

A Modified Whale Optimization Algorithm with Multi-Objective Criteria for Optimal Robot Path Planning

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1. **Motivation:** Exploration and exploitation are the two important property of every search and optimization algorithm [1]. Exploration aims to visit entirely new region of a search space whilst, on the other hand exploitation focuses on those regions of a search space recently visited. To be successful, optimization algorithms need to setup a proper mechanism to achieve good exploration and exploitation.
2. **Background:** Whale Optimization Algorithm (WOA) is a nature-inspired metaheuristic algorithm that mimics the hunting behavior of humpback whales. WOA achieves both exploitation and exploration respectively through bubble-net attacking method and search for prey. Mirjalili and Lewis [2] have proposed WOA which mimics the hunting behavior of humpback whales. A key merit of the WOA is its ability to maintain a good balance between exploration and exploitation using a single parameter known as search vector. Adaptive variation of the search vector allows the WOA to smoothly transit between exploration and exploitation. In WOA, exploration is performed by selecting a random search agent from existing population where randomization is biased towards initial and updated population. On the other hand, exploitation is achieved by maintaining the encircling prey and bubble-net attacking strategy. Although, search space vector used in WOA plays an important role for achieving exploration and exploitation, but still there is scope for further improvement which we suggest in this research.
3. **Main contribution:** We propose a Modified Whale Optimization Algorithm (MWOA) with 2-additional parameters: whale memory and a new random search agent. Whale memory is introduced to enhance exploitation ability of the WOA, whilst on the hand exploitation is achieved through a new random search agent (rather than selecting a random search agent from existing population as with WOA select a new random search agent from the current population).
4. **Results:** Computational experiments have been conducted to observe the behaviour of the proposed MWOA. The domain of inquiry in this research is an optimal mobile robot path planning problem [3]. Figure 1 shows the simulation results which indicates the superiority of the proposed MWOA over WOA.

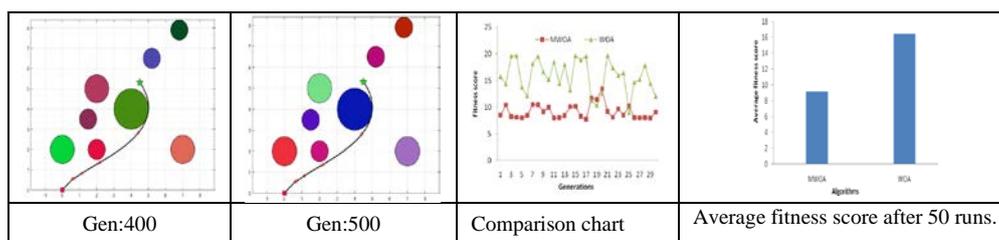


Fig. Computation simulation results of different generations by Modified Whale Optimization Algorithm for robot path planning

5. **Conclusions:** We have introduced MWOA, is a modified version of WOA with 2-additional parameters. We developed a robust experimental environment. Numerical results and comparisons are then shown to highlight the effectiveness and superiority of the proposed MWOA over standard WOA.

6. References

1. Črepinšek, M., Liu, S. H. and Mernik, M. "Exploration and exploitation in evolutionary algorithms: A survey." ACM Computing Surveys (CSUR), vol. 45, Issue 3, no. 35, 2013.
2. Mirjalili, S. and Lewis, A. "The whale optimization algorithm." Advances in Engineering Software, Vol. 95, pp. 51-67, 2016.
3. Dao, Thi-Kien, Tien-Szu Pan, and Jeng-Shyang Pan. "A multi-objective optimal mobile robot path planning based on whale optimization algorithm." *Signal Processing (ICSP), 2016 IEEE 13th International Conference on.* IEEE, 2016.