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A New Hybrid Conjugate Gradient Method Based on RMIL, LS and CD Methods

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Abstract: We propose a new hybrid conjugate gradient method for unconstrained optimization problems. The method combines the RMIL, LS and CD formulas through a convex combination to build a more effective search direction. This approach aims to improve both convergence and numerical performance. The hybrid parameter β_k is updated to satisfy the conjugacy condition and global convergence is proven under the strong Wolfe line search. Numerical results on test problems show that the new method is better than other existing approaches in terms of iterations and CPU time.

Keywords: *unconstrained optimization; hybrid conjugate gradient method; descent direction; line search; global convergence.*

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1 Introduction

Unconstrained optimization problems appear in many areas such as machine learning, data fitting, finance and control systems. These problems are generally written as

$$\begin{cases} \min\ f(x) \\ x \in \mathbb{R}^n, \end{cases} \tag{1}$$

where $f : \mathbb{R}^n \to \mathbb{R}$ is a continuously differentiable function.

When the dimension n is large, solving this problem efficiently becomes important. One of the most effective and memory-saving methods used is the nonlinear conjugate gradient (CG) method. These methods are known for their low storage requirements and

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