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PSOGP: A GENETIC PROGRAMMING BASED ADAPTABLE EVOLUTIONARY HYBRID PARTICLE SWARM OPTIMIZATION

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Abstract. *In this study we describe a method for extending particle swarm optimization. We have presented a novel approach for avoiding premature convergence to local minima by the introduction of diversity in the swarm. The swarm is made more diverse and is encouraged to explore by employing a mechanism which allows each particle to use a different equation to update its velocity. This equation is also continuously evolved through the use of genetic programming to ensure adaptability. We compare two variations of our algorithm, one utilizing random initialization while in the second one we utilize partial non-random initalization which forces some particles to use the standard PSO velocity update equation. Results from experimentation suggest that the modified PSO with complete random initialization shows promise and has potential for improvement. It is particularly very good at finding the exact optimum.*
Keywords: Particle swarm optimization, Genetic programming, Function optimization, Evolution, Velocity update equation

1. **Introduction.** This paper presents an extension to the well known particle swarm optimization algorithm. Unlike other population-based optimization approaches which are motivated by evolution, particle swarm optimization is motivated from the simulation of social behavior. There have been numerous attempts to incorporate evolution into PSO. This is usually done by creating a hybrid algorithm which combines aspects from evolutionary computation with PSO. These can be categorized into two broad categories. The first category consists of those hybrid algorithms which evolve the particles of PSO. The second category includes those hybrid algorithms in which the PSO algorithm itself is evolved. There have also been numerous approaches in which a different velocity update equation has been used for different particles in a swarm. Generally in these approaches, the particles are divided into multiple subgroups and each subgroup shows a different behavior achieved by using a separate update equation for that subgroup. There have also been numerous other modifications made to PSO and evolutionary algorithms in general. We introduce a novel approach which incorporates evolution into PSO [30]. In this approach a learning set is not required and the PSO adapts itself to the target problem at runtime by evolving the update equation through genetic programming [20]. This allows the PSO to perform better by adjusting itself according to the problem. We also introduce the concept of using a different update equation for each particle to avoid premature convergence to local minima because this introduces diversity in the swarm and encourages exploration. Each particle's velocity update equation is evolved separately by using genetic operators. We also present another variant which utilizes partial non-random initialization. We present a comparison of the two approaches and compare their performance with each other as well as with the standard PSO. In the next section, we