Particle Swarm Optimization and Social Interaction Between Agents

Kenneth Lee
TJHSST Computer Systems Lab 2007 - 2008

Abstract

Particle Swarm Optimization is a method of optimization for n-dimensional infinite search spaces. This project aims to test different social situations between the particles and their ability to converge on a solution. The different versions of the social interactions are tested using a benchmark function and then compared to each other.

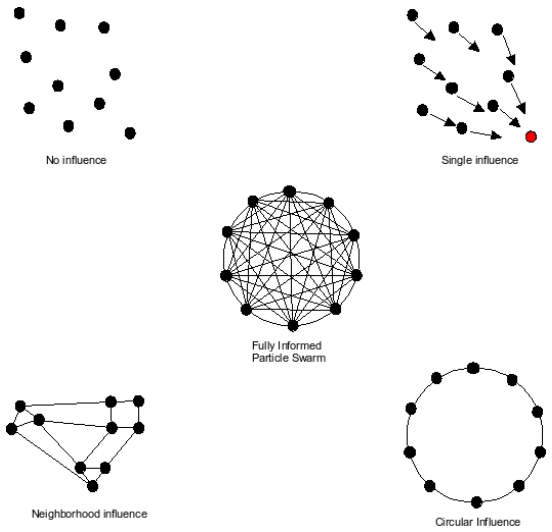

Figure 1: This image shows the different types of social interactions that were investigated throughout the course of the project

Background

PSO is a relatively new swarm intelligence technique. It was first created in 1995, inspired from flocks of birds and schools of fish. It is considered a good technique because it is both inexpensive in time and in memory.
PSO is used for n-dimensional optimization problems, because it is relatively easy to implement.

A set of particles is randomly created in the search space. Each particle is given a random velocity to move about the search space. Its velocity can be adjusted during the run by both cognitive and social interactions. The cognitive interactions involve the particle remembering where it had the highest fitness value, and wanting to return there.

The social influences are where the particle in influenced based on the other particles, either by their current position and fitness value or their personal best(pbest) fitness value.

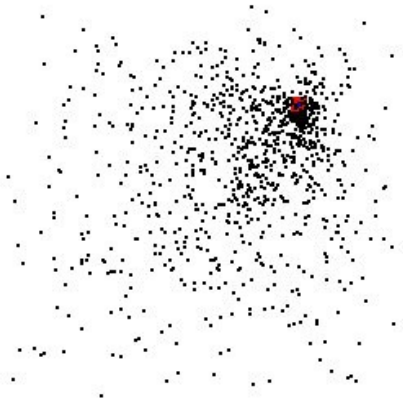

Figure 2: An Example Run of the Particles(shown in black) Converging on the Cornfield(shown in red)

Procedures

The first step for this project was to correctly recreate the basic PSO for a simple situation. This basic PSO had to include a method for the social interaction between agents. The method was then altered to include some different social intereactions. More specifically, those interactions are the Fully Informed Particle Swarm(FIPS) and the No Influence Particle Swarm(NIPS).

Testing and Results

I expect that the FIPS will fare better than some of the other types of interaction tested, but it will not be the most effecient in terms of time due to the n^2 addition required for that method. Overall, I believe that the Single Influenced Particle Swarm will do the best overall because of its simplicity and robustness. The NIPS will do the worst due to the tendancy of its particles to reach and maintain at local extrema.

1000 x 1000 Field	
	Iterations to Answer
No Influence	∞
Single Influence	50
Fully-Informed Swarm	∞

Chart 1: This chart shows the current results of the project for the number of iterations required for a particles swarm of 100 members to converge on the correct answer to the cornfield problem.