A Highly-Parallel TSP Solver for a GPU Computing Platform

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The traveling salesman problem (TSP for short) is probably the most widely studied combinatorial optimization problem and has become a standard testbed for new algorithmic ideas. Recently the use of a GPU (Graphics Processing Unit) to accelerate non-graphics computations has attracted much attention due to its high performance and low cost.

This paper presents a novel method to solve TSP instances with a GPU based on the CUDA architecture. Especially for CUDA, the proposed method highly parallelizes a serial metaheuristic algorithm which is a genetic algorithm with the OX (order crossover) operator and the 2-OPT local search. Genetic algorithms have obvious parallelism among individuals. However, the parallelism is not enough to obtain high performance of a GPU. To utilize an advantage of "many-thread" architecture of CUDA, we extract not only the parallelism among individuals but also another parallelism in the processing of each individual. That is, we parallelize the execution of each OX operator and each 2-OPT local search, too.

To evaluate the effectiveness of the proposed method, we conduct some experiments for TSPLIB benchmark problem instances using an NVIDIA GeForce GTX285 GPU and a 3.0 GHz Intel Core 2 Duo E6850 CPU. The experimental results show that our GPU implementation is about up to 10 times faster than the corresponding CPU implementation.

Quite recently, CUDA has been successfully used to accelerate various applications in scientific fields such as fluid dynamics, image processing, and simulations. However, in the field of genetic algorithms, almost no result is known except for our QAP solver presented at the International Workshop CIGPU 2009. This is because genetic algorithms have special property of frequent random access to large data-structures, which is not the case in the other successful fields. This paper presents the first result on solving TSP with a GPU. Therefore, we believe that this paper provide considerable contribution for the workshop participants, in particular of interest in parallel metaheuristics on emerging GPU computing platforms.