Advanced Parallel Genetic Algorithm with Gene Matrix for Global Optimization

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Abstract.
In this paper we address the parallelization of genetic algorithm (GA) as a tool to solve optimization problems. The proposed method which is called Parallel Genetic Algorithm with Gene Matrix (PGAGM), is a new parallel genetic algorithm technique that is based on distributed model for high dimensional problems. In this algorithm, Gene Matrix (GM) operator is used as an automatic termination criterion in order to assure that sufficient exploration of the search space has been conducted. The resulting technique shows excellent results with low execution time for finding the optimal solution.

Keywords: *Genetic algorithms, Distributed Computing, Hybrid Meta-heuristic, Global optimization, MPI.*

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Tabu search with multi-level neighborhood structures for high dimensional problems

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Abstract.
Metaheuristics have been successfully applied to solve different types of numerical and combinatorial optimization problems. However, they often lose their effectiveness and advantages when applied to large and complex problems. Moreover, the contributions of metaheuristics that deal with high dimensional problems are still very limited compared with low and middle dimensional problems. In this paper, Tabu Search algorithm based on variable partitioning is proposed for solving high dimensional problems. Specifically, multi-level neighborhood structures are constructed by partitioning the variables into small groups. Some of these groups are selected and the neighborhood of their variables are explored. The computational results shown later indicate that exploring the neighborhood of all variables at the same time, even for structured neighborhood, can badly effect the progress of the search. However, exploring the neighborhood gradually through smaller number of variables can give better results. The variable partitioning mechanism used in the proposed method can allow the search process to explore the region around the current iterate solution more precisely. Actually, this partitioning mechanism works as dimensional reduction mechanism. For high dimensional problems, extensive computational studies are carried out to evaluate the performance of newly proposed algorithm on large number of benchmark functions. The results show that the proposed method is promising and produces high quality solutions within low computational costs.

Keywords: *Metaheuristics, Tabu search, · High dimensional problems, · Global optimization.*

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Genetic Algorithm and Tabu Search Based Methods for Molecular 3D -Structure Prediction

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Abstract.

The search for the global minimum of a potential energy function is very difficult since the number of local minima grows exponentially with the molecule size. The present work proposes the application of genetic algorithm and tabu search methods, which are called GAMCP (Genetic Algorithm with Matrix Coding Partitioning) [7], and TSVP (Tabu Search with Variable Partitioning) [8], respectively, for minimizing the molecular potential energy function. Computational results for problems with up to 200 degrees of freedom are presented and are favorable compared with other four existing methods from the literature. Numerical results show that the proposed two methods are promising and produce high quality solutions with low computational costs.

Keywords: *Genetic algorithm, Tabu search, Protein 3D- structure prediction, Global optimization*.

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Finding the 3D-Structure of a Molecule Using Genetic Algorithm and Tabu Search Methods

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Abstract

The search for the global minimum of a potential energy function is very difficult since the number of local minima grows exponentially with the molecule size. The present work proposes the application of genetic algorithm and tabu search methods, which called GAMCP (Genetic Algorithm with Matrix Coding Partitioning) [4], and TSVP (Tabu Search with Variable Partitioning) [5], respectively, for minimizing the molecular potential energy function. Computational results for problems with up to 200 degrees of freedom are presented and favorable compared with other three existing methods from the literature. Numerical results show that the proposed two methods are promising and produce high quality solutions with low computational costs.

Keywords: *Genetic algorithm, Tabu search, Protein 3D- structure prediction, Global optimization*.

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Genetic Algorithm With Population Partitioning and Space Reduction for High Dimensional Problems

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Abstract

In this paper, we modify genetic algorithm (GA) with new strategies of population partitioning and space reduction for high dimensional problems. The proposed method is called GA with matrix-coding partitioning (GAMCP). In the GAMCP method, a population of chromosomes is coded in a one big matrix. This matrix is partitioned into several sub-matrices every generation, and GAMCP applies the genetic operations on the partitioned sub-matrices. Moreover, the gene matrix (GM) [5], [6] termination criteria are modified and applied in the GAMCP method in order to equip the search process with a self-check to judge how much exploration has been done and to maintain the population diversity. The computational experiments show the efficiency of the new elements proposed in the GAMCP method.

Keywords: *Meta-heuristics, Genetic algorithms, Global optimization, High dimensional problems.*

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