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Parallel Particle Swarm Optimization on GPU with Application to Trajectory Optimization

Qi Wu [1], Fenfen Xiong[2]

[1] Beijing Institute of Technology, School of Aerospace Engineering, Beijing,wuqi_55@163.com;
[2] Beijing Institute of Technology, School of Aerospace Engineering, Beijing, fenfenx@bit.edu.cn. Corresponding author;

Abstract

In simulation-based design optimization, one of the greatest challenges is the intensive computing burden. In order to reduce the computational time, a parallel implementation of the particle swarm optimization (PSO) algorithm on graphic processing unit (GPU) is presented in this paper. Instead of executed on the central processing unit (CPU) in a serial manner, the PSO algorithm is executed in parallel taking advantage of the general-purpose computing ability of GPU in the platform of compute unified device architecture (CUDA). The processes of the fitness evaluation, the updating of velocity and position of all the particles of PSO are parallelized and respectively introduced in detail. Comparative studies on optimization of three benchmark test functions are conducted by running the PSO algorithm on GPU (GPU-PSO) as well as CPU (CPU- PSO), respectively. The impact of design dimension, as well as the number of particles and optimization iteration in PSO on the computational time is investigated. From test results, it is observed that the computational time of GPU-PSO is much shorter compared to that of CPU- PSO, which demonstrates the remarkable speedup capability of GPU-PSO. Finally, GPU-PSO is applied to a practical gliding trajectory optimization problem to reduce the computing time, which further demonstrates the effectiveness of GPU-PSO.

Keywords: PSO; GPU; CUDA; trajectory optimization.