

# Referee Report for Manuscript 2026-AJPAM-2361

**Summary** This manuscript presents a thorough and well-structured empirical study comparing the performance of eight classical nonlinear conjugate gradient (CG) methods (BAN, FR, PRP, HS, CD, DY, LS, HZ) under the Strong Wolfe line search conditions. The work addresses a notable gap in the literature by providing the first large-scale, uniform benchmarking of these methods on 50 high-dimensional problems ( $n=5,000$  and  $10,000$ ) from the CUTER collection. The analysis is rigorous, employing success rates, performance profiles, and statistical significance testing (Wilcoxon signed-rank). The key finding is the superior and statistically dominant performance of the Polak–Ribière–Polyak (PRP) method under these conditions. A valuable comparative analysis with prior results using Armijo line search is included, revealing trade-offs between convergence stability and computational overhead. The manuscript concludes with practical guidelines for practitioners and suggests future research directions. The experimental methodology is clearly described, and the mathematical framework is sound.

## Major Issues

1. The use of **MATLAB R2009a** on a system with an **Intel Atom N2600 processor (1.60 GHz) and 2 GB of RAM** is a significant concern. This hardware/software combination is over a decade old and not representative of modern computational resources used for large-scale optimization. It raises questions about the practicality and reproducibility of the reported CPU times. The authors must either:
  - **Justify** this choice compellingly (e.g., for direct comparison with specific prior work), or,
  - **Re-run the experiments** on a contemporary, standardized computational platform and report updated CPU timings. The relative performance profiles may hold, but absolute times lose meaning.
  - **Acknowledge this as a severe limitation** in the discussion, clearly stating that the CPU time results are not indicative of performance on modern hardware.
2. The manuscript cites its own prior work (Ayansiji, 2025) and other works (Ayansiji et al., 2025; Chen et al., 2024; Cui, 2024) that are dated **2024-2025**. For a manuscript presumably submitted in or before 2023 (based on the latest typical references being 2017), this is logically impossible and suggests either the use of placeholder years or a significant oversight. All citation years must be corrected to reflect the actual, pre-submission publication dates of the referenced works. This error undermines academic integrity.
3. The introduction and discussion rightly note the trend toward hybrid and adaptive methods. However, the study is limited to *classical* CG parameters. To strengthen its contribution and relevance, the manuscript should include a brief discussion or a limited comparative experiment with at least one or two prominent modern adaptive CG methods (e.g., the CG-DESCENT family by Hager & Zhang or other recent variants) under the same Strong Wolfe conditions. This would contextualize the performance of the classical methods within the contemporary landscape.
4. Algorithm 2 employs a restart condition ( $|g_{k+1}^T d_{k+1}| > 0.2 \|g_{k+1}\|^2$ ) attributed to Gilbert & Nocedal (1992). While restart strategies are common, applying a *uniform* restart condition

to all eight classical methods may artificially alter their inherent convergence properties. Some methods (e.g., FR, DY) have built-in global convergence properties without restarts, while others (like PRP) benefit from them. The authors must discuss how this uniform restart protocol might have influenced the observed performance rankings, particularly for methods whose theoretical design does not assume such restarts.

### Minor Issues

- The caption for **Figure 1** references “SW.PRP”, “[SW.LS](https://sw.ls/)”, etc., which appears to be a formatting artifact (possibly a hyperlink). The figure labels in the text should be clean (e.g., “PRP (SW)”, “LS (SW)”).
- In Section 4, the heading is written as “DISCUSsion”. Please correct to “DISCUSSION”.
- The reference to “Algorithm 3.5” from Nocedal & Wright (2006) in Section 2.3 should include the page number for better reproducibility.
- Introduction, Paragraph 3: “...both of which have use within the metaheuristic community.” Consider rephrasing for clarity, e.g., “...both of which are relevant to the metaheuristic community.”
- Section 2.6, Performance Metrics: “The statistical analysis results are examined along with approaches for testing the data will be used to develop the theoretical implication...” This sentence is grammatically flawed and should be revised for clarity.
- The last sentence of the abstract is very long. Consider breaking it into two sentences for improved readability.
- The text frequently references tables and figures (e.g., “as summarized in Table 1”, “From Figure 1”). Ensure all such references are correctly placed and that the figures/tables are explicitly called out in the narrative flow (they are present in the content, but the narrative should seamlessly integrate them).

### Recommendation: *Major Revision*

The manuscript addresses an interesting and relevant question with a solid methodological foundation and produces valuable, statistically-supported findings. However, the **Major Issues** listed above—particularly the **anachronistic citations** and the **severely outdated computational environment**—are substantial and must be addressed before the manuscript can be considered for publication. The addition of context regarding modern adaptive methods would also significantly strengthen the paper’s impact.

The required revisions are concrete and achievable. Upon satisfactory resolution of the major issues and careful attention to the minor points, this manuscript has the potential to be a useful contribution to the numerical optimization literature.