

The Ph.D. Dissertation “An Improvement in the Harmony Search Algorithm to Solve Selected Variations of the Travelling Salesman Problem” discusses the adjustment of the Harmony Search algorithm (HS) to solve selected variations of the Travelling Salesman Problem (TSP), facilitating the designation of more beneficial solutions than those obtained utilizing selected methods existing in the literature on the subject. The main goal of the work was broken down into three additional goals:

- Defining a new structure of HS.
- An improvement of selected elements of the proposed approach based on the Asymmetric Travelling Salesman Problem (ATSP) instance.
- Verification of the efficiency of the prepared algorithm based on the instance of the ATSP, Probabilistic Travelling Salesman Problem (PTSP), Orienteering Problem (OP), Team Orienteering Problem (TOP), and the problem of planning the mobile collection of waste electrical and electronic equipment (WEEE).

The following thesis of the dissertation was formulated:

*Proposed improvements in the Harmony Search algorithm facilitate an improvement, in comparison to selected methods described in literature, of efficiency of solving selected variations of the traveling salesman problem.*

It was confirmed by means of numerous studies presented in the research chapters.

The dissertation starts with the introduction and ends with the summary as well as further research plans. It consists of six chapters:

- The first one includes the characteristic features of HS. It describes the mechanism of the algorithm operation and attention is paid to the controversies it arouses in the scientific environment. Additionally, popular modifications of the metaheuristic and the areas of its application are presented.
- The second chapter presents the formulation of the analyzed NP-hard combinatorial optimization problems. It presents definitions of the following issues: classical TSP, PTSP, OP, TOP, and mobile WEEE collection. It also features a review of methods used to solve their instances.
- The third chapter discusses the applied methodology of research work. It indicates the specification of applied technical means and sample collections, based on which the research was conducted. It also presents the collection method of results and enumerates methods, with the results of which a summary was made, to determine the efficiency of the proposed approach.
- The fourth chapter depicts the new approach to designing HS. It includes the structure of the proposed algorithm, results of initial research, and further directions of work which might affect its efficiency.
- The fifth chapter includes the results of tests concerning the improvement of the proposed HS structure. It verifies various methods of avoiding premature convergence and checks the impact of concurrent computing on HS efficiency. Additionally, the search space is targeted and the algorithm is hybridized with the local search method. Finally, the mechanism of harmony memory improvement is implemented and pheromone memory is added. As a result, the summary average error for the analyzed “test bed” was decreased from 13.42% down to 3.84%, hence receiving better results than those designated by some methods referred to in the literature on the subject.
- The sixth chapter presents an analysis of the efficiency of the new HS in the process of solving selected optimization problems. The manner of adjustment of the algorithm to the instances of PTSP, OP, TOP, and mobile WEEE collection is described there. It is shown that the HS efficiency is better from 2-opt for PTSP. The obtained average error for the remaining analyzed variations of TSP is stated to be at a more beneficial level

than many of the methods present in the literature on the subject and comparable to state-of-the-art techniques.

The conclusion features the summary of the conducted research and further direction of work, facilitating, among others, an additional improvement of the method efficiency.