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Killer Whale Algorithm: An Algorithm Inspired by the Life of Killer Whale

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Abstract

This paper proposed a new algorithm inspired by the life of Killer Whale. A group of Killer Whale called *Matriline* that consist of a leader and members. The leader's duty searches prey position and the optimum direction to chase the prey, meanwhile chase the prey is performed by the members. Optimum direction means minimum direction and maximum velocity. Global optimum is obtained by comparing the results of member's actions. In this algorithm, if value of objective function of members more than leader, hence the leader must find out another new potential prey. In order to obtain the performance of proposed algorithm, it is necessary to test the new algorithm together with other algorithm using known mathematical function that available in Comparing Continuous Optimizers (COCO) especially Black Box Optimization Benchmarking (BBOB). Optimization results show that the performances of purposed algorithm has outperformed than others algorithms such as Genetic Algorithm (GA), Imperialist Competitive Algorithm (ICA) and Simulated Annealing (SA).

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1. Introduction

Global optimization fundamentally is a method to find out the solution of optimization problems that contain many local optimum, in many areas of applications [1]. In order to solve optimization problem, many stochastic algorithms have been purposed such as GA [2], ICA [3] and SA [4]. Class of stochastic optimization techniques can be classified as pure random algorithm such as GA, SA, Particle Swarm Optimization (PSO) [5], Duelist Algorithm (DA) [6], Rain Water Algorithm (RWA) [7], Whale Optimization Algorithm (WOA) [8]; and organized stochastic algorithms such as ICA [3], Grey Wolf Optimizer (GWO) [9], Ant Colony Optimization [10] and Artificial Bee Colony (ABC) [11]. None of algorithms in the literature has capability to memorize pattern of optimization results.

In this paper, a new algorithm based on the life of the Killer Whale was proposed. The basic philosophy of algorithm is the movement patterns of Killer Whale in pursuit of prey and social structure of Killer whale. Moreover, the novelty of this algorithm is incorporating memorize capability of Killer Whale in the proposed algorithm [12]. The entire algorithms have own advantages and disadvantages. The relationship between the levels of complexities of the algorithm with the time consumptions to solve optimization problems are proportional. This phenomena usually called No Free Lunch (NFL) theorem [13]. As mentioned before, incorporating memorize capability in the algorithm will affect to time consumptions per iteration, however this algorithm require less iteration. This feature is useful to solve very complex optimization problem or huge optimization variables.

2. Killer whale algorithm

This section will discuss the proposed optimization algorithm based on mimics the leadership hierarchy and hunting mechanism of Killer Whale as well as memorize capability for each *Matriline* in mathematical model.

2.1. Inspiration

Killer Whales (*Orcinus Orca*) is the marine mammals as the highest peak of the food chain in marine ecological system or the apex marine predator. Killer Whale has three kinds of body morphological forms, such as type A, type B and type C, which type A has largest body shape than the other types of Killer Whales [14].

Basically, Killer Whales as apex marine predator are classified into two types of specialization depend on hunting patterns i.e. Fish-Feeding Residents and Mammal-Hunting Transients. Fish-Feeding Residents is Killer Whale with hunting pattern in the same area, meanwhile, the Mammal-Hunting Transients will hunt follow the prey migration season. The prey scanning is carried out using echolocation vocalizations. Killer Whales have 3 types of sounds namely Clicks, Whistles and Pulsed Calls [14].

2.2. Implementation into the form of algorithms based on inspiration

This section will discuss implementation of hutting pattern of Killer Whale in mathematical model.

- Foraging Geometry

According to [12], in order to implement of echolocation of Killer Whale, the mathematical model that represents Killer Whales in foraging of prey are utilized as search movement-agents to find best solution of objective function.

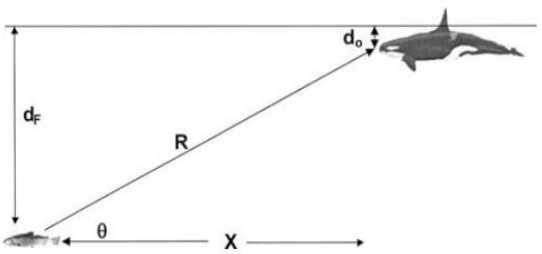

Fig. 1. Foraging Geometry of Killer Whale at depth d_o in pursuit of a Prey at range κ and a depth d_F [12].