

CLAIMS

1. A method of wireless communications, comprising:
generating a codeword by encoding information bits, using a multi-dimensional interpretation of a polar code of length N ;
determining, based on one or more criteria, a plurality of locations within the codeword to insert error correction codes;
generating the error correction codes based on corresponding portions of the information bits;
inserting the error correction codes at the determined plurality of locations;
transmitting the codeword.
2. The method of claim 1, wherein the one or more criteria comprise on at least one of:
locations of certain row-wise block codes within the codeword wherein the row-wise block codes comprise rate one block codes; or
a statistical analysis of when a correct decoding path falls off a decoding list.
3. The method of claim 2, wherein the statistical analysis of when a correct decoding path falls off the decoding list comprises an analysis of one or more decoding parameters.
4. The method of claim 1, further comprising
encoding the information bits using a first polar code of length K to obtain bits for transmission via K channels; and
further encoding the bits in each of the K channels using a second polar code of length M , wherein $N = K \times M$.
5. The method of claim 4, further comprising inserting error correction codes selectively generated for at least one of:
bits of one or more the K channels encoded with the second polar code, wherein the second polar code is rate less than 1; or
bits of one or more the K channels encoded with the second polar code, wherein the second polar code is rate 1.

6. The method of claim 1, further comprising generating error correction codes with comprise cyclic redundancy check (CRC) values generated from preset subsets of the information bits, wherein each subset has a same number of information bits.
7. The method of claim 1, further comprising inserting into the codeword one or more codes indicating how to decode portions of the codeword, wherein the one or more codes comprise at least one of a single parity check (SPC) code, a repetition code, or a rate zero code.
8. A method of wireless communications, comprising:
 - receiving a codeword generated by encoding information bits using a multi-dimensional interpretation of a polar code of length N;
 - decoding portions of the codeword using the multi-dimensional interpretation of the polar code; and
 - verifying the decoded portions of the codeword based on error correction codes inserted, based on one or more criteria, at a plurality of locations in the codeword.
9. The method of claim 8, wherein the one or more criteria comprise at least one of:
 - locations of certain row-wise block codes within the codeword, wherein the row-wise block codes comprise rate one block codes; or
 - a statistical analysis of when a correct decoding path falls off a decoding list.
10. The method of claim 8, wherein the codeword comprises:
 - information bits encoded using a first polar code of length K to obtain bits for transmission via K channels; and
 - bits in each of the K channels further encoded using a second polar code of length M, wherein $N = K \times M$.
11. The method of claim 8, wherein the decoding comprises:
 - decoding bits of the K channels encoded with the second polar code that is rate less than 1 using a first decoding approach, wherein the first decoding approach comprises performing successive cancelation (SC) list decoding; and

decoding bits of the K channels encoded with the second polar code that is rate 1 using a second decoding approach, wherein the second decoding approach involves taking hard decisions.

12. The method of claim 11, further comprising:
replicating at least a portion of the received codeword; and
using the replicated portion of the codeword to reduce latency of the SC list decoding.
13. The method of claim 8, wherein the error correction codes comprise cyclic redundancy check (CRC) values generated from preset subsets of the information bits, and wherein each subset has a same number of information bits.
14. The method of claim 13, wherein decoding the codeword comprises:
performing row-wise list-decoding of bits based on the CRC values; and
performing SC list decoding along columns after the row-wise decoding.
15. The method of claim 8, wherein decoding comprises:
determining, from the codeword, one or more codes indicating how to decode the portions of the codeword, wherein the one or more codes comprise at least one of a single parity check (SPC) code, a repetition code, or a rate zero code; and
decoding the portions of the codeword based on the one or more codes.
16. An apparatus for wireless communications, comprising:
at least one processor configured to:
generate a codeword by encoding information bits, using a multi-dimensional interpretation of a polar code of length N;
determine, based on one or more criteria, a plurality of locations within the codeword to insert error correction codes;
generate each of the error correction codes based on corresponding portions of the information bits; and
insert the error correction codes at the determined plurality of locations;
and
a transmitter configured to transmit the codeword.

17. The apparatus of claim 16, wherein the one or more criteria comprise on at least one of:
- locations of certain row-wise block codes within the codeword, wherein the row-wise block codes comprise rate one block codes; or
 - a statistical analysis of when a correct decoding path falls off a decoding list.
18. The apparatus of claim 17, wherein the statistical analysis of when a correct decoding path falls off the decoding list comprises an analysis of one or more decoding parameters.
19. The apparatus of claim 16, wherein the at least one processor is configured to generate the codeword by:
- encoding the information bits using a first polar code of length K to obtain bits for transmission via K channels; and
 - further encoding the bits in each of the K channels using a second polar code of length M , wherein $N = K \times M$.
20. The apparatus of claim 19, wherein the at least one processor is configured to insert the error correction codes by inserting error correction codes selectively generated for at least one of:
- bits of one or more the channels encoded with the second polar code that is rate less than 1; or
 - bits of one or more the channels encoded with the second polar code that is rate 1.
21. The apparatus of claim 16, wherein:
- the error correction codes comprise cyclic redundancy check (CRC) values generated from preset subsets of the information bits; and
 - each subset has a same number of information bits.
22. The apparatus of claim 16, wherein the at least one processor is configured to generate the codeword by:

inserting into the codeword one or more codes indicating how to decode portions of the codeword, wherein the one or more codes comprise at least one of a single parity check (SPC) code, a repetition code, or a rate zero code.

23. An apparatus for wireless communications, comprising:
 - a receiver configured to receive a codeword generated by encoding information bits using a multi-dimensional interpretation of a polar code of length N ;
 - at least one processor configured to:
 - decoding portions of the codeword using the multi-dimensional interpretation of the polar code; and
 - verifying the decoded portions of the codeword based on error correction codes inserted, based on one or more criteria, at a plurality of locations in the codeword; and
 - a memory coupled with the at least one processor.
24. The apparatus of claim 23, wherein the one or more criteria comprise at least one of:
 - locations of certain row-wise block codes within the codeword, wherein the row-wise block codes comprise rate one block codes; or
 - a statistical analysis of when a correct decoding path falls off a decoding list.
25. The apparatus of claim 23, wherein the codeword comprises:
 - information bits encoded using a first polar code of length K to obtain bits for transmission via K channels; and
 - bits in each of the K channels further encoded using a second polar code of length M , wherein $N = K \times M$.
26. The apparatus of claim 25, wherein the at least one processor is configured to decode the codeword by:
 - decoding bits of the K channels encoded with the second polar code that is rate less than 1 using a first decoding approach, wherein the first decoding approach comprises performing successive cancelation (SC) list decoding; and

decoding bits of the K channels encoded with a second polar code that is rate 1 using a second decoding approach, wherein the second decoding approach involves taking hard decisions.

27. The apparatus of claim 23, wherein the error correction codes comprise cyclic redundancy check (CRC) values generated from preset subsets of the information bits, wherein each subset has a same number of information bits.

28. The apparatus of claim 27, wherein the at least one processor is configured to decode the codeword by:

performing row-wise list-decoding of bits based on the CRC values; and

performing SC list decoding along columns after the row-wise decoding,

wherein the SC list decoding is performed in parallel for the columns.

29. The apparatus of claim 28, wherein the at least one processor is further configured to:

replicate at least a portion of the received codeword; and

use the replicated portion of the codeword to reduce latency of the SC list

decoding.

30. The apparatus of claim 23, wherein the at least one processor is configured to decode the codeword by:

determining, from the codeword, one or more codes indicating how to decode the portions of the codeword; and

decoding the portions of the codeword based on the one or more codes, wherein the one or more codes comprise at least one of a single parity check (SPC) code, a repetition code, or a rate zero code.