NatAlgReport

Name: Yosef Berezovskiy User-name: ttrq46

Two-letter code for your chosen NatAlgReal algorithm: WO

I consistently achieved a minimum value of 0.0 and a minimum point of [-7.974866532820138e-12, 1.3101123323454962e-10, 1.3756152828845343e-10, -2.6827069805045505e-11] or other minimum points similarly approximating to [0,0,0,0] and my average elapsed time was 0.4 seconds. As my experimentation has shown, the vanilla implementation of Whale Optimisation Algorithm solved the function successfully and produced optimal solution (mentioned earlier) with almost any set of number of whales or cycles - I used: 50 whales and 500 cycles, along with spiral constant equal to 2. Results with various spiral constants, b=5, have shown minimum points further away from [0,0,0,0], however still close enough to approximate [0,0,0,0].
I have used ImWOA[1] as an inspiration for my enhancement of my algorithm - although my algorithm performed considerably well - I still decided to try to enhance it assuming it can applied to harder optimisation problems. The enhancements suggested in the paper were aimed at addressing key limitations and improving its overall efficiency. Firstly, the division of iterations into exploration and exploitation phases, with 50% of iterations allocated for each, offered a balanced approach to search processes. This division sought to mitigate the issue of insufficient exploration in WOA, ensuring that the algorithm explored the search space adequately before converging towards an optimal solution. Additionally, modifications in the exploration phase involved the introduction of two distinct strategies for selecting random solutions from the population, enhancing randomness while avoiding unnecessary exploration. Moreover, the exploitation phase in ImWOA introduced co-operative hunting, where a group of solutions was updated simultaneously, fostering a more extensive search around the best solution. Unfortunately, given the scope of the problem and the effectiveness of the vanilla version of teh algorithm, I could not accurately assess the effect of the enhancement, however as the paper produces plenty of experimental data, I assume that enhanced algorithm would outperform vanilla version if faced another problem

Two-letter code for your chosen NatAlgDiscrete algorithm: WO

Adapting the WOA for the kGCP involved a discretization that translated the whales' continuous movement in original WOA into discrete graph coloring actions. In this adaptation, each whale represented a potential solution for kGCP, with its position in continuous space corresponding to a specific coloring of the graph. The assignment of discrete colors to each graph node mirrored the whale's position. This adaptation included modifying WOA's characteristic continuous movements, such as searching for prey, encircling prey, and bubble-net feeding, into discrete operations on the graph's coloring. Searching for prey was emulated by randomly altering node colors, and encircling and bubble-net feeding were adapted to change node colors selectively, based on the best solution or heuristic criteria. Fitness evaluation, crucial in WOA, was adapted to count color conflicts between adjacent nodes, aiming to minimise these conflicts.

Initially, the adaptation, based on the ImWOA[1], led to an increase in the number of conflicts, especially for larger graphs. For example, Graphs B and C experienced up to 600 conflicts, indicating a significant challenge in the algorithm's initial performance. Additionally, the implementation initially suffered from limited exploration, yielding poor results, such as 34 conflicts for Graph A and 200 for Graph B. However, significant enhancements were made to address these issues. Implementing a greedy search for the initial whale set notably reduced conflicts, bringing them down from 40-45 to 9-14 consistently for Graph A. Furthermore, the inclusion of an additional exploratory factor in the encircling function improved exploration, consistently yielding 6-9 conflicts for Graph A and 9-13 for Graph B.

[1] Chakraborty, S. et al. (2022) 'A novel improved whale optimization algorithm to solve numerical optimization and real-world applications', Artificial Intelligence Review, 55(6), pp. 4605–4716. Available at: https://doi.org/10.1007/s10462-021-10114-z.