Optimization with Quantum Genetic Algorithm

Volume 102 - Number 16

Year of Publication: 2014

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10.5120/17896-8732

Abstract

Recent development in quantum technology have shown that quantum computer can provide a dramatic advantage over classical computers for some algorithms. In particular, a polynomial-time algorithm for factoring, a problem which was previously thought to be hard for classical computers, has recently been developed [13]. Similarly, a quantum algorithm searching for unsorted database in square root of time it would take on a classical computer has also been described by Grover [4] - [3]. Both algorithms rely upon the inherent parallelism, superposition and entanglement property of quantum computing to achieve their improvements. Since most problems of real interest for genetic algorithms have a vast search space, it seems appropriate how quantum parallelism can be applied to Genetic Algorithms. In this paper we provide a brief background of quantum computers. We explain why and how quantum algorithms provides a fundamental improvements over classical ones for some problems. Further, we present here the Conventional Genetic Algorithm and the quantum approach of Genetic Algorithm(QGA) as well. The benefits and drawbacks of QGA are also analyzed. Moreover, this paper provides an improved version over the conventional QGA. This improvement originates from the best partial immigration technique applied to the quantum
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cromosomes. The main objective of the best partial immigration is to consider the string of qubits from the quantum chromosomes having best fitness and transfer the same randomly to the chromosomes of next generation for better mixing. The process is reiterated. To observe the performance the best partial immigration technique we have considered some popular optimization problems and performed the experiment on it. These problems are namely Travelling Salesman Problem (TSP), Binpacking Problem and Vertex Cover Problem. It has been observed that the obtained results outperforms the conventional QGA.

References

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Index Terms
Computer Science Distributed Systems

Keywords
Genetic Algorithm QGA Quantum computation