ABSTRACT

Particle Swarm Optimization (PSO) is an optimization technique that is used to solve many problems in different applications. However, most implementations are sequential. The optimization process requires a large number of evaluations of the objective function, especially in complex problems, involving a large amount of particles and dimensions. As a result, the algorithm may become inefficient in terms of performance, execution time and even the quality of the expected result. To overcome these difficulties,high performance computing and parallel algorithms can be used, taking into account to the characteristics of the architecture. This should increase performance, minimize response time and may even improve the quality of the final result. In this dissertation, the PSO algorithm is parallelized using three different strategies that consider different granularities of the problem, and the division of the optimization work among several cooperative sub-swarms. One of the developed parallel algorithms, namely PPSO, is implemented directly in hardware, using an FPGA. All the proposed strategies, namely PPSO (Parallel PSO), PDPSO (Parallel Dimension PSO) and CPPSO (Cooperative Parallel PSO), are implemented in a multiprocessor, multicomputer and GPU based parallel architectures. The different performed assessments show that the GPU achieved the best results for problems with high number of particles and dimensions when a strategy with finer granularity is used, namely PDPSO and CPPSO. In contrast with this, when using a strategy with a coarser granularity, namely PPSO, the multi-computer based implementation achieved the best results.

Keywords: Particle Swarm Optimization. High Performance Architecture. Parallel Algorithm.