Claims

1. A watermark generator for providing a watermark signal as a sequence of subsequent watermark coefficients based on a stream of subsequent stream values representing discrete valued data, the watermark generator comprising:

a differential encoder configured to provide the watermark signal, wherein the differential encoder is configured to apply a phase rotation to a current stream value of the stream values representing the discrete valued data or to a current watermark symbol, the current watermark symbol corresponding to a current stream value of the stream values representing the discrete valued data, to obtain a current watermark coefficient of the watermark signal;

wherein the differential encoder is configured to derive a phase of a previous spectral coefficient of a watermarked signal, which is a combination of a host signal and the watermark signal;

wherein the differential encoder is configured to provide the watermark signal such that a phase angle of the phase rotation applied to the current stream value or the current watermark symbol is dependent on the phase of the previous spectral coefficient of the watermarked signal; and

wherein the host signal is an audio signal, an image signal or a video signal, and the watermarked signal is an audio signal, an image signal or a video signal.

2. The watermark generator according to claim 1,

wherein the watermark generator comprises an information processor;

wherein the information processor is configured to provide the stream representing the discrete valued data in a time frequency domain, such that each stream value of the stream is associated to a frequency subchannel and a time slot; and

wherein the differential encoder is configured to obtain the current watermark coefficient in the time frequency domain, such that a frequency subchannel associated to the current watermark coefficient is identical to a frequency subchannel associated to the current stream value and such that a time slot associated to the current watermark coefficient is identical to a time slot associated to the current stream value.

3. The watermark generator according to claim 2,

wherein the differential encoder is configured to derive spectral coefficients of the watermarked signal in a time frequency domain, such that each spectral coefficient of the watermarked signal is associated to a frequency subchannel and a time slot, and

wherein the differential encoder is configured to determine the phase rotation, such that a time slot associated to the previous spectral coefficient of the watermarked signal, in dependence on which the phase angle of the phase rotation applied to the current stream value or the current watermark symbol is chosen, and the time slot associated to the current stream value are adjacent in time.

4. The watermark generator according to claim 3,

wherein the differential encoder is configured such that a frequency subchannel associated to the previous spectral coefficient of the watermarked signal and the frequency subchannel associated to the current stream value are identical.

5. The watermark generator according to one of the claims 1 to 4,

wherein the differential encoder is configured to additionally scale the current stream value or the current watermark symbol by a current scaling factor or by a current factor which is smaller than the current scaling factor; and

wherein the current scaling factor is provided by a psychoacoustical processing module in dependence on a host signal into which the watermark signal is to be embedded, and such that the current scaling factor describes a masking characteristic of the host signal.

6. The watermark generator according to claim 5,

wherein the differential encoder is configured to scale the current stream value or the current watermark symbol by the current scaling factor to adjust an amplitude of the current watermark coefficient such that a watermark is inaudible in a watermarked signal determined by a combination of the host signal and the watermark signal.

7. The watermark generator according to one of the claims 1 to 6,

wherein the differential encoder comprises a subconstellation selector configured to selectively provide a plurality of current watermark symbols which constitute a subconstellation in dependence on the current stream value,

wherein the differential encoder is configured to apply the phase rotation to each of the current watermark symbols of the subconstellation corresponding to the current stream value or to a scaled version thereof, to obtain a plurality of current candidate watermark coefficients ; and

wherein the differential encoder comprises a decider configured to choose one out of the current candidate watermark coefficients as the current watermark coefficient.

8. The watermark generator according to claim 7,

wherein the decider is configured to derive a plurality of current candidate watermarked spectral coefficients based on combinations of a current spectral coefficient of the host signal with the plurality of candidate watermark coefficients to determine the current candidate watermarked spectral coefficient with the highest power out of the plurality of current candidate watermarked spectral coefficients, to choose the current candidate watermark coefficient corresponding to the current candidate watermarked spectral coefficient having the highest power as the current watermark coefficient.

9. The watermark generator according to one of the claims 7 to 8,

wherein the subconstellation selector is configured to provide the plurality of current watermark symbols as complex values such that different current watermark symbols only differ in phase and such that phase differences of different adjacent current watermark symbols associated with the same current stream value are equal.

10. The watermark generator according to one of the claims 1 to 9,

further comprising a modulator configured to derive the watermark signal in a time domain based on the subsequent watermark coefficients.

11. A watermark decoder for providing discrete valued data in dependence on a watermarked signal, the watermark decoder comprising:

an information processor to provide a stream of complex valued spectral coefficients, the stream representing the watermarked signal; and

a differential decoder configured to determine a phase angle difference between a previous complex valued spectral coefficient and a current complex valued spectral coefficient,

configured to map phase angle differences within at least two different phase angle ranges to a first discrete value of the discrete-valued data and to map phase angle differences within at least another two different

phase angle ranges to a second discrete value of the discrete valued data;

wherein the differential decoder is configured to distinguish at least between four different phase angle ranges, and

wherein the differential decoder is configured to map adjacent phase angle ranges to different discrete values of the discrete-valued data; and

wherein the watermarked signal is an audio signal, an image signal or a video signal.

12. The watermark decoder according to claim 11,

wherein the information processor is configured to provide the stream of complex spectral coefficients in a time-frequency-domain such that each complex spectral coefficient is associated to one frequency subchannel and one time slot; and

wherein the differential decoder is configured such that the previous complex spectral coefficient and the current complex spectral coefficient are associated to adjacent time slots and the same frequency subchannel.

13. A method for providing a watermark signal as a sequence of subsequent watermark coefficients based on discrete-valued data, the method comprising:

Providing, in dependence on information units of the discrete-valued data, a stream of subsequent stream values such that the stream represents the discrete- valued data;

Applying a phase rotation to a current stream value of the stream values representing the discrete valued data or to a current watermark symbol, the current watermark symbol corresponding to a current stream value of the stream values representing the discrete valued data, to obtain a current watermark coefficient of the watermark signal;

Deriving a phase of a previous spectral coefficient of a watermarked signal which is a combination of a host signal and the watermark signal; and

Providing the watermark signal such that a phase angle of the phase rotation applied to the current stream value or to the current watermark symbol is dependent on the phase of the previous spectral coefficient of the watermarked signal;

wherein the host signal is an audio signal, an image signal or a video signal, and the watermarked signal is an audio signal, an image signal or a video signal.

14. A method for providing discrete-valued data in dependence on a watermarked signal, the method comprising:

Providing a stream of complex-valued spectral coefficients, the stream representing the watermarked signal;

Determining a phase angle difference between a previous complex valued spectral coefficient and a current complex-valued spectral coefficient;

Mapping phase angle differences within at least two different phase angle ranges to a first discrete value of the discrete-valued data and mapping phase angle differences within at least another two different phase angle ranges to a second discrete value of the discrete valued data;

wherein adjacent phase angle ranges are mapped to different discrete values of the discrete-valued data; and

wherein the watermarked signal is an audio signal, an image signal or a video signal.

15. A computer program for performing the method according to claim 13 or 14, when the computer program runs on a computer.

1. A watermark generator for providing a watermark signal as a sequence of subsequent watermark coefficients based on a stream of subsequent stream values representing discrete valued data, the watermark generator comprising:

a differential encoder configured to provide the watermark signal, wherein the differential encoder is configured to apply a phase rotation to a current stream value of the stream values representing the discrete valued data or to a current watermark symbol, the current watermark symbol corresponding to a current stream value of the stream values representing the discrete valued data, to obtain a current watermark coefficient of the watermark signal; wherein the differential encoder is configured to derive a phase of a previous spectral coefficient of a watermarked signal which is a combination of a host signal and the watermark signal;

wherein the differential encoder is configured to provide the watermark signal such that a phase angle of the phase rotation applied to the current stream value or the current watermark symbol is dependent on the phase of the previous spectral coefficient of the watermarked signal; and

wherein the host signal is an audio signal, an image signal or a video signal, and the watermarked signal is an audio signal, an image signal or a video signal.

2. The watermark generator according to claim 1,

wherein the watermark generator comprises an information processor;

wherein the information processor is configured to provide the stream representing the discrete valued data in a time frequency domain, such that each stream value of the stream is associated to a frequency subchannel and a time slot; and

wherein the differential encoder is configured to obtain the current watermark coefficient in the time frequency domain, such that a frequency subchannel associated to the current watermark coefficient is identical to a frequency subchannel associated to the current stream value and such that a time slot associated to the current watermark coefficient is identical to a time slot associated to the current stream value.

3. The watermark generator according to claim 2,

wherein the differential encoder is configured to derive spectral coefficients of the watermarked signal in a time frequency domain, such that each spectral coefficient of the watermarked signal is associated to a frequency subchannel and a time slot, and

wherein the differential encoder is configured to determine the phase rotation, such that a time slot associated to the previous spectral coefficient of the watermarked signal, in dependence on which the phase angle of the phase rotation applied to the current stream value or the

current watermark symbol is chosen, and the time slot associated to the current stream value are adjacent in time.

4. The watermark generator according to claim 3,
wherein the differential encoder is configured such that a frequency subchannel associated to the previous spectral coefficient of the watermarked signal and the frequency subchannel associated to the current stream value are identical.

5. The watermark generator according to one of the claims 1 to 4,
wherein the differential encoder is configured to additionally scale the current stream value or the current watermark symbol by a current scaling factor or by a current factor which is smaller than the current scaling factor; and
wherein the current scaling factor is provided by a psychoacoustical processing module in dependence on a host signal into which the watermark signal is to be embedded, and such that the current scaling factor describes a masking characteristic of the host signal.

6. The watermark generator according to claim 5,
wherein the differential encoder is configured to scale the current stream value or the current watermark symbol by the current scaling factor to adjust an amplitude of the current watermark coefficient such that a watermark is inaudible in a watermarked signal determined by a combination of the host signal and the watermark signal.

7. The watermark generator according to one of the claims 1 to 6,
wherein the differential encoder comprises a subconstellation selector configured to selectively provide a plurality of current watermark symbols which constitute a subconstellation in dependence on the current stream value,
wherein the differential encoder is configured to apply the phase rotation to each of the current watermark symbols of the subconstellation corresponding to the current stream value or to a scaled version thereof, to obtain a plurality of current candidate watermark coefficients; and
wherein the differential encoder comprises a decider configured to choose one out of the current candidate watermark coefficients as the current watermark coefficient.

8. The watermark generator according to claim 7,
wherein the decider is configured to derive a plurality of current candidate watermarked spectral coefficients based on combinations of a current spectral coefficient of the host signal

with the plurality of candidate watermark coefficients to determine the current candidate watermarked spectral coefficient with the highest power out of the plurality of current candidate watermarked spectral coefficients, to choose the current candidate watermark coefficient corresponding to the current candidate watermarked spectral coefficient having the highest power as the current watermark coefficient.

9. The watermark generator according to one of the claims 7 to 8,
wherein the subconstellation selector is configured to provide the plurality of current watermark symbols as complex values such that different current watermark symbols only differ in phase and such that phase differences of different adjacent current watermark symbols associated with the same current stream value are equal.

10. The watermark generator according to one of the claims 1 to 9,
further comprising a modulator configured to derive the watermark signal in a time domain based on the subsequent watermark coefficients.

11. A watermark decoder for providing discrete valued data in dependence on a watermarked signal, the watermark decoder comprising:
an information processor to provide a stream of complex valued spectral coefficients, the stream representing the watermarked signal; and
a differential decoder configured to determine a phase angle difference between a previous complex valued spectral coefficient and a current complex valued spectral coefficient, configured to map phase angle differences within at least two different phase angle ranges to a first discrete value of the discrete-valued data and to map phase angle differences within at least another two different phase angle ranges to a second discrete value of the discrete valued data;
wherein the differential decoder is configured to distinguish at least between four different phase angle ranges, and
wherein the differential decoder is configured to map adjacent phase angle ranges to different discrete values of the discrete-valued data; and
wherein the watermarked signal is an audio signal, an image signal or a video signal.

12. The watermark decoder according to claim 11,
wherein the information processor is configured to provide the stream of complex spectral coefficients in a time-frequency-domain such that each complex spectral coefficient is associated to one frequency subchannel and one time slot; and

wherein the differential decoder is configured such that the previous complex spectral coefficient and the current complex spectral coefficient are associated to adjacent time slots and the same frequency subchannel.

13. A method for providing a watermark signal as a sequence of subsequent watermark coefficients based on discrete-valued data, the method comprising:

Providing, in dependence on information units of the discrete-valued data, a stream of subsequent stream values such that the stream represents the discrete-valued data;

Applying a phase rotation to a current stream value of the stream values representing the discrete valued data or to a current watermark symbol, the current watermark symbol corresponding to a current stream value of the stream values representing the discrete valued data, to obtain a current watermark coefficient of the watermark signal;

Deriving a phase of a previous spectral coefficient of a watermarked signal which is a combination of a host signal and the watermark signal; and

Providing the watermark signal such that a phase angle of the phase rotation applied to the current stream value or to the current watermark symbol is dependent on the phase of the previous spectral coefficient of the watermarked signal;

wherein the host signal is an audio signal, an image signal or a video signal, and the watermarked signal is an audio signal, an image signal or a video signal.

14. A method for providing discrete-valued data in dependence on a watermarked signal, the method comprising:

Providing a stream of complex-valued spectral coefficients, the stream representing the watermarked signal;

Determining a phase angle difference between a previous complex valued spectral coefficient and a current complex-valued spectral coefficient;

Mapping phase angle differences within at least two different phase angle ranges to a first discrete value of the discrete-valued data and mapping phase angle differences within at least another two different phase angle ranges to a second discrete value of the discrete valued data;

wherein adjacent phase angle ranges are mapped to different discrete values of the discrete-valued data; and wherein the watermarked signal is an audio signal, an image signal or a video signal.

15. A computer program for performing the method according to claim 13 or 14, when the computer program runs on a computer.