

# **Worm Optimization Algorithm for the Euclidean Location-Allocation Problem**

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## **Abstract**

Facility location is a critical aspect of strategic planning for a broad spectrum of public and private firms. Whether a retail chain siting a new outlet, a manufacturer choosing where to position a warehouse, or a city planner selecting locations for fire stations, strategic planners are often challenged by difficult spatial resource allocation decisions. In fact, the literature reports that most of the models developed to solve the facility location problem are very hard to solve to optimality, as most problems are classified as NP-hard. One of the toughest facility location problems is the location-allocation problem, which comprises of two elements – Location: where to locate the central facilities; and Allocation: which subsets of the demand should be served from each facility. The Euclidean uncapacitated location allocation problem involves generating  $m$  new facilities to be located in  $\mathbb{R}^2$ , that will serve  $n$  fixed demand points with the objective of minimizing the transportation costs. Supply centers such as plants and warehouses may constitute the facilities while retailers and dealers may be considered as demand points.

This study addresses the Euclidean location-allocation problem with an unknown number of facilities, and an objective of minimizing the fixed and transportation costs. Since practical scenarios often require a large number of facilities and customers, heuristics for this problem became popular in the literature. Accordingly, a Worm Optimization (WO) algorithm is introduced and is applied to this NP-hard problem. The novel WO is based on the behaviors of the worm, which is a nematode with only 302 neurons. Nevertheless, these neurons allow worms to achieve several intricate behaviors including finding food, interchanging between solitary and social foraging styles, alternating between dwelling and roaming, and entering a type of stasis/declining stage.

WO's performance is evaluated by comparing its solutions to solutions of two other known metaheuristics for the problem under study, and the extensive computational results indicated that the proposed WO performs best.

## **Keywords**

Worm optimization, Euclidean location-allocation Problem, Design of experiments.

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## **Biography**

**Jean-Paul Arnaout** is an Associate Professor of Management at the Business Administration Department at Gulf University for Science and Technology. He received his PhD and M.S. from the Department of Engineering Management and Systems engineering at Old Dominion University, Norfolk, Virginia in 2006 and 2003 respectively. He received his bachelor's degree in Mechanical Engineering from the University of Balamand, Lebanon. Dr. Arnaout developed several simulation and optimization models in several areas including but not limited to port operations, supply chain, agriculture, and healthcare. His Research interests include Optimization Techniques, Modeling and Simulation, and Scheduling and Rescheduling. He can be reached at [arnaout.j@gust.edu.kw](mailto:arnaout.j@gust.edu.kw).