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## REVIEW OF THE DOCTORAL THESIS

**Thesis title:** Multi-objective Optimization for Smart City Concepts: Smart Floating Cities (SFC)

**Study program:** Applied Informatics

**Study field:** Applied Informatics

**Thesis author:** Ayca Kirimtat, M.Sc.

**Supervisor:** Prof. Ing. Ondřej Krejcar, Ph.D.

**Reviewer:** Prof. RNDr. Michal Munk, PhD.

The thesis deals with multi-objective optimization in the domains of smart cities and floating cities, in which the author uses a wide range of evolutionary algorithms and other computational techniques to solve problems and/or tasks. The issue is processed thoroughly and extensively. The thesis has an interdisciplinary or even transcendental character. The author has focused on connecting the concept of the smart city with the concept of the floating city. The topic of the thesis is current in terms of an alternative place to live, given the increasing sea levels as a result of global warming.

The thesis is clear and readable, and relatively demanding issues are clearly described. I positively evaluate that the thesis has an application domain; the results can be used to design smart floating cities through computational techniques. I appreciate the efforts of the author to link the theoretical work to the application outputs.

Chapter 2 defines the goal of the thesis as well as the tasks (partial objectives) needed to achieve the given goal. The main goal of the thesis, focusing on the implementation of multi-performance criteria into the design process of smart floating cities, results into two tasks (partial objectives), where the first is to design the concept of smart floating cities and the second is to develop a smart floating city design using computational techniques. The tasks arising from the goal of the thesis are detailed, described and solved in the next part of the thesis. I appreciate the precise and clear formulation as well as the feasibility of individual tasks (partial objectives), the solving of which led to the fulfillment of the given goal of the thesis.

In the analysis of the state of the art, I positively evaluate the clearly summarized studies in terms of definition, concepts, architecture and applications of smart cities. I would especially

highlight the clear summaries in the tables. The author used more than 150 sources, which shows her excellent orientation in the given issue.

Chapters 5, 6, and 7 represent the main part of the thesis, in which the author primarily solves three tasks, which she presents in the form of case studies. All three tasks are very well elaborated. This part is suitably supplemented by pseudocodes of individual techniques. I also appreciate the range in terms of combinations of methods, techniques and approaches to solving the individual tasks. Despite their extent, the thesis does not lose its clarity.

The model in case study 1 defines four separate functions (parameter  $i$ ) - agricultural, residential, green, and public areas. The concept of smart cities requires desalinated water, power stations, airports, or waste management. Other functions may be required for the model. Please explain how can we extend the model by adding a new function and if there is a limit to the number of functions.

Is there any link between case study 1 and case study 2? Does the model of case study 2 respect the distance of platforms according to the visual comfort and accessibility between areas?

Due to climate change, the population will migrate to the north. Do we have to change the UDI parameter in case study 3, if we move the floating city from 38.4072222 latitude to latitude close to 66 latitude (Polar circle) where the Polar day and Polar night occur?

In case study 3, the author correctly applies forward stepwise regression, i.e., the variables were gradually added to the model. It evaluates the quality of the models using a coefficient of determination. For this purpose, the author correctly uses adjusted  $R^2$ , due to the different number of variables in the models. The check of the model significance is absent, the increase in the coefficient of determination, whether adjusted or unadjusted, does not declare the significance of the model. The author focuses only on verifying the assumption of residuals independence using Durbin-Watson statistics. What are the assumptions of using multiple linear regression?

From the formal point of view, the thesis is precisely processed, except for some mathematical expressions, which in some parts of the thesis are not standardly written (e.g. 6.1.1 vs. 6.1.2). Similarly, mathematical expressions are part of sentences, so punctuation should not be missing. In any case, these are minor formal deficiencies that do not affect the overall formal smoothness of the work. I would especially like to highlight the clear structure of the work.

The results of the work were published in journals, series, and conference proceedings focused on the subject matter. The most important results of the thesis were published in the journals *Solar Energy* (Q2, CCC, Elsevier), *Building and Environment* (Q1, CCC, Elsevier) and *IEEE*

*Access* (Q2, CCC, IEEE). In the above mentioned journals, the results described in Chapters 4-7 are published, which can be described as key in terms of the contribution of the thesis. The quality of the outputs is also evidenced by the citation counts of these publications.

To sum up, I appraise the thesis as very good and transparent in terms of preprocessing, modeling as well as evaluation and comparison of results. The proof is the publication output of the author, therefore

**I recommend the Ph.D. thesis of Ayca Kiritat, M.Sc. to its defense.**

In Nitra, 19.08. 2021



prof. RNDr. Michal Munk, PhD.

