. The communications device according to claim 19, wherein the pilot information symbol is determined according to $F*W=A$, wherein A is an observation matrix A formed by all pilot information symbols, W is a sensing matrix, F is an N-dimensional DFT matrix, and N is the number of the antennas.~~

~~21. The communications device according to claim 19, wherein pilot information symbols sent on different antennas are different, and pilot information symbols sent by a same antenna on different pilot resources are different.~~

~~22. The communications device according to claim 19, further comprising:~~

~~a second determining module, configured to determine a signal-to-noise ratio of the receive end; and~~

~~a third determining module, configured to determine a LAMP parameter corresponding to a target signal-to-noise ratio range as the LAMP parameter used for channel estimation by the LAMP network, wherein the target signal-to-noise ratio range is a first signal-to-noise ratio range corresponding to the signal-to-noise ratio in at least two first signal-to-noise ratio ranges.~~

~~23. A communications device, comprising a memory, a processor, and a program or an instruction stored in the memory and capable of running on the processor, wherein when the program or the instruction is executed by the processor,~~

~~the steps of the pilot information symbol sending method according to any one of claims 1 to 6 are implemented; or when the program or the instruction is executed by the processor, the steps of the channel estimation method according to any one of claims 7 to 15 are implemented.~~

~~24~~20. A computer-readable storage medium, wherein the readable storage medium stores a program or an instruction, and when the program or the instruction is executed by a processor, the steps of the pilot information symbol sending method according to any one of claims 1 to 6 are implemented; or when the program or the instruction is executed by a processor, the steps of the channel estimation method according to any one of claims 7 to 15 are implemented.

~~25. A chip, wherein the chip comprises a processor and a communications interface, the communications interface is coupled to the processor, and the processor is configured to execute a program or an instruction to implement the steps of the pilot information symbol sending method according to any one of claims 1 to 6, or the steps of the channel estimation method according to any one of claims 7 to 15.~~

~~26. A computer program product, wherein the computer program product is executed by at least one processor to execute and implement the steps of the pilot information symbol sending method according to any one of claims 1 to 6, or the steps of the channel estimation method according to any one of claims 7 to 15.~~

~~27. A communications device, configured to execute the steps of the pilot information symbol sending method according to any one of claims 1 to 6, or the steps of the channel estimation method according to any one of claims 7 to 15.~~