Error Control Coding - Low-Density Parity-Check Codes

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Outline

1. 系統架構圖 (細部Block diagram)
2. 程式流程解釋 (流程/Pseudo code)
3. 模擬數據 (表格)
4. 模擬效能圖

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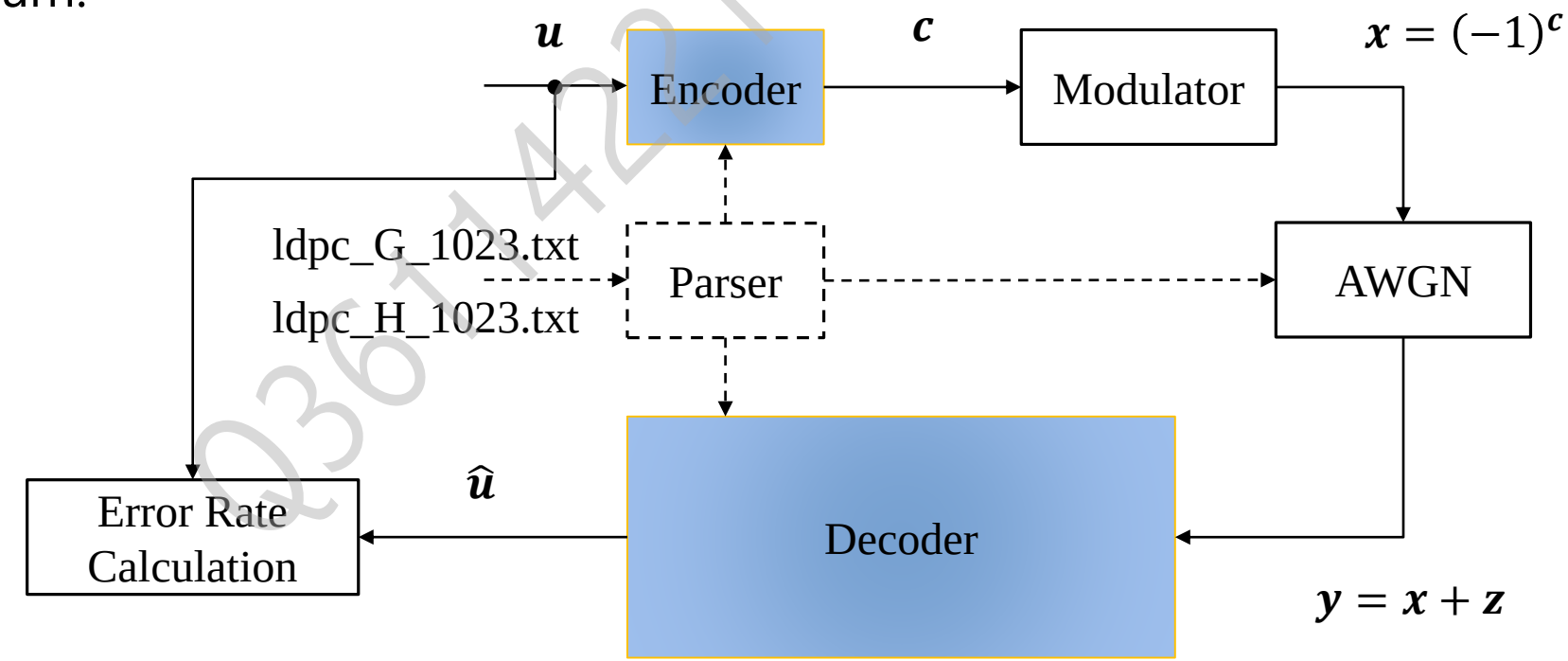
系統架構圖

Consider the (1023, 781) low-density parity-check (LDPC) code with block length $n = 1023$, dimension $k = 781$, row weight $\rho = 32$, and column weight $\gamma = 32$.

- Block diagram:



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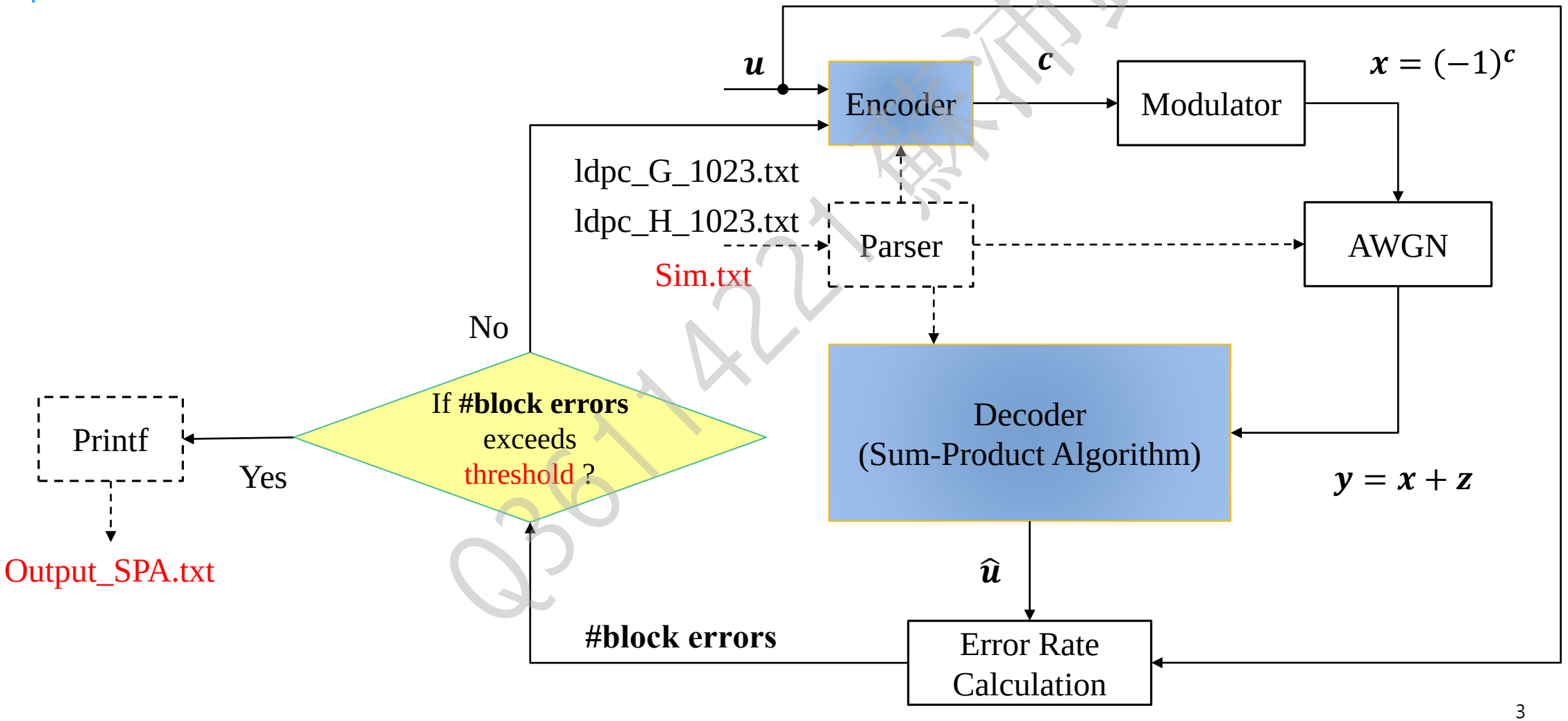
細部Block diagram



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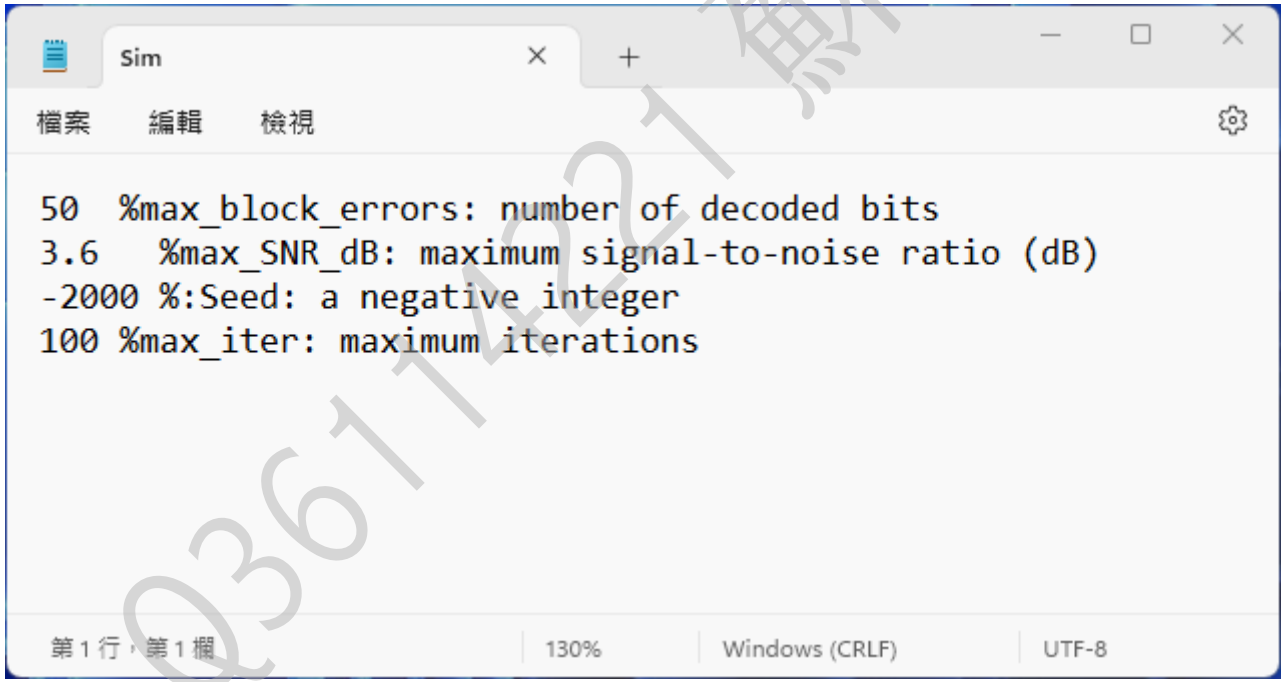
Decoding of Low-Density Parity-Check (LDPC) Codes

Input Sim.txt:



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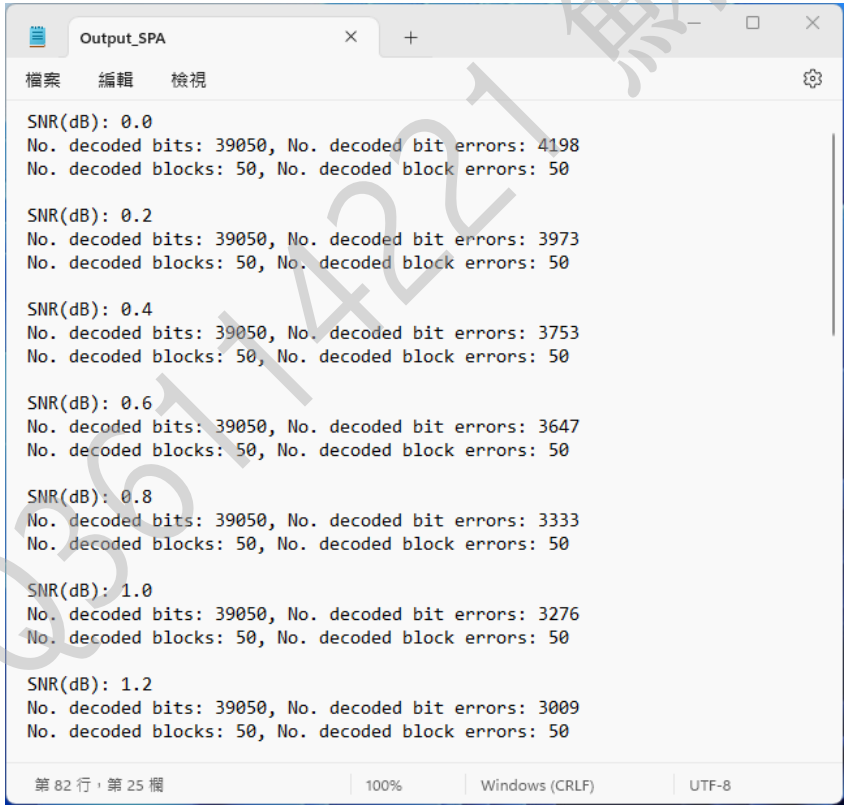
Decoding of Low-Density Parity-Check (LDPC) Codes

Output “Output_SPA.txt”:



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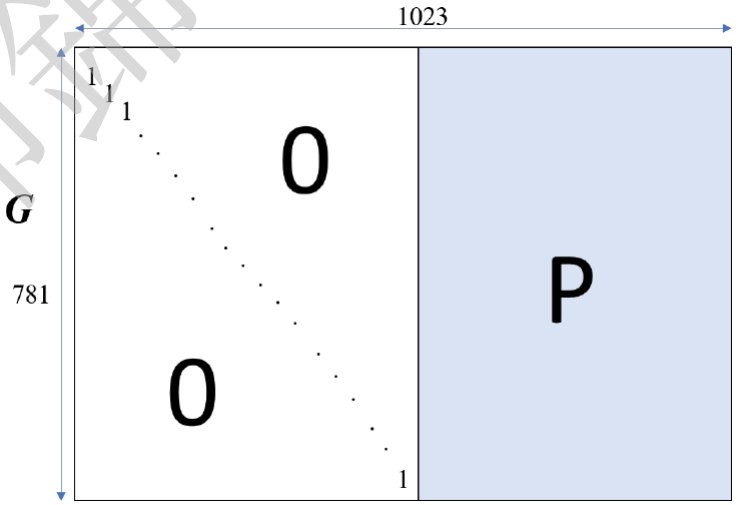
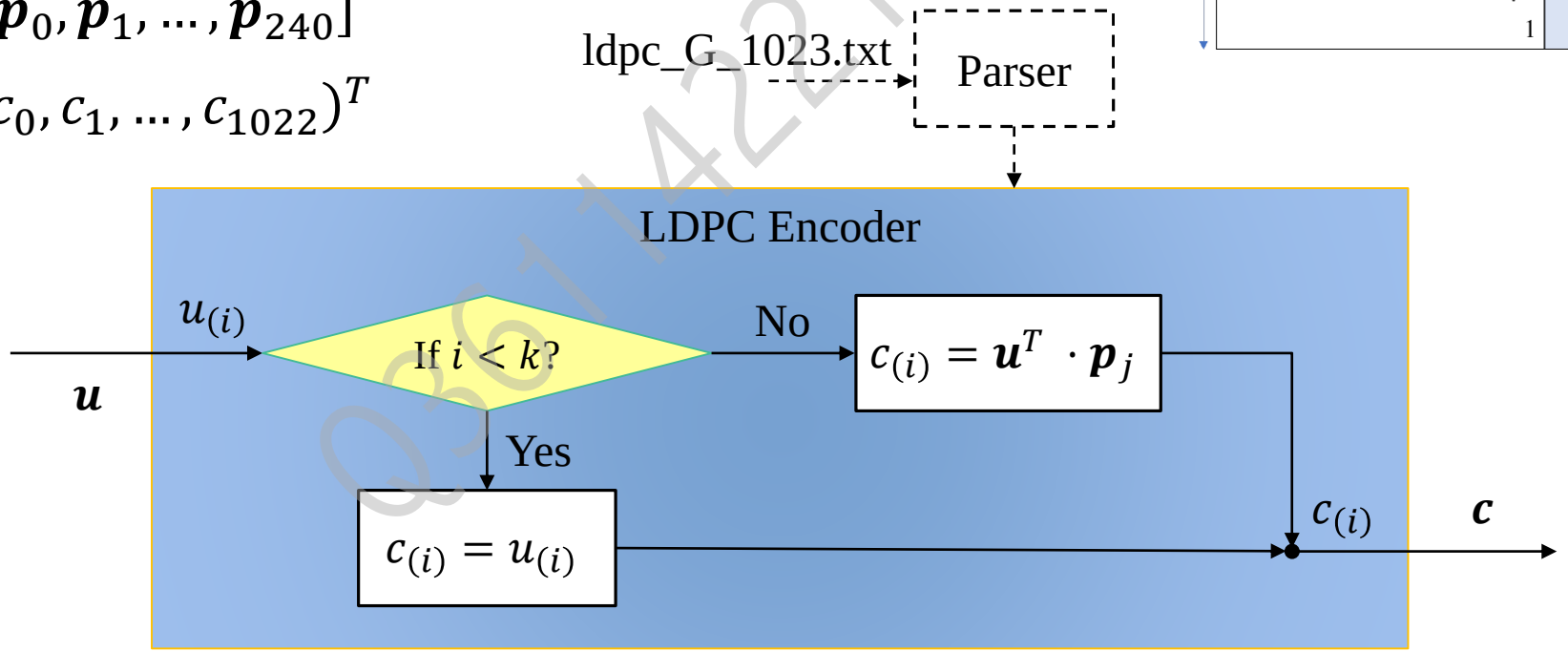
細部Block diagram

- $\boldsymbol{u} = (u_0, u_1, \ldots, u_{780})^T$
- $\boldsymbol{G} = [\boldsymbol{I}_{781} \quad \boldsymbol{P}]$
- $\boldsymbol{P} = [\boldsymbol{p}_0, \boldsymbol{p}_1, \ldots, \boldsymbol{p}_{240}]$
- $\boldsymbol{c} = (c_0, c_1, \ldots, c_{1022})^T$





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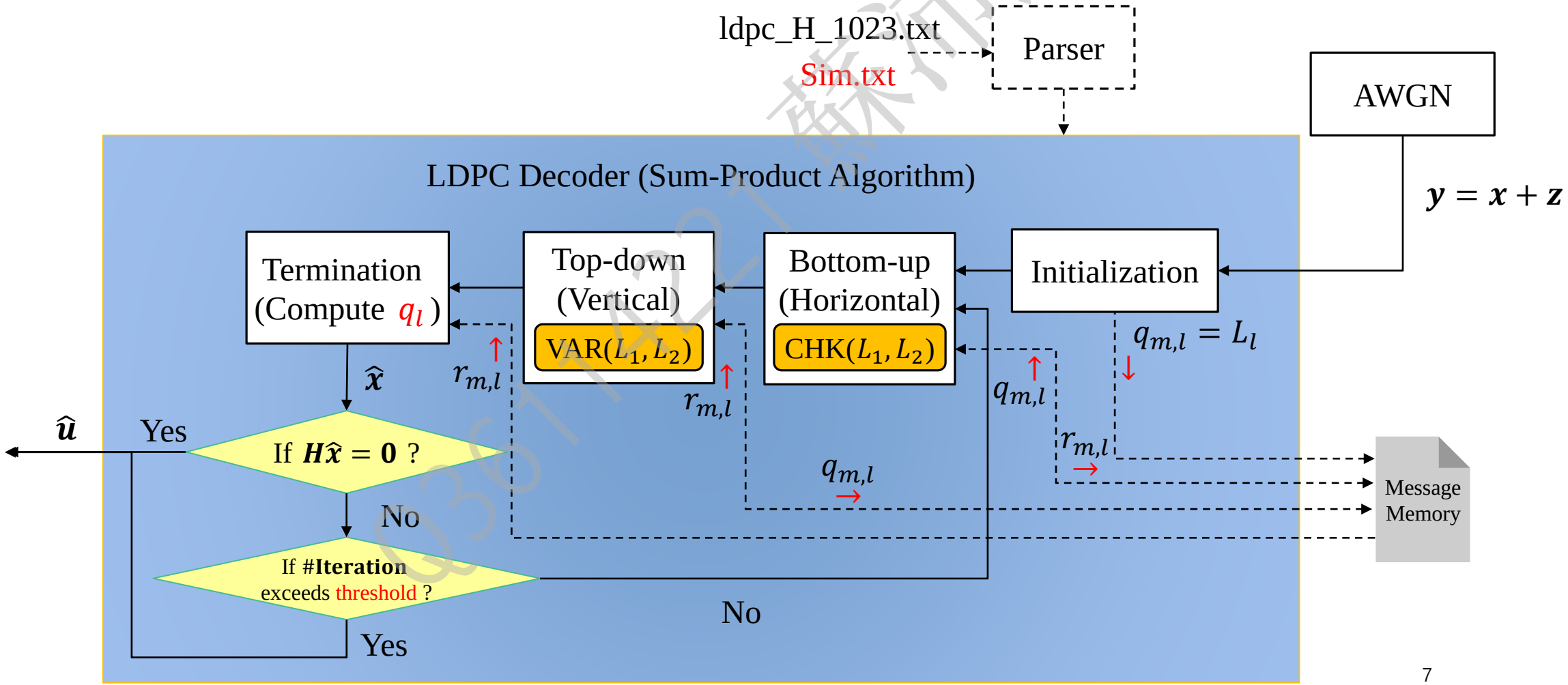
細部Block diagram



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程式流程解釋 (Encoder)

- $\boldsymbol{u} = (u_0, u_1, \dots, u_{780})^T$
- $\boldsymbol{G} = [\boldsymbol{g}_0, \boldsymbol{g}_1, \dots, \boldsymbol{g}_{1021}]$
- $\boldsymbol{c} = (c_0, c_1, \dots, c_{1022})^T$

- Pseudo code:

```
for i = 0, ..., k − 1 do
    if (i < k)
        c_i ← u_i
    then
        c_i ← u^T · g_i
end for
return c
```

```c
/* Encoder */
int *Encoder(int *u, int **G_matrix)
{
    int i, j;        // for loop counter
    int *c = (int *)calloc(n, sizeof(int));   // Codeword

    for (j = 0; j < n; j++)
    {
        if (j < k)
        {
            c[j] = u[j];
        }
        else
        {
            for (i = 0; i < k; i++)
            {
                c[j] = c[j]^(u[i]*G_matrix[i][j]);
            }
        }
    }

    return c;
}
```

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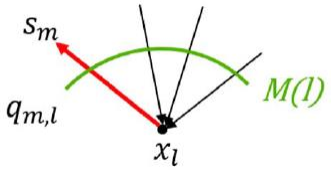
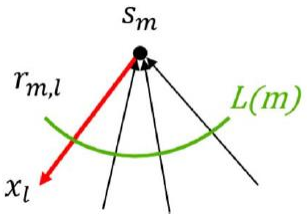
程式流程解釋 (Decoder)

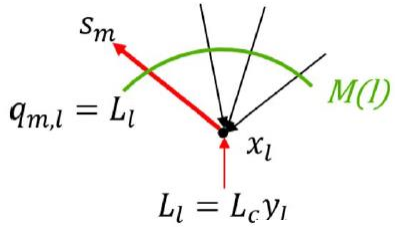
- Pseudo code:

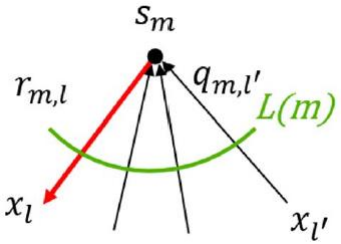
- $L(m) = \{l: H_{m,l} = 1\}, 1 \le m \le J$
- $M(l) = \{m: H_{m,l} = 1\}, 1 \le l \le n$

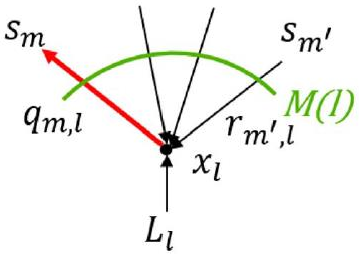


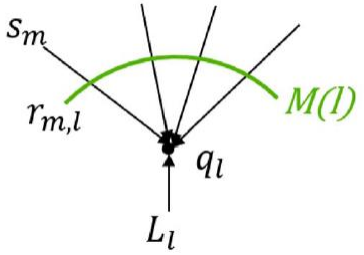


1) **for** $\forall\, m \in M(l), 1 \le l \le n$ // Initialization
2) $\quad q_{m,l} \leftarrow L_l = 2 \cdot y_l/\sigma^2$
3) **end for**
4) **repeat**
5) $\quad$ **for** $\forall\, l \in L(m), 1 \le m \le J$ // Step 1: Bottom-up (Horizontal)
6) $\quad\quad r_{m,l} \leftarrow \mathrm{CHK}_{l' \in L(m)\backslash l}(q_{m,l'})$
7) $\quad$ **end for**
8) $\quad$ **for** $\forall\, m \in M(l), 1 \le l \le n$ // Step 2: Top-down (Vertical)
9) $\quad\quad q_{m,l} \leftarrow \mathrm{VAR}(\mathrm{VAR}_{m' \in M(l)\backslash m}(r_{m',l}), L_l) = L_l + \sum_{m' \in M(l)\backslash m} r_{m',l}$
10) $\quad$ **end for**
11) $\quad$ **for** $1 \le l \le n$ // Step 3: Termination
12) $\quad\quad q_l \leftarrow \mathrm{VAR}(\mathrm{VAR}_{m \in M(l)}(r_{m,l}), L_l) = L_l + \sum_{m \in M(l)} r_{m,l}$
13) $\quad\quad$ **if** $q_l > 0$
14) $\quad\quad\quad \hat{x}_l = 0$
15) $\quad\quad$ **then**
16) $\quad\quad\quad \hat{x}_l = 1$
17) $\quad$ **end for**
18) $\quad$ **if** $\boldsymbol{H\hat{x} = 0}$
19) $\quad\quad$ **break**
20) **until** $\#iterations \ge threshold$
21) **return** $\hat{x}$









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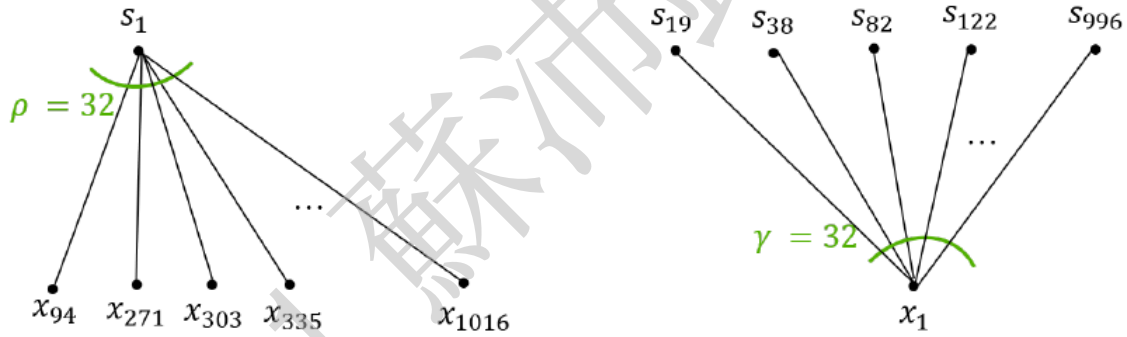
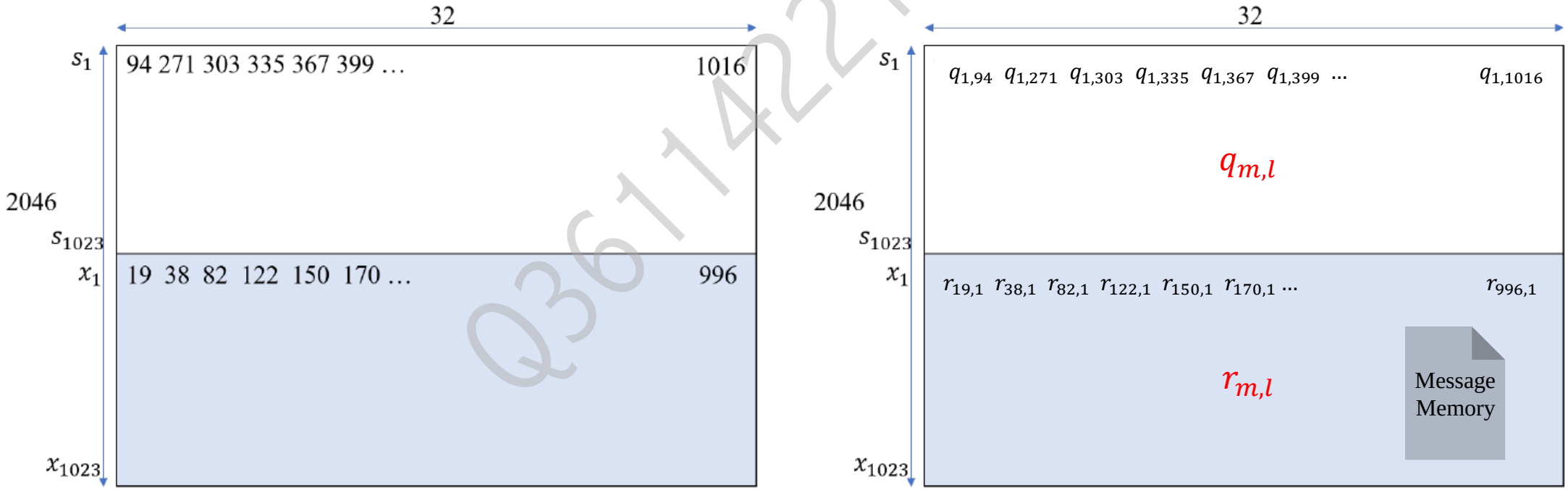
程式流程解釋 (Decoder)

- Message Memory



ldpc_H_1023.txt



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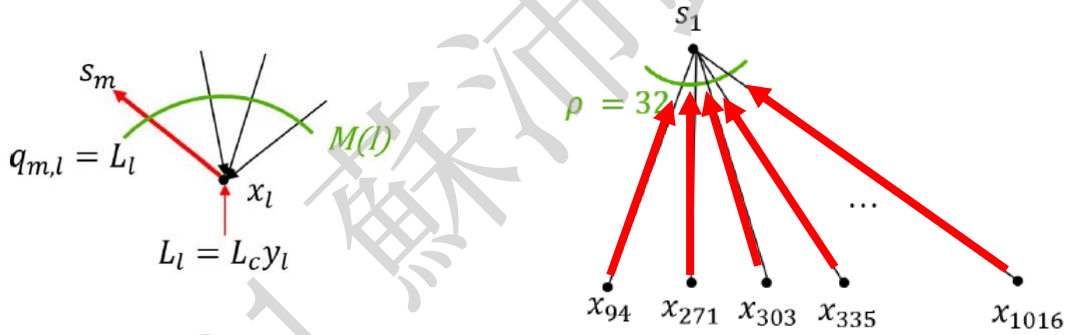
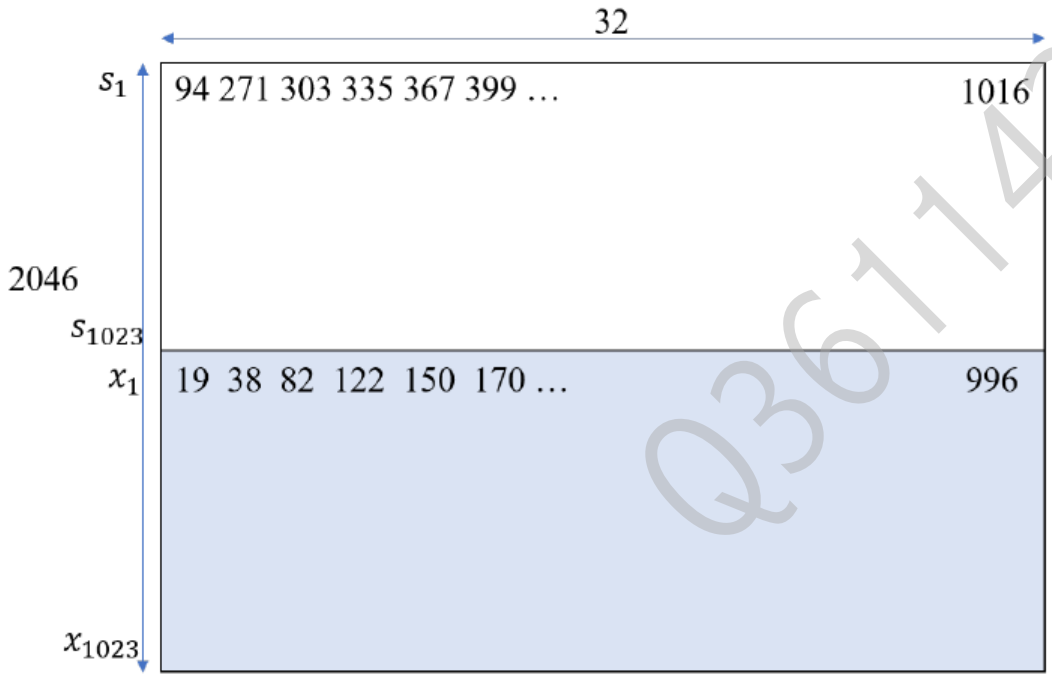
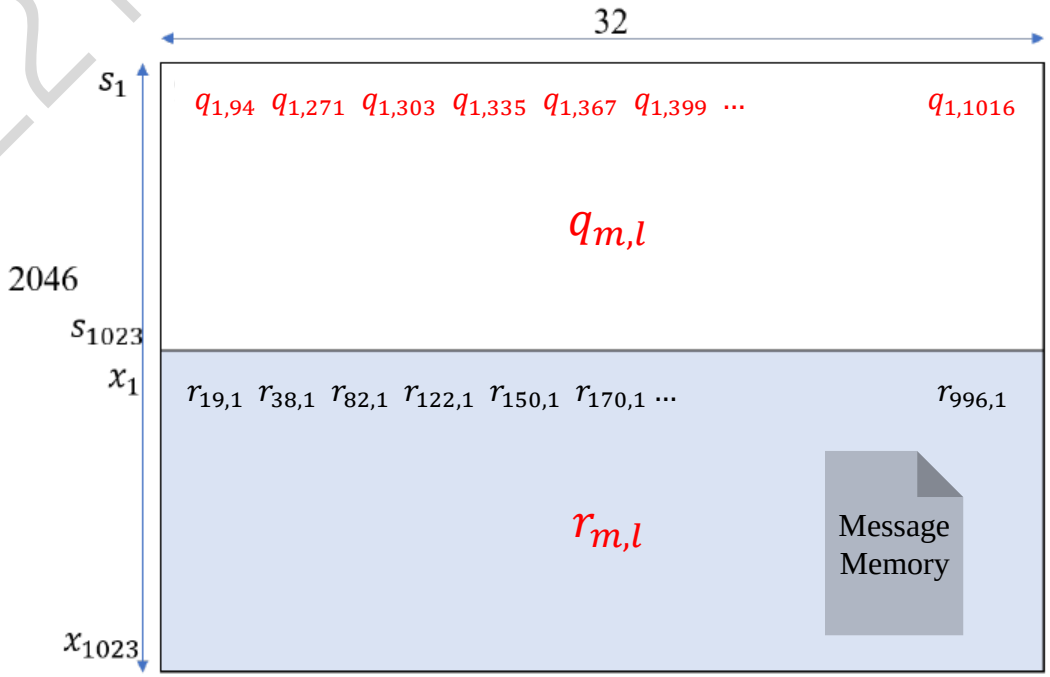
程式流程解釋 (Decoder)

- Initialization:



ldpc_H_1023.txt





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程式流程解釋 (Decoder)

```
/* Decoder */
void Decoder(int **H_info, double *y, int *u_est, double sigma, int max_iter)
{
    int i, j, f;    // for loop counter
    int *msg_mem_count;    // 記憶體的儲存位置 (以儲存計算完的 q_m,l 和 r_m,l 訊息)
    int *x_est = (int *)calloc(n, sizeof(int));     // the estimated codeword
    int parity_check = 0;   // 用來檢查 H*x_est = 0 是否成立
    double Lc = 2.0/(sigma*sigma);

    // 配置好所需的記憶體空間
    double **msg_mem = (double **)calloc(2*n, sizeof(double *));    // 用來儲存 q_m,l 和 r_m,l 訊息的記憶體空間
    for (i = 0; i < (2*n); i++)…
    double *q = (double *)calloc(n, sizeof(double));      // the log a posteriori probability for each variable node 'l'

    // Initialization
    for (i = 0; i < n; i++)
    {
        for (j = 0; j < num_weight; j++)
        {
            msg_mem[i][j] = Lc*y[(H_info[i][j]) - 1];
        }
    }

```

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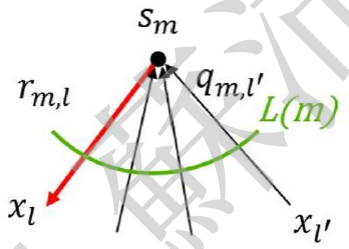
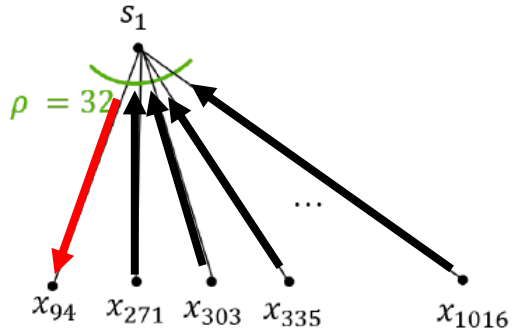
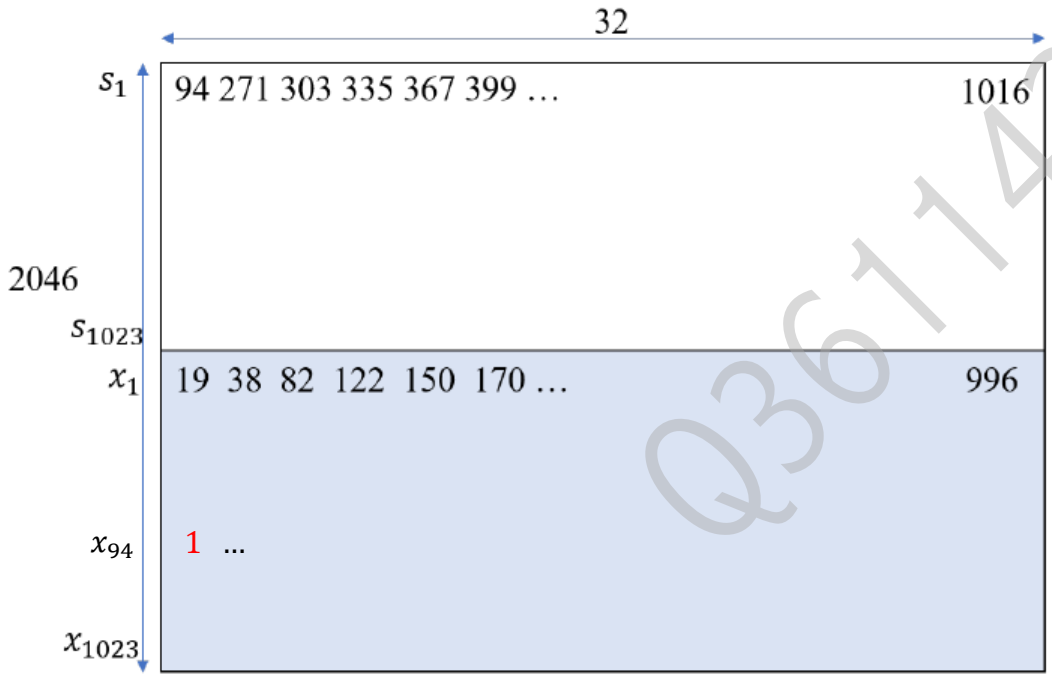
程式流程解釋 (Decoder)

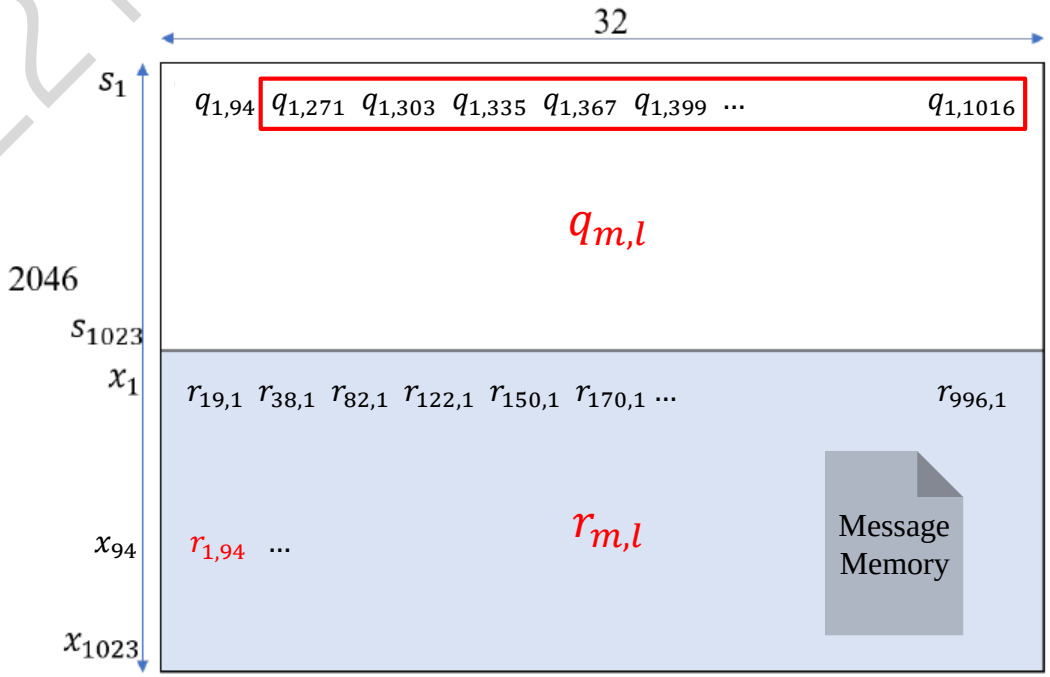
- Step 1: Bottom-up (Horizontal)





ldpc_H_1023.txt





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程式流程解釋 (Decoder)

```
309   /* Iterative Decoding */
310   for (i = 0; i < max_iter; i++)
311   {
312       msg_mem_count = (int *)calloc(2*n, sizeof(int));
313
314       for (j = 0; j < (2*n); j++)
315       {
316           if (j < n)
317           {
318               /* Step 1: Bottom-up (horizontal) */
319               for (f = 0; f < num_weight; f++)
320               {
321                   msg_mem[(H_info[j][f]) - 1 + n][msg_mem_count[(H_info[j][f]) - 1 + n]] = Bottom_up(msg_mem, j, f);
322                   msg_mem_count[(H_info[j][f]) - 1 + n] = msg_mem_count[(H_info[j][f]) - 1 + n] + 1;
323               }
324           }
325           else
326           {
327               for (f = 0; f < num_weight; f++)
328               {
329                   /* Step 2: Top-down (Vertical) */
330                   msg_mem[(H_info[j][f]) - 1][msg_mem_count[(H_info[j][f]) - 1]] = VAR(msg_mem, j, f, num_weight - 1) + (Lc*y[j - n]);
331                   msg_mem_count[(H_info[j][f]) - 1] = msg_mem_count[(H_info[j][f]) - 1] + 1;
332
333                   /* Step 3: Termination */
334                   q[j - n] = msg_mem[j][f] + VAR(msg_mem, j, f, num_weight - 1) + (Lc*y[j - n]);
335               }
336           }
337       }
338
```

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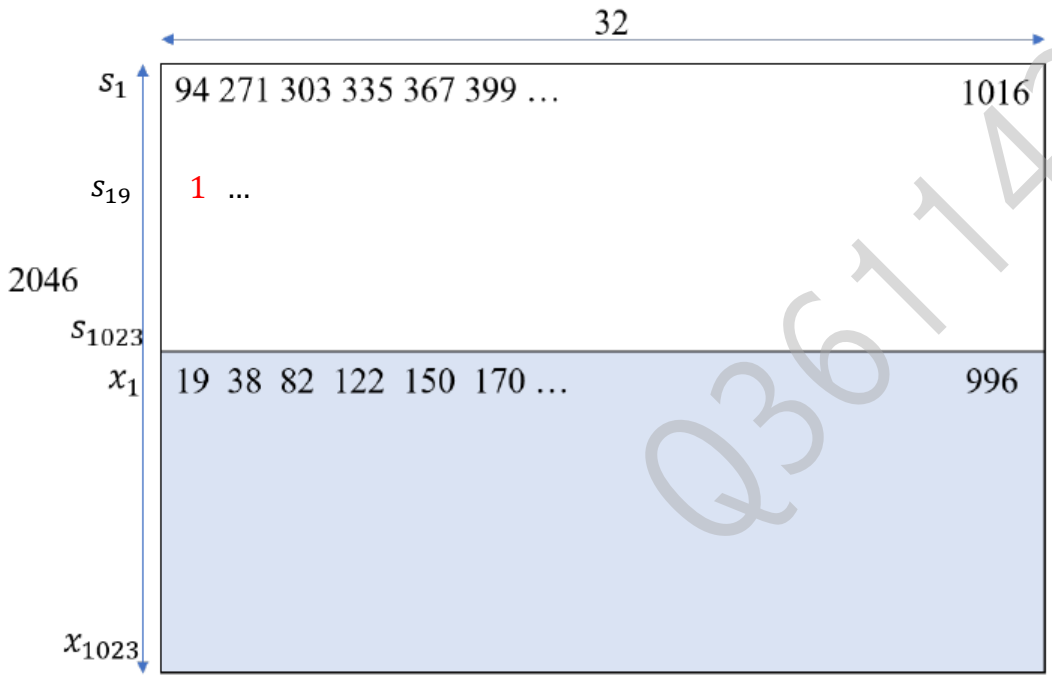
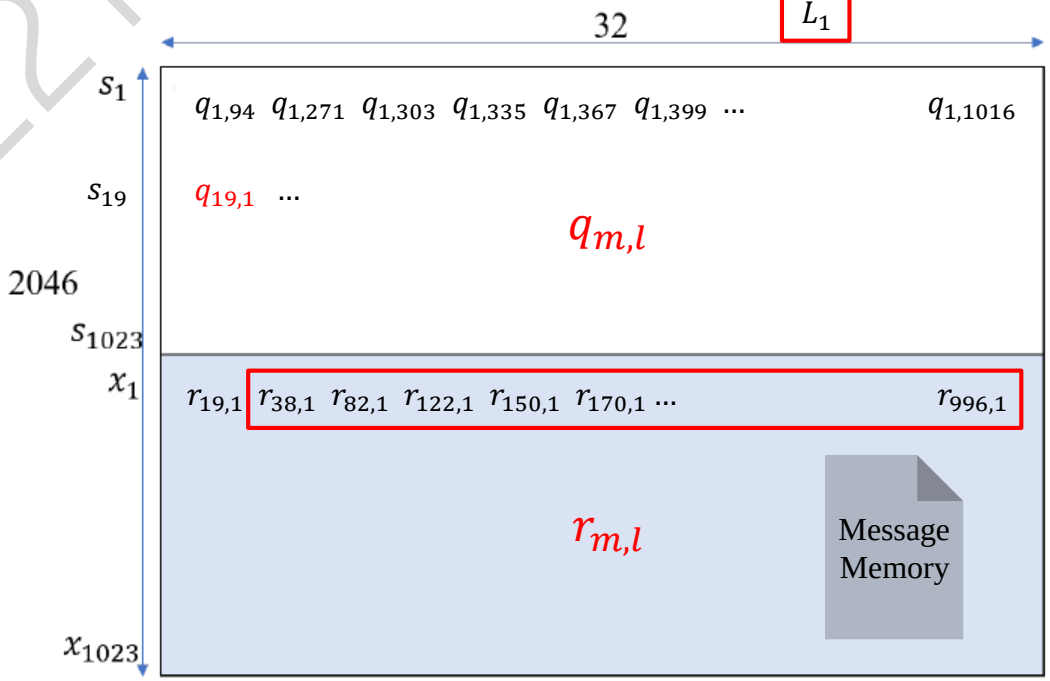
程式流程解釋 (Decoder)

- Step 2: Top-down (Vertical)

ldpc_H_1023.txt





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程式流程解釋 (Decoder)

```
309   /* Iterative Decoding */
310   for (i = 0; i < max_iter; i++)
311   {
312       msg_mem_count = (int *)calloc(2*n, sizeof(int));
313
314       for (j = 0; j < (2*n); j++)
315       {
316           if (j < n)
317           {
318               /* Step 1: Bottom-up (horizontal) */
319               for (f = 0; f < num_weight; f++)
320               {
321                   msg_mem[(H_info[j][f]) - 1 + n][msg_mem_count[(H_info[j][f]) - 1 + n]] = Bottom_up(msg_mem, j, f);
322                   msg_mem_count[(H_info[j][f]) - 1 + n] = msg_mem_count[(H_info[j][f]) - 1 + n] + 1;
323               }
324           }
325           else
326           {
327               for (f = 0; f < num_weight; f++)
328               {
329                   /* Step 2: Top-down (Vertical) */
330                   msg_mem[(H_info[j][f]) - 1][msg_mem_count[(H_info[j][f]) - 1]] = VAR(msg_mem, j, f, num_weight - 1) + (Lc*y[j - n]);
331                   msg_mem_count[(H_info[j][f]) - 1] = msg_mem_count[(H_info[j][f]) - 1] + 1;
332
333                   /* Step 3: Termination */
334                   q[j - n] = msg_mem[j][f] + VAR(msg_mem, j, f, num_weight - 1) + (Lc*y[j - n]);
335               }
336           }
337       }
338
```

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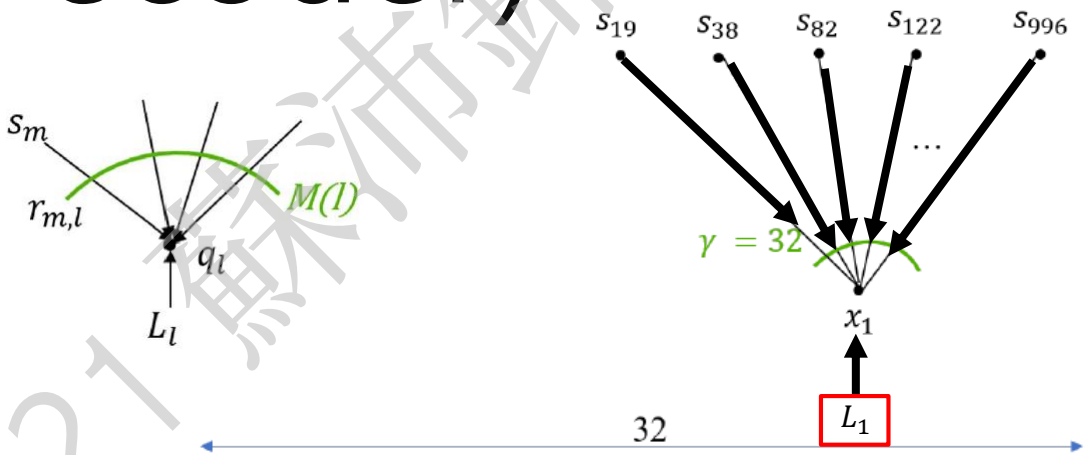
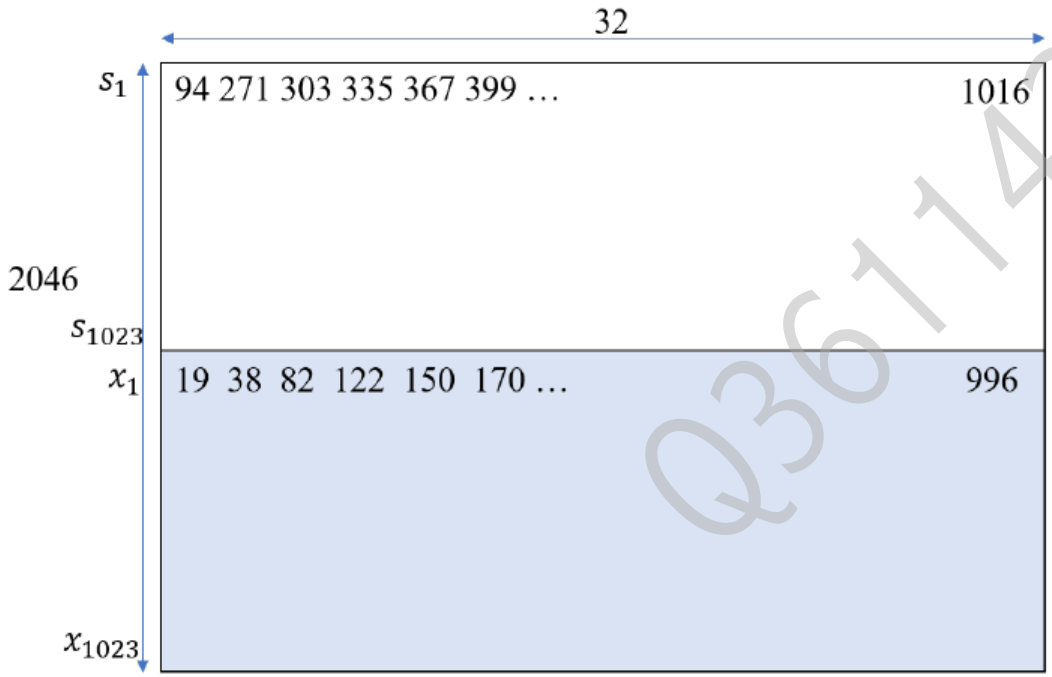
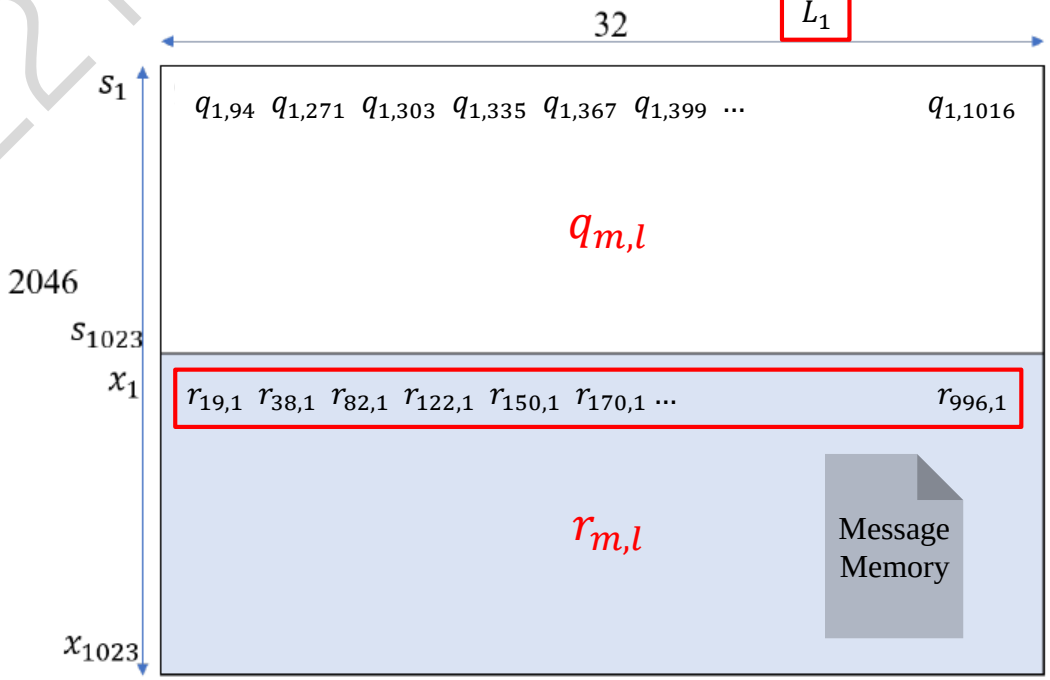
程式流程解釋 (Decoder)

- Step 3: Termination



ldpc_H_1023.txt





Q36114221 蘇市郎

程式流程解釋 (Decoder)

```
309   /* Iterative Decoding */
310   for (i = 0; i < max_iter; i++)
311   {
312       msg_mem_count = (int *)calloc(2*n, sizeof(int));
313
314       for (j = 0; j < (2*n); j++)
315       {
316           if (j < n)
317           {
318               /* Step 1: Bottom-up (horizontal) */
319               for (f = 0; f < num_weight; f++)
320               {
321                   msg_mem[(H_info[j][f]) - 1 + n][msg_mem_count[(H_info[j][f]) - 1 + n]] = Bottom_up(msg_mem, j, f);
322                   msg_mem_count[(H_info[j][f]) - 1 + n] = msg_mem_count[(H_info[j][f]) - 1 + n] + 1;
323               }
324           }
325           else
326           {
327               for (f = 0; f < num_weight; f++)
328               {
329                   /* Step 2: Top-down (Vertical) */
330                   msg_mem[(H_info[j][f]) - 1][msg_mem_count[(H_info[j][f]) - 1]] = VAR(msg_mem, j, f, num_weight - 1) + (Lc*y[j - n]);
331                   msg_mem_count[(H_info[j][f]) - 1] = msg_mem_count[(H_info[j][f]) - 1] + 1;
332
333                   /* Step 3: Termination */
334                   q[j - n] = msg_mem[j][f] + VAR(msg_mem, j, f, num_weight - 1) + (Lc*y[j - n]);
335               }
336           }
337       }
338
```

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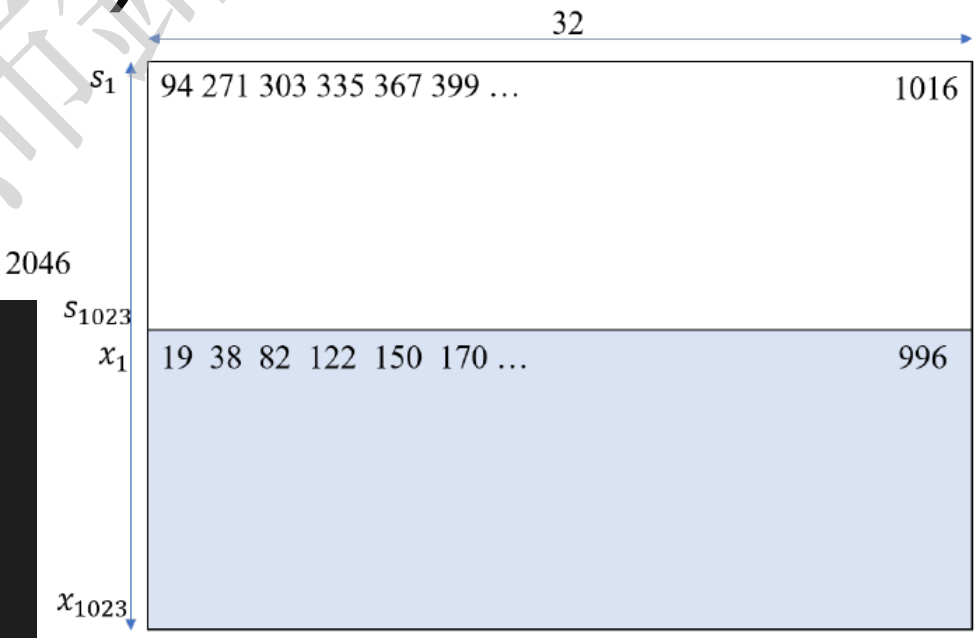
程式流程解釋 (Decoder)

- If $\boldsymbol{H}\hat{\boldsymbol{x}} = \boldsymbol{0}$, then $\hat{\boldsymbol{x}}$ is the codeword.
  - The algorithm stops.

```
344     parity_check = 0;
345     for (j = 0; j < n; j++)
346     {
347         parity_check = 0;
348         for (f = 0; f < num_weight; f++)
349         {
350             parity_check = parity_check^x_est[H_info[j][f]-1];
351         }
352
353         if (parity_check != 0)  // 當 H*x_est = 0 不成立時，迭代解碼演算法 -> [繼續]
354         {
355             break;
356         }
357     }
358
359     if (parity_check == 0)  // 當 H*x_est = 0 成立時，迭代解碼演算法 -> [停止]
360     {
361         break;
362     }
```



ldpc_H_1023.txt

0361 14221 蘇沛淵

程式流程解釋 (Bit-Flipping Decoder)

- Pseudo code:

```
repeat
    /* Step 1: Compute the parity-check sums (syndrome bits) */
    S^T = (s_1, s_2, ⋮, s_j) ← H x̂^T = H (x̂_1, x̂_2, ⋮, x̂_N)
    if S = 0
        break                    // Stop decoding
    /* Step 2: Find the number of unsatisfied parity-check equations */
    f_i ← Σ_{j∈{l:H_{i,l}=1}} s_j , 1 ≤ i ≤ n
    δ ← max_{i=1,..,n} {f_i}          // Decide the threshold δ (the largest f_i )
    /* Step 3: Identify the set S of bits for which f_i is the largest */
    for 1 ≤ k ≤ n
        if f_k ≥ δ
            /* Step 4: Flip the bits in the set S */
            x̂_k ← x̂_k ⊕ 1
    end for
until #iterations ≥ threshold
return x̂
```

Q36114221 蘇沛鎔

程式流程解釋 (Bit-Flipping Decoder)

- Step 1

```
223         for (i = 0; i < (2*n); i++)
224         {
225             /* Step 1: Compute the parity-check sums (syndrome bits) */
226             if (i < n)
227             {
228                 for (j = 0; j < num_weight; j++)
229                 {
230                     s[i] = s[i]^x[H_info[i][j]-1];
231                 }
232                 if (s[i] != 0)
233                 {
234                     check_sum_signal = 1;
235                 }
236             }
237 
238             /* Step 2: Find No. unsatisfied parity-check equations for each bit */
239             else
240             {
241                 // If S = 0, stop decoding
242                 if (check_sum_signal == 0)
243                 {
244                     break;
245                 }
246 
247                 for (j = 0; j < num_weight; j++)
248                 {
249                     f[i - n] = f[i - n] + s[H_info[i][j]-1];
250                 }
251             }
252         }
```

Q36114211 蘇沛源

程式流程解釋 (Bit-Flipping Decoder)

- Step 2

```
223     for (i = 0; i < (2*n); i++)
224     {
225         /* Step 1: Compute the parity-check sums (syndrome bits) */
226         if (i < n)
227         {
228             for (j = 0; j < num_weight; j++)
229             {
230                 s[i] = s[i]^x[H_info[i][j]-1];
231             }
232             if (s[i] != 0)
233             {
234                 check_sum_signal = 1;
235             }
236         }
237 
238         /* Step 2: Find No. unsatisfied parity-check equations for each bit */
239         else
240         {
241             // If S = 0, stop decoding
242             if (check_sum_signal == 0)
243             {
244                 break;
245             }
246 
247             for (j = 0; j < num_weight; j++)
248             {
249                 f[i - n] = f[i - n] + s[H_info[i][j]-1];
250             }
251         }
252     }
```

Q36114211蘇沛源

程式流程解釋 (Bit-Flipping Decoder)

- Step 3

```
259
260     /* Step 3: Identify the set S of bits for which f_i is the largest */
261     delta = f[0];
262     for (i = 1; i < n; i++)
263     {
264         if (f[i] >= delta)
265         {
266             delta = f[i];
267         }
268     }
269
270     /* Step 4: Flip the bits in the set S */
271     for (i = 0; i < n; i++)
272     {
273         if (f[i] >= delta)
274         {
275             x[i] = x[i]^(1);
276             if (i < k)
277             {
278                 u_est[i] = x[i];
279             }
280         }
281     }
```

Q36114221 蘇沛源

程式流程解釋 (Bit-Flipping Decoder)

- Step 4

```
259
260     /* Step 3: Identify the set S of bits for which f_i is the largest */
261     delta = f[0];
262     for (i = 1; i < n; i++)
263     {
264         if (f[i] >= delta)
265         {
266             delta = f[i];
267         }
268     }
269
270     /* Step 4: Flip the bits in the set S */
271     for (i = 0; i < n; i++)
272     {
273         if (f[i] >= delta)
274         {
275             x[i] = x[i]^(1);
276             if (i < k)
277             {
278                 u_est[i] = x[i];
279             }
280         }
281     }
```

Q36114221 蘇沛源

模擬參數設定

- 解碼採用 Sum-Product Algorithm (SPA)
- SNR (dB) → 0.0 : 0.2 : 3.8
- Seed (a negative integer): -2000
- maximum number of block errors = 100
- maximum number of iterations = 100

Q36114221 蘇沛錦

模擬數據

參考數值：

- Sum-Product Algorithm (Maximum 100 iterations):
  - BER = 4.0×10^{-2} at $E_b/N_0 = 2.2$ dB;
  - BER = 1.0×10^{-3} at $E_b/N_0 = 3.0$ dB.

- Sum-Product Algorithm (SPA)
- maximum number of block errors = 100
- maximum number of iterations = 100

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8
No. decoded bit errors	8238	8043	7659	7148	7015	6399	5983	5549	5317	4863	4434	4349	4108	4213	4150	4294	4130	4242	4374	4346
No. decoded bits	78100	78100	78100	78100	78100	78100	78100	78100	78881	81224	83567	108559	199936	374880	1243352	3159926	10789515	44584947	164494220	579430929
bit error rate (BER)	1.05E-01	1.03E-01	9.81E-02	9.15E-02	8.98E-02	8.19E-02	7.66E-02	7.10E-02	6.74E-02	5.99E-02	5.31E-02	4.01E-02	2.05E-02	1.12E-02	3.34E-03	1.36E-03	3.83E-04	9.51E-05	2.66E-05	7.50E-06

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8
No. decoded block errors	100																			
No. decoded blocks	100	100	100	100	100	100	100	100	101	104	107	139	256	480	1592	4046	13815	57087	210620	741909
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.90E-01	9.62E-01	9.35E-01	7.19E-01	3.91E-01	2.08E-01	6.28E-02	2.47E-02	7.24E-03	1.75E-03	4.75E-04	1.35E-04

Q3611421 蘇沛錦

模擬參數設定 (Bonus)

- 其他演算法: 解碼採用 Min-Sum Algorithm (MSA)
- SNR (dB) → 0.0 : 0.2 : 4.6
- Seed (a negative integer): -2000
- maximum number of block errors = 150
- maximum number of iterations = 100

Q36114221 蘇沛錦

模擬數據 (Bonus)

- 其他演算法: Min-Sum Algorithm (MSA)
- maximum number of block errors = 150
- maximum number of iterations = 100

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	17274	16783	16491	15737	15872	15001	14648	14394	13920	13538	13257	12861	12412	12446	11982	11722	11421	11633	11247	11355	11185	11034	11004	11043
No. decoded bits	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	118712	124179	129646	154638	239767	401434	901274	2849088	10659869	80500794	562676136
bit error rate (BER)	1.47E-01	1.43E-01	1.41E-01	1.34E-01	1.35E-01	1.28E-01	1.25E-01	1.23E-01	1.19E-01	1.16E-01	1.13E-01	1.10E-01	1.06E-01	1.05E-01	9.65E-02	9.04E-02	7.39E-02	4.85E-02	2.80E-02	1.26E-02	3.93E-03	1.04E-03	1.37E-04	1.96E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	150																							
No. decoded blocks	150	150	150	150	150	150	150	150	150	150	150	150	150	152	159	166	198	307	514	1154	3648	13649	103074	720456
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.87E-01	9.43E-01	9.04E-01	7.58E-01	4.89E-01	2.92E-01	1.30E-01	4.11E-02	1.10E-02	1.46E-03	2.08E-04

Q36114221 蘇沛錦

模擬參數設定 (Bonus)

- 其他演算法: 解碼採用 Bit-Flipping (BF) Algorithm
- SNR (dB) → 0.0 : 0.2 : 5.0
- Seed (a negative integer): -2000
- maximum number of block errors = 200
- maximum number of iterations = 200

Q36114221 蘇沛錦

模擬數據 (Bonus)

- 其他演算法: Bit-Flipping (BF) Algorithm
- maximum number of block errors = 200
- maximum number of iterations = 200

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	24258	24544	22738	21716	24629	19631	18463	19260	20451	18280	19676	15266	16834	17705	15470	15202	12170	13665	11666	9761	13401	12206	10295	10408	9859	9221
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.55E-01	1.57E-01	1.46E-01	1.39E-01	1.58E-01	1.26E-01	1.18E-01	1.23E-01	1.31E-01	1.17E-01	1.26E-01	9.77E-02	1.08E-01	1.13E-01	9.62E-02	9.45E-02	6.83E-02	6.63E-02	4.38E-02	2.35E-02	1.68E-02	5.76E-03	1.59E-03	4.03E-04	7.85E-05	1.48E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

Q36114221 蘇沛錦

模擬參數設定 (additional simulation)

- 考慮沒有進行編碼的情況 (i.e., uncoded BPSK)
- SNR (dB) → 0.0 : 0.5 : 8.0
- Seed (a negative integer): -2000
- number of decoded bits = 1000000

Q36114421 蘇沛淵

模擬數據 (additional simulation)

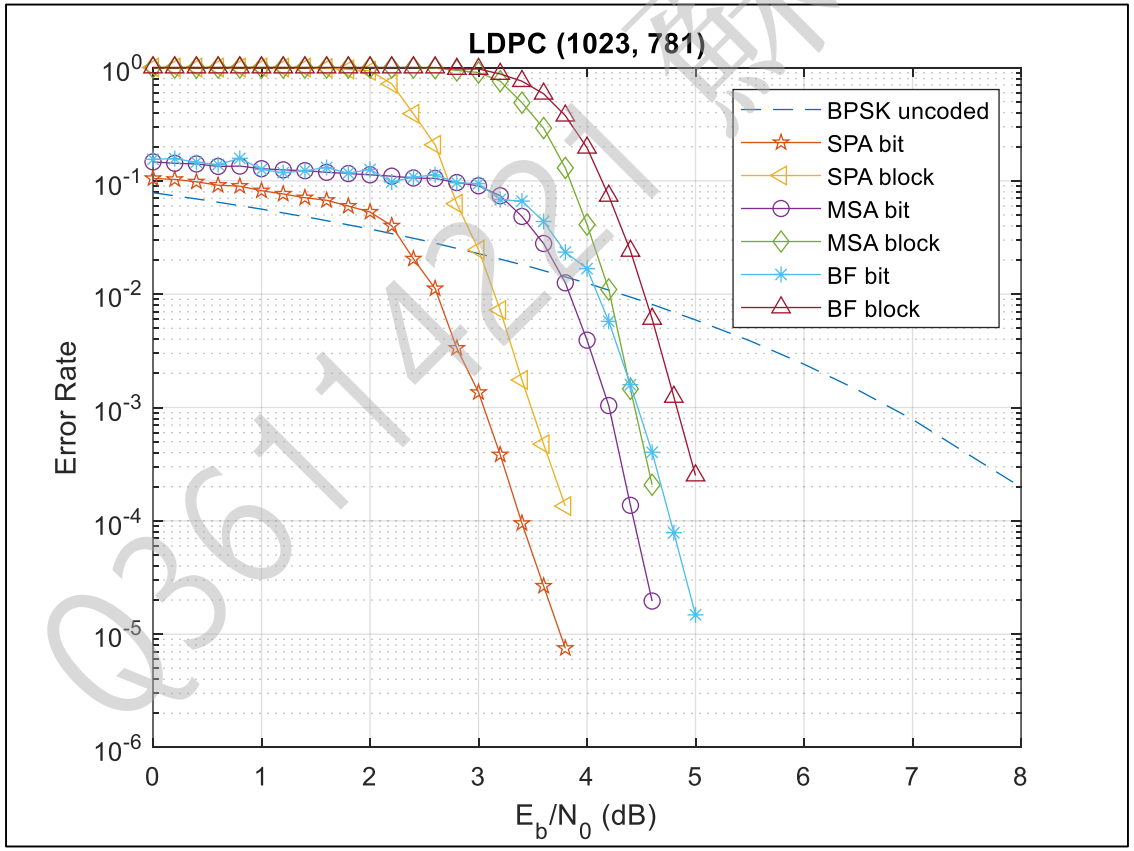
- uncoded BPSK
- number of decoded bits = 1000000

SNR (dB)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8
No. decoded bit errors	786342	670500	563344	463582	375601	297253	228033	172076	124546	87925	59341	38838	24102	14225	7846	3930	1979
No. decoded bits	10000000																
bit error rate (BER)	7.86E-02	6.71E-02	5.63E-02	4.64E-02	3.76E-02	2.97E-02	2.28E-02	1.72E-02	1.25E-02	8.79E-03	5.93E-03	3.88E-03	2.41E-03	1.42E-03	7.85E-04	3.93E-04	1.98E-04

Q36114221 蘇沛淵

模擬效能圖

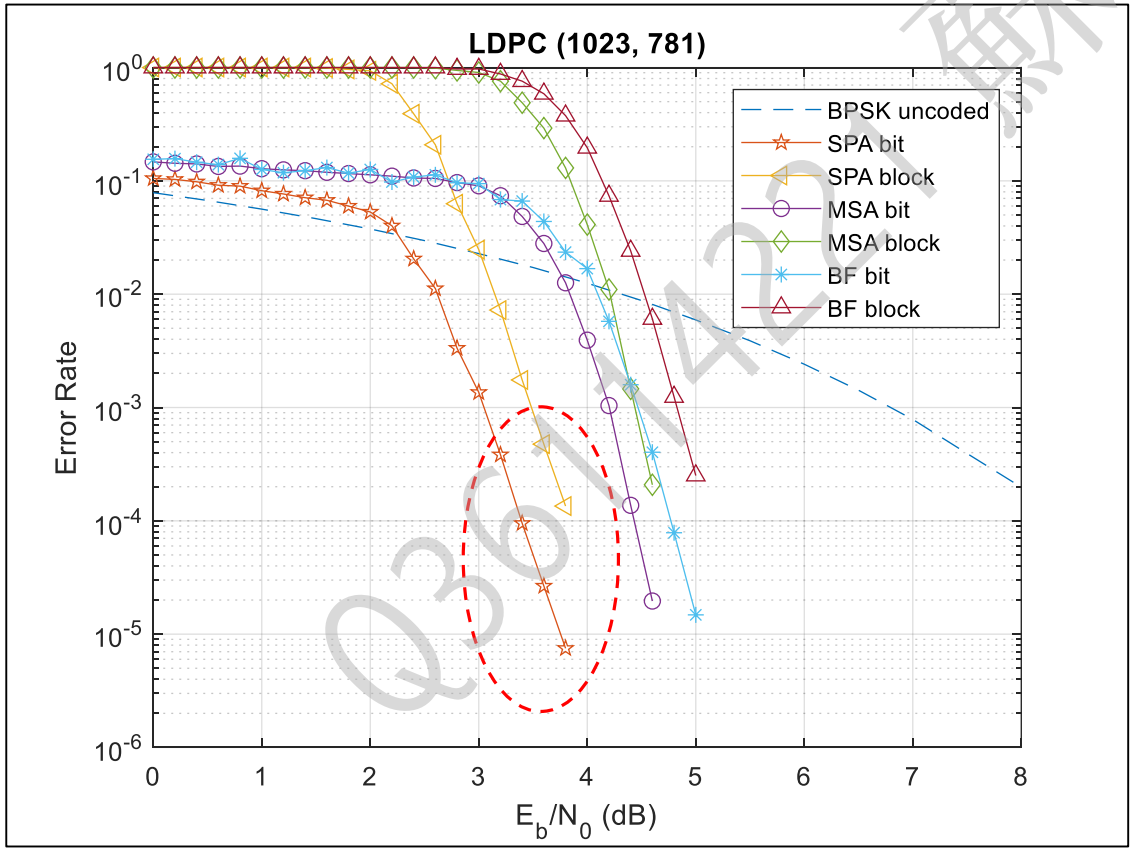
- 沒有編碼的情況 (uncoded BPSK) 和不同解碼演算法 (SPA, MSA, BF) 之比較



Q36114211 蔡沛錦

模擬效能圖

- 沒有編碼的情況 (uncoded BPSK) 和不同解碼演算法 (SPA, MSA, BF) 之比較



觀察:

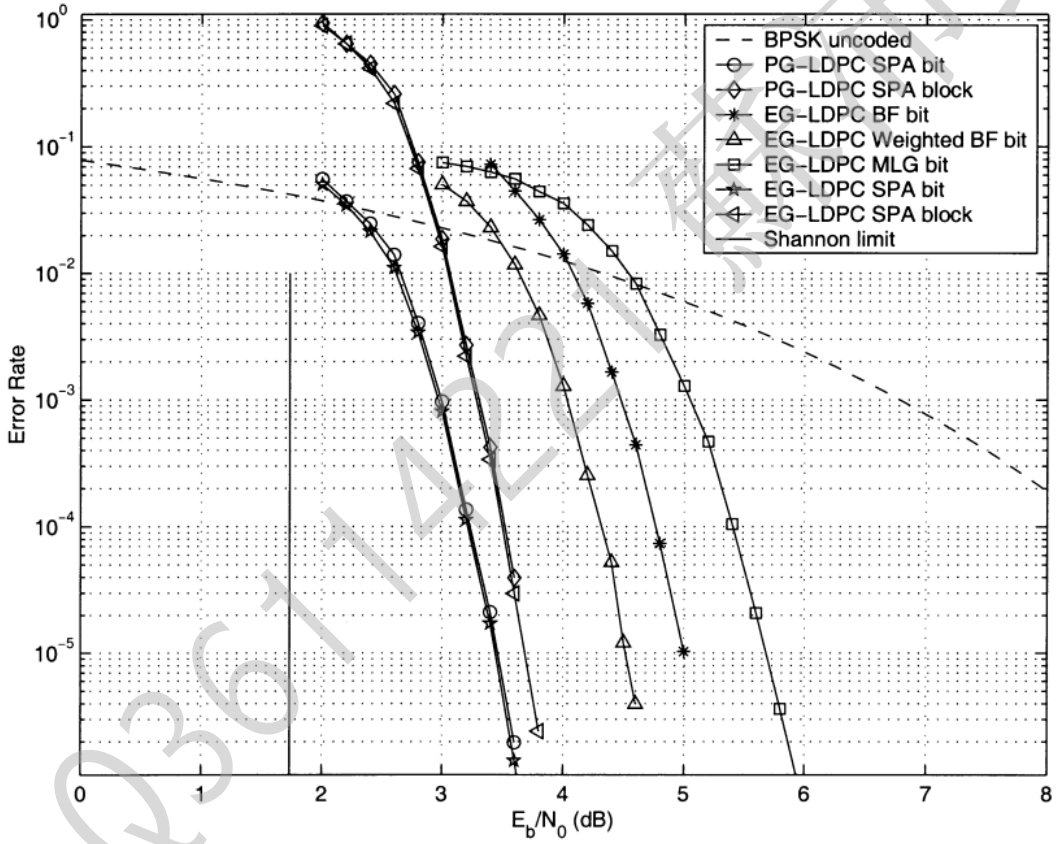
SPA 演算法在高 SNR 的環境下，BER 和 BLER 兩者的錯誤率表現應該可以更好

解決方法:

可以嘗試提高 maximum block errors 的數量，以及最大迭代次數，應該可以讓 SNR = 3.4 ~ 3.6 dB 的錯誤率再往下降 (但因時間因素限制，程式來不及跑完)

Q36114221 蘇沛錦

模擬效能圖 (Reference)*



Bit- and block-error probabilities of the type-I 2-D (1023,781) EG-LDPC code and (1057,813) PG-LDPC code based on different decoding algorithms. *

* Y. Kou, S. Lin and M. P. C. Fossorier, "Low-density parity-check codes based on finite geometries: a rediscovery and new results," in *IEEE Transactions on Information Theory*, vol. 47, no. 7, pp. 2711-2736, Nov. 2001, doi: 10.1109/18.959255.

不同block errors個數的比較 (Bonus)

模擬參數設定:

- 解碼採用 Sum-Product Algorithm (SPA)
- SNR (dB) → 0.0 : 0.2 : 3.6
- Seed (a negative integer): -2000
- maximum number of block errors = 10, 30, 50, 100
- maximum number of iterations = 100 (固定)

Q36114221 蘇沛瑋

不同block errors個數的比較 (Bonus)

模擬數據：Sum-Product Algorithm (SPA)

- maximum number of block errors = 10
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	783	805	735	704	736	637	649	586	488	450	430	425	431	382	424	478	442	455	468
No. decoded bits	7810	7810	7810	7810	7810	7810	7810	7810	7810	9372	9372	8591	19525	34364	101530	142142	1883772	7189886	17628732
bit error rate (BER)	1.00E-01	1.03E-01	9.41E-02	9.01E-02	9.42E-02	8.16E-02	8.31E-02	7.50E-02	6.25E-02	4.80E-02	4.59E-02	4.95E-02	2.21E-02	1.11E-02	4.18E-03	3.36E-03	2.35E-04	6.33E-05	2.65E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	10																		
No. decoded blocks	10	10	10	10	10	10	10	10	10	12	12	11	25	44	130	182	2412	9206	22572
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	8.33E-01	9.09E-01	4.00E-01	2.27E-01	7.69E-02	5.49E-02	4.15E-03	1.09E-03	4.43E-04

03611422 蘇沛璋

不同block errors個數的比較 (Bonus)

模擬數據：Sum-Product Algorithm (SPA)

- maximum number of block errors = 30
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	2442	2382	2264	2093	2008	1960	1844	1694	1613	1472	1374	1289	1321	1297	1267	1213	1320	1222	1179
No. decoded bits	23430	23430	23430	23430	23430	23430	23430	23430	23430	24211	25773	32802	49984	93720	362384	952039	2268024	10225633	55035508
bit error rate (BER)	1.04E-01	1.02E-01	9.66E-02	8.93E-02	8.57E-02	8.37E-02	7.87E-02	7.23E-02	6.88E-02	6.08E-02	5.33E-02	3.93E-02	2.64E-02	1.38E-02	3.50E-03	1.27E-03	5.82E-04	1.20E-04	2.14E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	30																		
No. decoded blocks	30	30	30	30	30	30	30	30	30	31	33	42	64	120	464	1219	2904	13093	70468
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.68E-01	9.09E-01	7.14E-01	4.69E-01	2.50E-01	6.47E-02	2.46E-02	1.03E-02	2.29E-03	4.26E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Sum-Product Algorithm (SPA)

- maximum number of block errors = 50
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	4076	3971	3718	3653	3442	3230	2988	2840	2691	2459	2205	2191	2062	1920	2098	2113	1904	2230	2202
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	46860	50765	91377	193688	526394	1499520	5088996	22374088	65244740
bit error rate (BER)	1.04E-01	1.02E-01	9.52E-02	9.35E-02	8.81E-02	8.27E-02	7.65E-02	7.27E-02	6.89E-02	6.30E-02	4.71E-02	4.32E-02	2.26E-02	9.91E-03	3.99E-03	1.41E-03	3.74E-04	9.97E-05	3.37E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	50																		
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	60	65	117	248	674	1920	6516	28648	83540
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	7.69E-01	4.27E-01	2.02E-01	7.42E-02	2.60E-02	7.67E-03	1.75E-03	5.99E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Sum-Product Algorithm (SPA)

- maximum number of block errors = 100
- maximum number of iterations = 100 (固定)

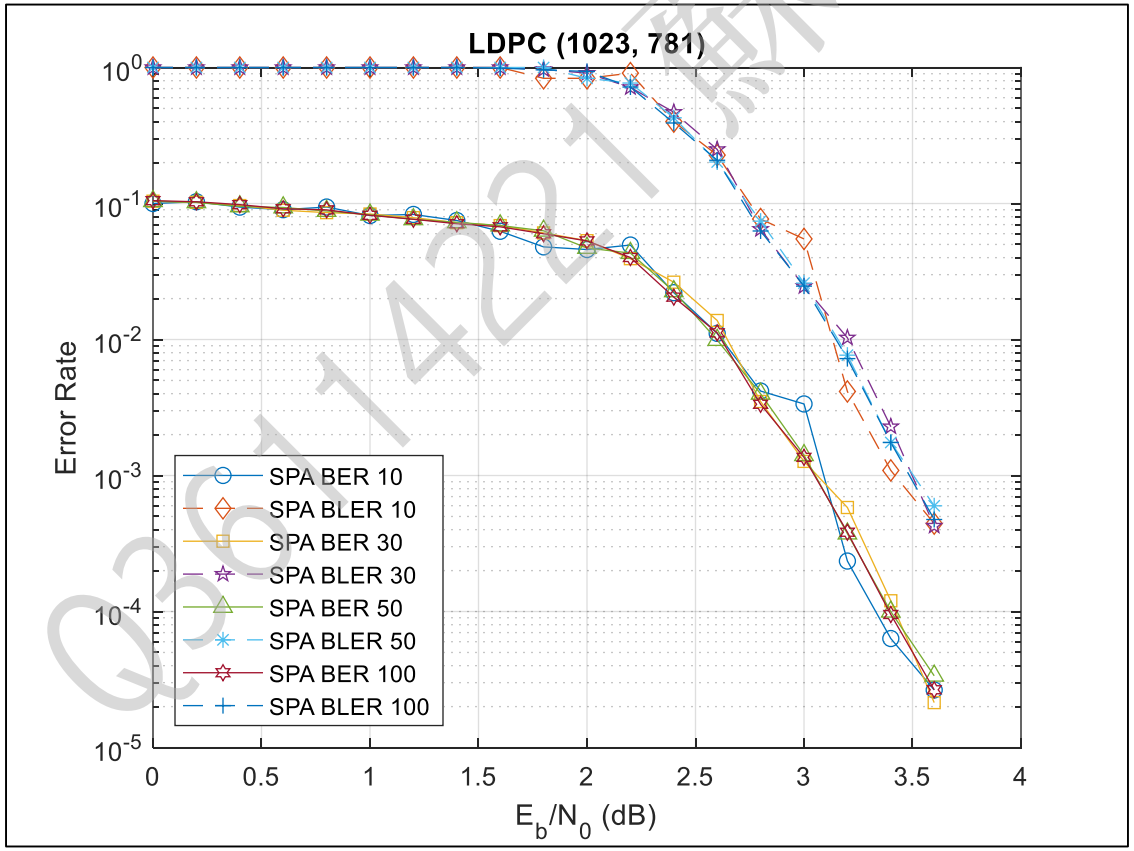
SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	8238	8043	7659	7148	7015	6399	5983	5549	5317	4863	4434	4349	4108	4213	4150	4294	4130	4242	4374
No. decoded bits	78100	78100	78100	78100	78100	78100	78100	78100	78881	81224	83567	108559	199936	374880	1243352	3159926	10789515	44584947	164494220
bit error rate (BER)	1.05E-01	1.03E-01	9.81E-02	9.15E-02	8.98E-02	8.19E-02	7.66E-02	7.10E-02	6.74E-02	5.99E-02	5.31E-02	4.01E-02	2.05E-02	1.12E-02	3.34E-03	1.36E-03	3.83E-04	9.51E-05	2.66E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	100																		
No. decoded blocks	100	100	100	100	100	100	100	100	101	104	107	139	256	480	1592	4046	13815	57087	210620
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.90E-01	9.62E-01	9.35E-01	7.19E-01	3.91E-01	2.08E-01	6.28E-02	2.47E-02	7.24E-03	1.75E-03	4.75E-04

0361422 蘇沛璋

不同block errors個數的比較 (Bonus)

模擬效能圖：maximum number of iterations = 100 (固定)



Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬參數設定:

- 解碼採用 Min-Sum Algorithm (MSA)
- SNR (dB) → 0.0 : 0.2 : 4.6
- Seed (a negative integer): -2000
- maximum number of block errors = 10, 30, 50, 100, 150
- maximum number of iterations = 100 (固定)

Q36114221 蘇沛瑋

不同block errors個數的比較 (Bonus)

模擬數據：Min-Sum Algorithm (MSA)

- maximum number of block errors = 10
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	1109	1113	1057	1054	1121	1024	967	962	893	870	899	902	873	820	786	832	725	795	786	693	792	774	687	851
No. decoded bits	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	10153	14839	35145	49984	99187	855976	5131170	52082547
bit error rate (BER)	1.42E-01	1.43E-01	1.35E-01	1.35E-01	1.44E-01	1.31E-01	1.24E-01	1.23E-01	1.14E-01	1.11E-01	1.15E-01	1.15E-01	1.12E-01	1.05E-01	1.01E-01	1.07E-01	7.14E-02	5.36E-02	2.24E-02	1.39E-02	7.98E-03	9.04E-04	1.34E-04	1.63E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	10																							
No. decoded blocks	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	13	19	45	64	127	1096	6570	66687
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	7.69E-01	5.26E-01	2.22E-01	1.56E-01	7.87E-02	9.12E-03	1.52E-03	1.50E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Min-Sum Algorithm (MSA)

- maximum number of block errors = 30
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	3501	3394	3299	3040	3061	2919	3070	2928	2851	2721	2658	2689	2628	2590	2331	2461	2203	2380	2231	2382	2262	2272	2195	2184
No. decoded bits	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	26554	35926	47641	77319	145266	567006	2319570	13530825	135170794
bit error rate (BER)	1.49E-01	1.45E-01	1.41E-01	1.30E-01	1.31E-01	1.25E-01	1.31E-01	1.25E-01	1.22E-01	1.16E-01	1.13E-01	1.15E-01	1.12E-01	1.11E-01	9.95E-02	9.27E-02	6.13E-02	5.00E-02	2.89E-02	1.64E-02	3.99E-03	9.79E-04	1.62E-04	1.62E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	30																							
No. decoded blocks	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	34	46	61	99	186	726	2970	17325	173074
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.82E-01	6.52E-01	4.92E-01	3.03E-01	1.61E-01	4.13E-02	1.01E-02	1.73E-03	1.73E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Min-Sum Algorithm (MSA)

- maximum number of block errors = 50
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	5840	5682	5424	5240	5307	5056	4791	4771	4698	4606	4228	4212	4179	4057	4079	4032	3813	3569	3952	3763	3716	3537	3840	3490
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	42174	45298	49203	85129	112464	299904	872377	3446553	24029808	242887095
bit error rate (BER)	1.50E-01	1.46E-01	1.39E-01	1.34E-01	1.36E-01	1.29E-01	1.23E-01	1.22E-01	1.20E-01	1.18E-01	1.08E-01	1.08E-01	1.07E-01	1.02E-01	9.67E-02	8.90E-02	7.75E-02	4.19E-02	3.51E-02	1.25E-02	4.26E-03	1.03E-03	1.60E-04	1.44E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	50																							
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	51	54	58	63	109	144	384	1117	4413	30768	310995
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.26E-01	8.62E-01	7.94E-01	4.59E-01	3.47E-01	1.30E-01	4.48E-02	1.13E-02	1.63E-03	1.61E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Min-Sum Algorithm (MSA)

- maximum number of block errors = 100
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	11477	11216	10918	10700	10625	10169	9823	9614	9619	9024	9055	8882	8449	8575	7957	7963	8020	7653	7505	7479	7479	7470	7095	7239
No. decoded bits	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	79662	78881	79662	89034	100749	161667	270226	640420	1835350	7212535	46788929	386237302
bit error rate (BER)	1.47E-01	1.44E-01	1.40E-01	1.37E-01	1.36E-01	1.30E-01	1.26E-01	1.23E-01	1.23E-01	1.16E-01	1.16E-01	1.14E-01	1.06E-01	1.09E-01	9.99E-02	8.94E-02	7.96E-02	4.73E-02	2.78E-02	1.17E-02	4.07E-03	1.04E-03	1.52E-04	1.87E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	100																							
No. decoded blocks	100	100	100	100	100	100	100	100	100	100	100	100	102	101	102	114	129	207	346	820	2350	9235	59909	494542
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.90E-01	9.80E-01	8.77E-01	7.75E-01	4.83E-01	2.89E-01	1.22E-01	4.26E-02	1.08E-02	1.67E-03	2.02E-04

Q36114221蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Min-Sum Algorithm (MSA)

- maximum number of block errors = 150
- maximum number of iterations = 100 (固定)

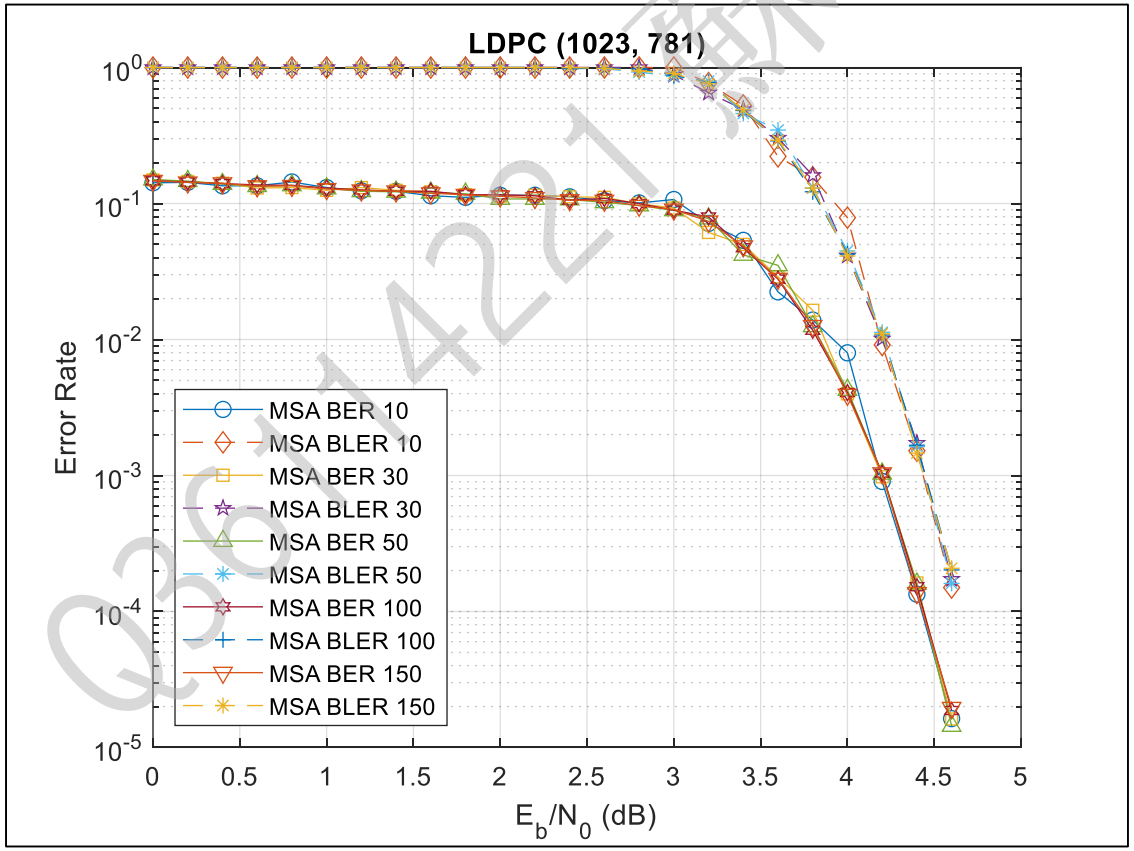
SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	17274	16783	16491	15737	15872	15001	14648	14394	13920	13538	13257	12861	12412	12446	11982	11722	11421	11633	11247	11355	11185	11034	11004	11043
No. decoded bits	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	118712	124179	129646	154638	239767	401434	901274	2849088	10659869	80500794	562676136
bit error rate (BER)	1.47E-01	1.43E-01	1.41E-01	1.34E-01	1.35E-01	1.28E-01	1.25E-01	1.23E-01	1.19E-01	1.16E-01	1.13E-01	1.10E-01	1.06E-01	1.05E-01	9.65E-02	9.04E-02	7.39E-02	4.85E-02	2.80E-02	1.26E-02	3.93E-03	1.04E-03	1.37E-04	1.96E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	150																							
No. decoded blocks	150	150	150	150	150	150	150	150	150	150	150	150	150	152	159	166	198	307	514	1154	3648	13649	103074	720456
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.87E-01	9.43E-01	9.04E-01	7.58E-01	4.89E-01	2.92E-01	1.30E-01	4.11E-02	1.10E-02	1.46E-03	2.08E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬效能圖: maximum number of iterations = 100 (固定)



Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬參數設定:

- 解碼採用 Bit-Flipping (BF) Algorithm
- SNR (dB) → 0.0 : 0.2 : 5.0
- Seed (a negative integer): -2000
- maximum number of block errors = 10, 30, 50, 100, 150, 200
- maximum number of iterations = 100 (固定)

Q3614221 蘇沛瑋

不同block errors個數的比較 (Bonus)

模擬數據：Bit-Flipping (BF) Algorithm

- maximum number of block errors = 10
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	2138	1067	1006	928	1011	933	935	879	843	1323	743	1322	675	676	617	544	619	592	527	485	538	510	397	541	1080	339
No. decoded bits	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	7810	9372	9372	17182	29678	49203	97625	295999	912208	3662109	44701316
bit error rate (BER)	2.74E-01	1.37E-01	1.29E-01	1.19E-01	1.29E-01	1.19E-01	1.20E-01	1.13E-01	1.08E-01	1.69E-01	9.51E-02	1.69E-01	8.64E-02	8.66E-02	7.90E-02	6.97E-02	6.60E-02	6.32E-02	3.07E-02	1.63E-02	1.09E-02	5.22E-03	1.34E-03	5.93E-04	2.95E-04	7.58E-06

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	10																									
No. decoded blocks	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	12	12	22	38	63	125	379	1168	4689	57236
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	8.33E-01	4.55E-01	2.63E-01	1.59E-01	8.00E-02	2.64E-02	8.56E-03	2.13E-03	1.75E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 30
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	4860	3215	3163	3474	3476	3429	3734	3154	2539	2907	2225	3295	2023	1983	3035	2486	1612	1395	1429	2085	1606	1238	2075	1800	1028	1757
No. decoded bits	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	23430	24211	28116	36707	44517	57794	121836	249139	937981	2339095	24326588	113177834
bit error rate (BER)	2.07E-01	1.37E-01	1.35E-01	1.48E-01	1.48E-01	1.46E-01	1.59E-01	1.35E-01	1.08E-01	1.24E-01	9.50E-02	1.41E-01	8.63E-02	8.46E-02	1.30E-01	1.03E-01	5.73E-02	3.80E-02	3.21E-02	3.61E-02	1.32E-02	4.97E-03	2.21E-03	7.70E-04	4.23E-05	1.55E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	30																									
No. decoded blocks	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	31	36	47	57	74	156	319	1201	2995	31148	144914
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.68E-01	8.33E-01	6.38E-01	5.26E-01	4.05E-01	1.92E-01	9.40E-02	2.50E-02	1.00E-02	9.63E-04	2.07E-04

03611422 蘇沛瑋

不同block errors個數的比較 (Bonus)

模擬數據：Bit-Flipping (BF) Algorithm

- maximum number of block errors = 50
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	6978	6445	5583	5105	5928	5692	5662	5501	6375	4453	3710	4759	3472	4663	3515	3607	3292	2531	3035	2378	2907	2774	2682	3882	3124	2467
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	40612	46079	53889	74195	106997	188221	372537	1468280	6650996	26069780	146634312
bit error rate (BER)	1.79E-01	1.65E-01	1.43E-01	1.31E-01	1.52E-01	1.46E-01	1.45E-01	1.41E-01	1.63E-01	1.14E-01	9.50E-02	1.22E-01	8.89E-02	1.19E-01	8.82E-02	8.88E-02	7.14E-02	4.70E-02	4.09E-02	2.22E-02	1.54E-02	7.45E-03	1.83E-03	5.84E-04	1.20E-04	1.68E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	50																									
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	50	51	52	59	69	95	137	241	477	1880	8516	33380	187752
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.62E-01	8.47E-01	7.25E-01	5.26E-01	3.65E-01	2.07E-01	1.05E-01	2.66E-02	5.87E-03	1.50E-03	2.66E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據：Bit-Flipping (BF) Algorithm

- maximum number of block errors = 100
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	12474	11366	13140	11154	10503	10569	10651	8921	9371	9605	7617	7941	7396	8365	8616	6607	6958	6929	9596	4574	6867	6202	5027	5866	6534	4628
No. decoded bits	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	78100	78881	79662	78881	86691	105435	132770	203060	429550	973907	2567928	9913233	53789032	295731898
bit error rate (BER)	1.60E-01	1.46E-01	1.68E-01	1.43E-01	1.34E-01	1.35E-01	1.36E-01	1.14E-01	1.20E-01	1.23E-01	9.75E-02	1.02E-01	9.47E-02	1.06E-01	1.08E-01	8.38E-02	8.03E-02	6.57E-02	7.23E-02	2.25E-02	1.60E-02	6.37E-03	1.96E-03	5.92E-04	1.21E-04	1.56E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	100																									
No. decoded blocks	100	100	100	100	100	100	100	100	100	100	100	100	100	101	102	101	111	135	170	260	550	1247	3288	12693	68872	378658
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.90E-01	9.80E-01	9.90E-01	9.01E-01	7.41E-01	5.88E-01	3.85E-01	1.82E-01	8.02E-02	3.04E-02	7.88E-03	1.45E-03	2.64E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 150
- maximum number of iterations = 100 (固定)

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	18486	18271	18263	17877	15205	15581	16803	14542	14535	16168	15433	13796	12676	12955	10398	11101	10217	10886	10769	9691	7579	8010	7664	8654	7537	8962
No. decoded bits	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117150	117931	124179	129646	156981	219461	323334	631829	1515921	5012458	17766969	77618123	508395074
bit error rate (BER)	1.58E-01	1.56E-01	1.56E-01	1.53E-01	1.30E-01	1.33E-01	1.43E-01	1.24E-01	1.24E-01	1.38E-01	1.32E-01	1.18E-01	1.08E-01	1.11E-01	8.82E-02	8.94E-02	7.88E-02	6.93E-02	4.91E-02	3.00E-02	1.20E-02	5.28E-03	1.53E-03	4.87E-04	9.71E-05	1.76E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	150																									
No. decoded blocks	150	150	150	150	150	150	150	150	150	150	150	150	150	150	151	159	166	201	281	414	809	1941	6418	22749	99383	650954
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.93E-01	9.43E-01	9.04E-01	7.46E-01	5.34E-01	3.62E-01	1.85E-01	7.73E-02	2.34E-02	6.59E-03	1.51E-03	2.30E-04

0361114221 蘇沛強

不同block errors個數的比較 (Bonus)

模擬數據：Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200
- maximum number of iterations = 100 (固定)

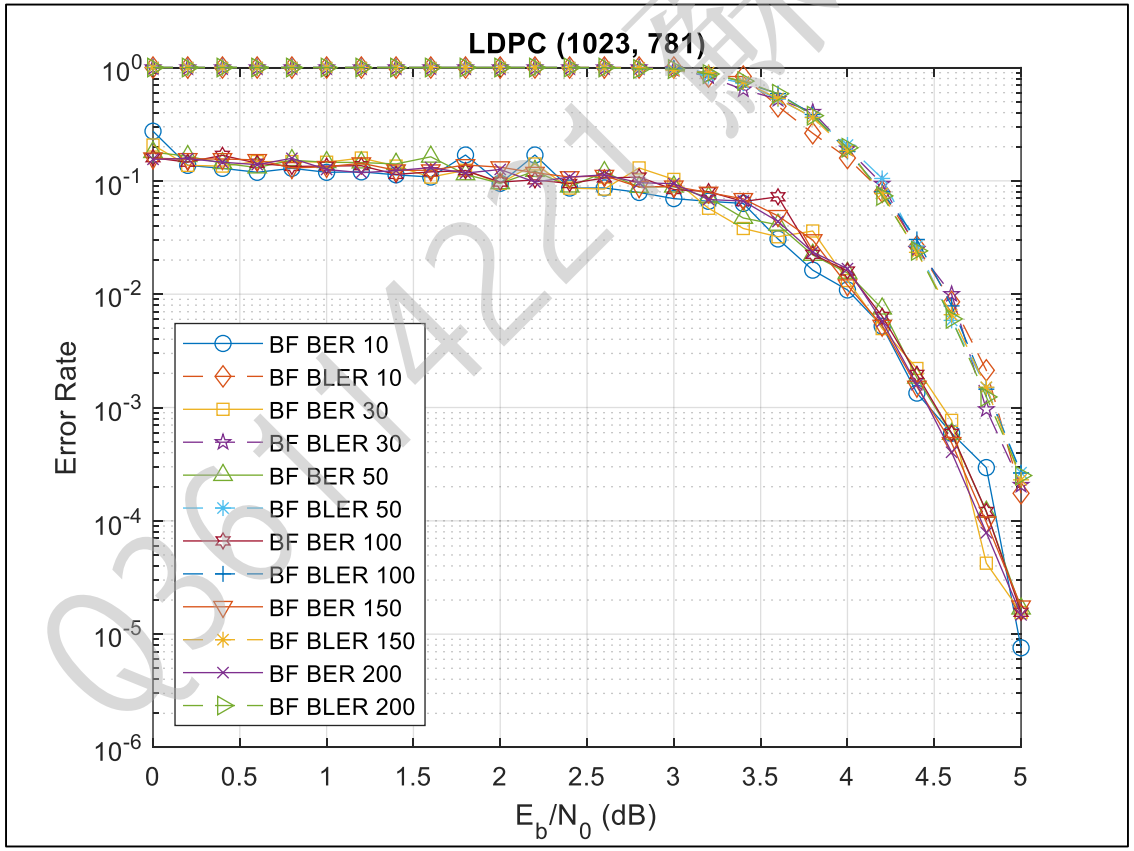
SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	24248	24524	22743	21704	24624	19632	18451	19260	20430	18287	19693	15240	16838	17694	15471	15203	12182	13670	11674	9761	13399	12215	10306	10404	9859	9217
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.55E-01	1.57E-01	1.46E-01	1.39E-01	1.58E-01	1.26E-01	1.18E-01	1.23E-01	1.31E-01	1.17E-01	1.26E-01	9.76E-02	1.08E-01	1.13E-01	9.62E-02	9.45E-02	6.84E-02	6.63E-02	4.38E-02	2.35E-02	1.68E-02	5.76E-03	1.59E-03	4.03E-04	7.85E-05	1.48E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

Q36114221 蘇沛鋸

不同block errors個數的比較 (Bonus)

模擬效能圖：maximum number of iterations = 100 (固定)



Q36114221 蘇沛鋸

不同iteration個數的比較 (Bonus)

模擬參數設定:

- 解碼採用 Sum-Product Algorithm (SPA)
- SNR (dB) → 0.0 : 0.2 : 3.6
- Seed (a negative integer): -2000
- maximum number of block errors = 50 (固定)
- maximum number of iterations = 10, 30, 50, 100, 150

Q36114221 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Sum-Product Algorithm (SPA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 10

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	4076	3971	3718	3653	3442	3230	2988	2839	2691	2466	2143	2137	1940	2044	1930	1866	1895	2186	1772
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	45298	46079	95282	118712	229614	702900	1325357	3227873	8003688
bit error rate (BER)	1.04E-01	1.02E-01	9.52E-02	9.35E-02	8.81E-02	8.27E-02	7.65E-02	7.27E-02	6.89E-02	6.31E-02	4.73E-02	4.64E-02	2.04E-02	1.72E-02	8.41E-03	2.65E-03	1.43E-03	6.77E-04	2.21E-04

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	50																		
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	58	59	122	152	294	900	1697	4133	10248
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.62E-01	8.47E-01	4.10E-01	3.29E-01	1.70E-01	5.56E-02	2.95E-02	1.21E-02	4.88E-03

03617421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據：Sum-Product Algorithm (SPA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 30

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	4076	3971	3718	3653	3442	3230	2988	2840	2691	2464	2208	2269	2062	1967	1995	1842	1921	2161	2073
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	46860	49203	95282	164010	375661	1005147	3016222	6399514	21893773
bit error rate (BER)	1.04E-01	1.02E-01	9.52E-02	9.35E-02	8.81E-02	8.27E-02	7.65E-02	7.27E-02	6.89E-02	6.31E-02	4.71E-02	4.61E-02	2.16E-02	1.20E-02	5.31E-03	1.83E-03	6.37E-04	3.38E-04	9.47E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	50																		
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	60	63	122	210	481	1287	3862	8194	28033
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	7.94E-01	4.10E-01	2.38E-01	1.04E-01	3.89E-02	1.29E-02	6.10E-03	1.78E-03

Q36114221 蘇沛錦

不同iteration個數的比較 (Bonus)

模擬數據: Sum-Product Algorithm (SPA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 50

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	4076	3971	3718	3653	3442	3230	2988	2840	2691	2463	2204	2184	2051	2001	1999	2047	1994	2194	2048
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	46860	50765	89815	151514	472505	1198054	4325959	12260138	33251856
bit error rate (BER)	1.04E-01	1.02E-01	9.52E-02	9.35E-02	8.81E-02	8.27E-02	7.65E-02	7.27E-02	6.89E-02	6.31E-02	4.70E-02	4.30E-02	2.28E-02	1.32E-02	4.23E-03	1.71E-03	4.61E-04	1.79E-04	6.16E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	50																		
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	60	65	115	194	605	1534	5539	15698	42576
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	7.69E-01	4.35E-01	2.58E-01	8.26E-02	3.26E-02	9.03E-03	3.19E-03	1.17E-03

03617421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Sum-Product Algorithm (SPA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 100

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	4076	3971	3718	3653	3442	3230	2988	2840	2691	2459	2205	2191	2062	1920	2098	2113	1904	2230	2202
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	46860	50765	91377	193688	526394	1499520	5088996	22374088	65244740
bit error rate (BER)	1.04E-01	1.02E-01	9.52E-02	9.35E-02	8.81E-02	8.27E-02	7.65E-02	7.27E-02	6.89E-02	6.30E-02	4.71E-02	4.32E-02	2.26E-02	9.91E-03	3.99E-03	1.41E-03	3.74E-04	9.97E-05	3.37E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	50																		
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	60	65	117	248	674	1920	6516	28648	83540
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	7.69E-01	4.27E-01	2.02E-01	7.42E-02	2.60E-02	7.67E-03	1.75E-03	5.99E-04

03617421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據：Sum-Product Algorithm (SPA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 150

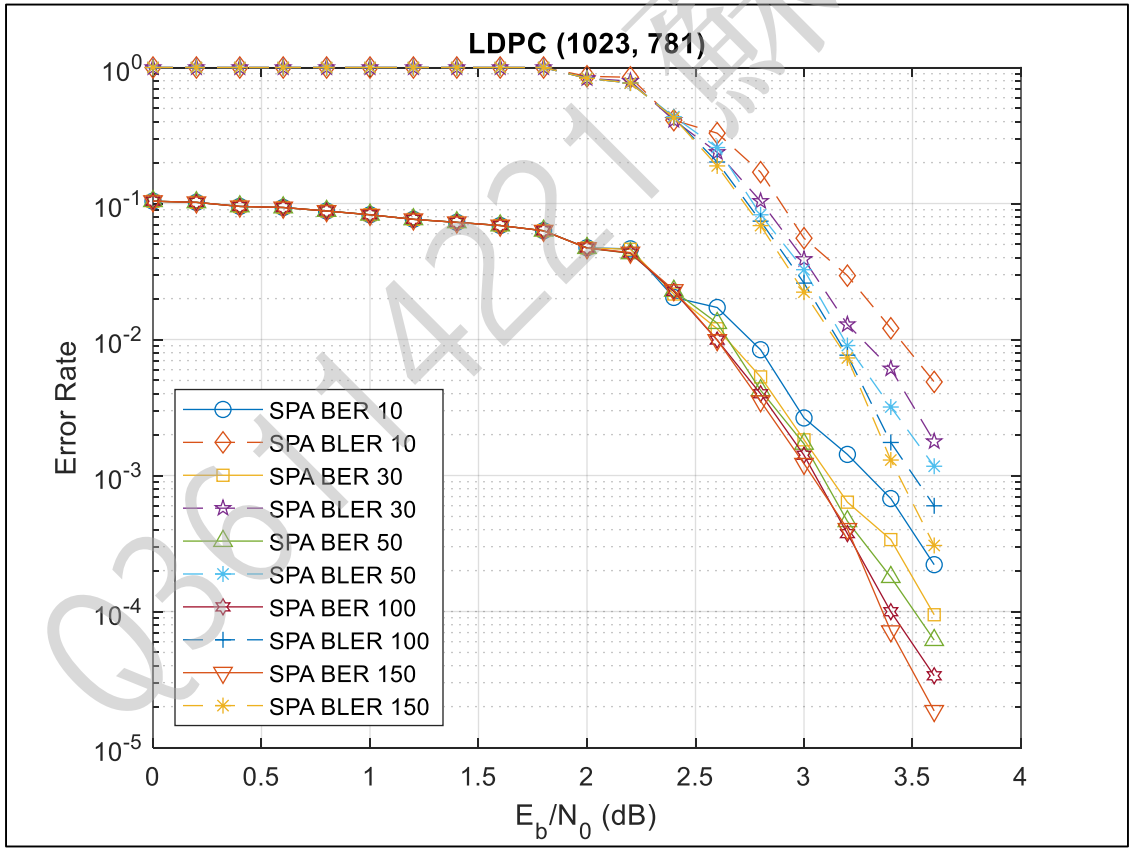
SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded bit errors	4076	3971	3718	3653	3442	3230	2988	2840	2691	2465	2204	2211	2109	2053	1999	2128	2159	2156	2373
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	46860	50765	91377	206965	567787	1750221	5336573	30060690	127688033
bit error rate (BER)	1.04E-01	1.02E-01	9.52E-02	9.35E-02	8.81E-02	8.27E-02	7.65E-02	7.27E-02	6.89E-02	6.31E-02	4.70E-02	4.36E-02	2.31E-02	9.92E-03	3.52E-03	1.22E-03	4.05E-04	7.17E-05	1.86E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
No. decoded block errors	50																		
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	60	65	117	265	727	2241	6833	38490	163493
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	8.33E-01	7.69E-01	4.27E-01	1.89E-01	6.88E-02	2.23E-02	7.32E-03	1.30E-03	3.06E-04

Q36114221 蘇沛錦

不同iteration個數的比較 (Bonus)

模擬效能圖：maximum number of block errors = 50 (固定)



Q36114221 蘇沛錦

不同iteration個數的比較 (Bonus)

模擬參數設定:

- 解碼採用 Min-Sum Algorithm (MSA)
- SNR (dB) → 0.0 : 0.2 : 4.6
- Seed (a negative integer): -2000
- maximum number of block errors = 50 (固定)
- maximum number of iterations = 10, 30, 50, 100, 150

Q36114221 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Min-Sum Algorithm (MSA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 10

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	5575	5556	5317	5466	5088	5100	4941	4827	4864	4576	4430	4465	4241	3986	3979	3917	3871	3745	3661	3718	3528	3714	3619	3760
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	42174	45298	49203	85129	112464	299904	872377	3446553	24029808	242887095
bit error rate (BER)	1.43E-01	1.42E-01	1.36E-01	1.40E-01	1.30E-01	1.31E-01	1.27E-01	1.24E-01	1.25E-01	1.17E-01	1.13E-01	1.14E-01	1.09E-01	1.00E-01	9.43E-02	8.65E-02	7.87E-02	4.40E-02	3.26E-02	1.24E-02	4.04E-03	1.08E-03	1.51E-04	1.55E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	50																							
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	51	54	58	63	109	144	384	1117	4413	30768	310995
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.26E-01	8.62E-01	7.94E-01	4.59E-01	3.47E-01	1.30E-01	4.48E-02	1.13E-02	1.63E-03	1.61E-04

03611421 蘇沛銘

不同iteration個數的比較 (Bonus)

模擬數據: Min-Sum Algorithm (MSA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 30

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	5568	5572	5394	5427	5148	5129	4960	4966	4806	4665	4206	4468	4324	4155	4005	3956	4134	4000	3836	3674	3916	3875	3505	3488
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	42174	45298	49203	85129	112464	299904	872377	3446553	24029808	242887095
bit error rate (BER)	1.43E-01	1.43E-01	1.38E-01	1.39E-01	1.32E-01	1.31E-01	1.27E-01	1.27E-01	1.23E-01	1.19E-01	1.08E-01	1.14E-01	1.11E-01	1.04E-01	9.50E-02	8.73E-02	8.40E-02	4.70E-02	3.41E-02	1.23E-02	4.49E-03	1.12E-03	1.46E-04	1.44E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	50																							
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	51	54	58	63	109	144	384	1117	4413	30768	310995
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.26E-01	8.62E-01	7.94E-01	4.59E-01	3.47E-01	1.30E-01	4.48E-02	1.13E-02	1.63E-03	1.61E-04

03611421 蘇沛銘

不同iteration個數的比較 (Bonus)

模擬數據: Min-Sum Algorithm (MSA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 50

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	5544	5554	5479	5545	5119	5121	4757	4892	4704	4431	4503	4358	4329	4469	4022	3982	3727	4114	3590	3615	3866	3631	3623	3570
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	42174	45298	49203	85129	112464	299904	872377	3446553	24029808	242887095
bit error rate (BER)	1.42E-01	1.42E-01	1.40E-01	1.42E-01	1.31E-01	1.31E-01	1.22E-01	1.25E-01	1.20E-01	1.13E-01	1.15E-01	1.12E-01	1.11E-01	1.12E-01	9.54E-02	8.79E-02	7.57E-02	4.83E-02	3.19E-02	1.21E-02	4.43E-03	1.05E-03	1.51E-04	1.47E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	50																							
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	51	54	58	63	109	144	384	1117	4413	30768	310995
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.26E-01	8.62E-01	7.94E-01	4.59E-01	3.47E-01	1.30E-01	4.48E-02	1.13E-02	1.63E-03	1.61E-04

03611421 蘇沛銘

不同iteration個數的比較 (Bonus)

模擬數據: Min-Sum Algorithm (MSA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 100

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	5840	5682	5424	5240	5307	5056	4791	4771	4698	4606	4228	4212	4179	4057	4079	4032	3813	3569	3952	3763	3716	3537	3840	3490
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	42174	45298	49203	85129	112464	299904	872377	3446553	24029808	242887095
bit error rate (BER)	1.50E-01	1.46E-01	1.39E-01	1.34E-01	1.36E-01	1.29E-01	1.23E-01	1.22E-01	1.20E-01	1.18E-01	1.08E-01	1.08E-01	1.07E-01	1.02E-01	9.67E-02	8.90E-02	7.75E-02	4.19E-02	3.51E-02	1.25E-02	4.26E-03	1.03E-03	1.60E-04	1.44E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	50																							
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	51	54	58	63	109	144	384	1117	4413	30768	310995
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.26E-01	8.62E-01	7.94E-01	4.59E-01	3.47E-01	1.30E-01	4.48E-02	1.13E-02	1.63E-03	1.61E-04

03611421 蘇沛銘

不同iteration個數的比較 (Bonus)

模擬數據: Min-Sum Algorithm (MSA)

- maximum number of block errors = 50 (固定)
- maximum number of iterations = 150

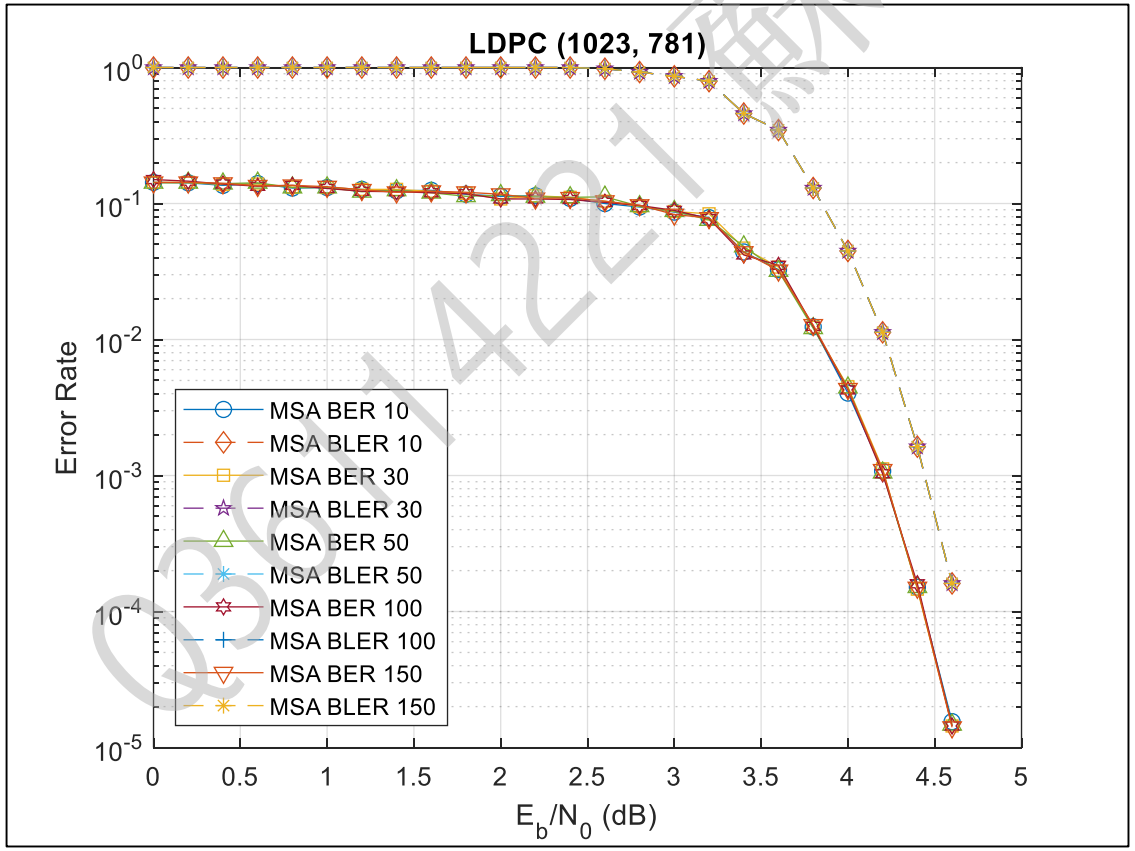
SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded bit errors	5595	5600	5496	5268	5306	5187	4906	4742	4789	4731	4558	4274	4294	4132	4102	3761	3851	3739	3618	3852	3782	3793	3610	3421
No. decoded bits	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39050	39831	42174	45298	49203	85129	112464	299904	872377	3446553	24029808	242887095
bit error rate (BER)	1.43E-01	1.43E-01	1.41E-01	1.35E-01	1.36E-01	1.33E-01	1.26E-01	1.21E-01	1.23E-01	1.21E-01	1.17E-01	1.09E-01	1.10E-01	1.04E-01	9.73E-02	8.30E-02	7.83E-02	4.39E-02	3.22E-02	1.28E-02	4.34E-03	1.10E-03	1.50E-04	1.41E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6
No. decoded block errors	50																							
No. decoded blocks	50	50	50	50	50	50	50	50	50	50	50	50	50	51	54	58	63	109	144	384	1117	4413	30768	310995
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.80E-01	9.26E-01	8.62E-01	7.94E-01	4.59E-01	3.47E-01	1.30E-01	4.48E-02	1.13E-02	1.63E-03	1.61E-04

03611421 蘇沛銘

不同iteration個數的比較 (Bonus)

模擬效能圖：maximum number of block errors = 50 (固定)



Q36114221 蘇沛翔

不同iteration個數的比較 (Bonus)

模擬參數設定:

- 解碼採用 Bit-Flipping (BF) Algorithm
- SNR (dB) → 0.0 : 0.2 : 5.0
- Seed (a negative integer): -2000
- maximum number of block errors = 200 (固定)
- maximum number of iterations = 10, 30, 50, 100, 150 , 200

Q3614221 蘇沛瑄

不同iteration個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200 (固定)
- maximum number of iterations = 10

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	19248	18871	18141	17256	16546	15709	14970	14301	13554	12734	12060	11453	10772	10115	9263	8445	7738	6810	5654	4595	3919	3340	2668	2385	1823	1663
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156981	158543	158543	185878	206184	261635	403777	841918	1525293	3706626	15829308	51247658
bit error rate (BER)	1.23E-01	1.21E-01	1.16E-01	1.10E-01	1.06E-01	1.01E-01	9.58E-02	9.16E-02	8.68E-02	8.15E-02	7.72E-02	7.33E-02	6.90E-02	6.48E-02	5.90E-02	5.33E-02	4.88E-02	3.66E-02	2.74E-02	1.76E-02	9.71E-03	3.97E-03	1.75E-03	6.43E-04	1.15E-04	3.25E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	201	203	203	238	264	335	517	1078	1953	4746	20268	65618
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.95E-01	9.85E-01	9.85E-01	8.40E-01	7.58E-01	5.97E-01	3.87E-01	1.86E-01	1.02E-01	4.21E-02	9.87E-03	3.05E-03

0361114221 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200 (固定)
- maximum number of iterations = 30

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	22844	22506	21761	19697	22498	18691	17575	17613	16722	16610	16509	14765	15943	15407	14588	14313	10673	10858	10756	8795	10060	10676	8681	8962	8364	8214
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.46E-01	1.44E-01	1.39E-01	1.26E-01	1.44E-01	1.20E-01	1.13E-01	1.13E-01	1.07E-01	1.06E-01	1.06E-01	9.45E-02	1.02E-01	9.86E-02	9.07E-02	8.90E-02	5.99E-02	5.27E-02	4.04E-02	2.12E-02	1.26E-02	5.03E-03	1.34E-03	3.47E-04	6.66E-05	1.32E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

03611421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200 (固定)
- maximum number of iterations = 50

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	24147	24475	22720	21716	24109	19574	18448	19142	19842	17221	19658	15218	16818	17042	15382	15160	12146	13613	11667	9724	13356	12154	10252	9838	9841	9151
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.55E-01	1.57E-01	1.45E-01	1.39E-01	1.54E-01	1.25E-01	1.18E-01	1.23E-01	1.27E-01	1.10E-01	1.26E-01	9.74E-02	1.08E-01	1.09E-01	9.56E-02	9.42E-02	6.82E-02	6.60E-02	4.38E-02	2.34E-02	1.67E-02	5.73E-03	1.58E-03	3.81E-04	7.83E-05	1.47E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

03611421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200 (固定)
- maximum number of iterations = 100

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	24248	24524	22743	21704	24624	19632	18451	19260	20430	18287	19693	15240	16838	17694	15471	15203	12182	13670	11674	9761	13399	12215	10306	10404	9859	9217
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.55E-01	1.57E-01	1.46E-01	1.39E-01	1.58E-01	1.26E-01	1.18E-01	1.23E-01	1.31E-01	1.17E-01	1.26E-01	9.76E-02	1.08E-01	1.13E-01	9.62E-02	9.45E-02	6.84E-02	6.63E-02	4.38E-02	2.35E-02	1.68E-02	5.76E-03	1.59E-03	4.03E-04	7.85E-05	1.48E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

03611421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200 (固定)
- maximum number of iterations = 150

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	24249	24540	22738	21714	24634	19624	18456	19274	20448	18274	19666	15247	16835	17699	15484	15193	12183	13672	11672	9756	13411	12218	10301	10414	9862	9217
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.55E-01	1.57E-01	1.46E-01	1.39E-01	1.58E-01	1.26E-01	1.18E-01	1.23E-01	1.31E-01	1.17E-01	1.26E-01	9.76E-02	1.08E-01	1.13E-01	9.62E-02	9.44E-02	6.84E-02	6.63E-02	4.38E-02	2.35E-02	1.68E-02	5.76E-03	1.59E-03	4.03E-04	7.85E-05	1.48E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

03611421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬數據: Bit-Flipping (BF) Algorithm

- maximum number of block errors = 200 (固定)
- maximum number of iterations = 200

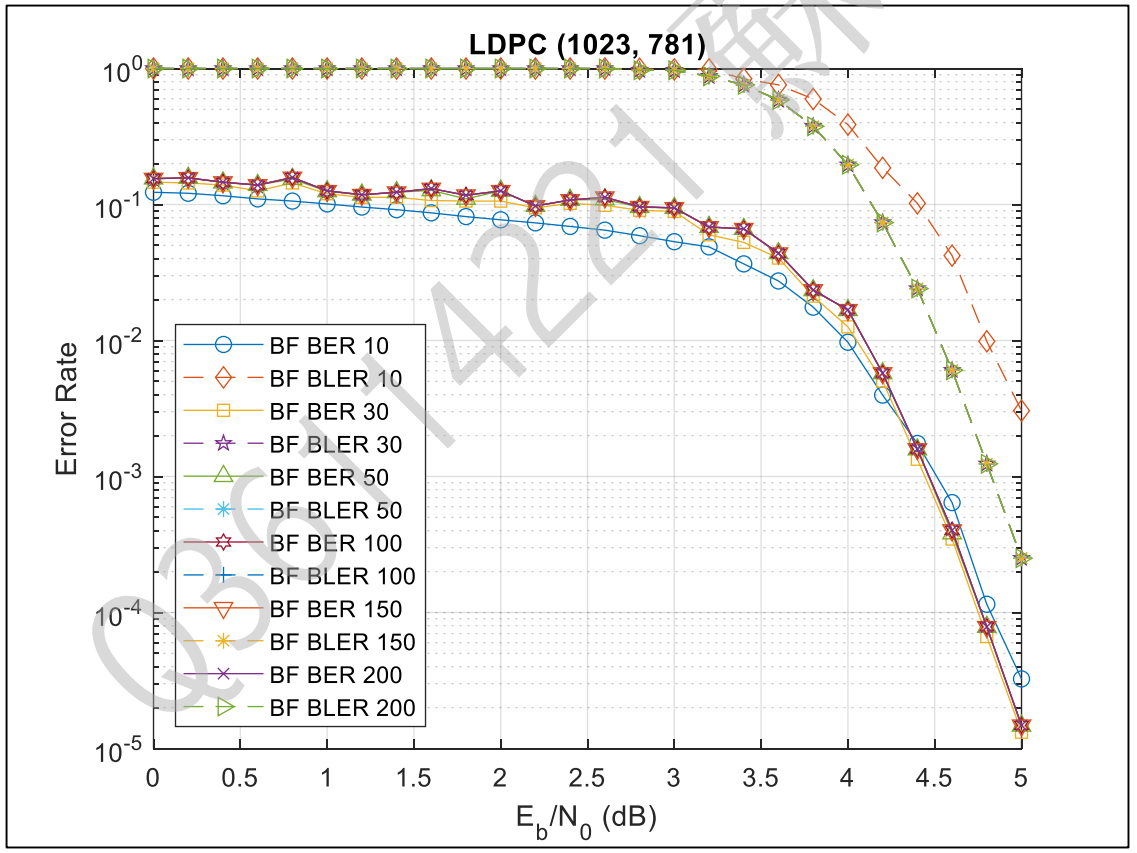
SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded bit errors	24258	24544	22738	21716	24629	19631	18463	19260	20451	18280	19676	15266	16834	17705	15470	15202	12170	13665	11666	9761	13401	12206	10295	10408	9859	9221
No. decoded bits	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	156200	160886	160886	178068	206184	266321	415492	798963	2120415	6487767	25830794	125617602	622838909
bit error rate (BER)	1.55E-01	1.57E-01	1.46E-01	1.39E-01	1.58E-01	1.26E-01	1.18E-01	1.23E-01	1.31E-01	1.17E-01	1.26E-01	9.77E-02	1.08E-01	1.13E-01	9.62E-02	9.45E-02	6.83E-02	6.63E-02	4.38E-02	2.35E-02	1.68E-02	5.76E-03	1.59E-03	4.03E-04	7.85E-05	1.48E-05

SNR (dB)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
No. decoded block errors	200																									
No. decoded blocks	200	200	200	200	200	200	200	200	200	200	200	200	200	200	206	206	228	264	341	532	1023	2715	8307	33074	160842	797489
block error rate (BLER)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.71E-01	9.71E-01	8.77E-01	7.58E-01	5.87E-01	3.76E-01	1.96E-01	7.37E-02	2.41E-02	6.05E-03	1.24E-03	2.51E-04

03611421 蘇沛璋

不同iteration個數的比較 (Bonus)

模擬效能圖：maximum number of block errors = 200 (固定)



Q36114221 蘇沛翔