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**Particle Swarm Optimization (PSO)**

**Abstract:**

This project will introduce the particle swarm optimization (PSO) algorithm as a stochastic algorithm used for solving optimization problems. So as to officially introduce the scientific detailing of PSO algorithm, the classical inertial version of PSO will be used, meanwhile PSO variants will be summarized. Before looking into implementation, this project will introduce important concepts and functions of PSO. Based on this knowledge, mathematical model of PSO algorithm will be formulated. Other than this, the theoretical analysis and experimental analysis will be discussed. Two study cases of optimizing functions, one of sphere and another of cube, are provided for implementation of PSO algorithm. This is to show how handful and versatile is to work with PSO.

**Introduction:**

Particle swarm optimization (PSO) is one of the rare tools which is amusingly easy to code and implement to produce bizarrely good results. This algorithm was proposed by Eberhart and Kennedy in 1995. It is a population based stochastic, something randomly determined, algorithm which is used to solve a numerical optimization problems like predicting score of a football team using a math equation. According to this algorithm, basically, goal is to minimize error terms (difference between actual answer and predicted answer). Such goal categorizes PSO as metaheuristic approach which means that a higher level procedure is used to find optimal solution for any optimization problem with imperfect data or limited computation capacity.

PSO, a unique computational method, is inspired from social behaviors of nature. By social behavior we mean, the collective behaviors of simple individuals interacting with their environment and each other like social foraging behaviors of birds’ flocking, schooling of fishes etc. Hence, it is also classified as swarm intelligence algorithm like other bacterial foraging algorithm, ant colony algorithm etc.

**Important concepts and functions of PSO:**

**Mathematical model od PSO:**

For every particle two vectors are considered, the velocity vector and the position vector. The position vector shows the position of a particle in certain landscape and the other, velocity vector shows the intensity and direction of movement of that particle. There are two equations mentioned below, which make up back bone of PSO. Note that the “k” in equations denotes the current iteration, therefore “k+1″ implies the next iteration.

From the equation we see that the next day’s position of individual particle is calculated by summing today’s position of particle and its velocity for the next day.

Position of individual particles updated as follows:

------------------------------------------------- (Will add more here) --------------------------------------

With the velocity calculated as follows:

­ Thus, we see that velocity in current day is used to calculate the velocity for next day and this is how it helps in deducing the position for next day.

**Impact of variants:**

--------------------------------------- (Will add about tuning of Equations) -------------------------------