RESCON 2025 CMS 09

APPLYING THE MODIFIED FIREFLY ALGORITHM TO SOLVE THE SINGLE-STAGE FIXED CHARGE TRANSPORTATION PROBLEM

E.M.D.B Ekanayake[1]* and W.N.P. Rodrigo[2]

[1]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka.*
*dananjayaekanayake96@gmail.com

Transportation problems are a fundamental class of optimization problems in operational research, aimed at determining the most cost-effective way to distribute goods from multiple sources to multiple destinations. These problems are widely applied in supply chain management, logistics, and distribution planning. Among the various types of transportation problems, this research investigated the Fixed Charge Transportation Problem (FCTP) focusing on single-stage FCTP where goods are transported directly from production to consumers without intermediate stages or redistribution centers. The primary considerations are determining which transportation routes to use and how much to ship across them while minimizing the total cost, which consists of both fixed and variable components. In this study, a Modified Firefly Algorithm (MFA) is proposed to address this challenge. Because it has less complexity and is easy to understand, it can also be used for discrete optimisation problems like transportation problems. The standard FA, inspired by the flashing behavior of fireflies, was improved in this study through several problem-specific modifications. The algorithm incorporated adaptive motion rules, refined attraction calculations based on cost functions, and constraint-handling mechanisms to ensure feasibility. The algorithm was implemented in Python and tested on a series of small- to medium-scale problem instances. The accuracy of this algorithm was discussed by comparing the results obtained with other existing heuristic methods. This method has achieved better or equal results compared to existing methods when applied to small- and medium-scale problems. It has also demonstrated efficiency in terms of convergence speed, obtaining accurate results within ten iterations and obtaining accurate results in minimal time. Also, the repeated trials with different numerical examples showed consistent results for the robustness of the algorithm. Accordingly, the modified FA model has shown success for small- and medium-scale numerical problems. It provides not only high-quality solutions but also a flexible basis for future improvements aimed at solving large-scale and multi-stage fixed charge transport problems.

Keywords: Firefly algorithm, Heuristic methods, Near optimum solution, Optimisation, Single-stage fixed charge transportation problem