Particle Swarm Optimization and Social Interactions Between Agent Particles

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Abstract

Particle Swarm Optimization is a method of optimization for n-dimensional infinte search spaces. This project aims to test different social influences, the way in which the particles communicate with eachother in order to find a global minimum, on the particles and their ability to converge on a correct solution. The different versions of the social interactions are tested using various benchmark functions and then the different methods are compared to eachother.

Background

Particle Swarm Optimization(PSO) is a technique used to optimize n-dimensional infinite search space problems. A large amount of particles exist in the search space and "fly" though it searching for the global minimum. Particles are influenced by both cognitive and social interactions changing their course of "flight". This project aims to alter the social interactions in order to increase the effeciency of the swarm.

If a way of social interaction is proven to be more effecient than the others, then it can replace the older method, and thus make the algorithm more powerful. This could also lead to other improvements increasing the quality of algorithm. \par Anyone who has a problem in which a optimal result needs to be found quickly can use this algorithm. It has seen extensive use in neural networks and finds potential in time-critical optimization problems where the constraints quickly change.

This project will deal only with the social interactions between agents. It will not deal with inertia or cognitive influences and they will remain constant thoughout the program. It should also be noted that thusfar in the project, the only form of comparing the different influences will be by iteration count not by actual time to run the program.
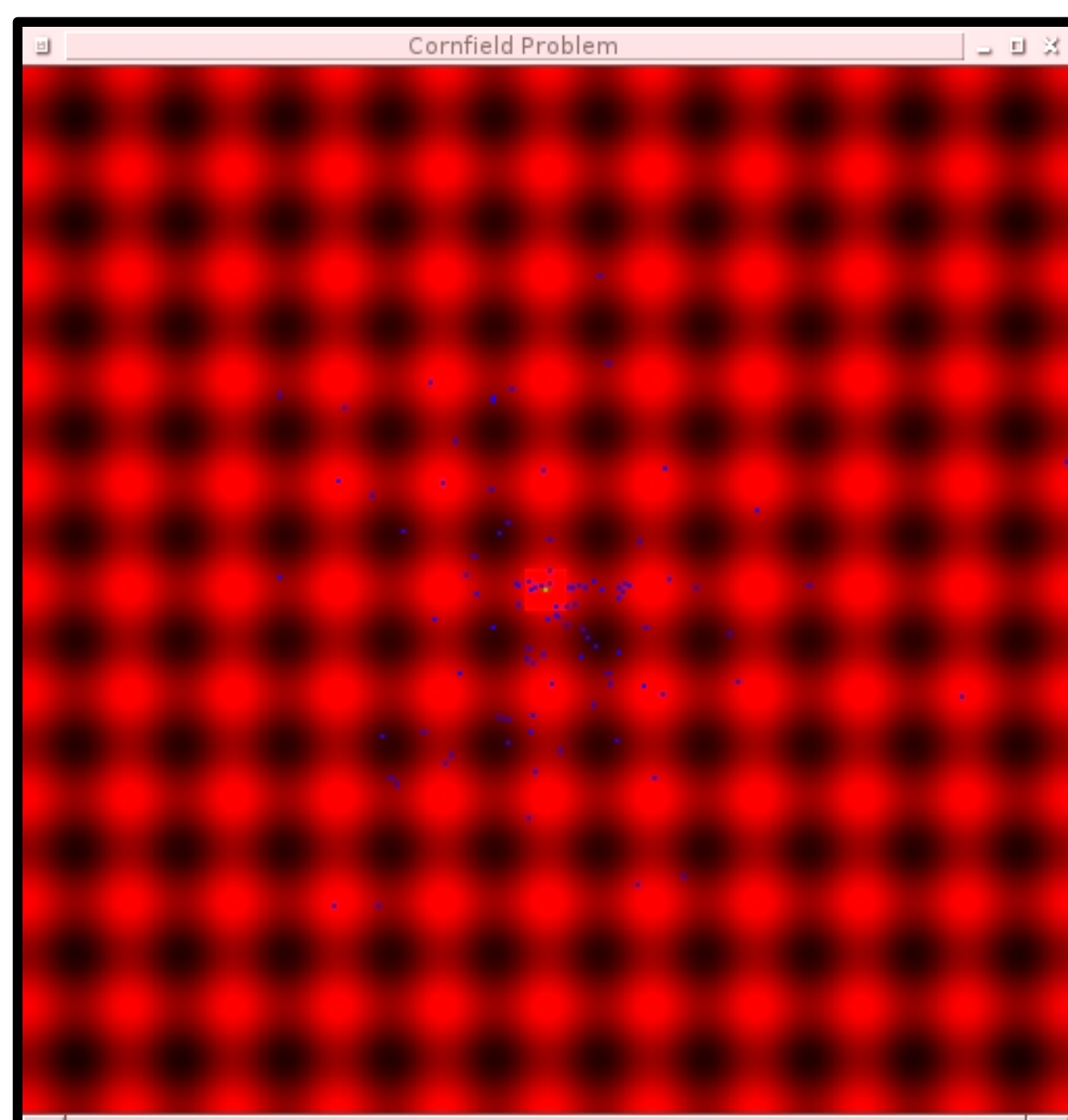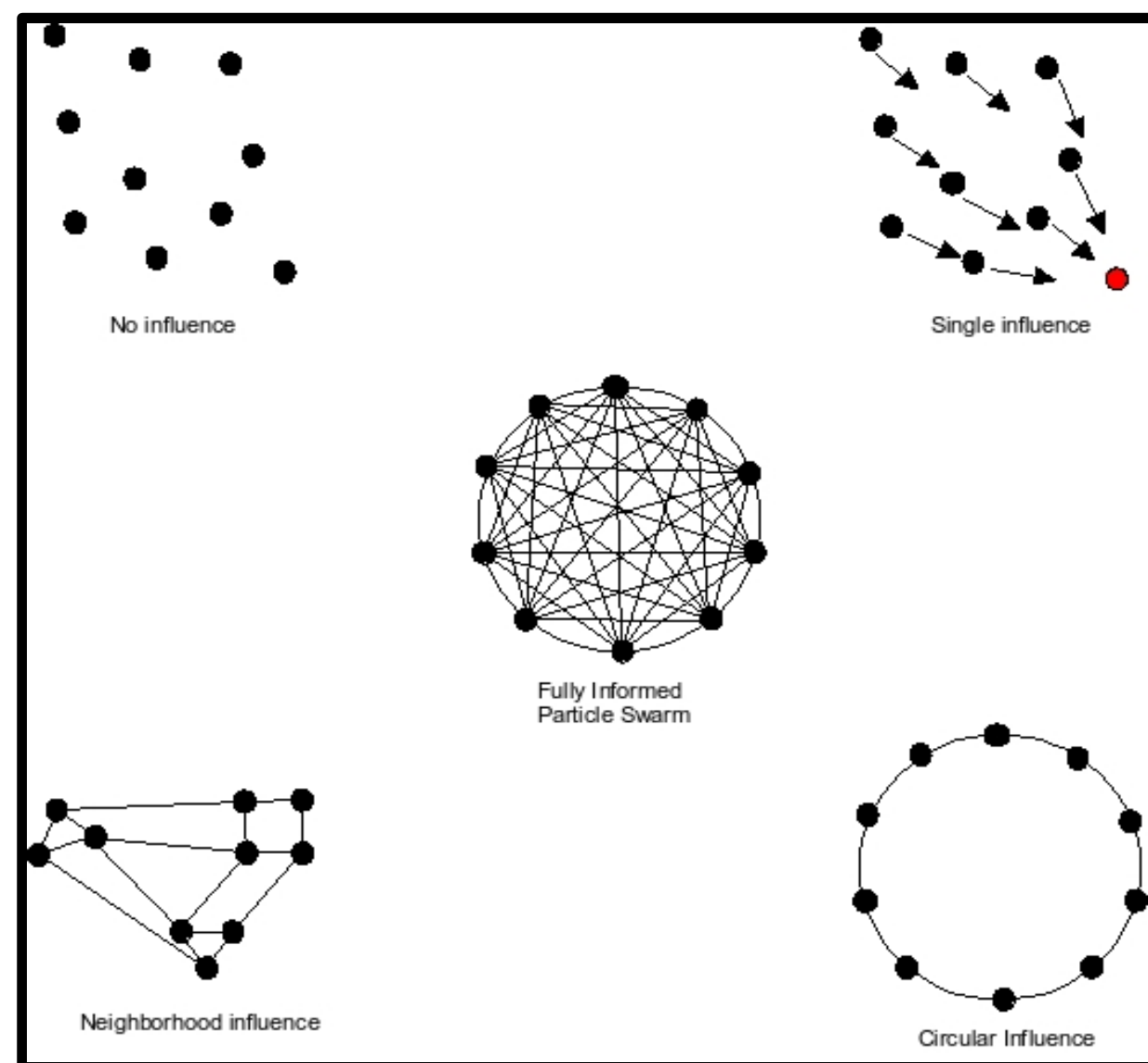

Figure 2: Screen Shot of Rastrigin Function

Figure 1: Social Interactions

Procedures

The first step for this project was to correctly recreate the basic PSO for a simple situation. This basic PSO had included a method for the social interaction between agents, more specifically a Singly Influenced Particle Swarm(SIPS). After the cannonical method was produced and tested to some extent, and the social interaction of the particles was made modular, other methods of social interaction were introduced into the program. More specifically, those interactions are the Fully Informed Particle Swarm(FIPS) and the No Influence Particle Swarm(NIPS).

Results

The particle swarms were tested against each other through various benchmark functions (Cornfield, Rastrigin, Six Camel Hump). The table below shows the number of iterations the swarm took in order to properly converge on the correct answer.

FIPS seems to be the most efficient social interaction. However this is not as clear cut, because the actual running time is not the same for each swarm. So, it is still rather unclear as to the actual best method.

	Cornfield	Rastrigin	Six Camel Hump
NIPS	∞	∞	∞
SIPS	7	142	42
FIPS	6	48	N/A

Table 1: Project Results