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A Comparative Study of Two New Conjugate Gradient Methods

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Abstract. In this paper, we compared the performance profile of the classical conjugate gradient coefficients FR , PRP with two new β_k . These two new β_k possess global convergence properties using the exact line search. Preliminary numerical results show that, the two new β_k is very promising and efficient when compared to CG coefficients FR , PRP .

Keywords: Conjugate gradient coefficient, exact line search, global convergence, large scale, unconstrained optimization.

PACS: 02.60.Pn, 02.60.Cb, 02.70.C

INTRODUCTION

The Conjugate gradient (CG) methods have played special roles in solving large scale nonlinear optimization problems, due to its lower storage and simple computation. Consider the following n variables unconstrained optimization problem:

$$\min f(x), x \in R^n \quad (1)$$

Where $f: R^n \rightarrow R$ is smooth and its gradient $g(x) = \nabla f(x)$ is available.

The conjugate gradient method for solving (1) generates a sequence of iterates by letting

$$x_{k+1} = x_k + \alpha_k d_k, \quad k = 0, 1, 2, \dots \quad (2)$$

where x_k is the current iterate point and α_k is a positive step size, the step size is computed by carrying out some line search for example the exact line search where,

$$\alpha_k = \arg \min_{\alpha \geq 0} f(x_k + \alpha d_k) \quad (3)$$

and the search direction d_k is defined by

$$d_k = \begin{cases} -g_k & \text{if } k = 0, \\ -g_k + \beta_k d_{k-1} & \text{if } k \geq 1, \end{cases} \quad (4)$$

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CONCLUSION

In this paper, we propose two new β_k for unconstrained optimization, we found that the proposed methods *MAMR* and *RMIL* come out with best numerical results in their efficiency, more than the classical conjugate gradient methods *FR* and *PRP*.

Our future work is concentrating on studying the convergence properties of our proposed methods using inexact line search.

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