

Verification of Conjugate Gradient Method

Weigang Zhong

Here I am testing the function of minimization by using Conjugate Gradient Method.

I used the built-in function `fminsearch` in optimization toolbox of Matlab as comparison.

The testing function is $f(\vec{u}) = \sum_{i=1}^{N-1} [\arctan(u_i) \sin(u_i) + \arctan(u_{i+1}) \cos(u_{i+1})]$.

`fminsearch` uses Nelder-Mead method to minimize the high dimensional function.

My function uses Conjugate Gradient iterative Method. Both of these two methods are guaranteed to converge to at least a local minimizer.

Take $N = 10$, choose same initial guess $u_i = 3$. Check the output minimizer \vec{u} and the minimum function value.

● Matlab

output minimizer is

4.7435
3.9719
3.9719
3.9719
3.9721
3.9719
3.9722
3.9720
3.9719
3.2111

output min function value
is

-17.5942

iteration number is

436

● My Conjugate Gradient Method

output minimizer is

4.74362
3.97198
3.97198
3.97198
3.97198
3.97198
3.97198
3.97198
3.97198
3.2111

output minimum function value is
-17.5942

iteration number is

36

They match. If we check the iteration numbers, we also can find that the Conjugate Gradient Method needs much less iteration steps than Nelder-Mead.