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A review on Particle Swarm Optimization Technique

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ABSTRACT: Particle Swarm Optimization (PSO) is a biologically inspired computational search and optimization method developed in 1995 by Eberhart and Kennedy based on the social behavior of bird flocking or fish schooling A number of basic variations developed by convergence speed and quality improvement solution are found. On the other hand, basic PSO is to handle the construction, simple optimization problem Modification PSO has been developed for solving the fundamental problem PSO. The observation and assessment 46 related studies in the period between 2002 and 2010 focused on the function of the PSO, advantages and disadvantages of PSO, the PSO basic variant and applications that are carried out using PSO. The PSO has tremendous applications in the power system too.

KEYWORDS*:* Particle Swarm Optimization (PSO), Variant PSO, Modification PSO, Bird Flocking, Basic PSO, Biological inspired intelligence search, Evolutionary Optimization.

I. INTRODUCTION

Theory of particle swarm optimization (PSO) has grown rapidly. PSO is used by many applications to different problems. The PSO algorithm emulates the behavior of the animal societies that do not have a leader in their group or flock like birds flocking and fish schooling. Typically, a herd of animals that no leaders will find food by random, then follow one of the members of the group that has the closest position with a food source (potential solution). The couples achieve their best condition simultaneously through communication between members who already have a better situation. Animal which has a better condition, sheep and others will be her know will simultaneously move to that place. This would be done repeatedly until the best conditions or discovered a food source. The process of the PSO algorithm to find the optimal values follows the work of this animal society. Particle swarm optimization consists of a swarm of particles, which particles form a possible solution. Recently there have been several modifications of native PSO. It modifies to accelerate the achievement of the best conditions. The new development will provide benefits and also to solve the variety of problems. Study on the development of the PSO is needed to do more to what extent its development, its advantages and disadvantages and how much use this method to solve a problem. Tutorial and theoretical made PSO in [1] and [2] which describe what PSO is tested simple data, and comparison with other evolutionary computation. This document will describe what changes, advantages and disadvantages of any change of the PSO and make a conclusion from this.

II. VARIANT IN PSO

Research is to look for the ability of a search algorithm to another area of search space in order to find a good optimum. Operation, on the other hand, the ability to focus the search around a promising area to refine a candidate solution [3] .With the exploration and exploitation, the swarm of particles flying through hyperspace and two critical reasoning ability , their memory of their own best position - the local best (lb) and knowledge of the global , or their best quarter - global best (gb) .

Position of the particle is affected by the speed. Let denote the position of the particle in the search space at time step; unless otherwise stated, t indicates discrete time steps. The position (x_i) of the particle is modified by the addition of a velocity (v_i) about the geographical position [1]

$$x_i(t+1) = x_i(t) + v_i(t+1) \qquad (1).$$

$$v_i(t) = v_i(t-1) + c_1r_1\,(\text{localbest}(t)-x_i(t-1)+ c_2r_2(\text{globalbest}(t) - x_i(t-1)$$
$$\text{with } x_i(0) \sim U(x_{min},x_{max}) \qquad (2) .$$

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Where
c_1 & c_2 are acceleration coefficient;
r_1 & r_2 are the random variables;

Consider a simple example of PSO, there is a function in [3]:
Objective function: Minimize f(x)
Which subjects to $x(b) \leq x \leq x(a)$
Where
x(a) is the upper limit;
x(b) is the lower limit;

Particle Swarm Optimization procedure consists of the following steps:

A. Assume that the size of the group of particles is N (which should be neither too small nor too large).

B. Initially generate the population x with the range x(b) and x(b) by randomly order to get x_1,x_2 ……….x_n. After that particle j and the velocity get iteration i are denoted as $x_j(i)$ and $v_j(i)$ respectively. Therefore, the initial particles will be $x_1(0)$, $x_2(0)$……..$x_n(0)$. Here, the vector $x_j(0)$ is called particle where j=1,2…..n. The value of objective function for each particle is expressed by $f[x_1(0)]$, $f[x_2(0)]$……..$f[x_n(0)]$.

C. Calculate the speed of all the particles. The velocity of the particles can be assumed as 0 initially and particles moves toward a optimal solution. Set the iteration i=1.

At the ith iteration, we can find out the two important parameters for each particle j as below:

A. The best value of $x_i(t)$ is declared as $P_{best}(j)$ with the objective function having lowest value (in case of minimization of the objective function). Then, G_{best} is chosen among all the particle value from its previous iterations.

B. By using (2), we can calculate the velocity of particle j at iteration i.
Where
c_1 is the learning rate for individual ability(also called the cognitive coefficient) c_2 is the learning rate for individual ability. (the value of c_1 and c_2 is usually taken as 2) r_1 and r_2 are the uniformly random numbers between 0 and 1.

C. By using (1), calculate the position or co-ordinates of the particle j at the ith iteration.

D. Now, the last step is the check for the convergence of the solution. If the position of all the particles is leading to an equal value, then the solution is said to be convergent. If it is not so then repeat the step (c) by updating the iterations i = i+1, by calculating the new values from P_{best} and $G_{best.}$

III. ADVANTAGES OF PSO

A. PSO algorithm is a derivative - free algorithm.
B. It is easy to implement, so that it can be applied in both scientific research and technical problems.
C. There is a limited number of parameters and the influence of parameters for the solutions is small in comparison with other optimization techniques.
D. The calculation PSO algorithm is very simple.
E. There are a number of techniques that convergence and the optimum value of the problem calculates easily in a short time.
F. PSO is less dependent on a set of first points than other optimization techniques.
G. It is conceptually very simple.

IV . LIMITATIONS OF PSO

A. PSO algorithm suffers from the partial optimism, which degrades the regulation of its speed and direction.
B. Problems with non-coordinate system (for instance, in the energy field) exit.

V. APPLICATIONS OF PSO IN POWER SYSTEM

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The particle swarm optimization has a wide range of application in the power systems. But still it is under research so to make prediction of more application is also feasible. Some of the applications of PSO in power system are given below:

A. Economic Dispatch(ED).
B. Reactive Power control (RPC).
C. Reduction in the power losses.
D. Optimal power flow calculation.
E. Design of power system controller.
F. Neural network training.
G. Enhancement in power quality.
H. Reconfiguration and placement of generators and capacitors in distribution systems.

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