Exercises from lecture 3 (Swarm intelligence) TEK5010 Multiagent systems 2020

Question 1

Could you explain the differences between swarm intelligence and game theory as applied to multiagent systems?

Question 2

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

$$A = \frac{1}{4\pi r^2} + kN(0, \sigma)$$

where A is the measured amplitude, 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 a parameter for adjusting the relative noise level.

a) Explain the canonical PSO.

b) Given 4 particles in a PSO with positions:

$$x_1 = (10,10), x_2 = (12,8), x_3 = (11, -10), x_4 = (-4,9)$$

Calculate an iteration of particle 1 assuming $\omega = 0.98, \omega_1 = 0.04, \omega_2 = 0.02$ and simulate the required probabilities. Also, assume that the position of the hidden emitter is $(0,0)$ 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 UpdateParticleVelocity (the 'to go' function) in the NetLogo program can be altered. Also, you could use new random initial position and velocities for the particles.

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. 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.