GPU-based Massively Parallel Implementation of Metaheuristic Algorithms

Robert Nowotniak, Jacek Kucharski

Computer Engineering Department
Technical University of Lodz

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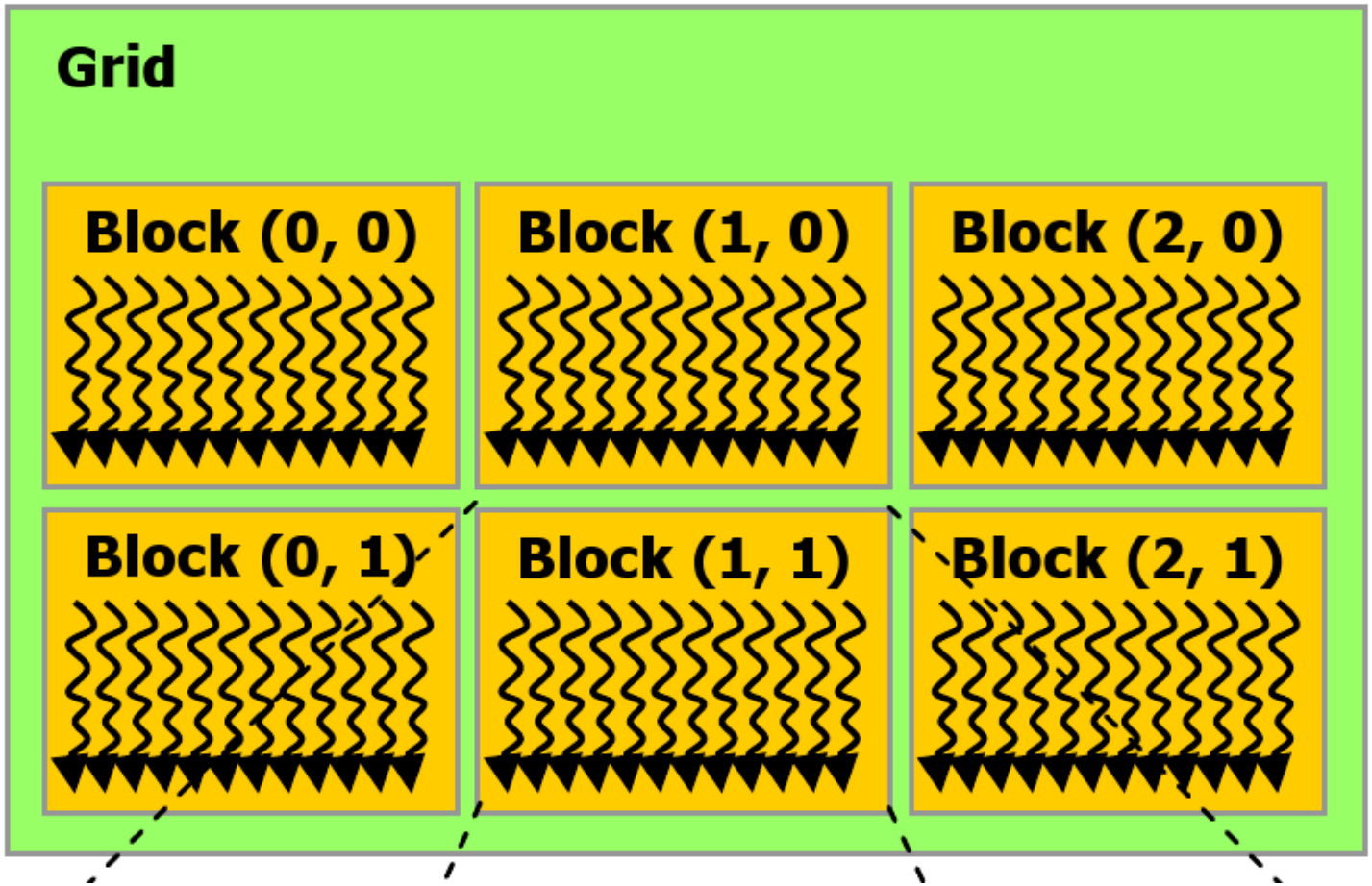
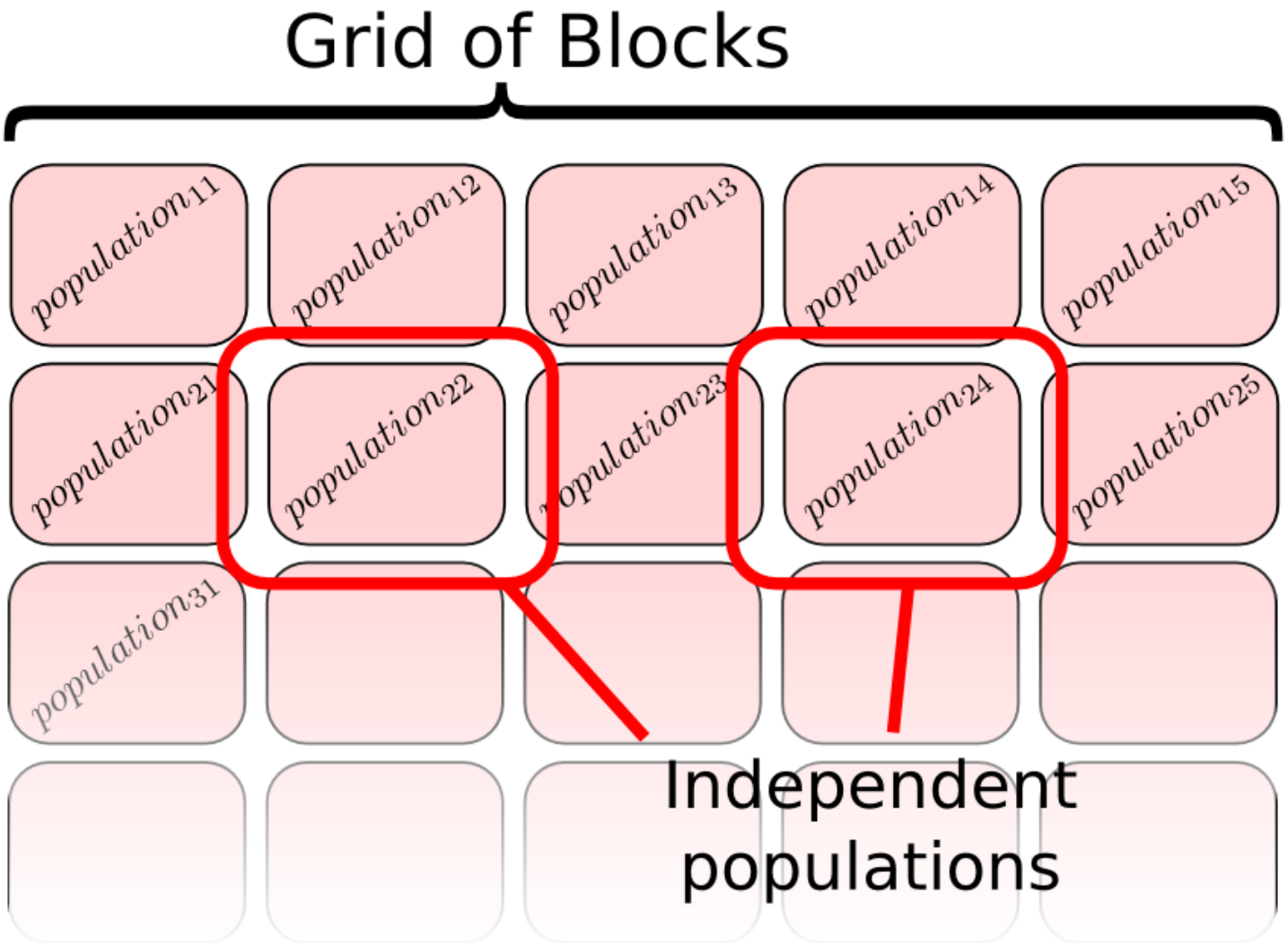
Thread hierarchy on CUDA GPU

In CUDA, **threads** are grouped in **blocks** and blocks constitute a **grid**. The unit of thread scheduling is **warp** (32 threads).



Grid of Thread Blocks

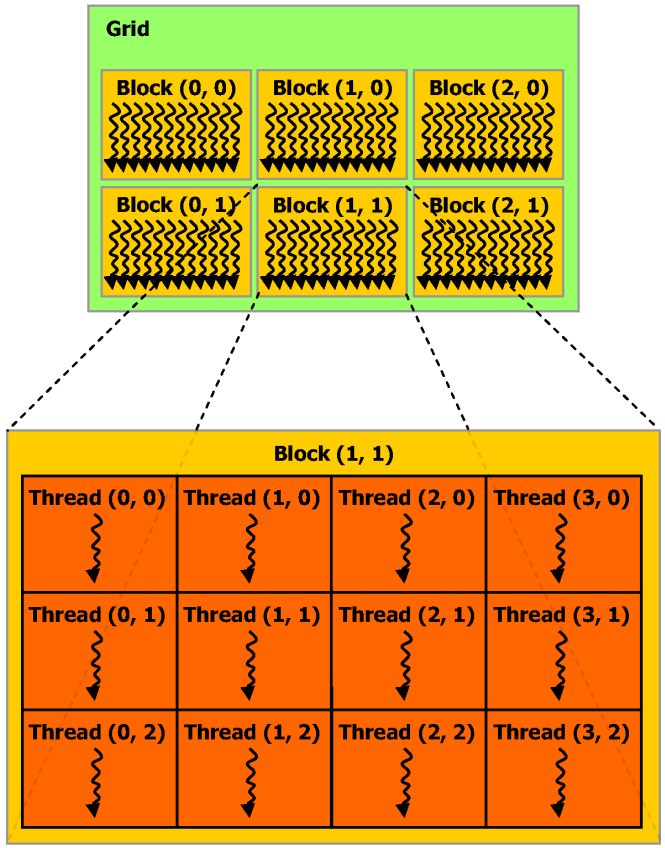
Proposed approach to parallelization



GPU-BASED IMPLEMENTATION OF METAHEURISTICS

Two levels:

1. **Coarse-grained parallelization**
   In a grid, there can be several hundred blocks evolving independent populations with same or different parameters simultaneously.
2. **Fine-grained parallelization**
   On the population level, each individual can be evaluated and transformed in a separate GPU thread. Thus, the whole population can be represented as a block of threads.



Hundreds of populations with same or different parameters can be evolved in parallel, simultaneously.

GPU-based implementation of Metaheuristics

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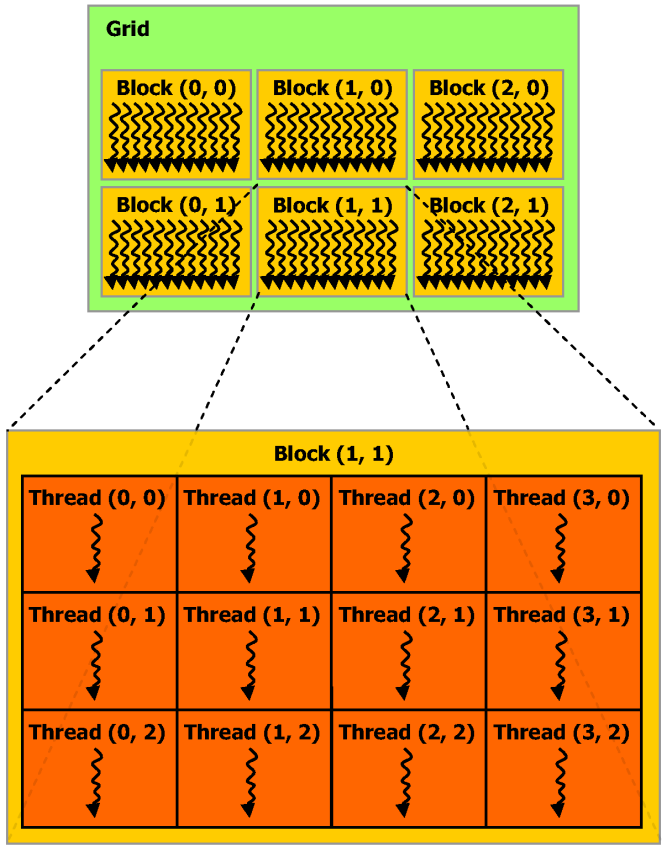

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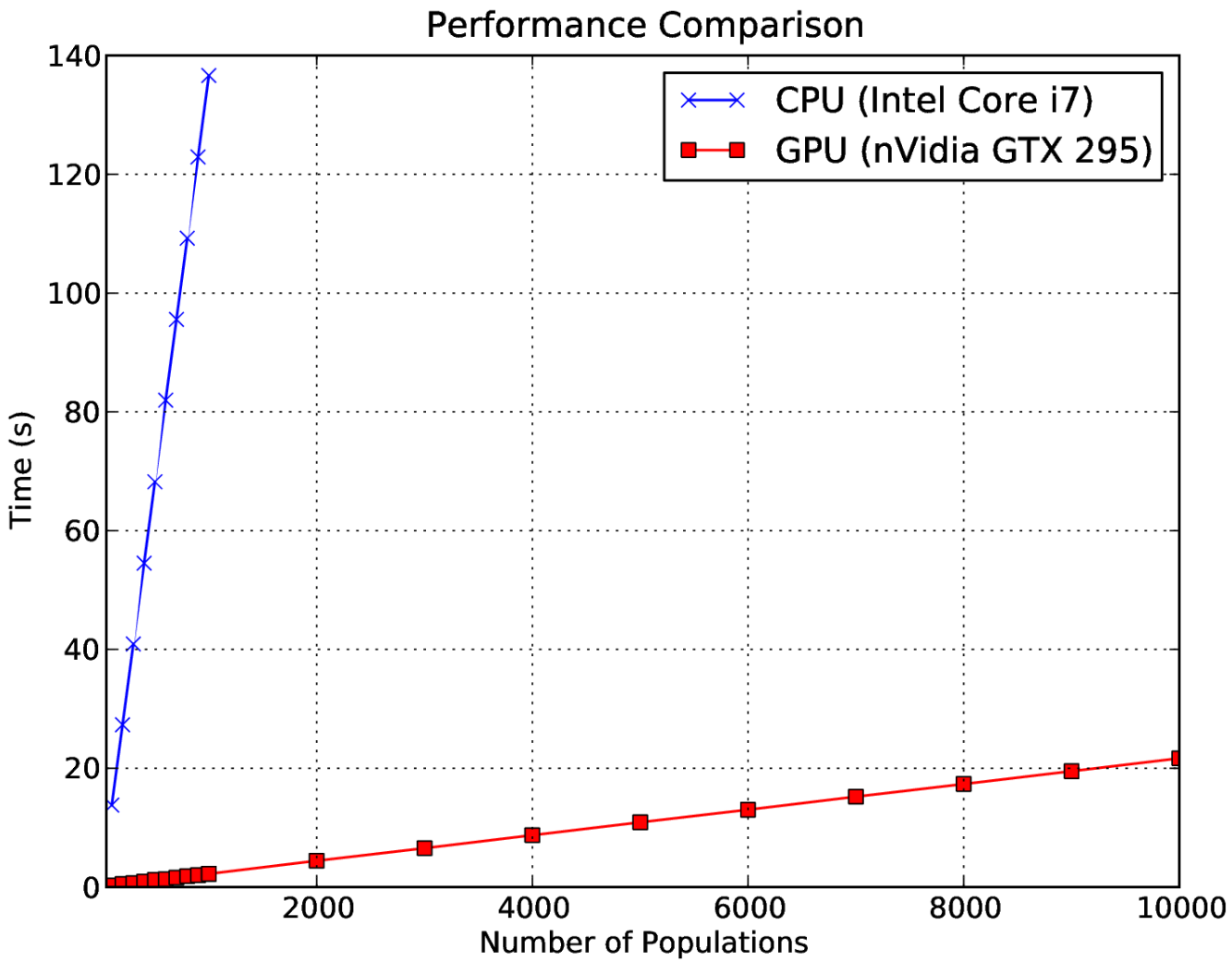
Performance comparison



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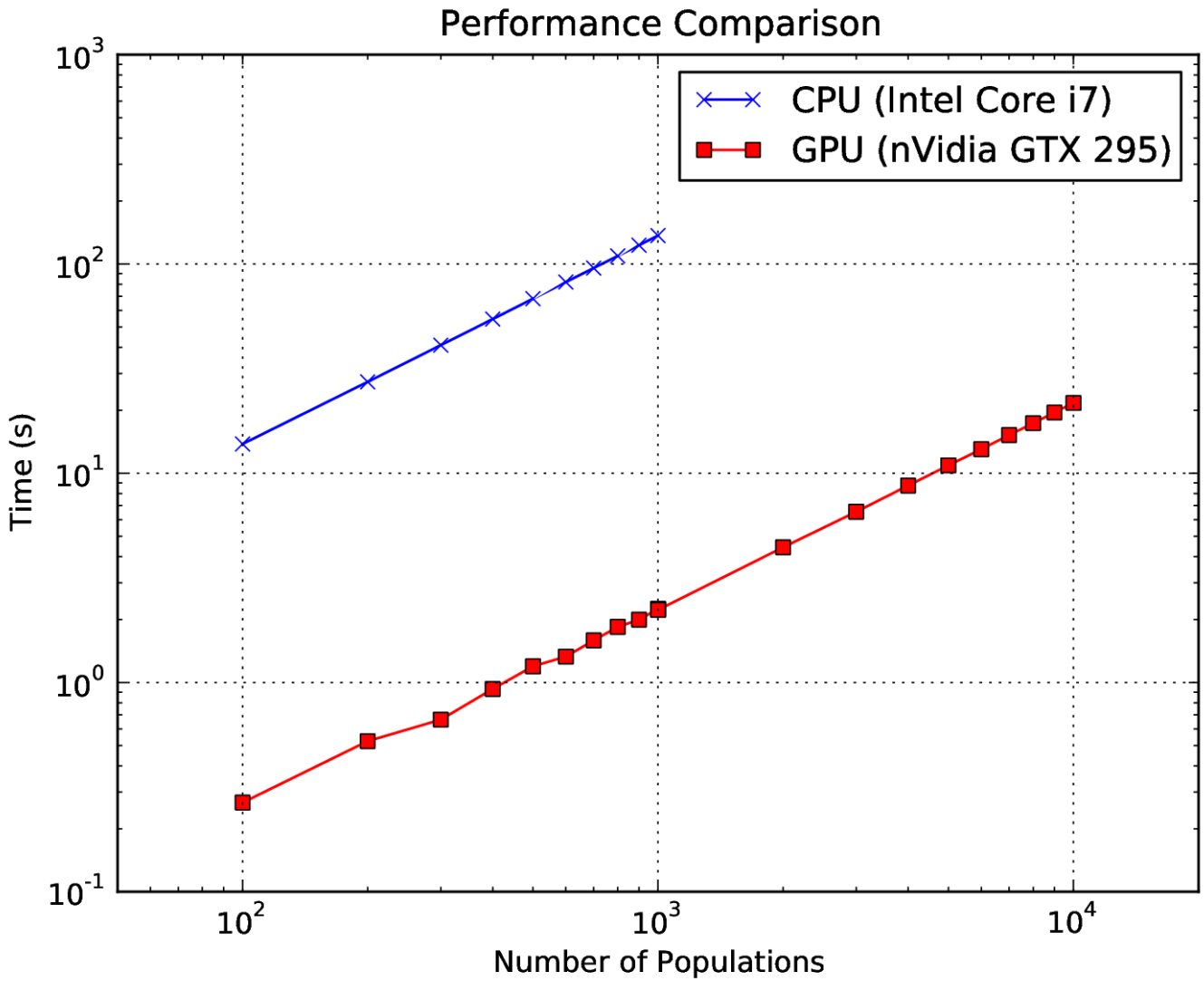
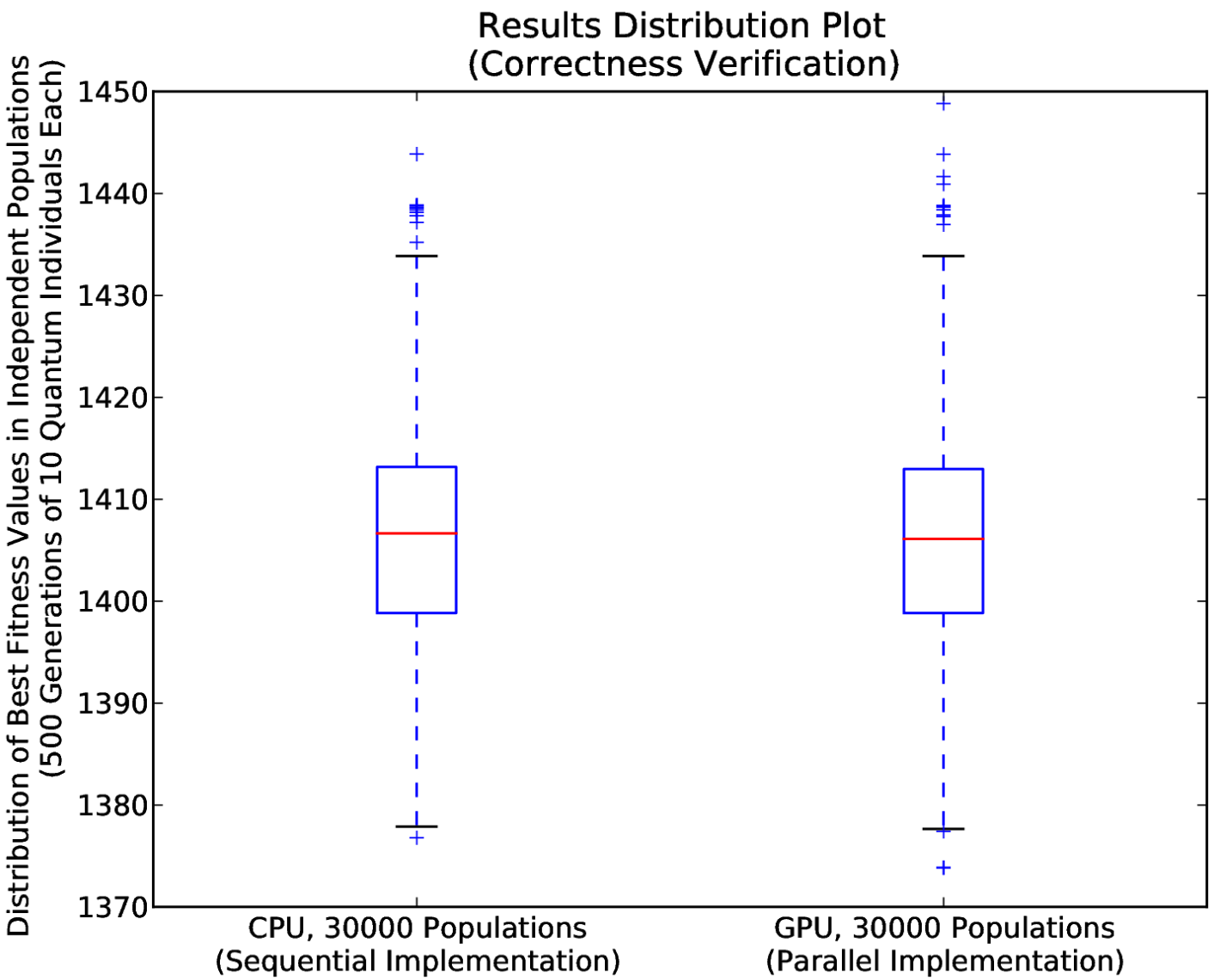


RESULTS

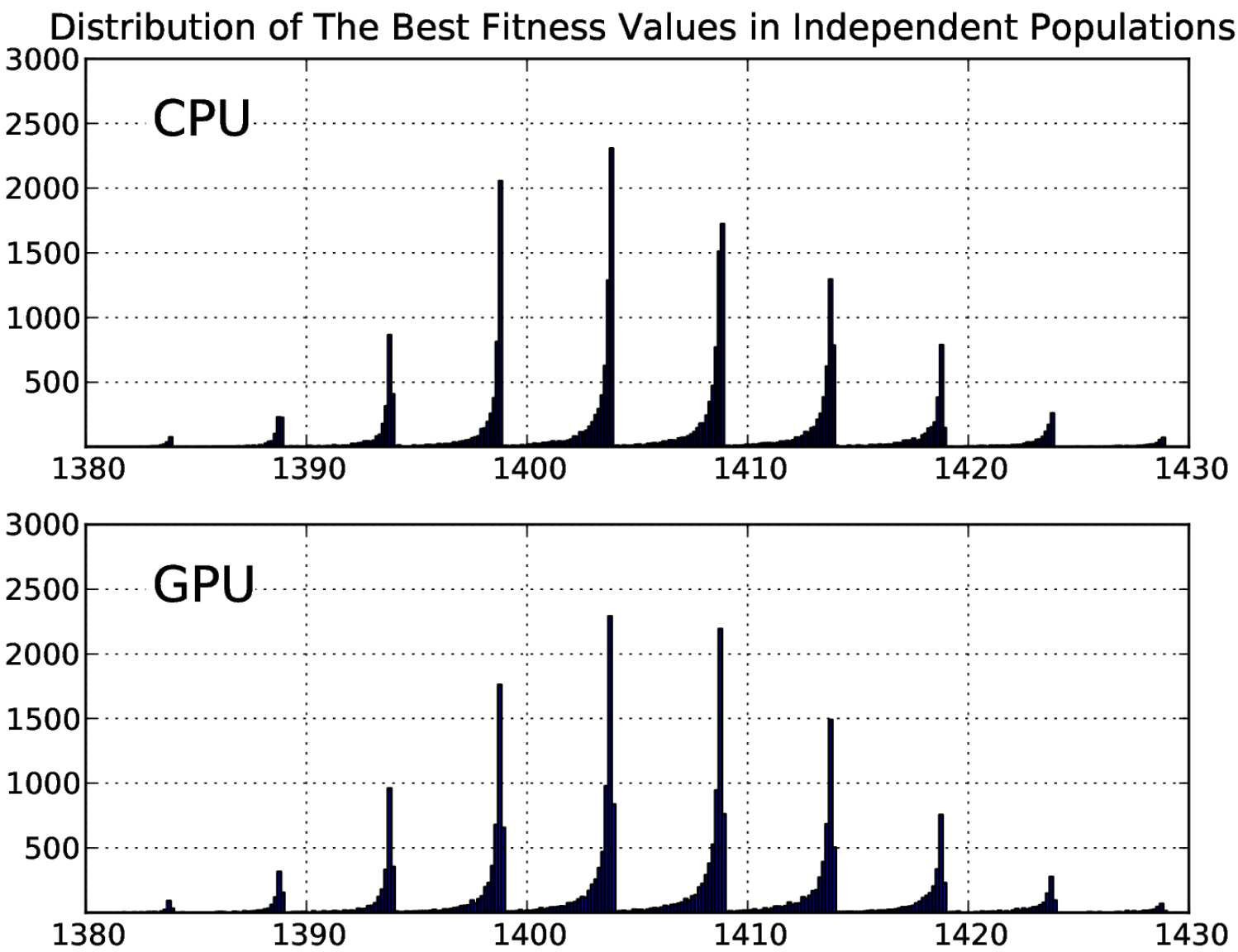
1. **Pentium-III 500MHz (Visual C++ 6.0)**
   0.723 experiments / second (according to [1])
2. **Intel Core i7 2.93GHz (1 core, ANSI C)**
   7.33 experiments / second
3. **NVidia GTX 295 (CUDA C)**
   890 experiments / second (**about 120x speedup**)
4. **8 GPUs (GTX295+GTX285+Tesla s1070+Tesla C2070)**
   3089 experiments / second (**over 400x speedup**)

[1] Han, K. H., Kim, J. H.: Genetic quantum algorithm and its application to combinatorial optimization problem. Proceedings of the 2000 Congress on Evolutionary computation, 2000

Correctness verification



Correctness verification



Thank you for your attention