Cellular PSO: A PSO for Dynamic Environments

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Abstract

Many optimization problems in real world are dynamic in the sense that the global optimum value and the shape of fitness function may change with time. The task for the optimization algorithm in these environments is to find global optima quickly after the change in environment is detected. In this paper, we propose a new hybrid model of particle swarm optimization and cellular automata which addresses this issue. The main idea behind our approach is to utilized local interactions in cellular automata and split the population of particles into different groups across cells of cellular automata. Each group tries to find an optimum locally which results in finding the global optima. Experimental results show that cellular PSO outperforms mQSO, a well known PSO model in literature, both in accuracy and complexity in a dynamic environment where peaks change in width and height quickly or there are many peaks.

Keywords Dynamic environments - Particle swarm optimization - Cellular Automata

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Keywords: Dynamic environments, Particle swarm optimization, Cellular Automata.

1 Introduction

In the real world, many applications are non-stationary problems which need to not only finding the global optimal solution but also keeping trace of its change. Particle swarm optimization algorithms (PSO) have gained popularity in recent years. PSO is a population-based method, a variant of evolutionary algorithms with moving towards the target rather than evolution, through the search space. The basic idea behind this approach is iterative ameliorating of global participant's perception of the target by exchanging local information among them. However due to the static context of PSO usage, some issues arise when using them in dynamic environments. These challenges lie in two aspects: outdated memory due to changing environment and diversity loss due to convergence. Of these two the diversity loss is by far more serious. It has been demonstrated that the time taken for a partially converged swarm to re-diversify, find the shifted peak, and then re-converge is quite deleterious to the performance of PSO [1].

In this paper we address diversity loss problem in adapting PSO to dynamic environments and propose a variant of multi swarm method to solve it. To this aim, embedded cellular automata are utilized to maintain diversity of particles and to scatter them over the search space. Particles in each cell of cellular automata search for a local optimum and broadcast the best solutions to neighborhood. Comparing the best

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