

CLAIMS

1. A method for a channel encoding using a Low-Density Parity-Check (LDPC) code, the method comprising:
 - determining a number of parity bits for puncturing;
 - forming parity bit sets from dividing the parity bits at predetermined intervals;
 - determining a number of parity bit sets based on the number of parity bits for puncturing; and
 - puncturing parity bits based on the determined number of parity bit sets to be punctured, and according to a predetermined order of parity bit sets to be punctured.
2. The method of claim 1, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 4, 13, 9, 18, 8, 15, 20, 5, 17, 2, 22, 24, 7, 12, 1, 16, 23, 14, 0, 21, 10, 19, 11, 3, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 16-Quadrature Amplitude Modulation (16-QAM).
3. The method of claim 1, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 15, 13, 10, 3, 17, 21, 8, 5, 19, 2, 23, 16, 24, 7, 18, 1, 12, 20, 0, 4, 14, 9, 11, 22, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 64 Quadrature Amplitude Modulation (64-QAM).
4. The method of claim 1, further comprising:
 - additionally puncturing remaining parity bits except for the punctured parity bits when the number of the parity bits for puncturing is not a multiple of the number of parity bit sets.
5. The method of claims 1, wherein the number of parity bit sets is determined by below equation;

$$A = \left\lceil \frac{N_p}{M_l} \right\rceil,$$
 where A denotes the number of parity bit sets for puncturing, N_p denotes a number of parity bits for puncturing, M_l denotes the number of bits in one parity bit set.
6. The method of claims 1, wherein the parity bit sets are formed by below equation;

$$P_j = \{p_k \mid j \equiv k \bmod q, 0 \leq k < N_l - K_l\},$$

where P_j denotes the j^{th} parity bit set, N_1 denotes a length of an LDPC codeword, K_1 denotes a length of an information word, M_1 denotes the number of bits in one parity bit set, q is a value satisfying $q = (N_1 - K_1) / M_1$, where K_1/M_1 is an integer, and $0 \leq j < q$.

7. An apparatus for a channel encoding in a communication system using a Low-Density Parity-Check (LDPC) code, the method comprising:

a puncturing pattern applier for determining a number of parity bits for puncturing, forming parity bit sets from dividing the parity bits at predetermined intervals, determining a number of parity bit sets based on the number of parity bits for puncturing, and puncturing parity bits based on the determined number of parity bit sets to be punctured, and according to a predetermined order of parity bit sets to be punctured.

8. The apparatus of claim 7, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 4, 13, 9, 18, 8, 15, 20, 5, 17, 2, 22, 24, 7, 12, 1, 16, 23, 14, 0, 21, 10, 19, 11, 3, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 16-Quadrature Amplitude Modulation (16-QAM).

9. The apparatus of claim 7, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 15, 13, 10, 3, 17, 21, 8, 5, 19, 2, 23, 16, 24, 7, 18, 1, 12, 20, 0, 4, 14, 9, 11, 22, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 64 Quadrature Amplitude Modulation (64-QAM).

10. The apparatus of claim 7, the puncturing pattern applier additionally punctures remaining parity bits except for the punctured parity bits when the number of the parity bits for puncturing is not a multiple of the number of parity bit sets.

11. The apparatus of claims 7, wherein the number of parity bit sets is determined by below equation;

$$A = \left\lceil \frac{N_p}{M_1} \right\rceil,$$

where A denotes the number of parity bit sets for puncturing, N_p denotes a number of parity bits for puncturing, M_1 denotes the number of bits in one parity bit set.

12. The apparatus of claims 7, wherein the parity bit sets are formed by below equation;

$$P_j = \{p_k \mid j \equiv k \bmod q, 0 \leq k < N_I - K_I\},$$

where P_j denotes the j^{th} parity bit set, N_I denotes a length of an LDPC codeword, K_I denotes a length of an information word, M_I denotes the number of bits in one parity bit set, q is a value satisfying $q = (N_I - K_I) / M_I$, where K_I/M_I is an integer, and $0 \leq j < q$.

13. A method for a channel decoding using a Low-Density Parity-Check (LDPC) code, the method comprising:

- demodulating a signal transmitted from a transmitter;
 - determining position information of the punctured parity bits by estimating information about a predetermined order of parity bit sets to be punctured and the number of parity bit sets; and
 - decoding data using the positions of the punctured parity bits,
- wherein determining position information of punctured parity bits comprises,
- determining a number of parity bits to be punctured;
 - determining a number of parity bit sets to be punctured based on the determined number of parity bits to be punctured; and
 - acquiring a predetermined order of parity bit sets.

14. The method of claim 13, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 4, 13, 9, 18, 8, 15, 20, 5, 17, 2, 22, 24, 7, 12, 1, 16, 23, 14, 0, 21, 10, 19, 11, 3, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 16-Quadrature Amplitude Modulation (16-QAM).

15. The method of claim 13, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 15, 13, 10, 3, 17, 21, 8, 5, 19, 2, 23, 16, 24, 7, 18, 1, 12, 20, 0, 4, 14, 9, 11, 22, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 64 Quadrature Amplitude Modulation (64-QAM).

16. The method of claim 13, the step of determining positions of the punctured parity bits, comprises:

- additionally determining positions of the remaining punctured parity bits when the number of the punctured bits is not a multiple of the number of parity bit sets.

17. The method of claims 13, wherein the number of parity bit sets is determined by below equation;

$$A = \left\lfloor \frac{N_p}{M_1} \right\rfloor,$$

where A denotes the number of parity bit sets for puncturing, N_p denotes a number of parity bits for puncturing, M_1 denotes the number of bits in one parity bit set.

18. The method of claims 13, wherein the parity bit sets are formed by below equation;

$$P_j = \{p_k \mid j = k \bmod q, 0 \leq k < N_1 - K_1\},$$

where P_j denotes the j^{th} parity bit set, N_1 denotes a length of an LDPC codeword, K_1 denotes a length of an information word, M_1 denotes the number of bits in one parity bit set, q is a value satisfying $q = (N_1 - K_1) / M_1$, where K_1 / M_1 is an integer, and $0 \leq j < q$.

19. An apparatus for a channel decoding using a Low-Density Parity-Check (LDPC) code, the method comprising:

- a demodulator for demodulating a signal transmitted from a transmitter;
- a puncturing pattern estimator for determining position information of the punctured parity bits by estimating information about a predetermined order of parity bit sets to be punctured and the number of parity bit sets; and
- a decoder for decoding data using the positions of the punctured parity bits, wherein determining position information of punctured parity bits comprises,
 - determining a number of parity bits to be punctured;
 - determining a number of parity bit sets to be punctured based on the determined number of parity bits to be punctured; and
 - acquiring a predetermined order of parity bit sets.

20. The apparatus of claim 19, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 4, 13, 9, 18, 8, 15, 20, 5, 17, 2, 22, 24, 7, 12, 1, 16, 23, 14, 0, 21, 10, 19, 11, 3, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 16-Quadrature Amplitude Modulation (16-QAM).

21. The apparatus of claim 19, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 15, 13, 10, 3, 17, 21, 8, 5, 19, 2, 23, 16, 24, 7, 18, 1, 12, 20, 0, 4, 14, 9, 11, 22, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 64 Quadrature Amplitude Modulation (64-QAM).

22. The apparatus of claim 19, the puncturing pattern estimator comprising:

the puncturing pattern estimator for additionally determining positions of the remaining punctured parity bits when the number of the punctured bits is not a multiple of the number of parity bit sets.

23. The apparatus of claims 19, wherein the number of parity bit sets is determined by below equation;

$$A = \left\lceil \frac{N_p}{M_1} \right\rceil,$$

where A denotes the number of parity bit sets for puncturing, N_p denotes a number of parity bits for puncturing, M_1 denotes the number of bits in one parity bit set.

24. The apparatus of claims 19, wherein the parity bit sets are formed by below equation;

$$P_j = \{p_k \mid j \equiv k \bmod q, 0 \leq k < N_I - K_I\},$$

where P_j denotes the j^{th} parity bit set, N_I denotes a length of an LDPC codeword, K_I denotes a length of an information word, M_1 denotes the number of bits in one parity bit set, q is a value satisfying $q = (N_I - K_I) / M_1$, where K_I / M_1 is an integer, and $0 \leq j < q$.

CLAIMS:

1. A method for channel encoding using a Low-Density Parity-Check (LDPC) code, the method comprising:
 - determining a number of parity bits for puncturing;
 - forming parity bit sets from dividing the parity bits at predetermined intervals;
 - determining a number of parity bit sets based on the number of parity bits for puncturing;
 and
 - puncturing parity bits based on the determined number of parity bit sets to be punctured, and according to a predetermined order of parity bit sets to be punctured.
2. The method of claim 1, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 4, 13, 9, 18, 8, 15, 20, 5, 17, 2, 22, 24, 7, 12, 1, 16, 23, 14, 0, 21, 10, 19, 11, 3, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 16-Quadrature Amplitude Modulation (16-QAM).
3. The method of claim 1, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 15, 13, 10, 3, 17, 21, 8, 5, 19, 2, 23, 16, 24, 7, 18, 1, 12, 20, 0, 4, 14, 9, 11, 22, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 64 Quadrature Amplitude Modulation (64-QAM).
4. The method of claim 1, further comprising:
 - additionally puncturing remaining parity bits except for the punctured parity bits when the number of the parity bits for puncturing is not a multiple of the number of parity bit sets.
5. The method of claims 1, wherein the number of parity bit sets is determined by below equation;

$$A = \left\lfloor \frac{N_p}{M_1} \right\rfloor,$$
 where A denotes the number of parity bit sets for puncturing, N_p denotes a number of parity bits for puncturing, M_1 denotes the number of bits in one parity bit set.
6. The method of claims 5, wherein the parity bit sets are formed by below equation;

$$P_j = \{p_k \mid j \equiv k \bmod q, 0 \leq k < N_I - K_I\},$$
 where P_j denotes the j^{th} parity bit set, N_I denotes a length of an LDPC codeword, K_I denotes a length of an information word, M_1 denotes the number of bits in one parity bit set, q is a value satisfying $q = (N_I - K_I) / M_1$, where K_I/M_1 is an integer, and $0 \leq j < q$.

7. An apparatus for channel encoding in a communication system using a Low-Density Parity-Check (LDPC) code, comprising:

a puncturing pattern applier arranged to:

determine a number of parity bits for puncturing;

form parity bit sets from dividing the parity bits at predetermined intervals;

determine a number of parity bit sets based on the number of parity bits for puncturing; and

puncture parity bits based on the determined number of parity bit sets to be punctured, and

according to a predetermined order of parity bit sets to be punctured.

8. The apparatus of claim 7, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 4, 13, 9, 18, 8, 15, 20, 5, 17, 2, 22, 24, 7, 12, 1, 16, 23, 14, 0, 21, 10, 19, 11, 3, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 16-Quadrature Amplitude Modulation (16-QAM).

9. The apparatus of claim 7, wherein the predetermined order of parity bit sets to be punctured is determined as 6, 15, 13, 10, 3, 17, 21, 8, 5, 19, 2, 23, 16, 24, 7, 18, 1, 12, 20, 0, 4, 14, 9, 11, 22, when a codeword length is 16200 and an information length is 7200, a modulation scheme is 64-Quadrature Amplitude Modulation (64-QAM).

10. The apparatus of claim 7, wherein the puncturing pattern applier additionally punctures remaining parity bits except for the punctured parity bits when the number of the parity bits for puncturing is not a multiple of the number of parity bit sets.

11. The apparatus of claims 7, wherein the number of parity bit sets is determined by below equation;

$$A = \left\lfloor \frac{N_p}{M_1} \right\rfloor,$$

where A denotes the number of parity bit sets for puncturing, N_p denotes a number of parity bits for puncturing, M_1 denotes the number of bits in one parity bit set.

12. The apparatus of claims 11, wherein the parity bit sets are formed by below equation;

$$P_j = \{p_k \mid j \equiv k \bmod q, 0 \leq k < N_I - K_I\},$$

where P_j denotes the j^{th} parity bit set, N_I denotes a length of an LDPC codeword, K_I denotes a length of an information word, M_1 denotes the number of bits in one parity bit set, q is a value satisfying $q = (N_I - K_I) / M_1$, where K_I/M_1 is an integer, and $0 \leq j < q$.

13. A method for channel encoding, substantially as herein described with reference to the accompanying drawings.

14. An apparatus for channel encoding, substantially as herein described with reference to the accompanying drawings.