

Particle Swarm Optimization as a description of individuals in society

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1 Velocity and Positional update algorithm

$$x_i(0) \in \mathbb{R}^n$$

$$v_i(0) = \vec{0}$$

$$v_i(t+1) = \begin{cases} \omega_c r_c [p_{\text{best}} - x_i(t)] + \\ m_i v_i(t) + \omega_s r_s [g_{\text{best}} - x_i(t)] + \\ \omega_r r_r [p_{\text{rand}} - x_i(t)] \end{cases}$$

$$x_i(t+1) = x_i(t) + v_i(t+1)$$

2 Explanation

2.1 Parts of the algorithm

1. i = individual number
2. $x_i(0) \in \mathbb{R}^n$ = Random starting position of individual i in the multidimensional space
3. $v_i(0) = \vec{0}$ = Every individual has no starting velocity
4. $v_i(t+1)$ = The next velocity from time t
5. $x_i(t+1)$ = The next position from time t Simply the current position with the velocity for time $t+1$ added
6. m_i = Individual inertia, how much the previous velocity should matter
7. ω_{csr} = Weight of how much the cognition/social/random vector should affect the outcome
8. r_{csr} = Random weights for how much the cognition/social/random vector should affect the outcome The random function is not evenly distributed for the different individuals and this is how genes and other potential static things are represented
9. p_{best} = Personal best, the best position that the particle has found itself in so far
10. g_{best} = Global best, the best position that the swarm, or the particles neighbours, have found themselves in so far
11. p_{rand} = Personal random, a random vector which ensures exploration
12. $x_i(t)$ = The individuals current position

2.2 Relation to individuals and society

Each individual start in a random position in life ($x_i(0) \in \mathbb{R}^n$), with different distances to different opportunities. In the beginning individuals don't have a velocity ($v_i(0) = \vec{0}$), but that will change as soon as time starts passing ($v_i(t) = \dots$).

Every individual will be differently much affected by different things happening around them, this is what is described by ω_{csr} which are the weights for the cognition, social and random vectors.

The cognition part is describing what we have experienced ourselves and the social part is how we are connected to the world around us, for example how much help you get from society and other individuals. The random vector is for random unforeseen events that happen to the individual, and just like in reality this will have different proportions on different individuals. For example if someones home burns down it might have such a negative impact

that they will never be able to fully recover, meanwhile it will barely have any impact at all on some, think a billionaire or someone with a lot of connections compared to a working class person in a country with little social wellfare.

For every new time step the next position will always be affected by the last position and what also what direction you are currently heading. Some people will have a higher chance of keep on heading in the same direction as they currently do, this is described by the inertia (m_i). The inertia can also change with time.

Some static parameters like genes are not clearly described here, since every position in the N-dimensional space is dynamic. But those parameters are described in the pseudo-random algorithm for generating r_{CSR} , which will not have evenly distributed outcomes.

There is a lot more to describe, but that is the gist of it.