

~~**METHOD, SYSTEM, DEVICE, AND ELECTRONIC SIGNATURE TOOL FOR AUDIO
COMMUNICATION MODULATION SCHEME SELF-ADAPTATION**~~

5 **FIELD**

The present disclosure relates to an electronic technique field, and more particularly to a method for audio communication modulation mode self-adaptation, a system for audio communication modulation mode self-adaptation, an apparatus for audio communication modulation mode self-adaptation in a mobile terminal, and an electronic signature token.

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BACKGROUND

In a current audio data transmission via an audio interface, different mobile terminals have different audio transmission characteristics. In order to be compatible with the audio transmission characteristics of different mobile terminals, an apparatus (such as an electronic signature token) communicating with the mobile terminal needs to try with audio data in different modulation modes automatically so as to find a most suitable modulation mode matched with each of the different mobile terminals.

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Currently, there are few audio communication means, and consequently no suitable mode can be compatible with the communication between different mobile terminals and different electronic signature tokens.

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Moreover, since both sides in the communication may not necessarily be fixed and can have their own different audio transmission characteristics, when the demodulation mode and the modulation mode not matched with each other are adopted during the audio data transmission, a data interaction speed may be reduced and it is easy for a distortion to occur in the interactive data.

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SUMMARY

Embodiments of the present disclosure seek to solve at least one of the problems existing in the related art.

Accordingly, a first objective of the present disclosure is to provide a method for audio communication modulation mode self-adaptation, which can determine an audio modulation mode quickly, such that audio data interaction may be performed quickly and the distortion degree of the

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What is claimed is:

1. A method for audio communication modulation mode self-adaptation, comprising:

modulating by a first device first audio data to be sent using at least two modulation modes supported by the first device respectively to generate first audio data frame streams in the at least
5 two modulation modes;

splicing by the first device the first audio data frame streams in the at least two modulation modes into a first audio data stream;

10 sending the first audio data stream to a second device via an audio interface of the first device;

demodulating by the second device the first audio data stream to obtain modulation modes correctly received by the second device and supported by the first device;

modulating by the second device second audio data to be sent using at least two modulation modes supported by the second device to generate second audio data frame streams in the at least
15 two modulation modes, wherein the second audio data comprise the modulation modes correctly received by the second device and supported by the first device;

splicing by the second device the second audio data frame streams in the at least two modulation modes into a second audio data stream, and sending the second audio data stream to the first device via an audio interface of the second device;

20 demodulating by the first device the second audio data stream to obtain modulation modes correctly received by the first device and supported by the second device and to obtain modulation modes correctly received by the second device and supported by the first device; and

selecting by the first device an optimal modulation mode used in the second device from the modulation modes correctly received by the second device and supported by the first device, and
25 selecting by the first device an optimal modulation mode used in the first device from the modulation modes correctly received by the first device and supported by the second device, according to a predetermined rule.

2. The method according to claim 1, wherein sending the first audio data stream to the second device via the audio interface of the first device comprises sending the first audio data stream to
30 the second device via the audio interface of the first device in one transmission and in a same time reference frame; and

wherein sending the second audio data stream to the first device via the audio interface of the second device comprises sending the second audio data stream to the first device via the audio interface of the second device in one transmission and in a same time reference frame.

3. The method according to claim 2, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

4. The method according to claim 3, wherein demodulating by the second device the first audio data stream to obtain the modulation modes correctly received by the second device and supported by the first device comprises:

demodulating by the second device the first audio data stream, finding by the second device a start moment of each modulation waveform according to the predetermined reference moment, demodulating by the second device the modulation waveform according to the start moment to obtain the first audio data, determining by the second device whether the first audio data is correct according to the predetermined rule, and if yes, obtaining by the second device the modulation modes correctly received by the second device and supported by the first device.

5. The method according to claim 3, wherein demodulating by the first device the second audio data stream to obtain the modulation modes correctly received by the first device and supported by the second device and the modulation modes correctly received by the second device and supported by the first device comprises:

demodulating by the first device the second audio data stream, finding by the first device a start moment of each modulation waveform according to the predetermined reference moment, demodulating by the first device the modulation waveform according to the start moment to obtain the second audio data, determining by the first device whether the second audio data is correct according to the predetermined rule, and if yes, obtaining by the first device the modulation modes correctly received by the first device and supported by the second device.

6. The method according to claim 1, wherein sending the first audio data stream to the second device via the audio interface of the first device comprises sending the first audio data stream to the second device via the audio interface of the first device in one transmission and in different time reference frames; and

wherein sending the second audio data stream to the first device via the audio interface of the second device comprises sending the second audio data stream to the first device via the audio

interface of the second device in one transmission and in different time reference frames.

7. The method according to claim 6, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

5 8. The method according to claim 7, wherein generating the first audio data frame streams by the first device comprises modulating by the first device the first audio data to be sent into the first audio data frame streams and generating by the first device a synchronization header information, and adding by the first device the generated synchronization header information to the first audio data frame streams for indicating a start moment of each modulation mode; and

10 wherein generating the second audio data frame streams by the second device comprises modulating by the second device the second audio data to be sent into the second audio data frame streams and generating by the second device a synchronization header information, and adding by the second device the generated synchronization header information to the second audio data frame streams for indicating a start moment of each modulation mode.

15 9. The method according to claim 8, wherein demodulating by the second device the first audio data stream to obtain the modulation modes correctly received by the second device and supported by the first device comprises:

20 demodulating by the second device the first audio data stream sent from the first device, finding by the second device synchronization headers of the modulation waveforms modulated using the modulation modes supported by the first device respectively, acquiring by the second device a synchronization information of each modulation waveform, finding by the second device a start moment of each modulation waveform according to the synchronization information, demodulating by the second device the modulation waveform according to the start moment to obtain the first audio data, determining by the second device whether the first audio data is correct
25 according to the predetermined rule, and if yes, obtaining by the second device the modulation modes correctly received by the second device and supported by the first device.

30 10. The method according to claim 8, wherein demodulating by the first device the second audio data stream to obtain the modulation modes correctly received by the first device and supported by the second device and the modulation modes correctly received by the second device and supported by the first device comprises:

demodulating by the first device the second audio data stream sent from the second device,

finding by the first device synchronization headers of the modulation waveforms modulated using the modulation modes supported by the second device respectively, acquiring by the first device a synchronization information of each modulation waveform, finding by the first device a start moment of each modulation waveform according to the synchronization information, demodulating by the first device the modulation waveform according to the start moment to obtain the second audio data, determining by the first device whether the second audio data is correct according to the predetermined rule, and if yes, obtaining by the first device the modulation modes correctly received by the first device and supported by the second device.

11. The method according to any one of claims 1 to 10, wherein the first audio data and the second audio data comprise data in a predetermined fixed format and/or transmission data containing variable contents.

12. The method according to any one of claims 1 to 11, further comprising:

modulating by the first device third audio data using the optimal modulation mode used in the second device to generate third audio data frame streams, wherein the third audio data comprise the optimal modulation mode used in the second device and the optimal modulation mode used in the first device; and

sending by the first device the third audio data frame streams to the second device via the audio interface of the first device.

13. The method according to any one of claims 1 to 11, further comprising:

modulating by the first device third audio data using the optimal modulation mode used in the second device to generate third audio data frame streams, wherein the third audio data comprise the optimal modulation mode used in the second device and the optimal modulation mode used in the first device and audio data to be sent; and

sending by the first device the third audio data frame streams to the second device via the audio interface of the first device.

14. The method according to claim 12 or 13, further comprising:

obtaining by the second device the optimal modulation mode used in the second device and the optimal modulation mode used in the first device according to the third audio data frame streams, modulating by the second device response audio data using the optimal modulation mode used in the second device, and sending by the second device the modulated response audio data to the first device.

15. The method according to any one of claims 1 to 14, wherein the first audio data frame streams are generated by modulating the first audio data to be transmitted into an analog waveform signal using the modulation modes supported by the first device to generate the first audio data frame streams; and

5 wherein the second audio data frame streams are generated by modulating the second audio data to be transmitted into an analog waveform signal using the modulation modes supported by the second device to generate the second audio data frame streams.

16. The method according to any one of claims 1 to 15, wherein
the first audio data further comprises identifiers of the at least two modulation modes
10 supported by the first device; and

the second audio data further comprises identifiers of the modulation modes obtained and correctly received by the second device and supported by the first device and identifiers of the at least two modulation modes supported by the second device.

17. The method according to any one of claims 1 to 16, wherein the first device is a mobile
15 terminal, and the second device is an electronic signature token.

18. A system for audio communication modulation mode self-adaptation, comprising a first device and a second device connected with each other via audio interfaces, wherein

the first device is configured for modulating first audio data to be sent using at least two modulation modes supported by the first device respectively to generate first audio data frame
20 streams in the at least two modulation modes, splicing the first audio data frame streams in the at least two modulation modes into a first audio data stream, sending the first audio data stream to the second device via the audio interface of the first device, demodulating a second audio data stream to obtain modulation modes correctly received by the first device and supported by the second device and to obtain modulation modes correctly received by the second device and supported by
25 the first device, and selecting an optimal modulation mode used in the second device from the modulation modes correctly received by the second device and supported by the first device, and selecting an optimal modulation mode used in the first device from the modulation modes correctly received by the first device and supported by the second device, according to a predetermined rule,

30 the second device is configured for demodulating the first audio data stream to obtain modulation modes correctly received by the second device and supported by the first device,

modulating second audio data to be sent using at least two modulation modes supported by the second device to generate second audio data frame streams in the at least two modulation modes, in which the second audio data comprise the modulation modes correctly received by the second device and supported by the first device, splicing the second audio data frame streams in the at least two modulation modes into the second audio data stream, and sending the second audio data stream to the first device via the audio interface of the second device.

19. The system according to claim 18, wherein sending the first audio data stream to the second device via the audio interface of the first device comprises sending the first audio data stream to the second device via the audio interface of the first device in one transmission and in a same time reference frame; and

wherein sending the second audio data stream to the first device via the audio interface of the second device comprises sending the second audio data stream to the first device via the audio interface of the second device in one transmission and in a same time reference frame.

20. The system according to claim 19, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

21. The system according to claim 20, wherein the second device is further configured for:

demodulating the first audio data stream, finding a start moment of each modulation waveform according to the predetermined reference moment, demodulating the modulation waveform according to the start moment to obtain the first audio data, determining whether the first audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the second device and supported by the first device.

22. The system according to claim 20, wherein the first device is further configured for:

demodulating the second audio data stream, finding a start moment of each modulation waveform according to the predetermined reference moment, demodulating the modulation waveform according to the start moment to obtain the second audio data, determining whether the second audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the first device and supported by the second device.

23. The system according to claim 18, wherein sending the first audio data stream to the second device via the audio interface of the first device comprises sending the first audio data stream to the second device via the audio interface of the first device in one transmission and in

different time reference frames; and

wherein sending the second audio data stream to the first device via the audio interface of the second device comprises sending the second audio data stream to the first device via the audio interface of the second device in one transmission and in different time reference frames.

5 24. The system according to claim 23, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

25. The system according to claim 24, wherein generating the first audio data frame streams by the first device comprises modulating by the first device the first audio data to be sent into the
10 first audio data frame streams and generating by the first device a synchronization header information, and adding by the first device the generated synchronization header information to the first audio data frame streams for indicating a start moment of each modulation mode; and

wherein generating the second audio data frame streams by the second device comprises modulating by the second device the second audio data to be sent into the second audio data frame
15 streams and generating by the second device a synchronization header information, and adding by the second device the generated synchronization header information to the second audio data frame streams for indicating a start moment of each modulation mode.

26. The system according to claim 25, wherein the second device is further configured for:

demodulating the first audio data stream sent from the first device, finding synchronization
20 headers of the modulation waveforms modulated using the modulation modes supported by the first device respectively, acquiring a synchronization information of each modulation waveform, finding a start moment of each modulation waveform according to the synchronization information, demodulating the modulation waveform according to the start moment to obtain the first audio data, determining whether the first audio data is correct according to the predetermined rule, and if
25 yes, obtaining the modulation modes correctly received by the second device and supported by the first device.

27. The system according to claim 25, wherein the first device is further configured for:

demodulating the second audio data stream sent from the second device, finding
synchronization headers of the modulation waveforms modulated using the modulation modes
30 supported by the second device respectively, acquiring a synchronization information of each modulation waveform, finding a start moment of each modulation waveform according to the

synchronization information, demodulating the modulation waveform according to the start moment to obtain the second audio data, determining whether the second audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the first device and supported by the second device.

5 28. The system according to any one of claims 18 to 27, wherein the first audio data and the second audio data comprise data in a predetermined fixed format and/or transmission data containing variable contents.

29. The system according to any one of claims 18 to 28, wherein the first device is further configured for:

10 modulating third audio data using the optimal modulation mode used in the second device to generate third audio data frame streams, wherein the third audio data comprise the optimal modulation mode used in the second device and the optimal modulation mode used in the first device; and

15 sending the third audio data frame streams to the second device via the audio interface of the first device.

30. The system according to any one of claims 18 to 28, wherein the first device is further configured for:

20 modulating third audio data using the optimal modulation mode used in the second device to generate third audio data frame streams, wherein the third audio data comprise the optimal modulation mode used in the second device, the optimal modulation mode used in the first device and audio data to be sent; and

 sending the third audio data frame streams to the second device via the audio interface of the first device.

25 31. The system according to claim 29 or 30, wherein the second device is further configured for:

 obtaining the optimal modulation mode used in the second device and the optimal modulation mode used in the first device according to the third audio data frame streams, modulating response audio data using the optimal modulation mode used in the second device, and sending the modulated response audio data to the first device.

30 32. The system according to any one of claims 18 to 31, wherein the first audio data frame streams are generated by modulating the first audio data to be transmitted into an analog waveform

signal using the modulation modes supported by the first device to generate the first audio data frame streams; and

wherein the second audio data frame streams are generated by modulating the second audio data to be transmitted into an analog waveform signal using the modulation modes supported by the second device to generate the second audio data frame streams.

33. The system according to any one of claims 18 to 32, wherein

the first audio data further comprises identifiers of the at least two modulation modes supported by the first device; and

the second audio data further comprises identifiers of the modulation modes obtained and correctly received by the second device and supported by the first device and identifiers of the at least two modulation modes supported by the second device.

34. The system according to any one of claims 18 to 33, wherein the first device is a mobile terminal, and the second device is an electronic signature token.

35. An apparatus for audio communication modulation mode self-adaptation in a mobile terminal, comprising:

a modulating module configured for modulating first audio data to be sent using at least two modulation modes supported by the apparatus to generate first audio data frame streams in the at least two modulation modes;

a splicing module configured for splicing the first audio data frame streams in the at least two modulation modes into a first audio data stream;

a transceiver module configured for sending the first audio data stream to an electronic signature token via an audio interface of the apparatus, and receiving a second audio data stream sent from the electronic signature token;

an acquiring module configured for demodulating the second audio data stream received to obtain modulation modes correctly received by the apparatus and supported by the electronic signature token, and to obtain modulation modes correctly received by the electronic signature token and supported by the apparatus; and

a selecting module configured for selecting an optimal modulation mode used in the electronic signature token from the modulation modes correctly received by the electronic signature token and supported by the apparatus, and selecting an optimal modulation mode used in the apparatus from the modulation modes correctly received by the apparatus and supported by the

electronic signature token, according to a predetermined rule.

36. The apparatus according to claim 35, wherein the transceiver module is further configured for sending the first audio data stream to the electronic signature token via the audio interface of the apparatus in one transmission and in a same time reference frame.

5 37. The apparatus according to claim 36, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

38. The apparatus according to claim 37, wherein the acquiring module is further configured for:

10 demodulating the second audio data stream, finding a start moment of each modulation waveform according to the predetermined reference moment, demodulating the modulation waveform according to the start moment to obtain the second audio data, determining whether the second audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the apparatus and supported by the electronic signature
15 token.

39. The apparatus according to claim 38, wherein the transceiver module is further configured for sending the first audio data stream to the electronic signature token via the audio interface of the apparatus in one transmission and in different time reference frames.

20 40. The apparatus according to claim 39, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

41. The apparatus according to claim 40, wherein the modulating module is further configured for:

25 modulating the first audio data to be sent into the first audio data frame streams and generating a synchronization header information, and adding the generated synchronization header information to the first audio data frame streams for indicating a start moment of each modulation mode.

42. The apparatus according to claim 40, wherein the acquiring module is further configured for:

30 demodulating the second audio data stream sent from the electronic signature token, finding synchronization headers of the modulation waveforms modulated using the modulation modes

supported by the electronic signature token respectively, acquiring a synchronization information of each modulation waveform, finding a start moment of each modulation waveform according to the synchronization information, demodulating the modulation waveform according to the start moment to obtain the second audio data, determining whether the second audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the apparatus and supported by the electronic signature token.

43. The apparatus according to any one of claims 35 to 42, wherein the first audio data and the second audio data comprise data in a predetermined fixed format and/or transmission data containing variable contents.

44. The apparatus according to any one of claims 35 to 43, wherein the modulating module is further configured for:

modulating third audio data using the optimal modulation mode used in the electronic signature token to generate third audio data frame streams,

in which the third audio data comprise the optimal modulation mode used in the electronic signature token and the optimal modulation mode used in the apparatus, and the transceiver module is further configured for sending the third audio data frame streams to the electronic signature token via the audio interface of the apparatus.

45. The apparatus according to any one of claims 35 to 43, wherein the modulating module is further configured for:

modulating third audio data using the optimal modulation mode used in the electronic signature token to generate third audio data frame streams,

in which the third audio data comprise the optimal modulation mode used in the electronic signature token, the optimal modulation mode used in the apparatus and audio data to be sent, and the transceiver module is further configured for sending the third audio data frame streams to the electronic signature token via the audio interface of the apparatus.

46. The apparatus according to any one of claims 35 to 45, wherein the first audio data frame streams are generated by:

modulating the first audio data to be transmitted into an analog waveform signal using the modulation modes supported by the apparatus to generate the first audio data frame streams.

47. The apparatus according to any one of claims 35 to 46, wherein the first audio data further comprises identifiers of the at least two modulation modes

supported by the apparatus; and

the second audio data further comprises identifiers of the modulation modes obtained and correctly received by the electronic signature token and supported by the apparatus and identifiers of the at least two modulation modes supported by the electronic signature token.

5 48. An electronic signature token, comprising:

a transceiver module configured for receiving a first audio data stream sent from an apparatus for audio communication modulation mode self-adaptation in a mobile terminal, and sending a second audio data stream spliced by a splicing module to the apparatus via an audio interface;

10 an acquiring module configured for demodulating the first audio data stream to obtain modulation modes correctly received by the electronic signature token and supported by the apparatus;

a modulating module configured for modulating second audio data to be sent using at least two modulation modes supported by the electronic signature token to generate second audio data frame streams in the at least two modulation modes, wherein the second audio data comprise the modulation modes correctly received by the electronic signature token and supported by the apparatus; and

the splicing module configured for splicing the second audio data frame streams in the at least two modulation modes into the second audio data stream.

20 49. The electronic signature token according to claim 48, wherein the transceiver module is further configured for:

sending the second audio data stream spliced by the splicing module to the apparatus via the audio interface in one transmission and in a same time reference frame.

25 50. The electronic signature token according to claim 49, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

51. The electronic signature token according to claim 50, wherein the acquiring module is further configured for:

30 demodulating the first audio data stream, finding a start moment of each modulation waveform according to the predetermined reference moment, demodulating the modulation waveform according to the start moment to obtain the first audio data, determining whether the first audio data is correct according to a predetermined rule, and if yes, obtaining the modulation

modes correctly received by the electronic signature token and supported by the apparatus.

52. The electronic signature token according to claim 48, wherein the transceiver module is further configured for:

5 sending the second audio data stream spliced by the splicing module to the apparatus via the audio interface in one transmission and in different time reference frames.

53. The electronic signature token according to claim 52, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

10 54. The electronic signature token according to claim 53, wherein the modulating module is further configured for:

modulating the second audio data to be sent into the second audio data frame streams and generating a synchronization header information, and adding the generated synchronization header information to the second audio data frame streams for indicating a start moment of each modulation mode.

15 55. The electronic signature token according to claim 54, wherein the acquiring module is further configured for:

20 demodulating the first audio data stream sent from the apparatus, finding synchronization headers of the modulation waveforms modulated using the modulation modes supported by the apparatus respectively, acquiring a synchronization information of each modulation waveform, finding a start moment of each modulation waveform according to the synchronization information, demodulating the modulation waveform according to the start moment to obtain the first audio data, determining whether the first audio data is correct according to a predetermined rule, and if yes, obtaining the modulation modes correctly received by the electronic signature token and supported by the apparatus.

25 56. The electronic signature token according to any one of claims 48 to 55, wherein the first audio data and the second audio data comprise data in a predetermined fixed format and/or transmission data containing variable contents.

57. The electronic signature token according to claim 55, wherein the acquiring module is further configured for:

30 obtaining an optimal modulation mode used in the electronic signature token and an optimal modulation mode used in the apparatus according to third audio data frame streams received by the

transceiver module, modulating response audio data using the optimal modulation mode used in the electronic signature token, and sending the modulated response audio data to the apparatus.

58. The electronic signature token according to any one of claims 48 to 57, wherein first audio data frame streams are generated by modulating the first audio data to be transmitted into an analog waveform signal using the modulation modes supported by the apparatus to generate the first audio data frame streams; and

wherein the second audio data frame streams are generated by modulating the second audio data to be transmitted into an analog waveform signal using the modulation modes supported by the electronic signature token to generate the second audio data frame streams.

59. The electronic signature token according to any one of claims 48 to 58, wherein the first audio data further comprises identifiers of the at least two modulation modes supported by the apparatus; and

the second audio data further comprises identifiers of the modulation modes obtained and correctly received by the electronic signature token and supported by the apparatus and identifiers of the at least two modulation modes supported by the electronic signature token.

METHOD, SYSTEM AND APPARATUS FOR AUDIO COMMUNICATION
MODULATION MODE SELF-ADAPTATION AND ELECTRONIC SIGNATURE TOKEN

5 **FIELD**

The present disclosure relates to an electronic technique field, and more particularly to a method for audio communication modulation mode self-adaptation, a system for audio communication modulation mode self-adaptation, an apparatus for audio communication modulation mode self-adaptation in a mobile terminal, and an electronic signature token.

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BACKGROUND

In a current audio data transmission via an audio interface, different mobile terminals have different audio transmission characteristics. In order to be compatible with the audio transmission characteristics of different mobile terminals, an apparatus (such as an electronic signature token) communicating with the mobile terminal needs to try with audio data in different modulation modes automatically so as to find a most suitable modulation mode matched with each of the different mobile terminals.

15 Currently, there are few audio communication means, and consequently no suitable mode can be compatible with the communication between different mobile terminals and different electronic signature tokens.

20 Moreover, since both sides in the communication may not necessarily be fixed and can have their own different audio transmission characteristics, when the demodulation mode and the modulation mode not matched with each other are adopted during the audio data transmission, a data interaction speed may be reduced and it is easy for a distortion to occur in the interactive data.

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SUMMARY

Embodiments of the present disclosure seek to solve at least one of the problems existing in the related art.

Accordingly, a first objective of the present disclosure is to provide a method for audio communication modulation mode self-adaptation, which can determine an audio modulation mode quickly, such that audio data interaction may be performed quickly and the distortion degree of the

What is claimed is:

1. A method for audio communication modulation mode self-adaptation, comprising:

modulating by a first device first audio data to be sent using at least two modulation modes supported by the first device respectively to generate first audio data frame streams in the at least two modulation modes;

splicing by the first device the first audio data frame streams in the at least two modulation modes into a first audio data stream;

sending the first audio data stream to a second device via an audio interface of the first device;

demodulating by the second device the first audio data stream to obtain modulation modes correctly received by the second device and supported by the first device;

modulating by the second device second audio data to be sent using at least two modulation modes supported by the second device to generate second audio data frame streams in the at least two modulation modes, wherein the second audio data comprise the modulation modes correctly received by the second device and supported by the first device;

splicing by the second device the second audio data frame streams in the at least two modulation modes into a second audio data stream, and sending the second audio data stream to the first device via an audio interface of the second device;

demodulating by the first device the second audio data stream to obtain modulation modes correctly received by the first device and supported by the second device and to obtain modulation modes correctly received by the second device and supported by the first device; and

selecting by the first device an optimal modulation mode used in the second device from the modulation modes correctly received by the second device and supported by the first device, and selecting by the first device an optimal modulation mode used in the first device from the modulation modes correctly received by the first device and supported by the second device, according to a predetermined rule.

2. The method according to claim 1, wherein sending the first audio data stream to the second device via the audio interface of the first device comprises sending the first audio data stream to the second device via the audio interface of the first device in one transmission and in a same time reference frame; and

wherein sending the second audio data stream to the first device via the audio interface of the second device comprises sending the second audio data stream to the first device via the audio interface of the second device in one transmission and in a same time reference frame,

preferably, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

3. The method according to claim 2, wherein demodulating by the second device the first audio data stream to obtain the modulation modes correctly received by the second device and supported by the first device comprises:

demodulating by the second device the first audio data stream, finding by the second device a start moment of each modulation waveform according to the predetermined reference moment, demodulating by the second device the modulation waveform according to the start moment to obtain the first audio data, determining by the second device whether the first audio data is correct according to the predetermined rule, and if yes, obtaining by the second device the modulation modes correctly received by the second device and supported by the first device; and/or

wherein demodulating by the first device the second audio data stream to obtain the modulation modes correctly received by the first device and supported by the second device and the modulation modes correctly received by the second device and supported by the first device comprises:

demodulating by the first device the second audio data stream, finding by the first device a start moment of each modulation waveform according to the predetermined reference moment, demodulating by the first device the modulation waveform according to the start moment to obtain the second audio data, determining by the first device whether the second audio data is correct according to the predetermined rule, and if yes, obtaining by the first device the modulation modes correctly received by the first device and supported by the second device.

4. The method according to claim 1, wherein sending the first audio data stream to the second device via the audio interface of the first device comprises sending the first audio data stream to the second device via the audio interface of the first device in one transmission and in different time reference frames; and

wherein sending the second audio data stream to the first device via the audio interface of the second device comprises sending the second audio data stream to the first device via the audio

interface of the second device in one transmission and in different time reference frames,

preferably, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

5 5. The method according to claim 4, wherein generating the first audio data frame streams by the first device comprises modulating by the first device the first audio data to be sent into the first audio data frame streams and generating by the first device a synchronization header information, and adding by the first device the generated synchronization header information to the first audio data frame streams for indicating a start moment of each modulation mode; and

10 wherein generating the second audio data frame streams by the second device comprises modulating by the second device the second audio data to be sent into the second audio data frame streams and generating by the second device a synchronization header information, and adding by the second device the generated synchronization header information to the second audio data frame streams for indicating a start moment of each modulation mode.

15 6. The method according to claim 5, wherein demodulating by the second device the first audio data stream to obtain the modulation modes correctly received by the second device and supported by the first device comprises:

20 demodulating by the second device the first audio data stream sent from the first device, finding by the second device synchronization headers of the modulation waveforms modulated using the modulation modes supported by the first device respectively, acquiring by the second device a synchronization information of each modulation waveform, finding by the second device a start moment of each modulation waveform according to the synchronization information, demodulating by the second device the modulation waveform according to the start moment to obtain the first audio data, determining by the second device whether the first audio data is correct according to the predetermined rule, and if yes, obtaining by the second device the modulation
25 modes correctly received by the second device and supported by the first device; and/or

 wherein demodulating by the first device the second audio data stream to obtain the modulation modes correctly received by the first device and supported by the second device and the modulation modes correctly received by the second device and supported by the first device comprises:

30 demodulating by the first device the second audio data stream sent from the second device, finding by the first device synchronization headers of the modulation waveforms modulated using

the modulation modes supported by the second device respectively, acquiring by the first device a synchronization information of each modulation waveform, finding by the first device a start moment of each modulation waveform according to the synchronization information, demodulating by the first device the modulation waveform according to the start moment to obtain the second audio data, determining by the first device whether the second audio data is correct according to the predetermined rule, and if yes, obtaining by the first device the modulation modes correctly received by the first device and supported by the second device.

7. The method according to any one of claims 1 to 6, further comprising:

modulating by the first device third audio data using the optimal modulation mode used in the second device to generate third audio data frame streams, wherein the third audio data comprise the optimal modulation mode used in the second device and the optimal modulation mode used in the first device, or the third audio data comprise the optimal modulation mode used in the second device and the optimal modulation mode used in the first device and audio data to be sent; and

sending by the first device the third audio data frame streams to the second device via the audio interface of the first device,

preferably, wherein the method further comprises:

obtaining by the second device the optimal modulation mode used in the second device and the optimal modulation mode used in the first device according to the third audio data frame streams, modulating by the second device response audio data using the optimal modulation mode used in the second device, and sending by the second device the modulated response audio data to the first device.

8. The method according to any one of claims 1 to 7, wherein

the first audio data further comprises identifiers of the at least two modulation modes supported by the first device; and

the second audio data further comprises identifiers of the modulation modes obtained and correctly received by the second device and supported by the first device and identifiers of the at least two modulation modes supported by the second device.

9. An apparatus for audio communication modulation mode self-adaptation in a mobile terminal, comprising:

a modulating module configured for modulating first audio data to be sent using at least two modulation modes supported by the apparatus to generate first audio data frame streams in the at

least two modulation modes;

a splicing module configured for splicing the first audio data frame streams in the at least two modulation modes into a first audio data stream;

5 a transceiver module configured for sending the first audio data stream to an electronic signature token via an audio interface of the apparatus, and receiving a second audio data stream sent from the electronic signature token;

10 an acquiring module configured for demodulating the second audio data stream received to obtain modulation modes correctly received by the apparatus and supported by the electronic signature token, and to obtain modulation modes correctly received by the electronic signature token and supported by the apparatus; and

15 a selecting module configured for selecting an optimal modulation mode used in the electronic signature token from the modulation modes correctly received by the electronic signature token and supported by the apparatus, and selecting an optimal modulation mode used in the apparatus from the modulation modes correctly received by the apparatus and supported by the electronic signature token, according to a predetermined rule.

10. The apparatus according to claim 9, wherein the transceiver module is further configured for sending the first audio data stream to the electronic signature token via the audio interface of the apparatus in one transmission and in a same time reference frame,

20 preferably, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

11. The apparatus according to claim 10, wherein the acquiring module is further configured for:

25 demodulating the second audio data stream, finding a start moment of each modulation waveform according to the predetermined reference moment, demodulating the modulation waveform according to the start moment to obtain the second audio data, determining whether the second audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the apparatus and supported by the electronic signature token.

30 12. The apparatus according to claim 9, wherein the transceiver module is further configured for sending the first audio data stream to the electronic signature token via the audio interface of

the apparatus in one transmission and in different time reference frames,

preferably, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

13. The apparatus according to claim 12, wherein the modulating module is further
5 configured for:

modulating the first audio data to be sent into the first audio data frame streams and generating a synchronization header information, and adding the generated synchronization header information to the first audio data frame streams for indicating a start moment of each modulation mode; and/or

10 wherein the acquiring module is further configured for:

demodulating the second audio data stream sent from the electronic signature token, finding synchronization headers of the modulation waveforms modulated using the modulation modes supported by the electronic signature token respectively, acquiring a synchronization information of each modulation waveform, finding a start moment of each modulation waveform according to
15 the synchronization information, demodulating the modulation waveform according to the start moment to obtain the second audio data, determining whether the second audio data is correct according to the predetermined rule, and if yes, obtaining the modulation modes correctly received by the apparatus and supported by the electronic signature token.

14. The apparatus according to any one of claims 9 to 13, wherein the modulating module is
20 further configured for:

modulating third audio data using the optimal modulation mode used in the electronic signature token to generate third audio data frame streams,

in which the third audio data comprise the optimal modulation mode used in the electronic signature token and the optimal modulation mode used in the apparatus, or the third audio data
25 comprise the optimal modulation mode used in the electronic signature token, the optimal modulation mode used in the apparatus and audio data to be sent; and the transceiver module is further configured for sending the third audio data frame streams to the electronic signature token via the audio interface of the apparatus.

15. The apparatus according to any one of claims 9 to 14, wherein

30 the first audio data further comprises identifiers of the at least two modulation modes supported by the apparatus; and

the second audio data further comprises identifiers of the modulation modes obtained and correctly received by the electronic signature token and supported by the apparatus and identifiers of the at least two modulation modes supported by the electronic signature token.

16. An electronic signature token, comprising:

5 a transceiver module configured for receiving a first audio data stream sent from an apparatus for audio communication modulation mode self-adaptation in a mobile terminal, and sending a second audio data stream spliced by a splicing module to the apparatus via an audio interface;

an acquiring module configured for demodulating the first audio data stream to obtain modulation modes correctly received by the electronic signature token and supported by the
10 apparatus;

a modulating module configured for modulating second audio data to be sent using at least two modulation modes supported by the electronic signature token to generate second audio data frame streams in the at least two modulation modes, wherein the second audio data comprise the modulation modes correctly received by the electronic signature token and supported by the
15 apparatus; and

the splicing module configured for splicing the second audio data frame streams in the at least two modulation modes into the second audio data stream.

17. The electronic signature token according to claim 16, wherein the transceiver module is further configured for:

20 sending the second audio data stream spliced by the splicing module to the apparatus via the audio interface in one transmission and in a same time reference frame,

preferably, wherein the same time reference frame means that a length of a start moment and/or an end moment at a time period of each modulation waveform with respect to a predetermined reference moment is predetermined.

25 18. The electronic signature token according to claim 17, wherein the acquiring module is further configured for:

demodulating the first audio data stream, finding a start moment of each modulation waveform according to the predetermined reference moment, demodulating the modulation waveform according to the start moment to obtain the first audio data, determining whether the
30 first audio data is correct according to a predetermined rule, and if yes, obtaining the modulation modes correctly received by the electronic signature token and supported by the apparatus.

19. The electronic signature token according to claim 16, wherein the transceiver module is further configured for:

sending the second audio data stream spliced by the splicing module to the apparatus via the audio interface in one transmission and in different time reference frames,

5 preferably, wherein the different time reference frames mean that a start moment of each modulation waveform is acquired according to a synchronization header information.

20. The electronic signature token according to claim 19, wherein the modulating module is further configured for:

10 modulating the second audio data to be sent into the second audio data frame streams and generating a synchronization header information, and adding the generated synchronization header information to the second audio data frame streams for indicating a start moment of each modulation mode,

preferably, wherein the acquiring module is further configured for:

15 demodulating the first audio data stream sent from the apparatus, finding synchronization headers of the modulation waveforms modulated using the modulation modes supported by the apparatus respectively, acquiring a synchronization information of each modulation waveform, finding a start moment of each modulation waveform according to the synchronization information, demodulating the modulation waveform according to the start moment to obtain the first audio data, determining whether the first audio data is correct according to a predetermined rule, and if
20 yes, obtaining the modulation modes correctly received by the electronic signature token and supported by the apparatus.

21. The electronic signature token according to claim 20, wherein the acquiring module is further configured for:

25 obtaining an optimal modulation mode used in the electronic signature token and an optimal modulation mode used in the apparatus according to third audio data frame streams received by the transceiver module, modulating response audio data using the optimal modulation mode used in the electronic signature token, and sending the modulated response audio data to the apparatus.

22. The electronic signature token according to any one of claims 16 to 21, wherein

30 the first audio data further comprises identifiers of the at least two modulation modes supported by the apparatus; and

the second audio data further comprises identifiers of the modulation modes obtained and

correctly received by the electronic signature token and supported by the apparatus and identifiers of the at least two modulation modes supported by the electronic signature token.

23. A system for audio communication modulation mode self-adaptation, comprising an apparatus for audio communication modulation mode self-adaptation in a mobile terminal
5 according to any one of claims 9 to 15 and an electronic signature token according to any one of claims 16 to 22 connected with each other via the audio interfaces.