WHAT IS CLAIMED IS:

1. A method for generating a codebook of a plurality of codebooks, the method comprising:

applying, by a designing device, a unitary rotation to a baseline multidimensional constellation to produce a multidimensional mother constellation, wherein the unitary rotation is selected to optimize a distance function of the multidimensional mother constellation;

applying, by the designing device, a set of operations to the multidimensional mother constellation to produce a set of constellation points; and

storing, by the designing device, the set of constellation points as the codebook of the plurality of codebooks.

2. The method of claim 1, wherein the distance function comprises a minimum product distance of the multidimensional mother constellation, and wherein the unitary rotation is selected to maximize the minimum product distance of the multidimensional mother constellation.

3. The method of claim 1, wherein the distance function comprises one of an average product distance of the multidimensional mother constellation, and a minimum of a generalized mean of distances of projections of pairs of constellation points of the multidimensional mother constellation with power p, where p is a real value between [0, 1].

4. The method of claim 1, wherein the baseline multidimensional constellation is selected to at least one of maximize a minimum Euclidean distance between points in the baseline multidimensional constellation and reduce a number of neighboring points to each point in the baseline multidimensional constellation.

5. The method of claim 1, wherein the multidimensional mother constellation is a N-dimensional complex constellation, where N is an integer number greater than or equal to 2, and wherein the baseline multidimensional constellation comprises one of an N-dimensional complex constellation, an N-dimensional lattice constellation, and a product of N quadrature amplitude modulation (QAM) constellations.

6. The method of claim 1, wherein the multidimensional mother constellation is a N-dimensional complex constellation, where N is an integer number greater than or equal to 2, wherein the baseline multidimensional constellation comprises a first N-dimensional real constellation and a second N-dimensional real constellation, wherein the unitary rotation comprises a first unitary rotation and a second unitary rotation, and wherein applying the unitary rotation to the baseline multidimensional constellation comprises:

applying the first unitary rotation to the first N-dimensional real constellation to produce a first rotated constellation;

applying the second unitary rotation to the second N-dimensional real constellation to produce a second rotated constellation; and

shuffling axes of the first rotated constellation and axes of the second rotated constellation to produce the multidimensional mother constellation.

7. The method of claim 1, wherein the set of operations comprises at least one of a mapping operation, a dimensional permutation operation, a phase rotation operation, and a conjugate operation.

8. The method of claim 1, wherein the set of operations comprises projections.

9. A method for transmitting data, the method comprising:

determining, by a transmitting device, a plurality of codebooks, wherein each codebook is generated by applying a unitary rotation to a baseline multidimensional constellation to produce a multidimensional mother constellation and applying a set of operations to the multidimensional mother constellation to produce the codebook, wherein the unitary rotation is selected to optimize a distance function of the multidimensional mother constellation;

encoding, by the transmitting device, a first data associated with a first data layer by selecting a first codeword from a first codebook, where the first codebook is assigned exclusively to the first data layer;

encoding, by the transmitting device, a second data associated with a second data layer by selecting a second codeword from a second codebook and assigning the second codebook exclusively to the second data layer; and

transmitting, by the transmitting device, the first codeword and the second codeword.

10. The method of claim 9, further comprising:

combining the first codeword and the second codeword to produce an output codeword; and

transmitting the output codeword.

11. The method of claim 9, wherein determining the plurality of codebooks comprises retrieving the plurality of codebooks from storage device.

12. The method of claim 9, wherein transmitting the first codeword and the second codeword occurs over shared resources of a communications network.

13. The method of claim 9, wherein encoding the first data comprises:

selecting the first codeword from a first plurality of codewords in the first codebook in accordance with a first value of the first data.

14. A method for receiving data, the method comprising:

determining, by a receiving device, a plurality of codebooks, wherein each codebook is generated by applying a unitary rotation to a baseline multidimensional constellation to produce a multidimensional mother constellation and applying a set of operations to the multidimensional mother constellation to produce the codebook, wherein the unitary rotation is selected to optimize a distance function of the multidimensional mother constellation;

receiving, by the receiving device, an output codeword including a plurality of codewords, wherein each codeword belonging to a different one of the plurality of codebooks, wherein each of the plurality of codebooks is associated with a different one of a plurality of data layers;

identifying, by the receiving device, a first one of a plurality of codewords within the output codeword, the first codeword belonging to a first one of the plurality of codebooks assigned exclusively to a first one of the plurality of data layers; and

decoding, by the receiving device, the first codeword to produce a first data.

15. The method of claim 14, wherein the first codeword is identified using a message passing algorithm (MPA).

16. The method of claim 14, wherein decoding the first codeword comprises:

searching the first codebook for an index associated with an entry in the first codebook corresponding to the first codeword; and

setting the first data to be equal to the index.

17. A designing device comprising:

a processor configured to apply a unitary rotation to a baseline multidimensional constellation to produce a multidimensional mother constellation, wherein the unitary rotation is selected to optimize a distance function of the multidimensional mother constellation, to apply a set of operations to the multidimensional mother constellation to produce a set of constellation points, and to store the set of constellation points as a codebook of a plurality of codebooks.

18. The designing device of claim 17, wherein the distance function comprises a minimum product distance of the multidimensional mother constellation, and wherein the unitary rotation maximizes the minimum product distance of the multidimensional mother constellation.

19. The designing device of claim 17, wherein the baseline multidimensional constellation is selected to maximize a minimum Euclidean distance between points in the baseline multidimensional constellation.

20. The designing device of claim 17, wherein the multidimensional mother constellation is a N-dimensional complex constellation, where N is an integer number greater than or equal to 2, wherein the baseline multidimensional constellation comprises a first N-dimensional real constellation and a second N-dimensional real constellation, wherein the unitary rotation comprises a first unitary rotation and a second unitary rotation, and wherein the processor is configured to apply the first unitary rotation to the first N-dimensional real constellation to produce a first rotated constellation, to apply the second unitary rotation to the second N-dimensional real constellation to produce a second rotated constellation, and to shuffle axes of the first rotated constellation and axes of the second rotated constellation to produce the multidimensional mother constellation.

21. A transmitting device comprising:

a processor configured to determine a plurality of codebooks, wherein each codebook is generated by applying a unitary rotation to a baseline multidimensional constellation to produce a multidimensional mother constellation, the unitary rotation selected to optimize a distance function of the multidimensional mother constellation, and applying a set of operations to the multidimensional mother constellation to produce the codebook, to encode a first data associated with a first data layer by selecting a first codeword from a first codebook, where the first codebook is assigned exclusively to the first data layer, and to encode a second data associated with a second data layer by selecting a second codeword from a second codebook and assigning the second codebook exclusively to the second data layer; and

a transmitter operatively coupled to the processor, the transmitter configured to transmit the first codeword and the second codeword.

22. The transmitting device of claim 21, wherein the processor is configured to combine the first codeword and the second codeword to produce an output codeword, and wherein the transmitter is configured to transmit the output codeword

23. The transmitting device of claim 21, wherein the processor is configured to select the first codeword from a first plurality of codewords in the first codebook in accordance with a first value of the first data.

24. A receiving device comprising:

a processor configured to determine a plurality of codebooks, wherein each codebook is generated by applying a unitary rotation to a baseline multidimensional constellation while maintaining a minimum Euclidean distance of the baseline multidimensional constellation to produce a multidimensional mother constellation and applying a set of operations to the multidimensional mother constellation to produce the codebook, to identify a first one of a plurality of codewords within an output codeword, the first codeword belonging to a first one of the plurality of codebooks assigned exclusively to a first one of a plurality of data layers, and to decode the first codeword to produce a first data, wherein the output codeword includes a plurality of codewords, wherein each codeword belongs to a different one of the plurality of codebooks, and wherein each of the plurality of codebooks is associated with a different one of the plurality of data layers; and

a receiver operatively coupled to the processor, the receiver configured to receive the output codeword.

25. The receiving device of claim 24, wherein the processor is configured to identify the first codeword using a message passing algorithm (MPA).

26. The receiving device of claim 24, wherein the processor is configured to search the first codebook for an index associated with an entry in the first codebook corresponding to the first codeword, and to set the first data to be equal to the index.

WHAT IS CLAIMED IS:

1. A method for transmitting data, the method comprising:

determining, by a transmitting device, a plurality of codebooks, wherein each codebook is generated by producing a multidimensional mother constellation by optimizing a distance function of the multidimensional mother constellation including a Euclidean distance of the multidimensional mother constellation, applying a set of operations to the multidimensional mother constellation to produce a set of constellation points, and storing the set of constellation points as the codebook;

encoding, by the transmitting device, a first data associated with a first data layer by selecting a first codeword from a first codebook, where the first codebook is assigned exclusively to the first data layer;

encoding, by the transmitting device, a second data associated with a second data layer by selecting a second codeword from a second codebook and assigning the second codebook exclusively to the second data layer; and

transmitting, by the transmitting device, the first codeword and the second codeword.

2. The method of claims 1, wherein transmitting the first codeword and the second codeword occurs over shared resources of a communications network.

3. The method of claim 1 , further comprising:

combining the first codeword and the second codeword to produce an output codeword; and

transmitting the output codeword.

4. The method of claim 1, wherein determining the plurality of codebooks comprises retrieving the plurality of codebooks from storage device.

5. The method of claim 1, wherein encoding the first data comprises:

selecting the first codeword from a first plurality of codewords in the first codebook in accordance with a first value of the first data.

6. The method of claim 1, wherein the multidimensional mother constellation is a N-dimensional complex constellation, where N is an integer number greater than or equal to 2.

7. The method of claim 1, wherein the distance function comprises a function of distances of a plurality of projection points corresponding to the mother constellation points.

8. The method of claim 1, wherein gray labeling is used during applying the set of operations to the multidimensional mother constellation to produce the set of constellation points.

9. A method for receiving data, the method comprising:

determining, by a receiving device, a plurality of codebooks, wherein each codebook is generated by producing a multidimensional mother constellation by optimizing a distance function of the multidimensional mother constellation including a Euclidean distance of the multidimensional mother constellation, applying a set of operations to the multidimensional mother constellation to produce a set of constellation points, and storing the set of constellation points as the codebook;

receiving, by the receiving device, an output codeword including a plurality of codewords, wherein each codeword belonging to a different one of the plurality of codebooks, wherein each of the plurality of codebooks is associated with a different one of a plurality of data layers;

identifying, by the receiving device, a first one of a plurality of codewords within the output codeword, the first codeword belonging to a first one of the plurality of codebooks assigned exclusively to a first one of the plurality of data layers; and

decoding, by the receiving device, the first codeword to produce a first data.

10. The method of claim 9, wherein the first codeword is identified using a message passing algorithm (MPA).

11. The method of claim 9, wherein decoding the first codeword comprises:

searching the first codebook for an index associated with an entry in the first codebook corresponding to the first codeword; and

setting the first data to be equal to the index.

12. The method of claim 9, wherein the distance function comprises a function of distances of a plurality of projection points corresponding to the mother constellation points.

13. The method of claim 9, wherein gray labeling is used during applying the set of operations to the multidimensional mother constellation to produce the set of constellation points.

14. A transmitting device comprising means configured to implement actions in a method in accordance with any one claims 1 to 8.

15. A receiving device comprising means configured to implement actions in a method in accordance with any one claims 9 to 13.