

CLAIMS

1. An interference cancellation apparatus, comprising:
 - a main receive antenna, configured to receive a radio frequency signal, and transmit the received radio frequency signal to a first-type interference canceller;
 - a divider, configured to acquire a radio frequency reference signal generated according to a transmit signal, and transmit the radio frequency reference signal to the first-type interference canceller and a second-type interference reconstructor;
 - the first-type interference canceller, configured to receive the radio frequency reference signal transmitted by the divider and the received radio frequency signal transmitted by the main receive antenna, and cancel a first-type self-interference component in the received radio frequency signal according to the radio frequency reference signal to acquire a first processed signal, wherein the first-type self-interference component comprises a main-path self-interference component;
 - a local-frequency signal generator, configured to acquire a self-interference channel parameter acquired by the second-type interference reconstructor, and generate a first local-frequency signal and a second local-frequency signal according to the self-interference channel parameter;
 - a down converter, configured to receive the first local-frequency signal generated by the local-frequency signal generator and the first processed signal acquired by the first-type interference canceller, and perform frequency mixing processing on the first local-frequency signal and the first processed signal to acquire a second processed signal;
 - a filter, configured to receive the second processed signal, and perform filtering processing on the second processed signal to acquire a third processed signal;
 - the second-type interference reconstructor, configured to acquire the second local-frequency signal generated by the local-frequency signal generator and the radio frequency reference signal acquired by the divider, and reconstruct the self-interference signal according to the self-interference channel parameter, the radio frequency reference signal, and the second local-frequency signal;
 - a coupler, configured to receive the third processed signal acquired by the filter and the reconstructed self-interference signal transmitted by the second-type interference reconstructor, and cancel a second-type self-interference signal in the third processed signal according to the reconstructed self-interference signal to generate a fourth processed signal; and
 - a digital down-conversion unit, configured to receive the fourth processed signal, convert the fourth processed signal into a digital signal, and perform digital down-conversion processing on the digital signal to acquire a fifth processed signal; wherein
 - the second-type interference reconstructor is further configured to acquire a digital baseband reference signal, receive the fifth processed signal transmitted by the digital down-conversion unit, and perform self-interference channel estimation according to the fifth processed signal and the digital baseband reference signal to acquire the self-interference channel parameter.

2. The apparatus according to claim 1, wherein the second-type interference reconstructor comprises:

a self-interference estimation module, configured to acquire the digital baseband reference signal, receive the fifth processed signal transmitted by the digital down-conversion unit, and perform self-interference channel estimation according to the digital baseband reference signal and the fifth processed signal to acquire the self-interference channel parameter; and

a self-interference signal reconstruction module, configured to acquire the second local-frequency signal generated by the local-frequency signal generator, receive the radio frequency reference signal acquired by the divider and the self-interference channel parameter acquired by the self-interference estimation module, and reconstruct the self-interference signal according to the self-interference channel parameter, the radio frequency reference signal, and the second local-frequency signal.

3. The apparatus according to claim 1, further comprising a first amplifier, wherein the first amplifier is configured to amplify the fourth processed signal.

4. The apparatus according to claim 1, further comprising a second amplifier and a third amplifier, wherein:

the second amplifier is configured to amplify the first processed signal; and

the third amplifier is configured to amplify the reconstructed self-interference signal.

5. The apparatus according to claim 1, further comprising a second amplifier and a fourth amplifier, wherein:

the second amplifier is configured to amplify the first processed signal; and

the fourth amplifier is configured to amplify the radio frequency reference signal received by the second-type interference reconstructor.

6. The apparatus according to claim 2, wherein the self-interference signal reconstruction module comprises:

a first power divider, a first attenuator group, a first mixer group, a first low-pass filter group, and a first delayer group, wherein:

the first power divider is configured to receive the radio frequency reference signal, and divide the radio frequency reference signal into at least one signal;

the first attenuator group comprises at least one attenuator, wherein the attenuator is configured to perform attenuation processing on one of the at least one radio frequency reference signal according to the self-interference channel parameter;

the first mixer group comprises at least one mixer, wherein the mixer is configured to perform, according to the second local-frequency signal, frequency mixing processing on one of the radio frequency reference signal after attenuation processing;

the first low-pass filter group comprises at least one low-pass filter, wherein the low-pass filter is configured to perform filtering processing on one of the radio frequency reference signal after frequency mixing processing; and

the first delayer group comprises at least one delayer and at least one combiner, wherein: the at least one delayer is connected in series by using a first input end and an output end of a combiner, an input end of a first delayer and a second input end of the combiner are configured to input one radio frequency reference signal after filtering processing, and an output end of a last combiner is configured to output the reconstructed self-interference signal.

7. The apparatus according to claim 2, wherein the self-interference signal reconstruction module comprises:

a second power divider, a second mixer group, a second low-pass filter group, a second attenuator group, and a second delayer group, wherein:

the second power divider is configured to receive the radio frequency reference signal, and divide the radio frequency reference signal into at least one signal;

the second mixer group comprises at least one mixer, wherein the mixer is configured to perform frequency mixing processing on one of the radio frequency reference signal according to the second local-frequency signal;

the second low-pass filter group comprises at least one low-pass filter, wherein the low-pass filter is configured to perform filtering processing on one of the radio frequency reference signal after frequency mixing processing;

the second attenuator group comprises at least one attenuator, wherein the attenuator is configured to perform, according to the self-interference channel parameter, attenuation processing on one of the radio frequency reference signal after filtering processing; and

the second delayer group comprises at least one delayer and at least one combiner, wherein: the at least one delayer is connected in series by using a first input end and an output end of a combiner, an input end of a first delayer and a second input end of the combiner are configured to input one radio frequency reference signal after attenuation processing, and an input end of a last combiner is configured to output the reconstructed self-interference signal.

8. The apparatus according to claim 1, wherein the local-frequency signal generator comprises a local-frequency signal source, a third power divider, and a phase shifter group, wherein:

the third power divider is configured to divide a local-frequency signal transmitted by the local-frequency signal source into at least one local-frequency signal, wherein one local-frequency signal is used as the first local-frequency signal, and the other local-frequency signals are input to the phase shifter group; and

the phase shifter group comprises at least one phase shifter, wherein the phase shifter is configured to perform phase shift processing on one local-frequency signal according to the self-

interference channel parameter, and the phase shifter group uses each local-frequency signal obtained after phase shift processing as the second local-frequency signal.

9. The apparatus according to claim 1, wherein:

the first-type interference canceller is specifically configured to perform, based on the received radio frequency signal, delay processing, amplitude adjustment processing, and phase adjustment processing on the radio frequency reference signal, so that an amplitude of the radio frequency reference signal is in a direction opposite or approximately opposite to an amplitude of the first-type self-interference component in the received radio frequency signal, and that a phase of the radio frequency reference signal is the same or approximately the same as a phase of the first-type self-interference component in the received radio frequency signal; or

perform, based on the received radio frequency signal, delay processing, amplitude adjustment processing, and phase adjustment processing on the radio frequency reference signal, so that an amplitude of the radio frequency reference signal is the same or approximately the same as an amplitude of the first-type self-interference component in the received radio frequency signal, and that a difference between a phase of the radio frequency reference signal and a phase of the first-type self-interference component in the received radio frequency signal is 180 degrees or approximately 180 degrees.

10. The apparatus according to claim 1, wherein the interference cancellation apparatus is a base station or an access terminal of a base station.

11. The apparatus according to claim 2, wherein the self-interference estimation module comprises a field-programmable gate array FPGA, a central processing unit CPU, or application-specific integrated circuit ASIC.

12. An interference cancellation method, comprising:

acquiring a radio frequency reference signal generated according to a transmit signal;

receiving a radio frequency signal by using a main receive antenna;

canceling a first-type self-interference component in the received radio frequency signal according to the radio frequency reference signal, to generate a first processed signal, wherein the first-type self-interference component comprises a main-path self-interference component;

generating a first local-frequency signal and a second local-frequency signal according to a self-interference channel parameter;

performing frequency mixing processing on the first local-frequency signal and the first processed signal to acquire a second processed signal;

performing filtering processing on the second processed signal to acquire a third processed signal;

acquiring a reconstructed self-interference signal according to the self-interference channel parameter, the radio frequency reference signal, and the second local-frequency signal;

canceling a second-type self-interference signal in the third processed signal according to the reconstructed self-interference signal to generate a fourth processed signal;

converting the fourth processed signal into a digital signal, and performing digital down-conversion processing on the digital signal to acquire a fifth processed signal; and

performing self-interference channel estimation according to the fifth processed signal and a digital baseband reference signal to acquire the self-interference channel parameter.

13. The method according to claim 12, wherein the method further comprises: amplifying the fourth processed signal.

14. The method according to claim 12, wherein the method further comprises:

amplifying the first processed signal; and

amplifying the reconstructed self-interference signal.

15. The method according to claim 12, wherein the method further comprises:

amplifying the first processed signal; and

before the acquiring the reconstructed self-interference signal according to the self-interference channel parameter, the radio frequency reference signal, and the second local-frequency signal, the method further comprises: amplifying the radio frequency reference signal.

16. The method according to claim 12, wherein the acquiring the reconstructed self-interference signal according to the self-interference channel parameter, the radio frequency reference signal, and the second local-frequency signal comprises:

dividing the radio frequency reference signal into at least one signal;

performing attenuation processing on each radio frequency reference signal according to the self-interference channel parameter;

performing, according to the second local-frequency signal, frequency mixing processing on each radio frequency reference signal after attenuation processing;

performing filtering processing on each radio frequency reference signal after frequency mixing processing; and

performing delay processing on each of the radio frequency reference signal after filtering processing, and performing combination to reconstruct the self-interference signal.

17. The method according to claim 12, wherein the acquiring the reconstructed self-interference signal according to the self-interference channel parameter, the radio frequency reference signal, and the second local-frequency signal comprises:

dividing the radio frequency reference signal into at least one signal;

performing frequency mixing processing on each of the radio frequency reference signal according to the second local-frequency signal;

performing filtering processing on each of the radio frequency reference signal after frequency mixing processing;

performing, according to the self-interference channel parameter, attenuation processing on each of the radio frequency reference signal after filtering processing; and

performing delay processing on each of the radio frequency reference signal after attenuation processing, and combining the radio frequency reference signal to reconstruct the self-interference signal.

18. The method according to claim 12, wherein the generating a first local-frequency signal and a second local-frequency signal according to a self-interference channel parameter comprises:

dividing a local-frequency signal into at least one local-frequency signal, wherein one local-frequency signal is used as the first local-frequency signal; and

performing phase shift processing on each local-frequency signal except the first local-frequency signal according to the self-interference channel parameter to generate the second local-frequency signal.

19. The method according to claim 12, wherein canceling a first-type self-interference component in the received radio frequency signal according to the radio frequency reference signal comprises:

performing, based on the received radio frequency signal, delay processing, amplitude adjustment processing, and phase adjustment processing on the radio frequency reference signal, so that an amplitude of the radio frequency reference signal is in a direction opposite or approximately opposite to an amplitude of the first-type self-interference component in the received radio frequency signal, and that a phase of the radio frequency reference signal is the same or approximately the same as a phase of the first-type self-interference component in the received radio frequency signal; or

performing, based on the received radio frequency signal, delay processing, amplitude adjustment processing, and phase adjustment processing on the radio frequency reference signal, so that an amplitude of the radio frequency reference signal is the same or approximately the same as an amplitude of the first-type self-interference component in the received radio frequency signal, and that a difference between a phase of the reference signal and a phase of the first-type self-interference component in the received radio frequency signal is 180 degrees or approximately 180 degrees.

20. The method according to claim 12, wherein the transmit signal comprises a self-interference channel estimation timeslot and a data transmission timeslot that are disposed at an interval.