

Quantum-Inspired Evolutionary Algorithms

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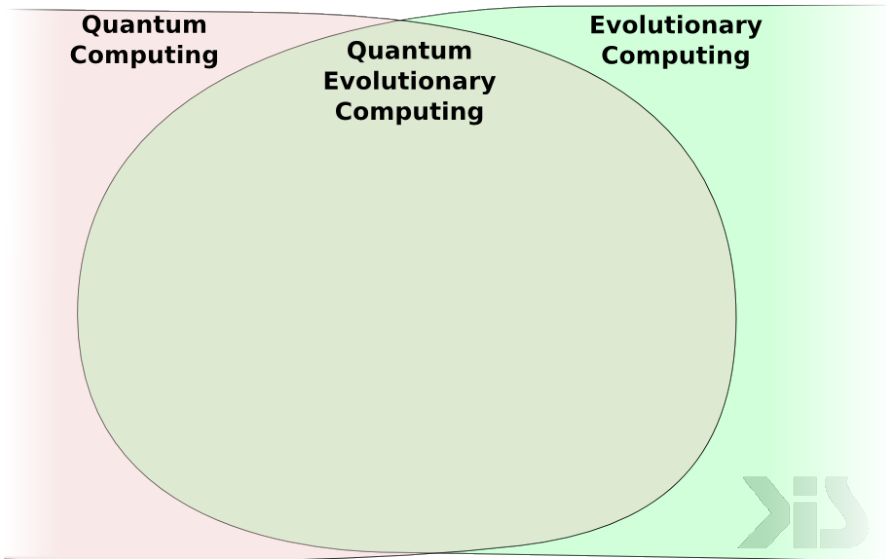


Outline

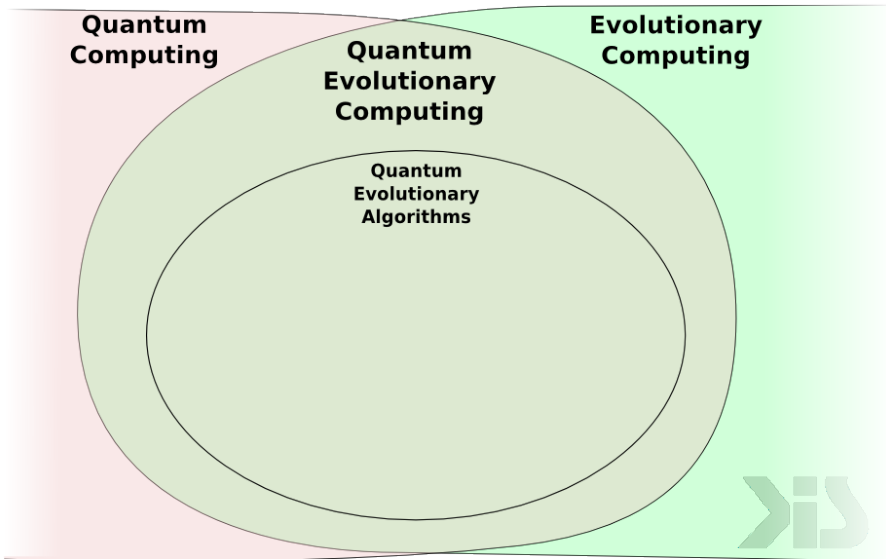
- 1 State of the art and scope of my research
- 2 Quantum elements in evolutionary algorithms
- 3 Theoretical analysis
- 4 Numerical experiments



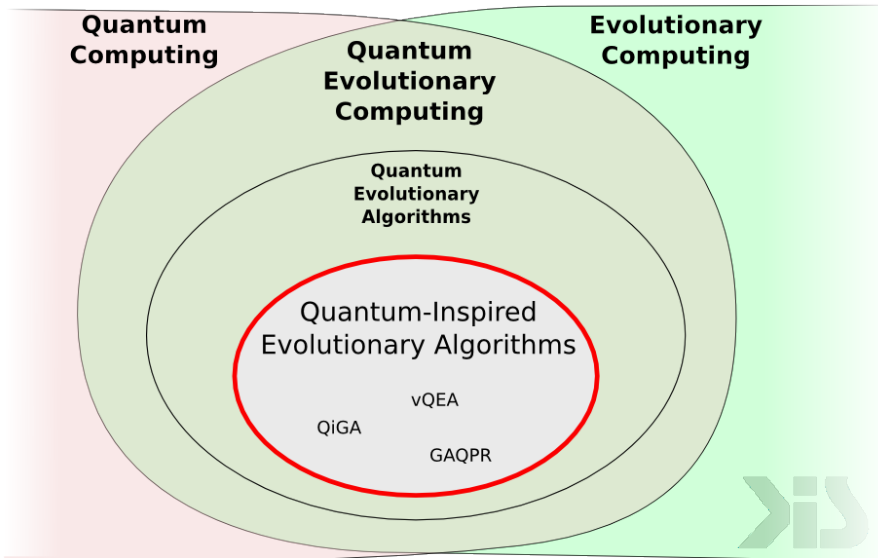
Scope of research



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Quantum elements in evolutionary algorithms

1 Representation of solutions

Instead of exact points in a search space –
probability distributions of sampling the space

2 Initialization

3 Genetic operators

4 Fitness evaluation



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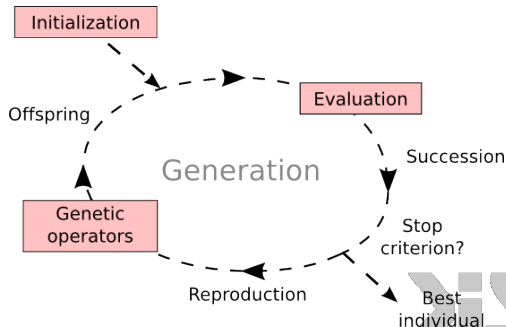
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Quantum Evolutionary Algorithms

Convergence and Performance – Theoretical Analysis

1 **Banach fixpoint theorem**

It is possible to define a new measure of quality for quantum genotypes and relevant metric space where the algorithms converge to optimum solutions.

2 Holland's schema theorem

Generalization of the theorem to the quantum-inspired genetic algorithm.

3 Markov chains

Analysis of the quantum-inspired evolutionary algorithm as a Markov process.

4 Walsh transforms



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Numerical experiments

- Methodology proposed by De Jong (1975)¹
- Test functions (Rosenbrock, Schwefel, Rastrigin, ...)
- Combinatorial optimization problems:
traveling salesman problem, knapsack problem,
feature selection problem²

¹DeJong, K. A. *An Analysis of the Behavior of a class of Genetic Adaptive Systems*. PhD thesis, University of Michigan, 1975

²Jopek Ł., Nowotniak R., Postolski M., L. Babout., Janaszewski M.: *Zastosowanie kwantowych algorytmów genetycznych do selekcji cech*. Zeszyty Naukowe AGH, Automatyka, w druku 2010



Thank you for your attention

