

UNIVERSITI TEKNOLOGI MARA

**HYBRID CONJUGATE GRADIENT
METHOD USING EXACT LINE
SEARCH WITH ITS APPLICATION**

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ABSTRACT

Unconstrained optimization involves finding the maximum or minimum value of a variable without being limited by any restrictions or boundaries. The conjugate gradient (CG) method is a numerical method widely recognised as an efficient choice for solving large-scale unconstrained optimization problems. However, classical CG methods often suffer from slow convergence rates and high computational costs when applied to complex, non-linear inverse problems, such as the Vehicle-Bridge Moving Force Identification (MFI). This research focuses on the performance of the hybrid CG method to address these challenges, specifically when used under exact line search. There are four hybrid CG coefficients used in this study by combining Rivaie-Mustafa-Ismail-Leong (RMIL) coefficient with Liu-Storey (LS), Hestenes-Stiefel (HS), Dai-Yuan (DY) and Linda-Aini-Mustafa-Rivaie (LAMR). Fifteen test functions from the CUTE library with different initial values and variables ranging from 2 to 10,000 are chosen for testing. The numerical results are assessed based on the Number of Iterations (NOI) and CPU time. The analysis reveals that the RMILLAMR hybrid algorithm significantly outperformed the other variants, achieving the highest success rate of 98.81% and proving it is the fastest and most efficient method. Furthermore, the RMILLAMR method is applied to the MFI problem under varying noise levels which are 1%, 5% and 10%. The results indicate high accuracy at 1% noise with a Relative Percentage Error (RPE) of only 5.01%. Thus, it is shown that RMILLAMR is applicable for solving real world problem.