MASTER'S THESIS

A matrix free method for unconstrained optimization problems

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A Matrix Free Method for Unconstrained Optimization Problems

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Abstract

These years people pay more and more attention to solve optimization problems which will help to handle a large number of application problems in different areas. The analysis of the minimum or maximum problem has become an active research topic in mathematics, computer science and economics.

In this thesis, we focus on methods for unconstrained optimization problems (UP). We apply an existing EPS method for nonlinear equations to UP via the dynamical system approach. By varying some method parameters, the stability region of the method can be tuned to get a balance between numerical stability and the order of accuracy.

One of the main contributions of this thesis is to increase the problem dimension to a high order of magnitude, which has not been achieved for a lot of problems. For many optimization problems, $n = 10^4$ is already considered large. Beyond this problem size the computer will run out of memory. Our experiments have succeeded in solving problem sizes of $n = 10^5$ and $n = 10^6$.

Large problems can be solved because the method used is matrix-free. This is done by computing only the first order derivative and diagonal elements of the Hessian of the given objective function. The performance of our method is shown by testing 27 well-known problems.

Table of Contents