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Peer Review

Review of: "An Approximate QUBO Formulation for Solving Practical SAT Problems"

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The article presents a practical and computationally efficient approximate QUBO formulation for SAT problems and demonstrates promising performance on benchmark datasets; however, several weaknesses limit its overall scientific robustness. First, the proposed method relies heavily on the assumption that real-world SAT instances contain a high proportion of binary clauses, which restricts its generalizability and reduces effectiveness for problems with diverse clause structures, as partially reflected in weaker results for some COMP23 instances. Second, the method intentionally produces an approximate QUBO where the ground state does not necessarily correspond to a valid SAT solution, yet the theoretical implications, error bounds, and reliability of the approximation are insufficiently analyzed, weakening methodological rigor. Third, the experimental evaluation lacks comparisons with more diverse or modern hybrid SAT/QUBO solvers and does not include statistical validation or sensitivity analysis of parameters such as annealing sweeps and read numbers. Additionally, scalability is not deeply investigated for large or heterogeneous real-world datasets. To strengthen the study, the authors should provide formal theoretical guarantees or approximation bounds, evaluate performance across broader SAT categories, include statistical robustness testing, and benchmark against additional state-of-the-art classical and quantum-inspired solvers to better establish real-world applicability and methodological reliability.

Declarations

Potential competing interests: No potential competing interests to declare.

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