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An Improved Particle swarm optimization Algorithm for complex nonlinear Problems

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Abstract

Particle swarm optimizer (PSO) is a very logical algorithm to obtained best solutions in engineering and mathematical field. However the traditional PSO algorithm and the existing different algorithm have the issue of delayed and slow convergence speed in different application problems. To deal with such kind of problems an Improved particle swarm optimization (PSO) is proposed in this paper. The proposed Improved PSO algorithm is been tested on some famous complex benchmark functions.

1 Introduction

Particle swarm optimization(PSO) is one among such technique and is been widely used in constrained and unconstrained function optimization problems.Particle swarm optimization(PSO) Algorithm was originally designed by kennedy and eberher[1]. In PSO Algorithm the swarm is made up of some light particles with velocities[2], each of which show a attainable solution in an area.The use of PSO Algorithm in different areas, such as in rapid and flexible deployment of UAVs. In [3], training neural networks,Solving complex non linear problems, security, localization in WSNs[4]. and in robots path planning and tracking. The flowchart off Improve PSO algorithm is shown in figure (1). In particle swarm optimization algorithm there are two update functions velocity (v) and position (x) as given in equation (1) and (2). (c_1) and (c_2) are acceleration particle,(r_1) and (r_2) are random variables Beside that, The Improved PSO algorithm uses the inertial factor ω to check and balance the global and local improvement ability.

$$V_i^k = \omega V_i^{k-1} + c_1 r_1 (P_{best,_i} - X_i^{k-1}) + c_2 r_2 (G_{best,_i} - X_i^{k-1}) \quad (1)$$

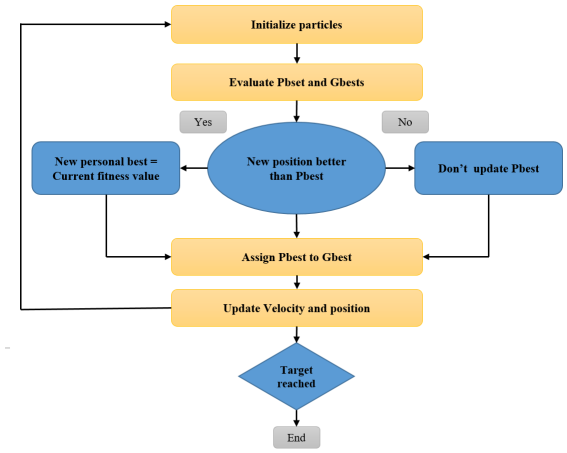

Figure 1: The Flowchart of Improved PSO Algorithm

$$X_i^k = X_i^{k-1} + V_i^k \quad (2)$$

$$\omega = (\omega_{max} - t) * \frac{\omega_{\max} - \omega_{\min}}{Max_{it}} \quad (3)$$

ω refer to the initial inertia factor. ω_{max} correspond to the inertial factor before the start of iteration while ω_{min} correspond to the inertial factor after maximum number of iteration. t is the number of optimization while Max_{it} is the maximum number of iteration.

2 Contribution

For optimization problems of uni modal function, the convergence speed of the algorithm is very important.So the main contribution of this paper that the Improved particle swarm optimization algorithm(IPSO) is been applied

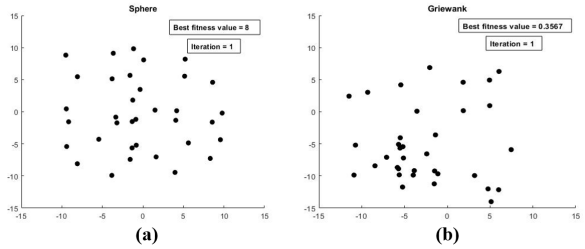

Figure 2: Initial distribution of Particles

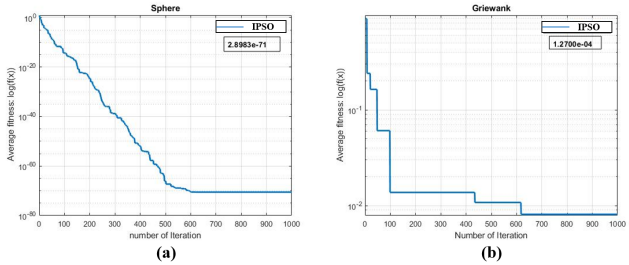

Figure 3: Average fitness of function

to some some complex non linear problems in order to solve them. For testing the effect of algorithm, two classical, complex, non-linear and multi-model functions are selected to test. The functions are:

$$f_3(x) = \sum_{i=1}^{n}(x_i^2) \tag{4}$$

$$f_4(x) = -1/4000\sum_{i-1}^{n} x_i^2 - \Pi_{i=1}^{n} cos(x_i/\sqrt{i}) + 1 \tag{5}$$

3 Experimental results and Discussion

These different type of test functions are been simulated in Matlab. The most important thing is to find the global optimum solution, for that simulation experiments are tested on Griewank and Sphere function In which Griewank is quite a complex functions. These equations are highly multi model and multi dimensional complex functions. The initial distribution of the particles are shown in figure 2(a) and (b). The PSO algorithm is used to find the performance optimization curve of these functions. In Figure 3(a) and (b) the optimization curve of 2 different functions are shown when the PSO optimization method is used for optimization process.

4 Conclusion

In this paper an improved PSO algorithm is proposed in which unlike the traditional PSO algorithm the inertial weight is been by equation (3). which provide additional power to the particles of swarm. This method is uncomplicated and less mathematical than other methods. Moreover, the performance of the new Improved PSO is analyzed by some experiments on different benchmark functions and from the results we can confirm the superiority of the proposed algorithm.

Acknowledgement

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