Master's Thesis

Convergence Properties of Levenberg-Marquardt Methods with Generalized Regularization Terms

Guidance

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Abstract

Levenberg-Marquardt methods (LMMs) are the most typical algorithms for solving nonlinear equations $F(x) = 0$, where $F\colon \mathbb{R}^n \to \mathbb{R}^m$ is a continuously differentiable function. They sequentially solve subproblems represented as squared residual of the Newton equations with the L_2 regularization to determine the search direction. However, since the subproblems of the LMMs are usually reduced to linear equations with n variables, it takes much time to solve them when $m \ll n$.

In this paper, we propose a new LMM which generalizes the L_2 regularization of the subproblems of the ordinary LMMs. By virtue of the generalization, we can choose a suitable regularization term for each given problem. Moreover, we show that a sequence generated by the proposed method converges globally and quadratically under some reasonable assumptions. Finally, we conduct numerical experiments to confirm that the proposed method performs better than the existing LMMs for some problems that satisfy $m \ll n$.