(MRFO)
Manta Ray Foraging Optimization Algorithm

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Key points:

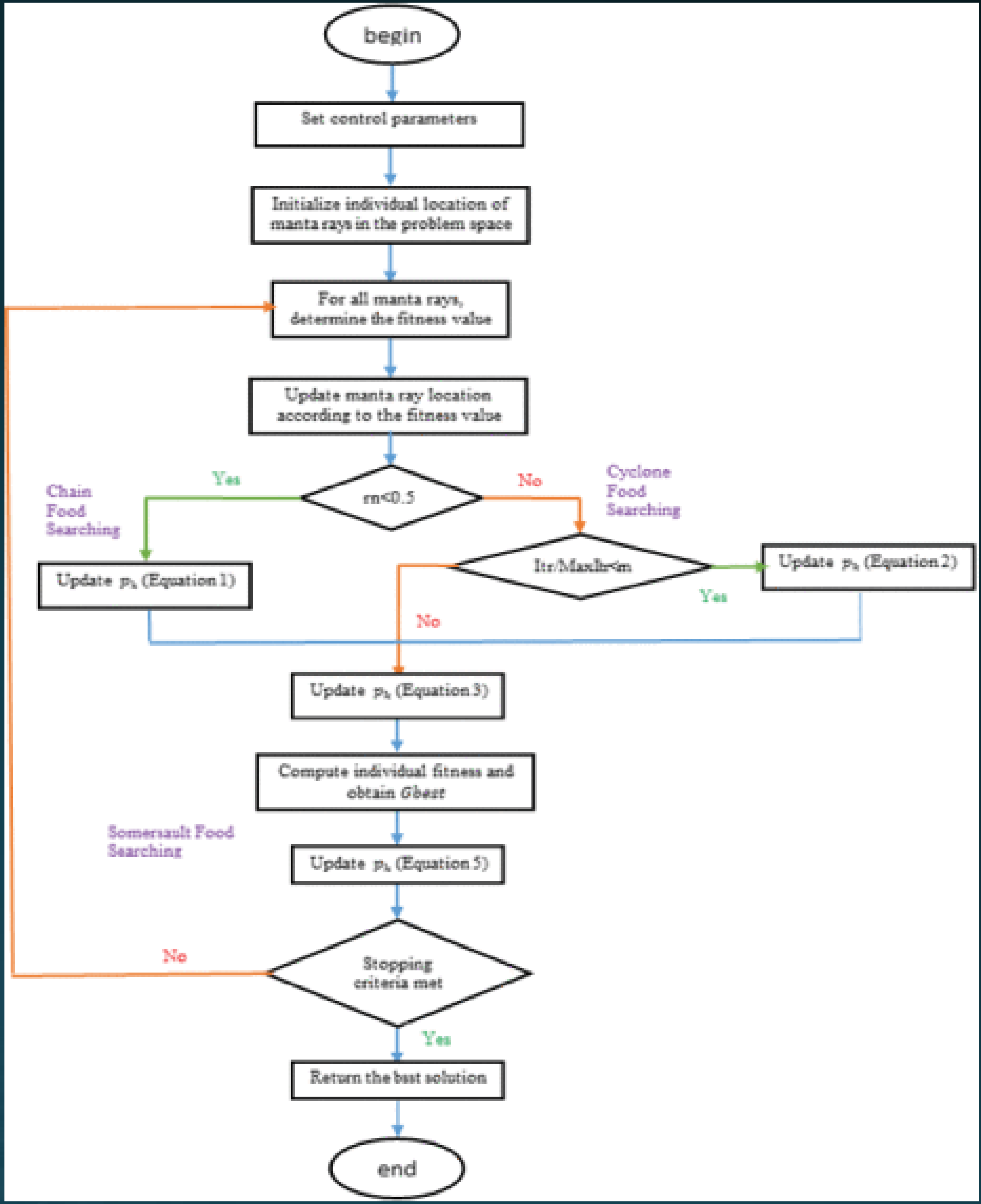
- What is the MRFO algorithm?
- The procedural stages of MRFO algorithm.
- Where to use MRFO algorithm?
- Mathematical example of MRFO algorithm.

What is the (MRFO) algorithm?

Manta Ray Foraging Optimization is a newly developed swarm-based metaheuristic algorithm based on the smart conduct performed by manta rays in search of food.

- Chain food searching.
- Cyclone food searching.
- Somersault food hunting.

Procedural stages of MRFO algorithm



(MRFO)'s applications:

- Engineering Design.
- Resource Allocation.
- Machine Learning.
- Feature Selection.

Mathematical example of (MRFO) algorithm

Population size: N = 3
Maximum iteration: maxItr = 5
Lower bound = -10
Upper bound = 10
Random number: r = 0.1 (in range [0 , 1])
Fitness function: $f(x) = \sum_{i=1}^{n} x_i^2$

Particle	Initial position
1	1.3
2	2.0
3	0.6

The solution:

1. Starting the loop by computing the fitness function of each particle to calculate the pbest and gbest.

2. Choose randomly between the strategies either chain foraging or cyclone foraging to calculate the next new position.

3. Calculate someresult foraging.

4. Return the best selution.

Particle	pbest
1	1.69
2	4.0
3	0.36

gbest is: particle 3 = 0.36

either Chain foraging:

$$X(t+1) = \begin{cases} gbest + r\left(pbest(t) - x(t)\right) + \beta\left(pbest(t) - x(t)\right) & i = 1 \\ gbest + r\left(x_{i-1}(t) - x(t)\right) + \beta\left(pbest(t) - x(t)\right) & i = 2 \ldots N \end{cases}$$

$$\beta = 2 * e^{r\left(\frac{maxItr - Itr + 1}{maxItr}\right)} * \sin(2 * \pi * r)$$

1. Calculating the value of β then the new position of each particle.
2. Make sure the values are within the range of the lower and upper bound.
3. Computing new fitness function for each particle to caculate new pbest&gbest.
4. Make sure the values are within the range of the lower and upper bound.
5. Computing someresult foraging.

Value of β = 1.3008
New gbest: particle 3 = 0.0353

Particle	New position
1	0.9063
2	2.8916 (2.0)
3	0.1878

Particle	New pbest
1	0.8213
2	8.3734 (4.0)
3	0.0353

or Cyclone foraging:

$$X(t+1) = \begin{cases} gbest + r\left(pbest(t) - x(t)\right) + \alpha\left(pbest(t) - x(t)\right) & i = 1 \\ gbest + r\left(x_{i-1}(t) - x(t)\right) + \alpha\left(pbest(t) - x(t)\right) & i = 2 \ldots N \end{cases}$$

$$\alpha = 2 \, * r \sqrt{|\log(r)|}$$

1. Calculating the value of α then the new position of each particle.
2. Make sure the values are within the range of the lower and upper bound.
3. Calculating new fitness function for each particle.
4. Make sure the values are within the range of the lower and upper bound.
5. Computing someresult foraging.

Value of α = 0.2
New gbest: particle 3 = 0.0012

Particle	new position
1	0.477
2	0.69
3	0.452

Particle	New pbest
1	0.2043
2	0.4761
3	0.0012

Someresult foraging:

$$X(t+1) = x(t) + gbest\ (\ r * pbest - r * x(t)\ ) \quad I = 1\ldots N$$

1. Applying the equation above over each particle.
2. Make sure the values are within the range of the lower and upper bound.
3. Computing new fitness function for each particle to calculate new solution.
4. Choose the minimum solution as the best solution.
5. Repeat the loop all over till the end of iteration, then return the best solution among all loops.

Chain foraging:

New position	New pbest
0.9063	0.8213
2.0	(4.0)
0.1878	0.0353

best solution:
particle 3 = 0.1873

Someresult	Fitness function
0.9060	0.8208
2.0071	4.0284
0.1873	0.0351

Cyclone foraging:

New position	New pbest
0.477	0.2043
0.69	0.4761
0.452	0.0012

best solution:
particle 3 = 0.4519

Someresult	Fitness function
0.4761	0.2268
0.6899	0.4758
0.4519	0.2043

Thank you <3