Function value optimization with PSO

* Problem Description:

The problem purpose is to trying minimize function value by finding global optimum point in the search space.

benchmark functions are described as bellow:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Name | Test Function | S | Global opt. |  |
| **E** | Rosenbrock | C:\Users\somayeh\Desktop\Untitled.png |  |  | 0 |
| Step | C:\Users\somayeh\Desktop\Untitled.png |  |  | 0 |
| **M** | Ackley | C:\Users\somayeh\Desktop\Untitled.png |  |  | 0 |
| Griewank | C:\Users\somayeh\Desktop\Untitled.png |  |  | 0 |
| **H** | Rastrigin | C:\Users\somayeh\Desktop\Untitled.png |  |  | 0 |
| Generalized Penalized | C:\Users\somayeh\Desktop\Untitled.png |  |  | 0 |

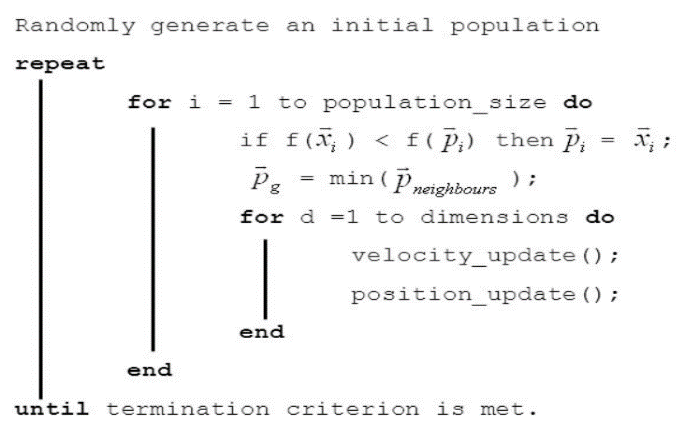
**Description:**

denotes the solution space dimension, denotes a subset of , and the global optimal solution and the global optimal value of classical benchmark functions are given in column 5 and column 6, respectively. Ten independent experiments must be completed for each optimization function considering .

* Algorithm Description:

PSO algorithm is a decentralized Swarm Intelligence search process. The swarm consist of particles with position and velocity related to them. Each particle remembers its best point ever seen as parameter calls “**pbest**”. The whole swarm best reached point remembers as parameter calls “**gbest**”.

The basic concept of PSO lies in accelerating each particle toward its **pbest** and the **gbest** locations, with a random weighted acceleration at each time.



Our PSO algorithm properties come in below:

* + **Initializing:**

Initial particles position set randomly base on problem domain.

initial particles velocity takes positive and negative 10% of particles position as velocity.

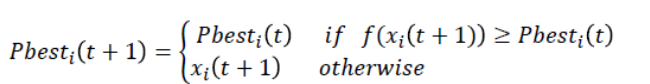
* + **Position & velocity update:**

**

*d* is the dimension, *c1* and *c2* are positive constants, *rand1* and *rand2* are random numbers, and *w* is the inertia weight.

usually *c1+ c2 = 4*. No good reason other than empiricism.

* + **Pbest & Gbest update:**





* + **Inertia weight update:**
    - Large inertia weight facilitates global exploration
    - small on facilitates local exploitation

By decreasing the inertia weight best performance archives.

many research works are conducted where the value is chosen as: w(initial) = 0.9 and decrease to w(final) =0.2.

We use exponential manner for this purpose as below:

min (math.exp(- 0.9 \* t+1)\*wMax, wMin)

* GA learning process:
* GA One-minute run Results:
* GA Algorithm analysis: