Claims

1. A communication system, comprising: a transmitter configured to transmit a continuous-time signal, comprising: a modulator configured to modulate a plurality of information bits to obtain a discrete-time baseband signal, where the plurality of information bits are encoded in a plurality of zeros of the z-transform of the discrete-time baseband signal and at least one of the zeros has a radius that is not equal to one; and a signal generator configured to generate the continuous-time signal based upon the discrete-time baseband signal; a receiver, comprising: a demodulator configured to sample a received continuous-time signal at a given sampling rate; a decoder configured to decode a plurality of decoded information bits from the samples of the received signal by: determining a plurality of zeros of a z-transform of a received discrete-time baseband signal based upon samples from the received continuous-time signal; identifying zeros from the plurality of zeros that encode information bits including at least one zero that has a radius that is not equal to one; and outputting the plurality of decoded information bits based upon the identified zeros.

2. The communication system of claim 1, wherein the plurality of zeros of the z-transform of the received discrete-time baseband signal comprises a plurality of zeros that encode information bits and at least one zero introduced by multipath propagation of the transmitted signal.

3. The communication system of claim 1, wherein the z-transform of the discrete-time baseband signal comprises a zero for each of a plurality of encoded bits.

4. The communication system of claim 3, wherein each zero in the z-transform of the discrete-time baseband signal is limited to being one of a set of conjugate-reciprocal pairs of zeros.

5. The communication system of claim 4, wherein: each conjugate reciprocal pair of zeros in the set of conjugate-reciprocal pairs of zeros comprises: an outer zero having a first radius that is greater than one; an inner zero having a radius that is the reciprocal of the first radius; and where the inner and outer zero have phases that are the same phase; the radii of the outer zeros in each pair of zeros in the set of conjugate-reciprocal pairs of zeros are the same; and the phases of the outer zeros in each pair of zeros in the set of conjugate-reciprocal pairs of zeros are evenly spaced over one complete revolution.

6. The communication system of claim 4, wherein the discrete-time baseband signal is a Huffman sequence.

7. The communication system of claim 1, wherein at least one of the zeros of the z-transform of the discrete-time baseband signal encodes a plurality of information bits.

8. The communication system of claim 7, wherein the at least one zero in the z-transform of the discrete-time baseband signal that encodes a plurality of information bits is limited to being a zero from a set of more than two zeros.

9. The communication system of claim 7, wherein the at least one zero in the z-transform of the discrete-time baseband signal that encodes a plurality of encoded bits is limited to being a zero from a set of multiple conjugate-reciprocal pairs of zeros.

10. The communication system of claim 9, wherein each conjugate-reciprocal pair of zeros in the set of multiple conjugate-reciprocal pairs of zeros have phases that are distinct from the other conjugate-reciprocal pair of zeros in the set of multiple conjugate-reciprocal pairs of zeros.

11. The communication system of claim 9, where each zero in the set of multiple conjugate-reciprocal pairs of zeros have the same phase.

12. The communication system of claim 11, wherein the decoder determines the most likely set of zeros for the z-transform of the discrete-time baseband signal used to generate the transmitted signal using an autocorrelation codebook.

13. The communication system of claim 12, wherein the decoder performs the weighted comparison using an inverse discrete Fourier transform of delayed and weighted samples of the received continuous-time signal.

14. The communication system of claim 1, wherein the decoder is configured to determine the most likely set of zeros for the z-transform of the discrete-time baseband signal used to generate the transmitted signal based upon the samples of the received continuous-time signal.

15. The communication system of claim 1, wherein the decoder determines the decoded information bits by performing a weighted comparison of samples of the z-transform of the received discrete-time baseband signal with each zero in a set of zeros.

16. The communication system of claim 15, wherein each zero in the z-transform of the discrete-time baseband signal used to generate the transmitted signal is limited to being one of a set of conjugate-reciprocal pairs of zeros.

17. The communication system of claim 16, wherein the decoder is configured to separate zeros of the received signal that encode information bits and zeros of the received signal introduced by multipath propagation of the transmitted signal by selecting a predetermined number of the zeros of the received signal based upon the distance between each zero in the received signal and a corresponding closest zero in the set of possible zeros.

18. The communication system of claim 15, wherein each zero in the z-transform of the discrete-time baseband signal used to generate the transmitted signal is limited to being one of a conjugate-reciprocal pairs of zeros.

19. The communication system of claim 1, wherein the decoder is configured to determine zeros

that encode information bits by identifying zeros from a set of possible zeros that are closest to the zeros of the received signal determined based upon a given distance measure.

20. The communication system of claim 19, wherein the transmitter and receiver are configured to transition to communicating using a non-blind communication scheme, wherein the non-blind communication scheme is configured based upon the estimated channel characteristics.

21. The communication system of claim 1, wherein the receiver is configured to estimate characteristics of a channel over which the received continuous-time signal was transmitted.

22. The communication system of claim 1, wherein the receiver comprises a plurality of receive antennas and the decoder determines the decoded information bits based upon a plurality of continuous-time signals received by the plurality of receive antennas.

23. The communication system of claim 1, wherein the continuous-time time transmitted signal comprises a carrier frequency modulated based upon the discrete-time baseband signal.

24. The communication system of claim 1, wherein the demodulator comprises an analog to digital converter.

25. The communication system of claim 1, wherein the plurality of information bits are encoded so that at least one pole is located at the origin.

26. A communication device, comprising: a modulator configured to modulate a plurality of information bits to obtain a discrete-time baseband signal, where the plurality of information bits are encoded in a plurality of zeros of the z-transform of the discrete-time baseband signal and at least one of the zeros has a radius that is not equal to one; and a signal generator configured to generate a continuous-time signal based upon the discrete-time baseband signal; and a transmitter configured to transmit the continuous-time signal.

27. The communication system of claim 26, wherein the continuous-time transmitted signal comprises a carrier frequency modulated signal based upon the discrete-time baseband signal.

28. The communication device of claim 26, wherein the plurality of information bits are encoded so that at least one pole is located at the origin.

29. A receiver, comprising: a demodulator comprising an analog to digital converter configured to sample a continuous-time received signal; a decoder configured to decode a plurality of bits of information based upon the samples of the continuous-time received signal by: determining a plurality of zeros of a z-transform of a received discrete-time baseband signal based upon samples from the received continuous-time signal; identifying zeros from the plurality of zeros that encode the plurality of information bits including at least one zero that has a radius that is

not equal to one; and outputting a plurality of decoded information bits based upon the identified zeros.