Assignment 5 – Part 1

Due date: December 2, 2011
Type your answers and submit a printed hard copy.
Hand-written solutions are not accepted.
Don’t submit your program code.

1 Computer Exercises (60 marks)

The Rosenbrock function is defined as follows:

\[
\text{argmin } f(X) = \sum_{i=1}^{n-1} [100 \times (x_i^2 - x_{i+1})^2 + (1 - x_i)^2], -30.0 \leq x_i \leq 30.0
\]

In this exercise, you will use PSO to find the global optimum of Rosenbrock function with n=10. You will implement a PSO with swarm size 20 to run for 1,000 time steps (generations). The inertia weight is a constant=1 and the \( c_1 = c_2 = 2 \). The network structure is a fully connected \( \text{gbest} \) PSO.

You will use the following \( V_{\text{max}} \) to conduct your experiments.

- \( V_{\text{max}}(t+1) = V_{\text{max}}(t) \times (1 - (t/n)^5) \), where \( V_{\text{max}}(0) = (x_{\text{max}} - x_{\text{min}})/2 \), \( V_{\text{max}}(n) = 0.001 \) and \( n = 1,000 \) (total number of time steps).
- \( V_{\text{max}}(t+1) = V_{\text{max}}(t) + \text{fis}(t + 1, \text{fitness}(t), V_{\text{max}}(t)) \), where \( \text{fis} \) is a fuzzy inference system that infers the amount of \( V_{\text{max}} \) to decrease for particle update, i.e. each particle has its own \( V_{\text{max}} \).

When a particle position (dimension) is pushed outside the boundaries, reset the velocity for that dimension to 0 as that discussed in the class.

For each of the 2 \( V_{\text{max}} \) implementations, you will make 20 runs. During each run, you will collect population average fitness, population best fitness, population dispersion, the number of clamped velocity (dimension) and the number of out-of-bound particles (dimension) at each time step. Next, calculate the mean and standard error. Finally, you will produce 5 figures that summarize these data information (50 marks). Since the number of data points is large, you will plot the average of 10 data points in your figures.
Also, for each of the 5 figures, give a plot that summarizes the data at the last 100 time steps.

Based on your data, discuss your observation about the PSO performance under the two different $V_{max}$ implementations (10 marks). You might consider plotting the average $V_{max}$ at each time step to support your discussion.