

# Chapter 4

## Quantum-Inspired Algorithms for AI and Machine Learning

**Kamaleswari Pandurangan**

 <https://orcid.org/0009-0002-8621-7843>

*Department of CSE, Er. Perumal Manimekalai  
College of Engineering, India*

**B. Galebathullah**

 <https://orcid.org/0000-0003-4915-5444>

*Department of CSE, Madanapalle Institute of  
Technology and Science, India*

**A. Priyadharshini**

 <https://orcid.org/0000-0003-3152-8089>

*Jain School of Engineering and Technology, Jain  
University (Deemed), India*

**Haseeba Yaseen**

 <https://orcid.org/0000-0002-7963-0915>

*Department of IT, Vasavi College of Engineering,  
India*

**Rakheeba Taseen**

 <https://orcid.org/0009-0007-4514-6002>

*School of CSE, Presidency University, India*

**P. Ravichandran**

*PMC College of Engineering, India*

### ABSTRACT

*Quantum-inspired algorithms help handle complex optimization and inference challenges in AI and ML. Quantum-like algorithms based on quantum mechanics address challenges classical computer paradigms can't. These algorithms innovate data handling, solution finding, and pattern recognition. Quantum effects like superposition, entanglement, and tunneling influenced them. In particular, they work in parallel to explore large solution spaces and speed up processing for large datasets. Next, quantum-inspired algorithms including quantum annealing, optimization, and neural networks are discussed. Simulated annealing and the quantum approximate optimization algorithm (QAOA) make combinatorial optimization tasks in AI and ML easier. Quantum-inspired evolutionary and swarm intelligence algorithms tackle multi-modal optimization issues quickly. Furthermore, quantum-inspired neural networks (QNNs) have revolutionized deep learning. QNNs use quantum gates and quantum circuits to improve classification, regression, and generative modeling.*

DOI: 10.4018/979-8-3693-7076-6.ch004

Copyright ©2025, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.

## INTRODUCTION

Quantum-inspired algorithms are a cutting-edge area of research in artificial intelligence (AI) and machine learning (ML). They offer innovative solutions to complex optimization and inference issues that traditional computer paradigms find difficult to address (Stein et al., 2022). These algorithms utilize principles from quantum physics, leveraging quantum phenomena including superposition, entanglement, and tunnelling to enhance data processing, problem-solving, and pattern identification (Anand et al., 2024). Quantum-inspired techniques differ from conventional algorithms in that they operate in parallel, enabling them to efficiently explore vast solution spaces and accelerate processing for large datasets. This feature is particularly valuable in the fields of artificial intelligence (AI) and machine learning (ML), where the intricacy and magnitude of data can be overwhelming. This post will examine many quantum-inspired algorithms that are transforming the field of AI and machine learning. Quantum annealing and the Quantum Approximate Optimization Algorithm (QAOA) are two fundamental methods used to streamline combinatorial optimization tasks (Chen et al., 2023). Moreover, quantum-inspired evolutionary and swarm intelligence systems offer rapid solutions to multimodal optimization difficulties.

A notable breakthrough has occurred in the realm of quantum-inspired neural networks (QNNs). Quantum Neural Networks (QNNs) enhance the performance of deep learning tasks such as classification, regression, and generative modelling by integrating quantum gates and circuits. These networks utilize quantum principles to store and analyze data in multidimensional feature spaces, resulting in significant enhancements in representation learning and feature acquisition (Sack & Serbyn, 2021). This exploration will demonstrate how quantum-inspired algorithms are not only enhancing the capabilities of artificial intelligence (AI) and machine learning (ML), but also laying the groundwork for future advancements in these domains.

12 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:  
[www.igi-global.com/chapter/quantum-inspired-algorithms-for-ai-and-machine-learning/360856](http://www.igi-global.com/chapter/quantum-inspired-algorithms-for-ai-and-machine-learning/360856)

## Related Content

---

### Quantum Computing Significance on Multidimensional Data: R-Tree Search Based on Grover's Search Algorithm

T. Hemaand Micheal Olaolu Arowolo (2023). *Handbook of Research on Quantum Computing for Smart Environments* (pp. 217-230).

[www.irma-international.org/chapter/quantum-computing-significance-on-multidimensional-data/319870](http://www.irma-international.org/chapter/quantum-computing-significance-on-multidimensional-data/319870)

### Quantum Computing Machine Intelligence for Optimal Battery Performance

Pushpender Sarao, R. V. V. Krishna, P. S. Ranjitand Babu E. R. (2024). *Real-World Challenges in Quantum Electronics and Machine Computing* (pp. 263-277).

[www.irma-international.org/chapter/quantum-computing-machine-intelligence-for-optimal-battery-performance/353111](http://www.irma-international.org/chapter/quantum-computing-machine-intelligence-for-optimal-battery-performance/353111)

### Quantum Enhanced Autocrash Detection System

S. Gunaa, M. Saravanan, G. Devadharshiniand G. Deetchana (2025). *Real-World Applications of Quantum Computers and Machine Intelligence* (pp. 235-248).

[www.irma-international.org/chapter/quantum-enhanced-autocrash-detection-system/367058](http://www.irma-international.org/chapter/quantum-enhanced-autocrash-detection-system/367058)

### Quantum Information Constraints From Early Quantum Postulates: The Planck-Einstein Perspective on No-Cloning and Quantum Security

Shweta Dourand Ankit Chouhan (2026). *Merging Quantum Cloning and Blockchain Solutions for Health Informatics* (pp. 83-120).

[www.irma-international.org/chapter/quantum-information-constraints-from-early-quantum-postulates/408512](http://www.irma-international.org/chapter/quantum-information-constraints-from-early-quantum-postulates/408512)

### Quantum Networking-Based Smart Jacket for Monitoring the Health Conditions of Patients Using IoT

Poovi Nandhini S., Mark Richard M., Ramesh S. M., S. Preethiand S. Rohit (2025). *AI and Quantum Network Applications in Business and Medicine* (pp. 275-290).

[www.irma-international.org/chapter/quantum-networking-based-smart-jacket-for-monitoring-the-health-conditions-of-patients-using-iot/366430](http://www.irma-international.org/chapter/quantum-networking-based-smart-jacket-for-monitoring-the-health-conditions-of-patients-using-iot/366430)