Systematic Mapping and Critical Evaluation of Quantum and Quantum-Inspired Optimization Algorithms

in the Context of Large-Scale Operations Research Applications

Alara Onur
Üsküdar Amerikan Koleji

***Abstract*—The growing intersection of quantum computing and operations research (OR) has opened new avenues for solving high-dimensional optimization problems that remain computationally intractable under classical paradigms. This study presents a systematic mapping and critical evaluation of both quantum and quantum-inspired optimization algorithms, with a particular focus on their scalability, convergence efficiency, and applicability to large-scale operations research challenges. Through a structured review of contemporary literature and empirical implementations, the research categorizes existing algorithms into key families—such as quantum annealing, variational quantum algorithms (VQAs), and hybrid quantum–classical frameworks—while identifying trends in algorithmic performance across industrial logistics, network design, and resource allocation models. The systematic mapping process was conducted collaboratively, emphasizing transparent data collection, inclusion–exclusion criteria, and reproducible methodology following evidence-based review standards. Critical evaluation highlighted the need for unified performance metrics, improved hybridization strategies, and enhanced interpretability in quantum-inspired heuristics. The research also provided valuable insight into refining methodological rigor, including bibliometric analysis, coding frameworks, and academic presentation of findings. Ultimately, this work contributes to the ongoing dialogue between quantum computation and operations research, demonstrating how quantum-enhanced optimization can accelerate decision-making processes in complex, data-intensive environments.**

Optimization lies at the core of operations research (OR), underpinning decision-making processes across industries such as logistics, finance, manufacturing, and energy systems [1]. However, as the dimensionality and interconnectivity of modern optimization problems continue to increase, classical algorithms face significant computational bottlenecks. Problems such as the Quadratic Assignment Problem (QAP), Vehicle Routing Problem (VRP), and Supply Chain

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