(1)

Advanced Parallel Genetic Algorithm with Gene matrix for Global Optimization

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Abstract:

Keywords:

Published In:

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(2)

Performance analysis of synchronous and asynchronous distributed genetic algorithms on multiprocessors

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Abstract:

Because of their effectiveness and flexibility in finding useful solutions, Genetic Algorithms (GAs) are very popular search techniques for solving complex optimization problems in scientific and industrial fields. Parallel GAs (PGAs), and especially distributed ones have been usually presented as the way to overcome the time-consuming shortcoming of sequential GAs. In the case of applying PGAs, we can expect better performance, the reason being the exchange of knowledge during the parallel search process. The resulting distributed search is different compared to what sequential panmictic GAs do, then deserving additional studies. This article presents a performance study of three different PGAs. Moreover, we investigate the effect of synchronizing communications over modern shared-memory multiprocessors. We consider the master-slave model along with synchronous and asynchronous distributed GAs

Keywords:

Parallel distributed computing, Genetic algorithms, Synchronization, MPI, Speed-up

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(3)

Parallel execution combinatorics with metaheuristics: Comparative study

Amr Abdelhafez, Gabriel Luque, Enrique Alba

Abstract:

Optimization arises everywhere in industrial and engineering fields, with complex and time-consuming problems to be solved. Exact search techniques cannot afford practical solutions for most of the real-life problems in reasonable time-bound. Metaheuristics proved to be numerically efficient solvers for such problems in terms of solution quality, however, they could require large time and energy to get the optimal solution. Parallelization (i.e., distributed) is a promising approach for overcoming the overwhelming energy and time consumption values of these methods. Despite recent approaches in running metaheuristics in parallel, the community still lacks for novel studies comparing and benchmarking the canonical optimization techniques while being running in parallel. In this work, we present two extensive studies to the solution quality, energy consumption, and execution time for three different metaheuristics (Genetic Algorithm, Variable Neighborhood Search, and Simulated Annealing) and their distributed counterparts. The main aim of our studies is exploring the efficiency of parallel execution of the metaheuristics while being running in new computing environments. Here, we want to identify the combinatorics between metaheuristics and solving optimization problems while being run in parallel. For our studies, we consider a multicore machine with 32 cores. This choice to a recent and commonly used system shall enrich the existing literature for multicore systems against the enormous existing studies over cluster systems. The analyses and discussions for the results of the different algorithms exhibit the combinatorics between the different metaheuristics and the parallel execution using a different number of cores. The outcome of these studies builds a guide for future designs of efficient and energy-aware optimization techniques.

Keywords:

Parallel, Sequential Metaheuristics, Optimization, Energy, Genetic algorithm, Variable neighborhood search, Simulated annealing

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(4)

Speed-up of synchronous and asynchronous distributed Genetic Algorithms: a first common approach on multiprocessors

Amr Abdelhafez, Enrique Alba

Abstract:

Genetic Algorithms (GAs) are being used to solve a wide range of problems in real world problems, and it is important to study their implementations to improve the solution quality and reduce the execution time. Designing parallel (e.g., distributed) GAs is one research line to do so. In distributed GAs, every individual represents a tentative solution. Individuals are split (and sparsely communicated) over many islands, with genetic operators being applied locally in each island. In addition, in order to maintain diversity and reduce the number of the evaluations, a migration operator is used to enhance their behavior. This article presents a basic study on the speed-up of parallel GAs where a common approach is followed to better understand synchronous and asynchronous versions together. We analyze the behavior of GAs over a homogeneous multiprocessor system. We will report results showing linear and even super linear speed-up in both cases of study. The parallel performance of the synchronous and asynchronous versions is very good in a multiprocessor computer, both in terms of time and solution quality. Besides, a statistical analysis of the algorithms clearly proves that both cases have a similar numerical behavior over a homogeneous parallel system.

Keywords:

Genetic Algorithms, speed-up, synchronous and asynchronous

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(5)

A component-based study of energy consumption for sequential and parallel genetic algorithms

Amr Abdelhafez, Enrique Alba & Gabriel Luque

Abstract:

Recently, energy efficiency has gained attention from researchers interested in optimizing computing resources. Solving real-world problems using optimization techniques (such as metaheuristics) requires a large number of computing resources and time, consuming an enormous amount of energy. However, only a few and limited research efforts in studying the energy consumption of metaheuristics can be found in the existing literature. In particular, genetic algorithms (GAs) are being used so widely to solve a large range of problems in scientific and real-world problems, but hardly found explained in their internal consumption behavior. In the present article, we analyze the energy consumption behavior of such techniques to offer a useful set of findings to researchers in the mentioned domains. We expand our study to include several algorithms and different problems and target the components of the algorithms so that the results are still more appealing for researchers in arbitrary domains of application. Our experiments on the sequential GAs show the controlling role of the fitness operator on energy consumption and also reveal possible energy hot spots in GAs operations, such as mutation operator. Further, our distributed evaluations besides a statistical analysis of the results demonstrate that the communication scheme could highly affect the energy consumption of the parallel evaluations of the GAs.

Keywords:

genetic algorithms, energy consumption, sequential and parallel

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(6)

Analyzing the Energy Consumption of Sequential and Parallel Metaheuristics

Amr Abdelhafez ; Gabriel Luque ; Enrique Alba

Abstract:

Real-life problems are usually time-consuming since they require solving large instances of NP-hard problems. Exact search methods in most of the cases cannot afford practical solutions for such problems. Metaheuristics arise as promising solvers for these problems, by obtaining acceptable solutions in terms of quality and computational cost in a reasonable time bound. Nowadays, energy efficiency is also taken into consideration during the design of new algorithms because of the million times that algorithms run on labs and computation centers. This work presents two novel experiments for investigating the numerical performance and energy efficiency of the sequential and parallel metaheuristics. The main aim of this study is to analyze the energy consumption of three well-known and commonly used metaheuristics (Genetic Algorithm, Variable Neighborhood Search, and Simulated Annealing) and their parallel versions. The discussions reveal the differences/similarities between the different sequential/parallel algorithms, which include trajectory-based and population-based metaheuristics so that this study is useful for the future design of energy-aware algorithms.

Keywords:

metaheuristics, energy

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