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Optimization of thread partitioning parameters in speculative multithreading based on artificial immune algorithm

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Key words: Speculative multithreading, Thread partitioning, Artificial immune algorithm

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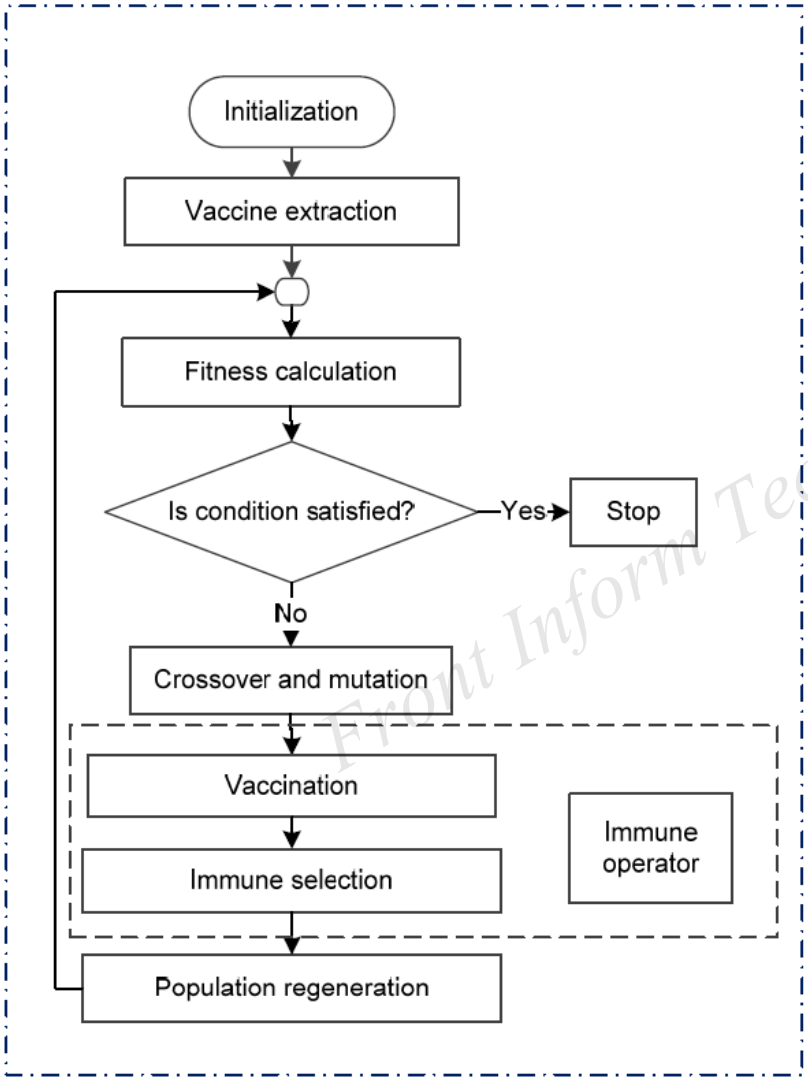
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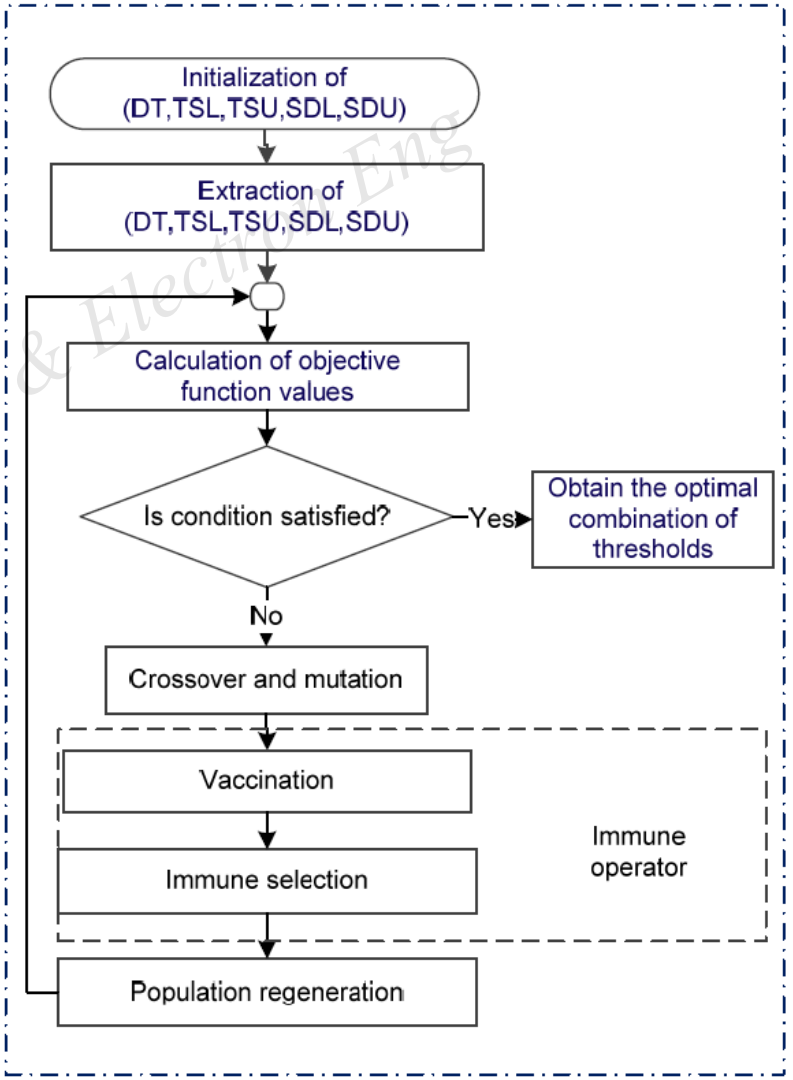
Introduction

- Using unified values of partition parameters to partition different applications leads to the fact that every application cannot own its optimal partition scheme.
- To solve the problem, five parameters affecting thread partition are extracted from heuristic rules. They are the dependence threshold (DT), lower limit of thread size (TSL), upper limit of thread size (TSU), lower limit of spawning distance (SDL), and upper limit of spawning distance (SDU). Their ranges are determined in accordance with heuristic rules, and their step-sizes are set empirically.
- Under the condition of setting speedup as an objective function, all combinations of five threshold values form the solution space, and our aim is to search for the best combination to obtain the best thread granularity, thread dependence, and spawning distance, so that every application has its best partition scheme.

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Flowchart of optimizing with AIA





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Experimental results

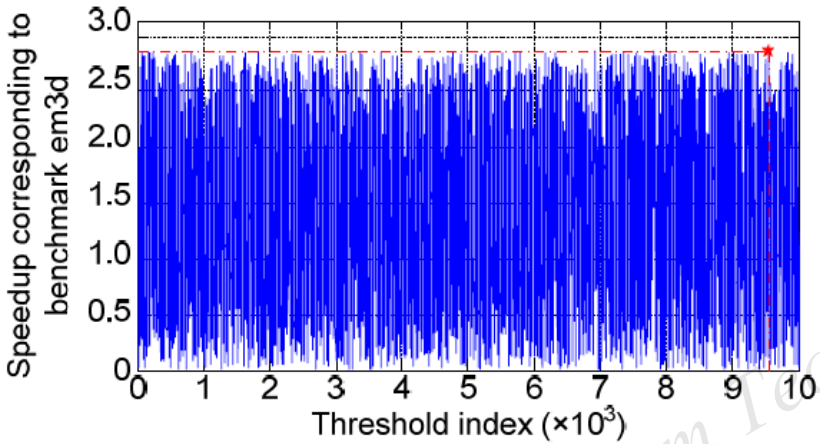


Fig. 10 Speedups of em3d corresponding to collections of thresholds (DT, TSL, TSU, SDL, SDU)

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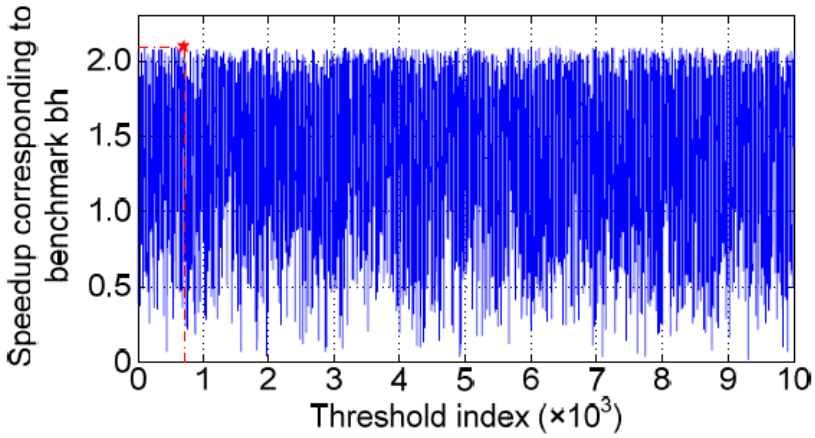


Fig. 12 Speedups of bh corresponding to collections of thresholds (DT, TSL, TSU, SDL, SDU)

Experimental results (Con'd)

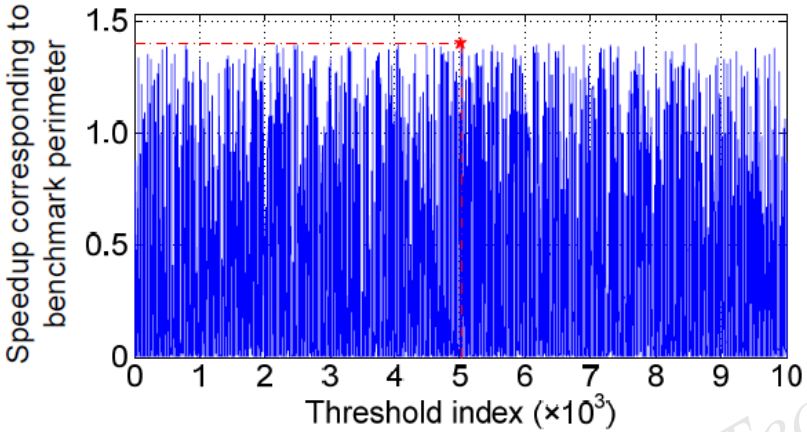


Fig. 14 Speedups of perimeter corresponding to collections of thresholds (DT, TSL, TSU, SDL, SDU)

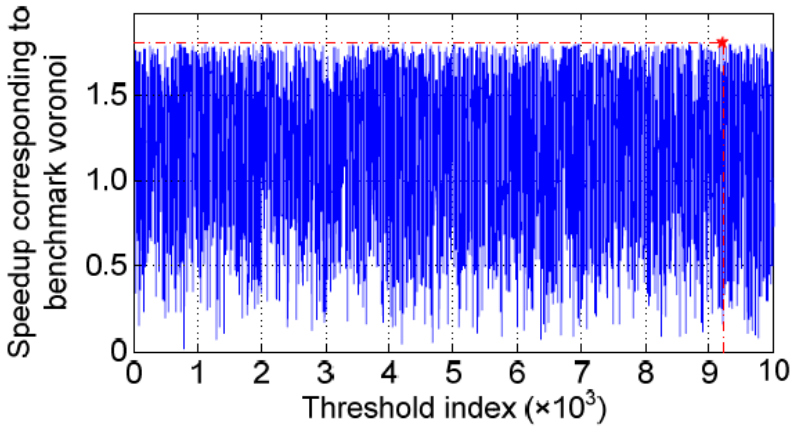


Fig. 15 Speedups of voronoi corresponding to collections of thresholds (DT, TSL, TSU, SDL, SDU)

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Experimental results (Con'd)

Table 4 The optimal combinations of parameters

Benchmark	DT	TSL	TSU	SDL	SDU
em3d	7	10	48	9	39
bh	7	16	48	4	32
health	10	17	34	4	31
perimeter	4	26	49	6	31
voronoi	5	16	46	1	30
treeadd	4	21	44	6	39
power	8	15	44	2	43
tsp	4	16	42	8	31
msp	12	23	39	4	38
bisort	6	19	40	8	45

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Conclusions

- We use the artificial immune algorithm (AIA) to search for the optimal solution. On Prophet, which is a generic SpMT processor to evaluate the performance of multithreaded programs, Olden benchmarks are used to implement the process.

- Experiments show that we can obtain the optimal parameter values for every benchmark, and Olden benchmarks partitioned with the optimized parameter values deliver a performance improvement of 3.00% on a 4-core platform compared with a machine learning based approach, and 8.92% compared with a heuristics-based approach.

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