GPU-based Massively Parallel Implementation of Metaheuristic Algorithms

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

Grid of Blocks

Independent populations
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.
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Performance Comparison

- CPU (Intel Core i7)
- GPU (nVidia GTX 295)
Performace Comparison

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- GPU (nVidia GTX 295)

Time (s)

Number of Populations

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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)

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Correctness verification

Results Distribution Plot (Correctness Verification)

Distribution of Best Fitness Values in Independent Populations (500 Generations of 10 Quantum Individuals Each)

- CPU, 30000 Populations (Sequential Implementation)
- GPU, 30000 Populations (Parallel Implementation)
CORRECTNESS VERIFICATION

Distribution of The Best Fitness Values in Independent Populations

CPU

GPU
Thank you for your attention