

LMS Algorithm

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Abstract

Use Least Mean Square Algorithm (LMS) to let an initial point approach the desired point.

Introduction

When we want to find a desired point with a sample point, we can use Least Mean Square Algorithm(LMS) to realize it.

Method

1-1. Give two lines L1: $3x+7y=2$, L2: $-4x+5y=-3$, calculate the desired point, $x_d = 31/43 = 0.7209$, $y_d = -1/43 = -0.02326$, and use LMS to let an initial point approach the desired point.

1-2. Give two lines L1: $3x+7y=2$, L2: $-4x+5y=-3$, calculate the error of the lines and the initial point to find the desired point, and iterate it to the optimal desired point.

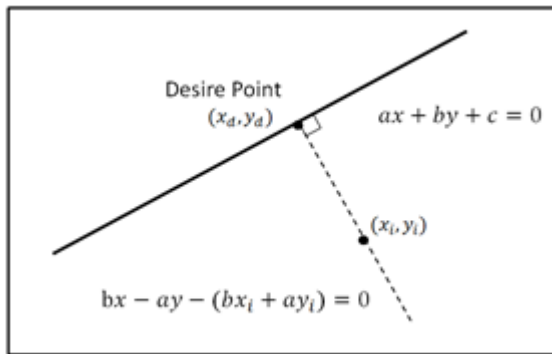


Figure1. Find the desired point

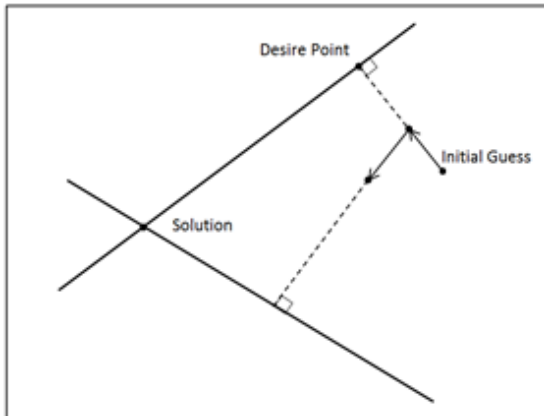


Figure2. The first time iteration

2-1. Give three lines L1: $12x+27y=6$, L2: $-7x+19y=27$, L3: $-43x+21y=-63$, calculate the desired point, $x_d = 0.8993$, $y_d = 0.80228$, and use LMS to let an initial point approach the desired point.

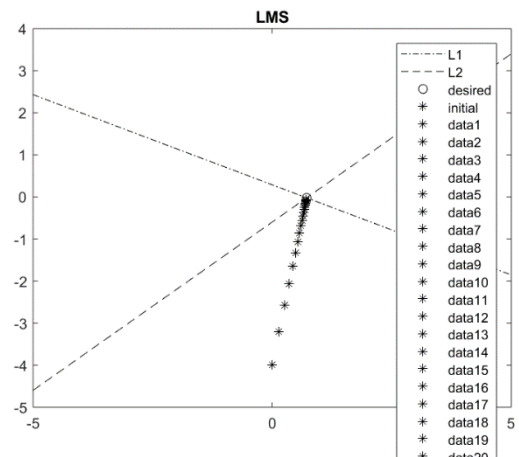
2-2. Give three lines L1: $12x+27y=6$, L2: $-7x+19y=27$, L3: $-43x+21y=-63$, calculate the error of the lines and the initial point to find the desired point, and iterate it to the optimal desired point.

Result

1-1.

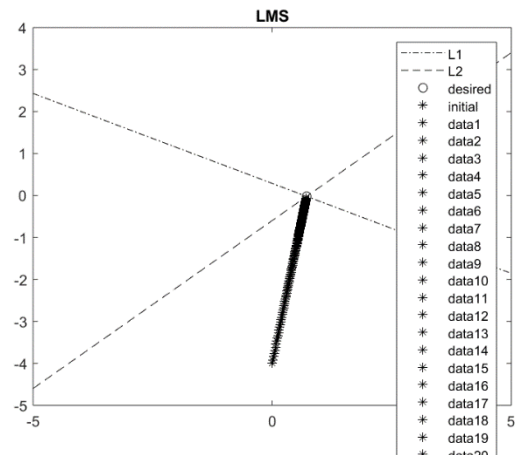
a. Initial (0, -4), $\mu=0.1$

Output: $x = 0.712618$, $y = -0.0691046$



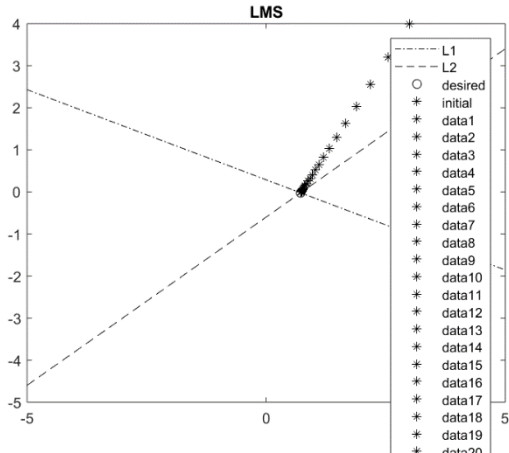
b. Initial (0, -4), $\mu=0.01$

Output: $x = 0.71098$, $y = -0.0781411$



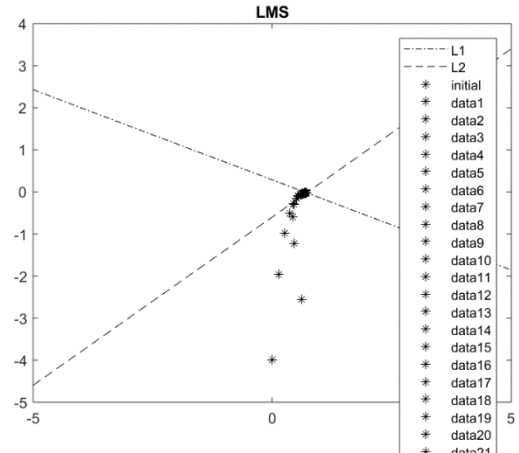
c. Initial (3, 4), $\mu=0.1$

Output: $x = 0.72954$, $y = -0.00805638$



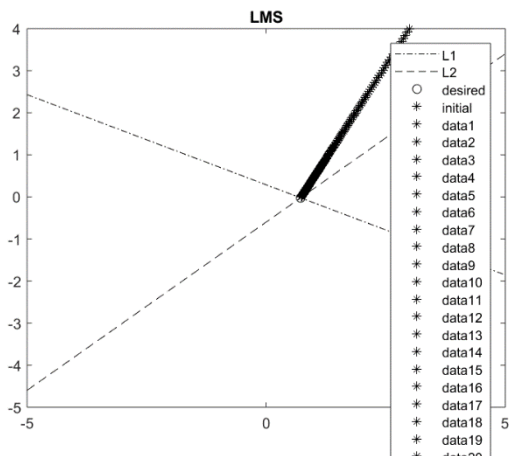
b. Initial (0, -4), $\mu=0.2$

Output: $x = 0.714401$, $y = -0.0249006$



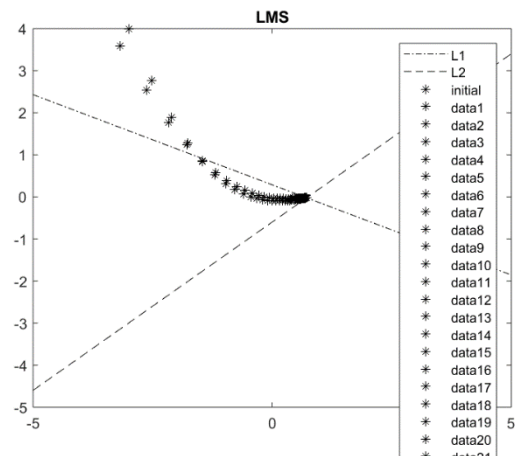
d. Initial (3, 4), $\mu=0.01$

Output: $x=0.730874$, $y=-0.00570117$



c. Initial (-3, 4), $\mu=0.1$

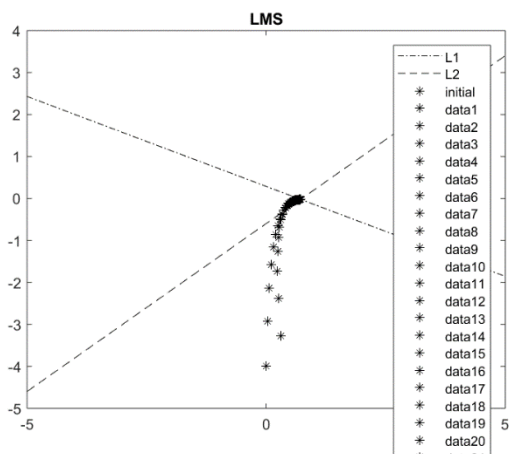
Output: $x = 0.720152$, $y = -0.0234007$



1-2.

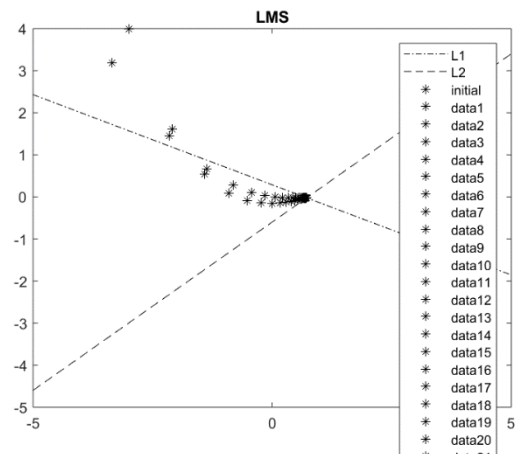
a. Initial (0, -4), $\mu=0.1$

Output: $x = 0.720134$, $y = -0.0234039$



d. Initial (-3, 4), $\mu=0.2$

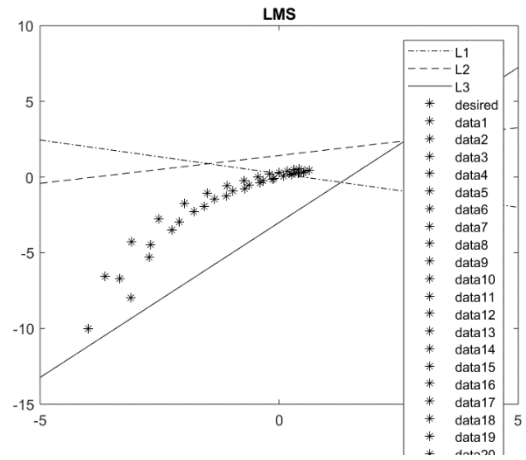
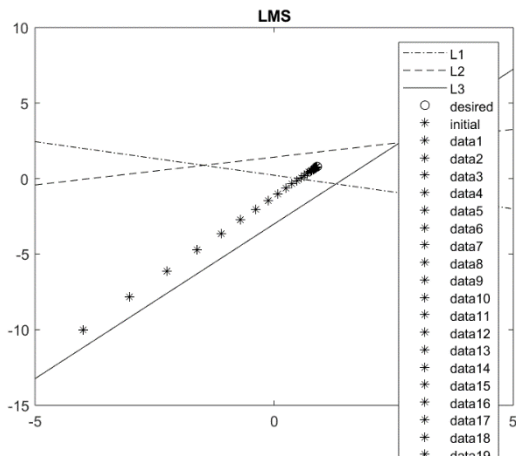
Output: $x = 0.715112$, $y = -0.024717$



2-1.

a. Initial (-4, -10), $\mu=0.1$

Output: $x = 0.889823$, $y = 0.779337$



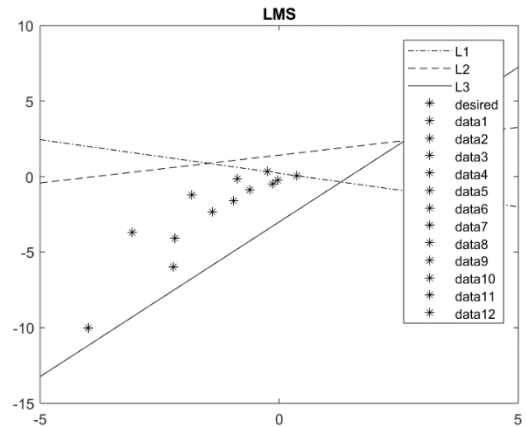
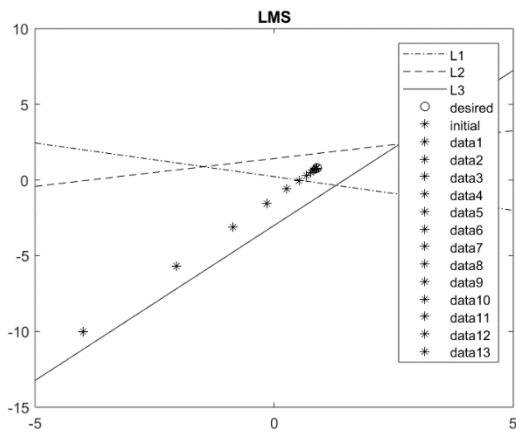
b. Initial (-4, -10), $\mu=0.2$

Output: $x = 0.364286$, $y = 0.0486613$

Three errors all > 0.02

b. Initial (-4, -10), $\mu=0.2$

Output: $x = 0.892901$, $y = 0.786122$



c. Initial (4, -13), $\mu=0.1$

Output: $x = 1.03351$, $y = 0.493555$

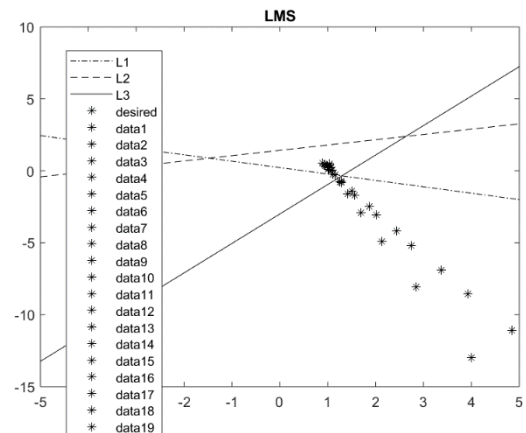
Three errors all > 0.0275

2-2.

a. Initial (-4, -10), $\mu=0.1$

Output: $x = 0.632034$, $y = 0.433435$

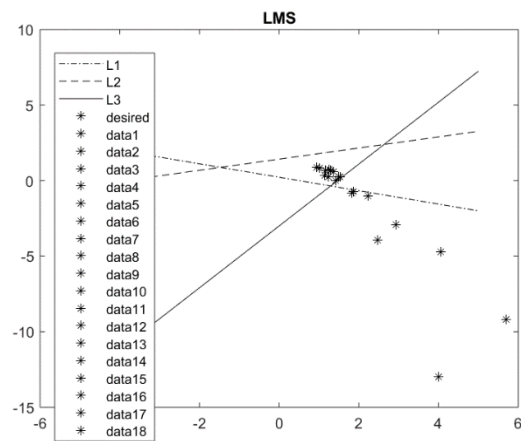
Three errors all > 0.0275



d. Initial (4, -13), $\mu=0.2$

Output: $x = 1.24982$, $y = 0.723003$

Three errors all > 0.04



Discussion and Conclusion

1. When μ increases, the pattern will be more discrete and the distance of point to point will increase.
2. Use smaller μ can get more accurate desired point.
3. Method 1 is better than method 2.

References

Textbook