# Report for Project 2
## (NCS and OLMP)

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## 1. Algorithm description

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|---|---|
| **Main Idea of NCS** | • Search with a population of individuals ←→ a population of search agents (processes).<br>• NCS aims to control each search agent to search the part of the search space that other search agents will not search<br>  • NCS first calculates the negative correlation (i.e. search behavior diversity) between different search agents<br>  • Then, selects the search agents that have higher negative correlation with other search agents. |
| **Applications of NCS** | Minimizing the Symbol-Error-Rate (SER) for Amplify-and-Forward Relaying Systems is nontrivial since the SER surface is non-convex and has multiple minima. |
| **Main Idea of OLMP** | The idea is to transform the threshold tuning problem into a constrained optimization problem (i.e., minimizing the size of the pruned model subject to a constraint on the accuracy loss), and then use powerful derivative-free optimization algorithms to solve it. |
| **Applications of OLMP** | OLMP<br>LMP<br>DNN compression<br>DNN<br>ANN<br>Handwritten character recognition |

## 2. Parameter description

| Parameters | Your final values and results | | |
|---|---|---|---|
| | F6 | F12 | OLMP |
| lambda | 0.942 | 0.944 | 0.000000001 |
| r | 0.99 | 1 | 100 |
| epoch | 3 | 5 | 1 |
| n | 1 | 8 | 92 |
| Final Result | 390.01148260552054 | 683.2432304597523 | 0.9889914106747684 |
| Running Time | 48.58 | 75.34 | 59.89 |

**Parameters Summary:**

1. `epoch`

   `epoch` controls the iteration times for each period.

   (1) For F6, the best range is [1,30], when larger than 30, it has approximately no effects on result, and the results are very large.
   (2) For F12, the best range is [1,6], when larger than 20, it has approximately no effects on result, and the results are very large.
   (3) For OLMP, `epoch` has no relation to the result.

2. `lambda`

   `lambda` can affect the search process and consequently the performance of NCS.

   (1) For F6, there is no certain range for it, I chose the smallest value in my tests, which is 0.942.
   (2) For F12, the best range is [0.3,1.7], and the results of them are equal, so I chose 0.944.
   (3) For OLMP, `lambda` has no relation to the result.

3. `r`

   `r` is a parameter that is suggested to be set beneath 1.

   (1) For F6, there is no certain range for it, I chose the smallest value in my tests, which is 0.99.
   (2) For F12, the best range is [0.0,1.0], when larger than 1.0, the results become very large and changes irregularly.
   (3) For OLMP, `r` has no relation to the result.

4. `n`

   n controls the initially generated population.

   (1) For F6, the best range is [1,6], when larger than 9, the results become very large and changes irregularly.
   (2) For F12, the best range is [1,11], when larger than 11, the results become very large and changes irregularly.
   (3) For OLMP, it is irregular in any range of n, so I test all ns, and chose the smallest one.

## 3. Tuning procedure

I wrote a program to test the parameters with input or randomly generated values. At first, I test them separately. For integer parameters, such as epoch and n, I tested them with all possible values, and then chose a value with the smallest result. For float number values, firstly I tested them with random numbers, and then find out the best range to be tested next, and then do these steps cyclically.