1) Genetic Algorithm: (LAB-02) CH|10|24

A genetic algorithm is a computer science and operations research technique that uses natural selection to find solutions to complex problems. It is used to solve optimization problem by mimicking biological evolution such as inheritance, mutation, selection, crossover.

Application fields:

- Designing efficient and cost effective structures like building bridges and aircraft companies.
- Optimizing sequence alignments for DNA, RNA or proteins to identify similarity or evolutionary relationship.
- Evolving the physical design of robots for specific tasks or environments.

Optimization techniques:

- Elitism
- Adaptive mutation
- Hybridization
- Dynamic population.

2) Particle Swarm Optimization:

Particle swarm optimization is a computational algorithm that uses a swarm of particles to find optimal solutions to complex problems. Its based on the idea that organisms like birds and fish can work together to find best solution without a leader.

Application fields:

- Robotics
- Image Processing
- Scheduling problem
- Telecommunications

Optimization techniques:

- Combine PSO with other optimization methods to leverage their strengths and achieve better results.
- Limit maximum velocities of particles to prevent them from overshooting good solutions and help them converge more readily.
- Use multiple swarms with different strategies or parameters to explore the solution space more effectively and maintain diversity.

5) Ant Colony Optimization:

Ant colony optimization is a method used to solve optimization problems by mimicking how ants find shortest paths to food.

Application Fields:

- Traffic management
- Logistics and supply chain management: ACO is used to optimize routes for delivery trucks.
- In manufacturing, healthcare ACO is applied to allocate resources such as machines, personnel and materials.

Optimization techniques:

- Use a combination of global pheromone updates and local updates to balance exploration and exploitation
- Use multiple colonies of ants with different strategies or pheromone types to explore various parts of solution space simultaneously.

4) Cuckoo search:

Cuckoo search is like a group of cuckoo birds trying to find the best places for their eggs. They explore different nests. Check for the best options and get rid of the bad ones. By doing this repeatedly they find best solution to a problem.

Application fields:

- Bioinformatics
- Computer Networks
- Robotics
- Structural Optimization

Optimization technique:

- use different methods to explore solution space more effectively such as changing how eggs are laid or how nests are chosen.
- Introduce methods to maintain diversity among the nests
- Implement parallel versions of the algorithm to speed up the search process by evaluating multiple nests simultaneously

5) Grey wolf optimizer:

The Grey wolf optimizer is like a pack of grey wolves working together to find the best food source. They use a social hierarchy to guide their search with the best wolves leading the others. By mimicking their hunting behaviour GWO efficiently explores possible solution to find best one for a given problem.

Application fields

- Mechanical Engineering design
- process optimization
- Power system optimization
- Image segmentation

Optimization techniques

- Parameter tuning
- Introduce methods to increase diversity
- Implement techniques to handle constraints

6) Parallel cellular algorithm and problems:

In this a given problem is systematically divided into smaller manageble segments known as cells. Each cell represents an individuals potential solution or a specific part of the overall solution landscape. By communicating and exchanging information with neighbouring cells each cell can adapt and refine its approach based on collective knowledge leading to a more comprehensive exploration of sate space.

Application fields:

- Image Processing
- Data compression
- Cryptography

Optimization techniques:

- Use cloud technology to easily handle more cells and large problems as needed.
- Provide quick updates on each cell's performance to refine their solutions immediately.
- change how cells behave based on performance to improve solutions.

) Optimization via Gene Expression algorithm:

his is an optimization technique inspired by biological ocesses, particularly gene expression. It starts with a pulation of potential solution represented by genes.

Solutions are evaluated for their effectiveness and the best are selected similar to natural selection

Application fields:

- Engineering Design
- Finance
- Telecommunications

Optimization techniques:

- Use straight forward gene representations for solutions like binary strings or real number to make processing easier.
- Random mutation: make small random changes to genes in a solution to introduce variety.