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Xianzhen Jiang, Jinbao Jian

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# Improved Fletcher-Reeves and Dai-Yuan conjugate gradient methods with the strong Wolfe line search <sup>☆</sup>

XIANZHEN JIANG<sup>a</sup>, JINBAO JIAN<sup>b,\*</sup>

<sup>a</sup>*Guangxi Colleges and Universities Key Lab of Complex System Optimization and Big Data Processing, Yulin Normal University, Yulin, Guangxi, 537000, China*

<sup>b</sup>*College of Science, Guangxi University for Nationalities, Nanning, Guangxi, 530006, China*

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## Abstract

The conjugate gradient methods are very effective iterative methods for solving large-scale unconstrained optimization. In this paper, based on the conjugate parameters of the Fletcher-Reeves (FR) method and the Dai-Yuan (DY) method, combining the second inequality of the strong Wolfe line search, two new conjugate parameters are constructed, and follow using the new parameter of the DY and FR parameter, another FR type conjugate parameter is presented. Utilizing the strong Wolfe line search to yield the steplengths, three improved conjugate gradient methods are proposed for large-scale unconstrained optimization. Under usual assumptions, the improved methods are all proved to possess sufficient descent property and global convergence. Finally, three group experiments and their corresponding performance profiles are reported, which show that the proposed methods are very promising.

*Keywords:* unconstrained optimization; conjugate gradient method; strong Wolfe line search; global convergence

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\*Corresponding author. E-mail: jianjb@gxu.edu.cn.

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