Particle Swarm Optimization (PSO)

MATH 3220

Student Presentations

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Outline

- **Definition**
- **History**
- **How it works**
- **Scenario/Key words**
- **Pseudo-Code**
- **Algorithm**
- **Application**
- **Advantages/Disadvantages**
- **Works Cited**

What is PSO?

- How did it get its name?
- “A population based stochastic optimization technique” (Hu)
- It provides a population-based search procedure
- Getting the best solution from the problem by taking particles and moving them around in the search space

HISTORY

- Dr. Eberhart and Dr. Kennedy 1995
- Originated as a real life example of simplified social system.
- Intended to graphically simulate the choreography of bird of a bird block or fish school.
- Found that its model can be used as an optimizer.

How does it work?

- The system is initialized with a population of random solutions and searches for optima by updating generations.
- There is no crossover and mutation.
- The particles fly through the problem space by following the current optimum particles.

(Hu)

Scenario

- Birds searching for food
- Searching for one piece
- Only know how far food is

Strategy

- Follow bird nearest to food

Key Words

- Particles
- Fitness
- Pbest
- Values
- Local best (lbest)
- Global best (gbest)

C:\Documents and Settings\User\Local Settings\Temp\alp_anim.gif

Pseudo-Code

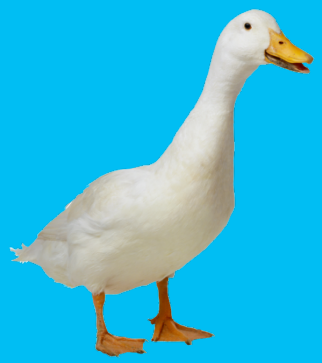
For each particle
    Initialize particle
END

Do
    For each particle
        Calculate fitness value
        If the fitness value is better than the best fitness value (pBest) in history
            set current value as the new pBest
    End

    Choose the particle with the best fitness value of all the particles as the gBest
    For each particle
        Calculate particle velocity according equation (a)
        Update particle position according equation (b)
    End

While maximum iterations or minimum error criteria is not attained

Algorithm



- v[] = v[] + c1 * rand() * (pbest[] - present[]) + c2 * rand() * (gbest[] - present[])
- present[] = persent[] + v[]

v[] is the particle velocity, persent[] is the current particle (solution). pbest[] and gbest[] are defined as stated before. rand () is a random number between (0,1). c1, c2 are learning factors. usually c1 = c2 = 2.

Application

- Telecommunications
- data mining
- power systems
- signal processing
- Function optimization
- artificial neural network training
- fuzzy system control
- where Genetic Algortihm can be applied.

Advantages/Disadvantages

- Easy to perform
- Few parameters to adjust
- Efficient in global search
- Slow convergence in refined search stage
- Weak local search ability

Works Cited

Hu, Xiaohui. "Particle Swarm Optimization." *Particle Swarm Optimization*. 10 Oct. 2010. <http://www.swarmintelligence.org/index.php>.

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