Claims

1. Information encoder for encoding an information signal ~~(IS)~~, the information encoder ~~(1)~~ comprising:

an analyzer ~~(2)~~ for analyzing the information signal ~~(IS)~~ in order to obtain linear prediction coefficients of a predictive polynomial A(z);

a converter ~~(3)~~ for converting the linear prediction coefficients of the predictive polynomial A(z) to frequency values $f_1 \ldots f_n$ of a spectral frequency representation of the predictive polynomial A(z), wherein the converter ~~(3)~~ is configured to determine the frequency values $f_1 \ldots f_n$ by analyzing a pair of polynomials P(z) and Q(z) being defined as

$$P(z) = A(z) + z^{-m-l} A(z^{-1}) \text{ and}$$

$$Q(z) = A(z) - z^{-m-l} A(z^{-1}),$$

wherein m is an order of the predictive polynomial A(z) and l is greater or equal to zero, wherein the converter ~~(3)~~ is configured to obtain the frequency values ~~($f_1 \ldots f_n$)~~ by establishing a strictly real spectrum ~~(RES)~~ derived from P(z) and a strictly imaginary spectrum ~~(IES)~~ from Q(z) and by identifying zeros of the strictly real spectrum ~~(RES)~~ derived from P(z) and the strictly imaginary spectrum ~~(IES)~~ derived from Q(z), wherein the converter ~~(3)~~ comprises a limiting device ~~(11)~~ for limiting the numerical range of the spectra ~~(RES, IES)~~ of the polynomials P(z) and Q(z) by multiplying the polynomials P(z) and Q(z) or one or more polynomials derived from the polynomials P(z) and Q(z) with a filter polynomial B(z), wherein the filter polynomial B(z) is symmetric and does not have any roots on a unit circle;

a quantizer ~~(4)~~ for obtaining quantized frequency ~~($f_{q1} \ldots f_{qn}$)~~ values from the frequency values ~~($f_1 \ldots f_n$)~~; and

a bitstream producer (5) for producing a bitstream comprising the quantized frequency values (f_{q1}...f_{qn}).

2. Information encoder according to the preceding claim, wherein the converter (3) comprises a determining device (6) to determine the polynomials P(z) and Q(z) from the predictive polynomial A(z).

3. Information encoder according to one of the preceding claims, wherein the converter (3) comprises a zero identifier (9) for identifying the zeros of the strictly real spectrum (RES) derived from P(z) and the strictly imaginary spectrum (IES) derived from Q(z).

4. Information encoder according to the preceding claim, wherein the zero identifier (9) is configured for identifying the zeros by

a) starting with the real spectrum (RES) at null frequency;

b) increasing frequency until a change of sign at the real spectrum (RES) is found;

c) increasing frequency until a further change of sign at the imaginary spectrum (IES) is found; and

d) repeating steps b) and c) until all zeros are found.

5. Information encoder according to claim 3 or claim 4, wherein the zero identifier is configured for identifying the zeros by interpolation.

6. Information encoder according to one of the preceding claims, wherein the converter (3) comprises a zero-padding device (10) for adding one or more coefficients having a value "0" to the polynomials P(z) and Q(z) so as to produce a pair of elongated polynomials $P_e(z)$ and $Q_e(z)$.

7. Information encoder according to claim 5 or claim 6, wherein the converter (3) is configured in such way that during converting the linear prediction coefficients to frequency values ($f_1 \ldots f_n$) of the spectral frequency representation (RES, IES) of the predictive polynomial A(z) at least a part of operations with coefficients known to be have the value "0" of the elongated polynomials $P_e(z)$ and $Q_e(z)$ are omitted.

8. Information encoder according to one of the claims 5 to 7, wherein the converter (3) comprises a composite polynomial former (13) configured to establish a composite polynomial $C_e(P_e(z), Q_e(z))$ from the elongated polynomials $P_e(z)$ and $Q_e(z)$.

9. Information encoder according to the preceding claim, wherein the converter (3) is configured in such way that the strictly real spectrum (RES) derived from P(z) and the strictly imaginary spectrum (IES) from Q(z) are established by a single Fourier transform by transforming the composite polynomial $C_e(P_e(z), Q_e(z))$.

10. Information encoder according to one of the preceding claims, wherein the converter (3) comprises a Fourier transform device (8) for Fourier transforming the pair of polynomials P(z) and Q(z) or one or more polynomials derived from the pair of polynomials P(z) and Q(z) into a frequency domain and an adjustment device (7, 12) for adjusting a phase of the spectrum (RES) derived from P(z) so that it is strictly real and for adjusting a phase of the spectrum (IES) derived from Q(z) so that it is strictly imaginary.

11. Information encoder according to the preceding claim, wherein the adjustment device (7, 12) is configured as a coefficient shifter (7) for circular shifting of coefficients of the pair of polynomials P(z) and Q(z) or the one or more polynomials derived from the pair of polynomials P(z) and Q(z).

12. Information encoder according to the preceding claim, wherein the coefficient shifter (7) is configured for circular shifting of coefficients in such way that an original midpoint of a sequence of coefficients is shifted to the first position of the sequence.

13. Information encoder according to claim 10, wherein the adjustment device (7, 12) is configured as a phase shifter (12) for shifting a phase of the output of the Fourier transform device (8).

14. Information encoder according to the preceding claim, wherein the phase shifter (12) is configured for shifting the phase of the output of the Fourier transform device (8) by multiplying a k-th frequency bin with $\exp(i2\pi kh/N)$, wherein N is the length of the sample and $h = (m+l)/2$.

15. Information encoder according to one of the claims 1 to 9, wherein the converter (3) comprises a Fourier transform device (14) for Fourier transforming the pair of polynomials P(z) and Q(z) or one or more polynomials derived from the pair of polynomials P(z) and Q(z) into a frequency domain with half samples so that the spectrum (RES) derived from P(z) is strictly real and so that the spectrum (IES) derived from Q(z) is strictly imaginary.

16. Information encoder according to one of the preceding claims, wherein the converter (3) comprises a composite polynomial former (13) configured to establish a composite polynomial C(P(z), Q(z)) from the polynomials P(z) and Q(z).

17. Information encoder according to the preceding claim, wherein the converter (3) is configured in such way that the strictly real spectrum (RES) derived from P(z) and the strictly imaginary spectrum (IES) from Q(z) are

established by a single Fourier transform by transforming the composite polynomial C(P(z), Q(z)).

18. Information encoder according to one of the claims 6 to 18, wherein the converter ~~(3)~~ comprises a limiting device ~~(11)~~ for limiting the numerical range of the spectra ~~(RES, IES)~~ of the elongated polynomials $P_e(z)$ and $Q_e(z)$ or one or more polynomials derived from the elongated polynomials $P_e(z)$ and $Q_e(z)$ by multiplying the elongated polynomials $P_e(z)$ and $Q_e(z)$ with a filter polynomial B(z), wherein the filter polynomial B(z) is symmetric and does not have any roots on a unit circle.

19. Method for operating an information encoder ~~(1)~~ for encoding an information signal ~~(IS)~~, the method comprises the steps of:

analyzing the information signal ~~(IS)~~ in order to obtain linear prediction coefficients of a predictive polynomial A(z);

converting the linear prediction coefficients of the predictive polynomial A(z) to frequency values ~~(f_1...f_n)~~ of a spectral frequency representation ~~(RES, IES)~~ of the predictive polynomial A(z), wherein the frequency values ~~(f_1...f_n)~~ are determined by analyzing a pair of polynomials P(z) and Q(z) being defined as

$$P(z) = A(z) + z^{-m-l} A(z^{-1}) \text{ and}$$

$$Q(z) = A(z) - z^{-m-l} A(z^{-1}),$$

wherein m is an order of the predictive polynomial A(z) and l is greater or equal to zero, wherein the frequency values ~~(f_1...f_n)~~ are obtained by establishing a strictly real spectrum ~~(RES)~~ derived from P(z) and a strictly imaginary spectrum ~~(IES)~~ from Q(z) and by identifying zeros of the strictly real spectrum ~~(RES)~~ derived from P(z) and the strictly imaginary spectrum ~~(IES)~~ derived from Q(z);

limiting the numerical range of the spectra (RES, IES) of the polynomials P(z) and Q(z) by multiplying the polynomials P(z) and Q(z) or one or more polynomials derived from the polynomials P(z) and Q(z) with a filter polynomial B(z), wherein the filter polynomial B(z) is symmetric and does not have any roots on a unit circle;

obtaining quantized frequency ($f_{q1}...f_{qn}$) values from the frequency values ($f_1...f_n$); and

producing a bitstream (BS) comprising the quantized frequency values ($f_{q1}...f_{qn}$).

20. Computer program for, when running on a processor, executing the method according to the preceding claim.