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Особенности применения алгоритма Swarm Particles.

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PSO Particle Swarm optimization (PSO) was developed by Dr. Eberhart and Dr. Kennedy in 1995, Swarm intelligence concept is originally obtained from the behavior of birds in a flock. Particles like artificial living birds in a swarm. The Swarm resembles an artificial life system Alife.

Alife develops computational techniques based on Biological phenomena to solve computational problems. Computer design of group dynamics of particles in the swarm are deduced from the social behavior of birds in a flock, and from their social behavior interacting with each other and the environment.

PSO algorithm is a promising futuristic algorithm Advantage of this method is that is simpler, fast converging, and gives more accurate result during its fast run time, and can be implemented with ease.

A group particles is called a swarm. The swarm particles emulate birds' behavior in nature. This algorithm is successful because it mimics God's creations' behavior. Population size and particle iteration is also mimicked from a birds' swarm. Optimization of the particles' movement is done by mapping the swarm into a confined space then DE-mapping it, knowing its trajectory and velocity. This is how these coordinates guide for making a better algorithm. A particles acts intelligent by sending its location and temperature, and it can also communicate with the particles around it that form a stochastic star. A particle in this star has memory, particle moves between five particles of the star then updates data.

A particle acts as a member of the population by updating its location and temperature to the center of the swarm's population. When particles converge to a point, the location is updated, and the update makes a point on the curve. The particle can find the local maximum and minimum through learning continuously and moving to the curve and returning. The particle can also act as a multi agent by sending various data such as radiation levels, current potential, time, and X Y position. The swarm is formed by a population of these agents.

Swarm particles forming a star between iteration 0 and iteration N, Fig.1.

The particles in the swarm oscillate in steady state. These oscillations are reduced to zero once MPP is reached. While in dynamic state oscillations continue according to algorithm saved from previous days, and in a stochastic manner. This is how the low cost microcontrollers that have embedded RAM detect MPP that make the curve. Particles in the swarm form a neural network, neurons are connected through synapses. The neural network is a simplified model that uses the concept of nerves in animals, Fig.2.

The MPP remains valid until replaced by other with more power is found. The old point becomes known point G and the optimal point is called MPP. Tis is orthogonal learning between two points G and MPP. Velocity of a particle is computed by measuring distance between two points and the time taken by the particle to travel.

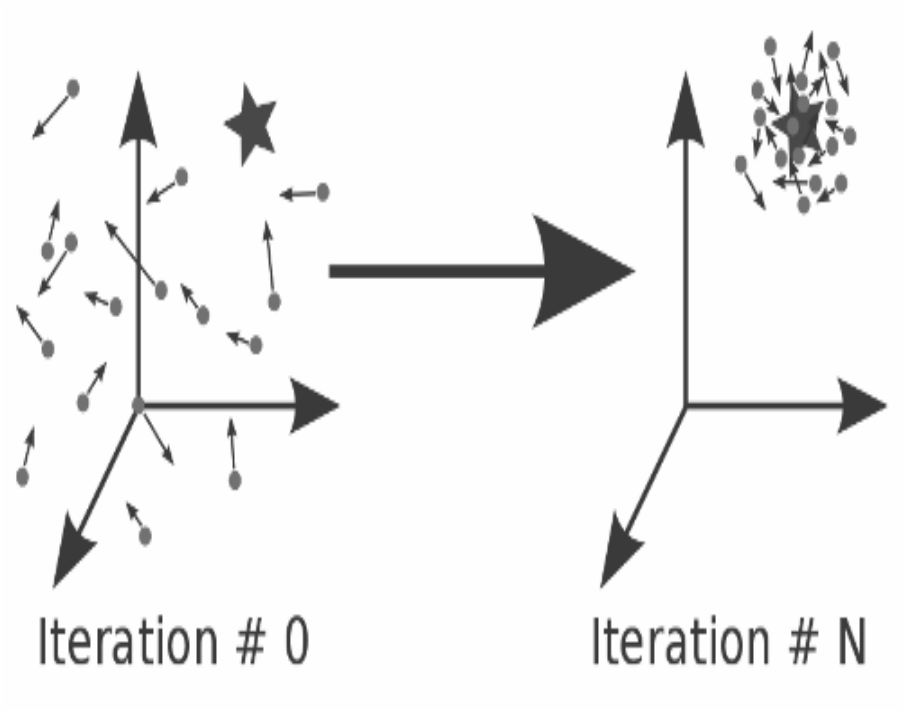


Figure 1 Swarm particles forming a star between iteration 0 and iteration N.

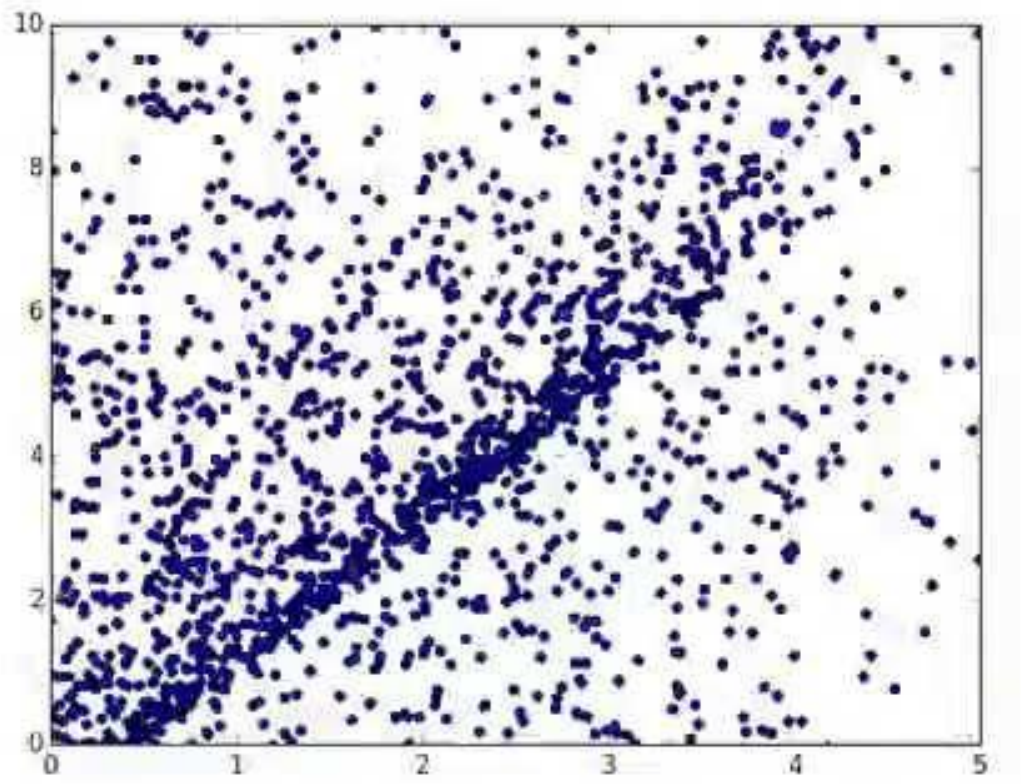


Figure 2 Swarm particles forming the curve

As a multi objective optimization, and to obtain better results multi swarm optimization method is used to eliminate errors and to obtain accurate results.

PSO expression for calculation:

$V_{\vec{i}}^{k+1} = w.V_{\vec{i}}^{k} + c1.r1.(P\,best_{\vec{k}} - X_{\vec{i}}^{k}) + c2.r2.(G\,best_{\vec{k}} - X_{\vec{i}}^{k})$

$X_{\vec{i}}^{k+1} = X_{\vec{i}}^{k} + V_{\vec{i}}^{k+1},$

where

$V_{\vec{i}}^{k}$- velocity the component in dimension d of the ith particle

K-Iteration

$X_{\vec{i}}^{k}$- the component in dimension d of the ith particle position for iteration k

Pbest- is the best position achieved yet by particle i and

Gbest- is the best position found by neighbors of particle i

W- weight inertia

r1 & r2 are random factors between 0 and 1 and c1 andc2

Pseudocode for particles in a swarm:

For each particle

Create particle (search space)

Initialize particle Particle n = Array . new particle position

End

Do

For each particle calculate update current position

If current position>Pbest

Update Pbest

If Pbest>Gbest

Update Gbest

End

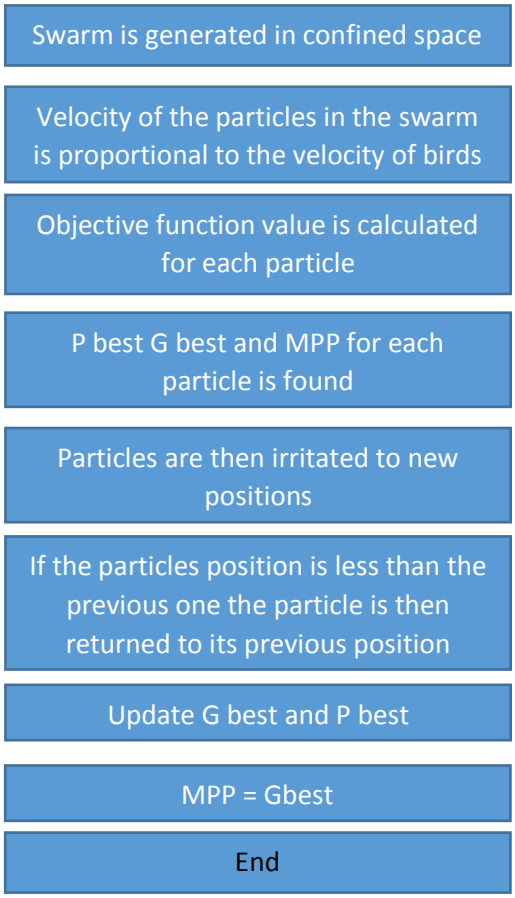
For each particle update time travelled

Calculate velocity

Update velocity

End

Steps how PSO algorithm is applied then executed:



Particle Swarm optimization algorithm proved its effectiveness in objects, which do not have precise analytical description.

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