Coding Assignment 3 – Particle Swarm Optimization

Instructor: [redacted]

Particle Swarm Optimization was developed by Kennedy and Eberhart in 1995 [1]. The underlying equations are as follows:

$$v_i^{t+1} = \mathrm{w}v_i^t + c_1 r_1 (xBest_i^t - x_i^t) + c_2 r_2 (gBest_i^t - x_i^t) \quad (1)$$

$$\mathrm{x_i^{t+1}} = \mathrm{x_i^t} + \mathrm{v_i^{t+1}} \quad (2)$$

For the full pseudocode and algorithm outline, please refer to lecture notes (PSO.pdf) on Canvas.

1. Write the code for PSO in Matlab or a programming language of your choice. Solve the following problems studied in Assignment 2. The default parameters to be used are outlined in Table 1.

   a. $\min \mathrm{f} = x^2 + y^2 - \mathrm{xy} - 4\mathrm{x} - \mathrm{y}$
   b. $\min f = (1-x)^2 + (-x^2 + y)^2$

Parameter	Default
nparticles	The number of particles is set to 30
Initial x	Uniformly (-100,100) distributed random matrix of length nparticles x nvars
Initial v	Uniformly (-1000,1000) distributed random matrix of length nparticles x nvars
Maximum v	100
nvars	Number of variables
w	0.7
$\boldsymbol{r_1}$ **and** $\boldsymbol{r_2}$	Uniformly (0,1) distributed random vector of length nvars
$\boldsymbol{c_1}$ **and** $\boldsymbol{c_2}$	2.0
Function tolerance	1e-6
Max iterations	400

Table 1 - Default parameters

2. For both problems run PSO five times, are report/discuss your solutions.
3. Change the number of particles to 10, 100, 1000. Discuss your observations.
4. Change both $\boldsymbol{c_1}$ and $\boldsymbol{c_2}$ to 0.5 then change both to 5. Discuss your observations.
5. Solve the following constrained optimization problem using PSO and the external penalty scheme outlined in the lecture notes. Describe your reasoning for your *penalty factor* value or scheme of choosing such a value. Is your solution a constrained optimum?

c. min $f = (1 - x)^2 + (-x^2 + y)^2$
subject to $-10\text{x} - 3\text{y} + 25 \leq 0$

6. Submit your solutions for each of the questions of Canvas. Attach your code in an appendix.

References

[1] Kennedy, J. and Eberhart, R. C., "Particle swarm optimization," Proc. IEEE int'l conf. on neural networks, Vol. IV, 1942-1948, IEEE service center, Piscataway, NJ, 1995.