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A MARRIAGE IN HONEY BEE OPTIMISATION APPROACH TO THE ASYMMETRIC TRAVELLING SALESMAN PROBLEM

Yuksel Celik[1] and Erkan Ulker[2]

[1]Computer Programming Department
Vocational School
Karamanoglu Mehmetbey University
Karaman 70100, Turkey
celik_yuksel@hotmail.com

[2]Computer Engineering Department
Selcuk University
Konya, Turkey
eulker@selcuk.edu.tr

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Abstract. *In the travelling salesman problem (TSP), a travelling salesman completes a tour of "n" number of cities by stopping once in each city and completes the tour by returning to his starting point, while minimizing the distance and the cost. The asymmetric travelling salesman problem (ATSP) is the problem in which the cost of travel from city A to B is different from that from B to A. Marriage in Honey Bee Optimisation (MBO) is a meta-heuristic procedure inspired by the mating and insemination process of honey bees. In this study, we seek to use an MBO algorithm for an optimal solution to the ATSP problem, which has previously been solved by different methods. The results of the MBO algorithm for ATSP are compared with Genetic Algorithm (GA), another meta-heuristic method.*

Keywords: Marriage in honey bee optimisation (MBO), Travelling salesman problem (TSP), Asymmetric travelling salesman problem (ATSP), Swarm intelligence

1. **Introduction.** The Travelling Salesman Problem (TSP), for N given nodes (cities), is the problem of finding the shortest (with the least cost) route that comes back to the starting point after stopping by each node once. It is easily defined but is an NP-Hard problem [1]. The solution to this problem can also be viewed as a Hamilton circle [2].

TSP can be defined mathematically in two ways: the graph problem and the permutation problem [3]. The TSP can be represented as a graph problem as follows: given a graph $G = (V, E)$, let F denote all Hamilton circles on G. For every edge E, there is a given weight ratio. The TSP is the problem of finding one tour (Hamilton circle) that visits all nodes with the least cost [3].

Three basic variants of the TSP problem have been proposed: Symmetric, Asymmetric and Euclidean. If the distances from city A to B and from city B to A are always equal, then this is called the symmetric TSP. The opposite case, in which the return distances are not always the same, is called the asymmetric TSP. The Euclidean TSP is the case in which the n nodes of the graph are points in R^d, and the distances between them are the Euclidean distances [4]. Over the last decade, there has been widespread usage of meta-heuristic algorithms' searching and optimisation tools in various problem areas. Meta-heuristic algorithms are easy to use and provide a general perspective that can be exploited in their own comprehensive applications as well in search and other optimisation tools.