Particle Swarm Optimization

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The formula of the Particle Swarm Optimization algorithm is as follows:

$$v_n(t+1) = \omega(t) \cdot v_n(t) + c_1 r_1 \cdot [p_n - x_n(t)] + c_2 r_2 \cdot [g - x_n(t)]$$

The iterative expression is as follows:

$$x_n(t+1) = x_n(t) + v_n(t+1)$$

The inertia factor $\omega(t)$ can be a linearly decreasing weight function or a constant:

$$\omega(t) = \begin{cases} \omega_{\max} - \dfrac{\omega_{\max} - \omega_{\min}}{t_{\max}} \times t & \omega_{\max} \approx 0.9,\ \omega_{\min} \approx 0.4 \\ C \in [0.6,\ 0.75] \end{cases}$$

The parameters is elaborated as:

- n: the amount of particles (usually $20 \sim 40$).
- $v_n(t)$: the velocity of the t epoch of the n-th particle.
- $x_n(t)$: the distance of the t epoch of the n-th particle.
- c_1: the individual learning factor of the particle.
- c_2: the swarm learning factor of the particle.
- r_1: the random float number is between 0 and 1.
- r_2: the random float number is between 0 and 1.
- p_n: the best solution of the n-th particle.
- g: the global optimal solution of particle swarm.

Some empirical values are provided by scholars: Clerc($c_1 = c_2 = 2.05$), Carlisle($c_1 = 2.8,\ c_2 = 1.3$), Trelea($\omega = 0.6,\ c_1 = c_2 = 1.7$), Eberhart($\omega = 0.729,\ c_1 = c_2 = 1.494$).