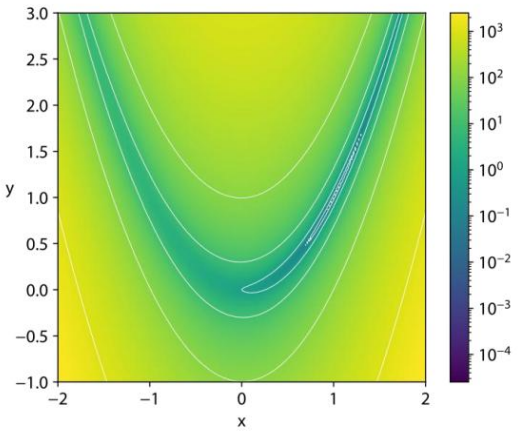
Numerical Optimization in Robotics

Homework_1 Instruction

1. Problem description:Linear-search Steepest Gradient Descent



$$f(\mathbf{x}) = f(x_1, x_2, \ldots, x_N) = \sum_{i=1}^{N/2} \left[100 \left(x_{2i-1}^2 - x_{2i} \right)^2 + \left(x_{2i-1} - 1 \right)^2 \right]$$

You have to implement Linear-search Steepest Gradient Descent to optimize the function given above. It is obvious that the global minimum of the function is $(1,1,\ldots,1)_{N\times 1}$, so you can check if the result of your program is admissible.

2. Problem analysis

Rosenbrock function: In mathematical optimization, the Rosenbrock function is a non-convex function used to test the performance of optimization algorithms and was proposed by Howard Harry Rosenbrock in 1960 . Also known as the Rosenbrock valley or Rosenbrock banana function, or simply as the banana function.

For more: *https://en.wikipedia.org/wiki/Rosenbrock_function*
https://blog.csdn.net/weixin_45735391/article/details/118705597

Linear-search Steepest Gradient Descent with Armijo condition: you can find related knowledge in the course slide 54-68.

For more: you can find more details in the reference book.

3. Assignment requirements

- ✓ Your homework ***should*** be a ***zip*** including your code, an documentation and an instruction.
- ✓ You can complete this chapter assignment in different programming languages, but I suggest you apply ***MATLAB*** or ***C++*** for this homework.
- ✓ You ***must*** given an instruction named ***'readme'*** to tell the reader how to run your code and check your answer.
- ✓ You ***have to*** give an report for this assignment which includes (1) the ***workflow and result*** of your homework; (2) your ***analysis*** of the homework; (3) any ***question or suggestion*** of the course and the homework.

✓ You can add your notes of this course to your homework.

4. Scoring Criteria

Unqualified: The results are incorrect, or the assignment is not written in the required format.

Qualified: The results are somewhat different from the standard results, but there is a correct knowledge and understanding of the assignment requirements.

Good: The results are correct. The program converges correctly to the minimum value of the objective function.

OutStanding: There are two chance for you to get an ***'OutStanding'*** :

(1) Your program can optimize a Rosenbrock function for a given N of dimensions.

(2) Your program can visualize a two-dimension Rosenbrock function.

What's more, you must have an in-depth understanding of Rosenbrock function optimization, which should be expressed in your report.