TEK5010 Multiagent systems

Lecture 3: Swarm intelligence

Exercise: PSO

Question 1

A Particle Swarm Optimization (PSO) is applied to the search for a hidden RF transmitter. The search area is a square stretched out between coordinates $(-100, -100)$ and $(100, 100)$. The sampled signal as a function of distance from the emitter is given by:

$$P = \frac{1}{4\pi r^2} + k\|N(0, \sigma)\|$$

where P is the measured signal power, r is distance between transmitter and the sampling location and N is a Gaussian noise distribution with zero mean and σ standard deviation, k is the noise level.

a) Explain the canonical PSO.

b) Given 4 particles in a PSO with positions and velocities:

$$x_1 = (10, 10), x_2 = (12, 8), x_3 = (11, -10), x_4 = (-4, 9)$$
$$v_1 = (1, 0.75), v_2 = (0, 2), v_3 = (-1,1), v_4 = (2, 0)$$

Calculate an iteration of particle 1 assuming $\omega = 0.98, \omega_1 = 0.04, \omega_2 = 0.02$ and simulate the required probabilities. Also, the hidden emitter is at $(0, 0)$ and that $k = 0$, i.e. a noise free system.

c) Simulate the next iterations of this PSO problem by altering the the NetLogo version of PSO, found under: 'File->Models Library->Sample Models->Computer Science->Particle Swarm Optimization'. Remark, the 'to setup-search-landscape' function in the NetLogo program should be altered to reflect the emitter search field. Also, you could alter initial position of the particles in the 'to setup' function.

d) Release the 4 particles from (-75, -75) plus some randomness. How does this affect the optimization?

e) What happen if you add noise to the system? You could set $k = 0.0001$. Compare the two different initial positions of the particles (from local point vs random over entire search area). Would you use PSO in a real swarm robotic system where the mobile robots are released from same location?

f) Optional: Play with different PSOs, parameters and possibly other swarm algorithms on this problem.