Computational Inverse Problems: Final Homework

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1 Problem 1

The LM algorithm is implemented using two parameter updating strategies:

1. adjust the damping factor λ by multiplying or dividing a certain factor. See file “LM_original.py”
2. run root-finding algorithm to obtain a nearly exact solution of λ.

   See file “LM_root_finding.py”

The test example is simple and is used in a lot of books and papers.

1.1 Example Description

The following least square problem is used for test:

$$\min_x f(x) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2 \tag{1}$$

The optimal solution is $(1, 1)$.

1.2 Comparison

1. both strategies are able to find the optimizer from initial point $(-1.92, 2)$, but strategy 2 takes less iterations to achieve the desired accuracy.
2. original strategy 1 cannot converge to the optimizer from initial point $(300, 2)$ and $(-1.92, 2000)$
3. root-finding strategy 2 can successfully return the optimizer from the above initial points

2 Problem 2

The four examples in the specified paper are implemented. The inputs are set within $(-1, 1)$ so scaling is ignored in all problems. See file “LM_NN.py”

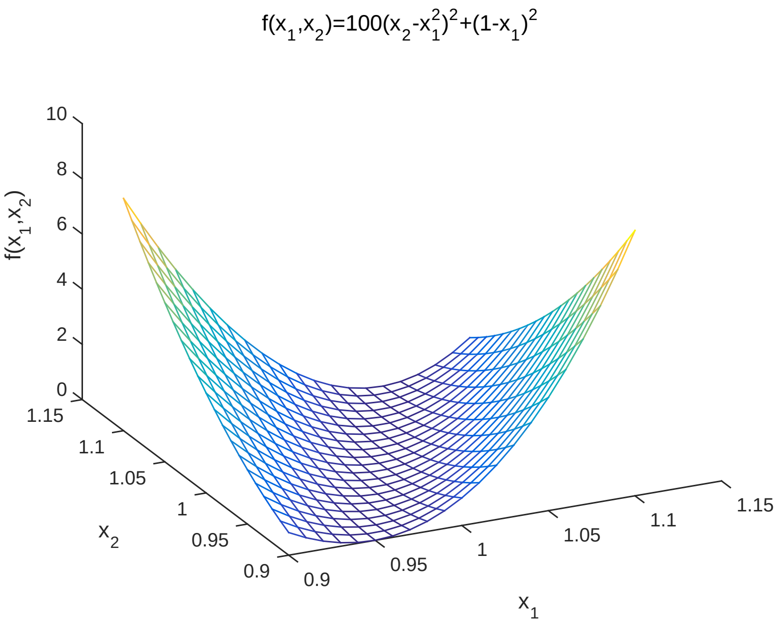

Figure 1: Problem 1. The shape of function $f(x)$

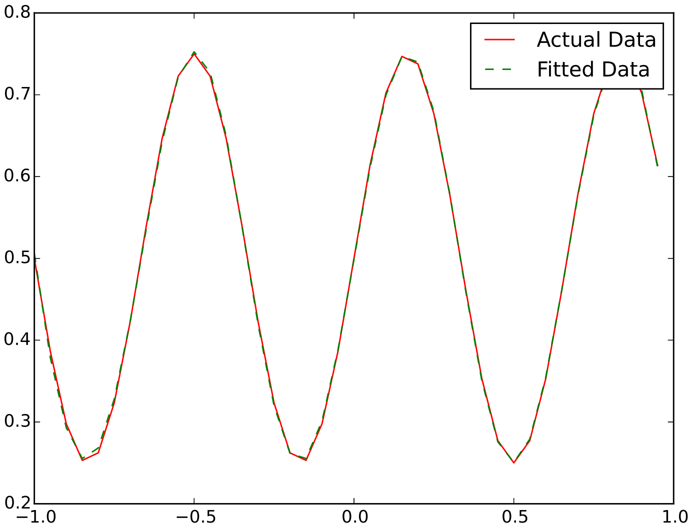

Figure 2: Problem 2. Example 1

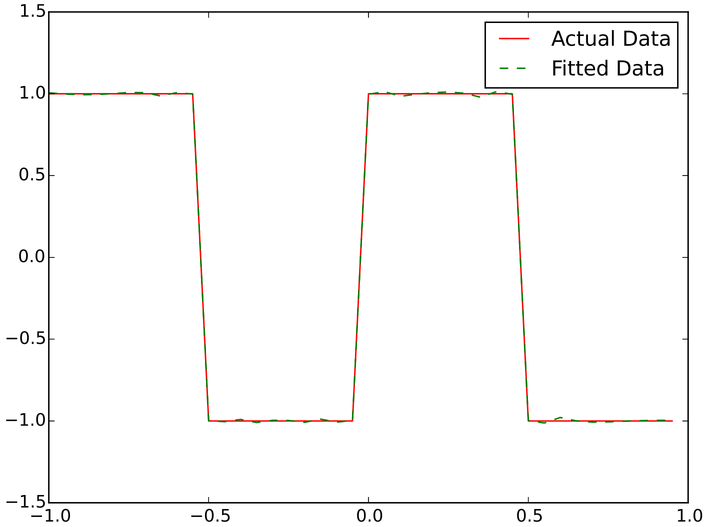

Figure 3: Problem 2. Example 2

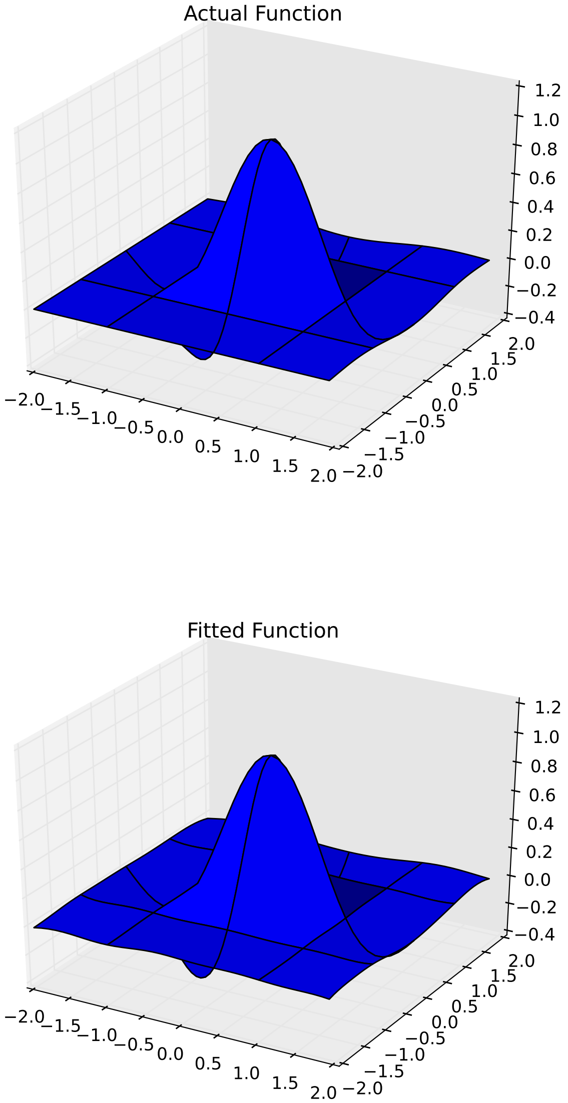

Figure 4: Problem 2. Example 3